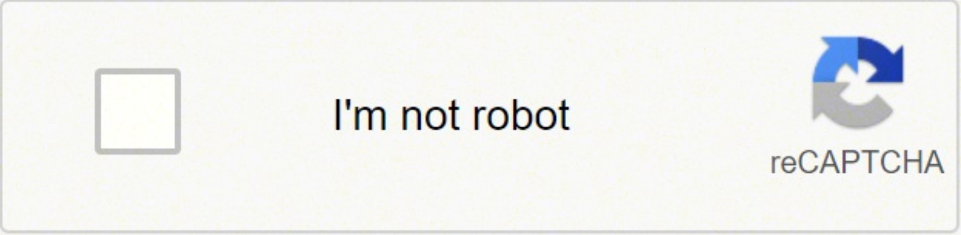

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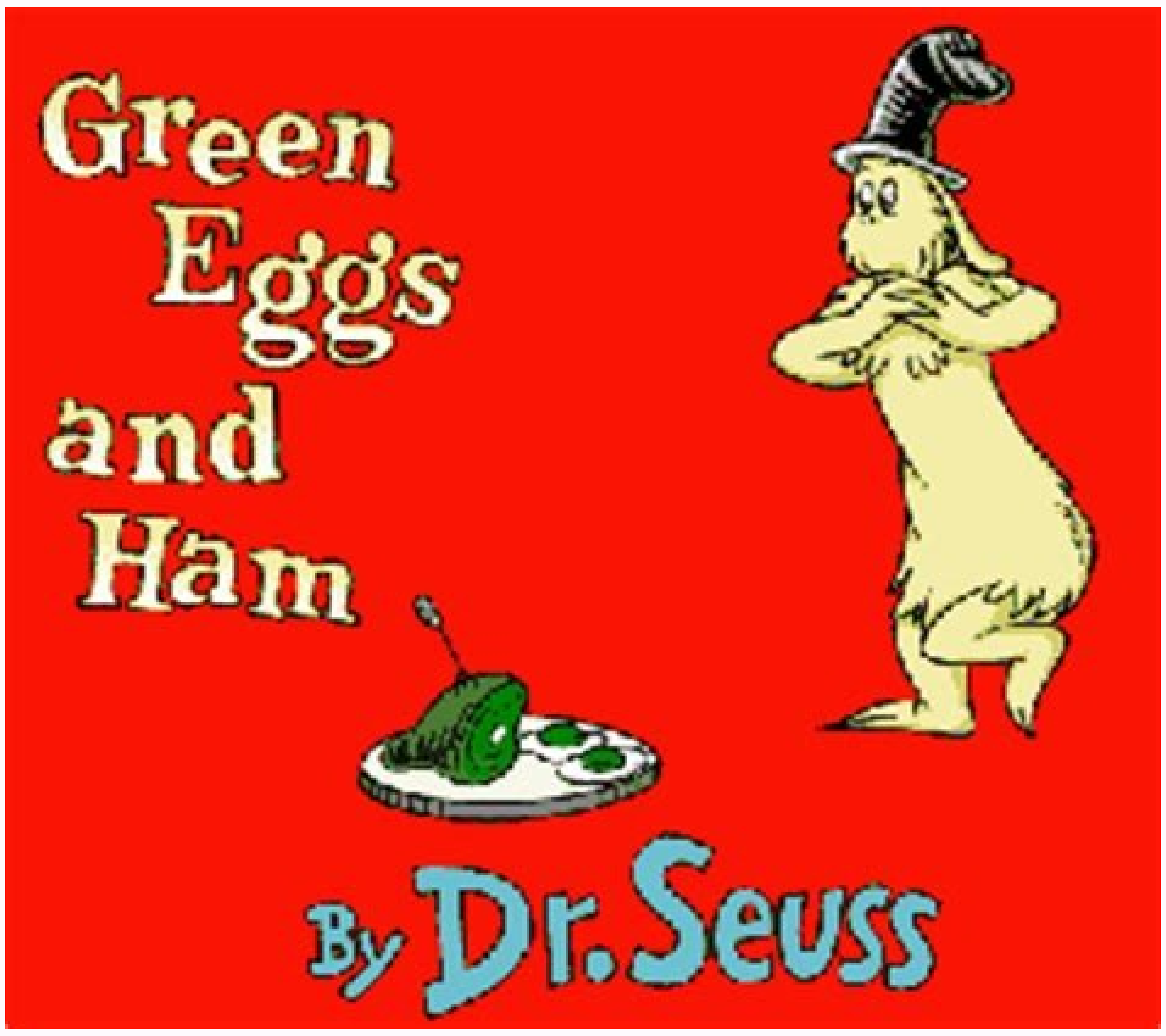
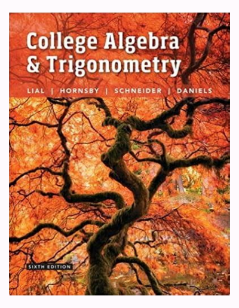
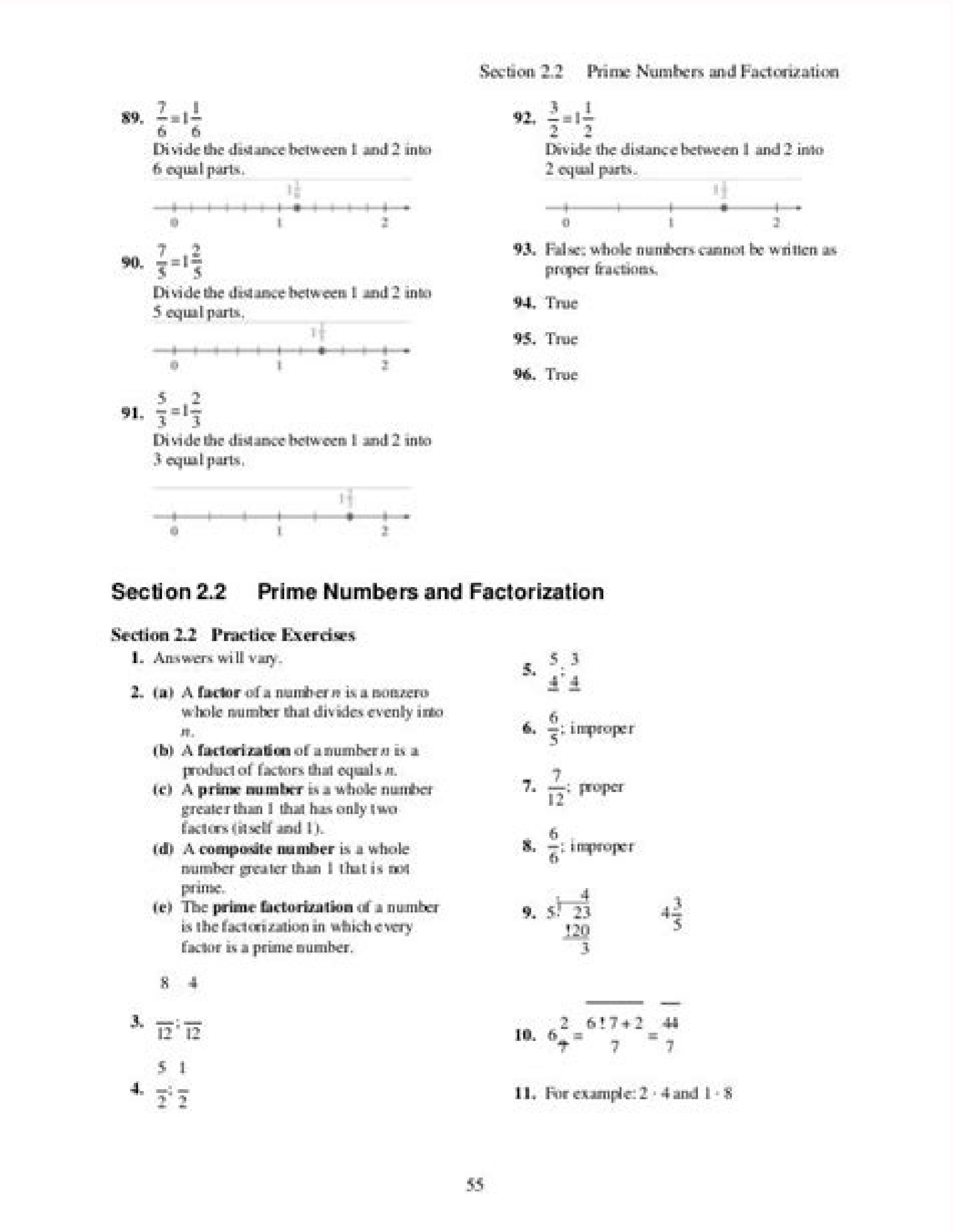






Section 2.2 Prime Numbers and Factorization

89. $\frac{7}{6}=1\frac{1}{6}$
Divide the distance between 1 and 2 into 6 equal parts.

90. $\frac{7}{5}=1\frac{2}{5}$
Divide the distance between 1 and 2 into 5 equal parts.

91. $\frac{5}{3}=1\frac{2}{3}$
Divide the distance between 1 and 2 into 3 equal parts.

92. $\frac{3}{2}=1\frac{1}{2}$
Divide the distance between 1 and 2 into 2 equal parts.

93. False; whole numbers cannot be written as proper fractions.

94. True

95. True

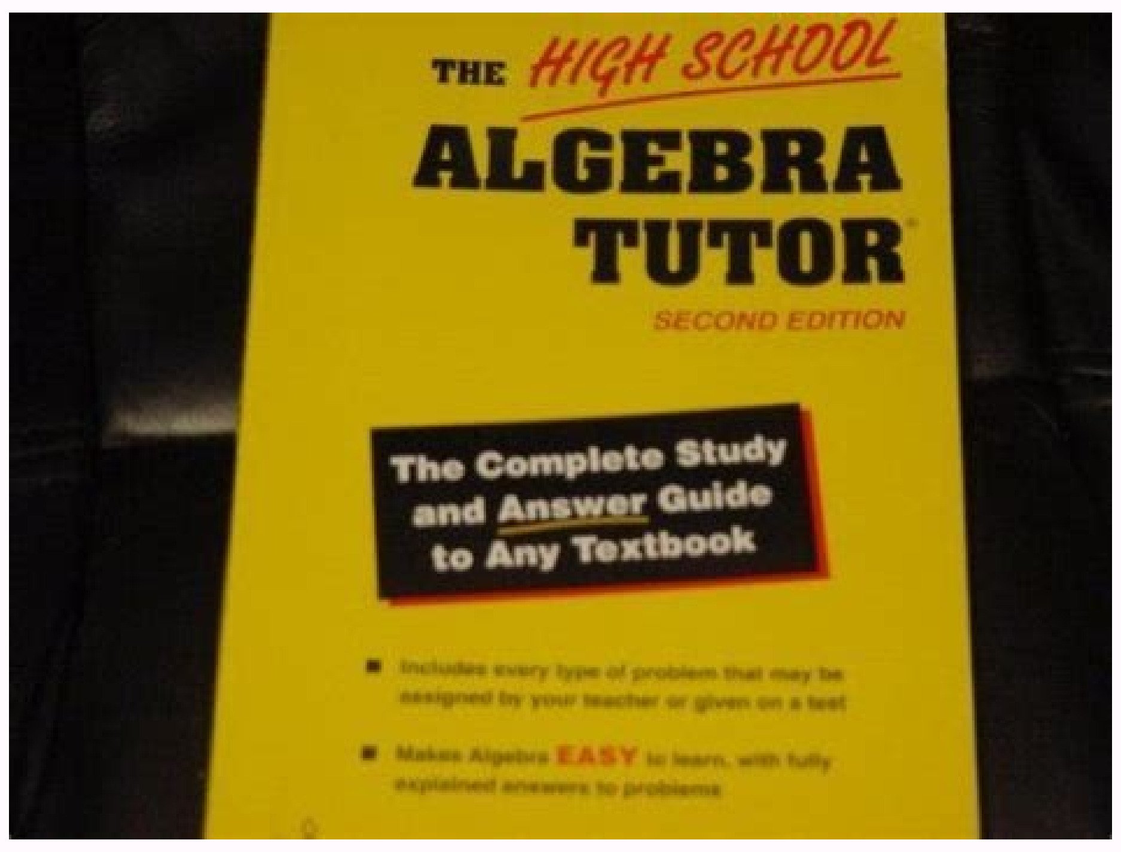
96. True

Section 2.2 Prime Numbers and Factorization

Section 2.2 Practice Exercises

1. Answers will vary.
2. (a) A **factor** of a number n is a nonzero whole number that divides evenly into n.
   (b) A **factorization** of a number n is a product of factors that equals n.
   (c) A **prime number** is a whole number greater than 1 that has only two factors (itself and 1).
   (d) A **composite number** is a whole number greater than 1 that is not prime.
   (e) The **prime factorization** of a number is the factorization in which every factor is a prime number.
3. $\frac{8}{12}; \frac{4}{12}$
4. $\frac{5}{2}; \frac{1}{2}$
5. $\frac{5}{4}; \frac{3}{4}$
6. $\frac{6}{5}$; improper
7. $\frac{7}{12}$; proper
8. $\frac{6}{6}$; improper
9. $5\overline{)23}$ 4 20 3 $4\frac{3}{5}$
10. $6\frac{2}{7}=\frac{6\cdot 7+2}{7}=\frac{44}{7}$
11. For example: $2\cdot 4$ and $1\cdot 8$

55



Find 2n(x). 5 a ax 1 b 2 4ac 2 b2 b 1 2a 4a Obtain a common denominator and add the terms outside parentheses. Each year thereafter, she would receive a $5000 raise. g(x) 5 Section 2.6 241 Transformations of Graphs For Exercises 63–78, use transformations to graph the functions. That is, the vertex of a parabola gives the maximum or minimum value of the dependent variable. False 15. (10, 20) 15 10 10 (0, 0) (60, 0) 10 0 20 30 40 50 60 x b. Not possible 83. AB BA AC CA AD DA AE EA BC CB BD DB BE EB CD DC CE EC DE ED Each outcome in the second row involves the same 2 people as the outcome directly above in the first row, but in the reverse order. y 5 4 3 2 a. An 3. 32x5 2 240x4 1 720x3 2 1080x2 1 810x 2 243 63. (1, 26); m 5 23 68. A female honey bee hatches from a fertilized egg, so she has two parents: one male and one female. 1 p p(x) x11 a n b(x) 5 5 n(x) 0x 2 3 0 EXAMPLE 3 Denominator is zero for x 5 21. 2 6 5i 9 65. 4 2 2(x 1 1) 1 12 1 x . Find the 8th term of an arithmetic sequence with a1 5 22 and a15 5 68. See also Circle; Ellipse; Hyperbola; Parabola Conjugate axis, 653 Conjugates complex, 109, 158 explanation of, 40 product of, 40, 41, 109 Conjugate zeros theorem, 333, 334 Constant functions, 202, 301 Constant of variation, 383, 384, 393 Constraint equations, 292–293 Constraints, 548–549 Continuous functions, 249 Contradictions, 85, 158 Converse, 167 Coordinate plane. See Rectangular coordinate system Center of circle, 177 of ellipse, 635 of hyperbola, 651 Center-radius form, 178 Centroid, 504 Change-of-base formula, 448–449 Circle explanation of, 177, 634 general form of equation of, 179–180, 275 on graphing utility, 180 standard form of equation of, 177–179, 275, 634 Clearing fractions, 84, 213 Clearing parentheses, 12 Coefficient matrix, 607–608 Coefficients binomial, 732–734 leading, 38, 50 Cofactor of element of matrix, 615 Column matrix, 586 Combinations in applications, 745 explanation of, 744, 766 on graphing utility, 746 permutations vs., 744–745 Common logarithmic functions, 430–431, 454, 483 I-1 I-2 Subject Index Common logarithms approximation of, 431 explanation of, 430–431 to express solution to exponential equations, 454 Common ratio, 712–714, 765 Commutative property of addition, 10 of matrix addition, 588 of multiplication, 10 Complementary events, 753 Completing the square explanation of, 115–116 to graph parabolas, 286, 288 to solve quadratic equations, 116–118 Complex conjugates, 109, 158 Complex fractions explanation of, 64 method to simplify, 64–66 Complex numbers addition and subtraction of, 107–108 division of, 110 evaluating special products with, 109 explanation of, 105–106, 158 on graphing utility, 110 multiplication of, 108–109 real and imaginary parts of, 106 set of, 105, 333 simplifying powers of i and, 107 in standard form, 106 Complex polynomials, 321–322 Composition of functions, 266–270, 277 Compound fractions. Given a geometric sequence with a3 5 20 and a8 5 640, find a1 and r. a b(3) p y 5 h(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x d. 5 2 Let Pn be the statement 8 1 4 1 p 1 (24n 1 12) 5 22n(n 2 5). 22, 21, 2 , 2 , ... 2 4 18 6 2 2 30. 10 8 6 4 5 4 3 2 2 1 2 3 4 5 6 7 8 9 x 2162142122102826 24 22 22 24 1 2 4 x 25 24 23 22 21 21 22 23 26 23 24 25 28 210 24 25 y 48. 3 3 3 a. f (6) f (x) f (23) f (23) b. Round to the nearest $1000. Now suppose that we create two functions from the left and right sides of the equation. 9 73. { } c. Evaluate T(80,000) and interpret the meaning in the context of this problem. 1, 3, 5, 7, 9, ... Answer 7. Writing Linear Cost, Revenue, and Profit Functions At a summer art show a vendor sells lemonade for $2.00 per cup. {22, 1} e f 3 1 3 77. Range: {y 0 y # 4} or in interval notation: (2`, 4]. y 90. (Hint: Refer to Figure 8-12 from page 755.) Student Answer Appendix CHAPTER R Section R.1 Practice Exercises, pp. Therefore, the value of a probability is a number between 0 and 1, inclusive. 0 1 2 6 0 or 0 6 2 1 0 ; 5 71. A car traveling 60 mph (88 ft/sec) undergoes a constant deceleration until it comes to rest approximately 9.09 sec later. c3 1 c4 1 c5 1 p 1 c20 1 1 1 1 1 82. (2`, 25) ´ (22, `) e. Graph H 14. (a3 1 4b)6; term containing a9. Find the probability that a student guesses on each question and gets a perfect score. Identify the vertex. Objective 1: Prove a Statement Using Mathematical Induction For Exercises 3–16, use mathematical induction to prove the given statement for all positive integers n. 2 13 b. 3 ai 5 i51 n(n 1 1) 2 n2(n 1 1)2 4 Section 8.4 Mathematical Induction 729 In Examples 3 and 4, we use mathematical induction to prove statements that do not involve a sum. Determine the time required for the object to hit the ground. 249 2 12 15 or 3 15 2 2 26 2524 23 22 21 21 22 23 5 216.1 x 40.7 16.1 230 210 8 6 4 2 4 2 73. Hundreds of text-specific, open-ended, and multiple-choice questions are included in the question bank. y 5 g(x) 5 3 2 4 3 35. 727 Extended principle of induction: Mathematical induction can be extended to prove statements that might hold true only for integers greater than or equal to some positive integer j. 1 64. Then use the equation to calculate the corresponding y values. Profit at (0, 0): z 5 0 100 (0, 90) (80, 90) Profit at (0, 90): z 5 21,600 80 Profit at (80, 90): z 5 34,400 (120, 60) Profit at (120, 60): z 5 33,600 60 Profit at (120, 0): z 5 19,200 40 f. 0.139, 0.00139, 0.0000139, ... Test 10. The y-intercept is (0, 14,820) and means that the amount owed after the initial down payment is $14,820. 8 6 25. Write d as a function of s. 1 x23 2 10. e f ; x < 0.5269 e ln 19 4 5 1 ln 2 ln 3 f or {5 ln 3}; t < 5.4931 25. 82: © Echo/Getty RF; p. When graphing a function requiring multiple transformations on the parent function, it is important to follow the correct sequence of steps. 5 4 3 2 7 5 (2, 5) 1 25 24 23 22 21 21 (23, 22) 22 23 24 1 2 3 4 5 x 200 Chapter 2 Functions and Relations y 5 b. The graph in Exercise 63 shows the average height of girls based on their age. an 5 100,000(0.85) or 85,000(0.85)n21 a2 b 3 4 128 b. c d ?A5 c d 0 1 1 3 0 21 0 23 0 23 0 d 23 Section 6.4 Practice Exercises, pp. If P(E) 5 0.842, what is the value of P(E)? 4x 1 8y 5 8 y 5 4 3 2 For Exercises 57–63, write an equation of the line having the given conditions. 2 129 units < 10.77 units Skill Practice 1 Find the distance between the points (21, 4) and (3, 26). y 5 1 c. 5 10 5 10 30 15 6 1 18 9 7 37 b. In Example 4, we use the techniques of counting learned in Section 8.6 to determine the probability of an event. The domain of f + g is the set of real numbers x in the domain of g such that g(x) is in the domain of f. Find a6. The person has elevated blood pressure or is a nonsmoker. Substitute 4 for x. (g + f)(0) y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x e. (0, 12) ´ (68, 184) b. A 5 5, B 5 3, C 5 21 Section 5.3 Practice Exercises, pp. 50 1 10 1 2 1 1 1 5 25 125 56. f (x) 5 1 x 9. c y 5 4 3 2 25 24 23 22 21 21 22 1 b. Identity function: f (x) 5 x Constant functions f(x) 5 b 4 1 0 1 4 f(x) 22 21 0 1 2 22 21 0 1 2 1 25 24 23 22 21 21 22 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 x f(x) 22 21 0 1 2 28 21 0 1 8 1 1 2 3 4 5 6 7 8 9 x 23 x f(x) 28 21 0 1 8 22 21 0 1 2 7. {23, 4} 19. In such a case, the goal is to look for a pattern that can be expressed mathematically as a function of the term number. 23, 5, 2 b. • Write About It exercises are designed to emphasize mathematical language by asking students to explain important concepts. 5 2k11 From the string of inequalities we have shown that (k 1 1)! . {(3z, 22z 1 1, z) 0 z is any real number} 15. [29, `) b. y 5 3.5x 2 2.95 17. f (x) 5 2 1 x 44. {64, 6i} 12 does not check. (2`, 22) ´ (22, `) g. The second column gives the profit for Friday, Saturday, and Sunday, respectively. (f + g)(5) 110. The table gives the number of calories and the amount of cholesterol for selected fast food hamburgers. Now suppose that we wanted to arrange the letters in the word NINE. 648: © Michael Evans/Life File/Getty Images RF; p. Explain why {a1, a3, a5, ...} is also an arithmetic sequence. R.6. {29, 4} exponential 3. Given an equilateral triangle with sides of length x, write a relationship that represents the perimeter P(x) as a function of x. The graph of y 5 f(x 2 h) is a shift in the positive x direction. y 5 x 5 23 23 37. Linear functions f(x) 5 mx 1 b The functions given in Table 2-2 were introduced in Section 2.1, Exercises 31–36, and in the Problem Recognition Exercises on page 228. P(A) 5 524 . None e. 3(x 1 3) 2x 2 22 3600x2 2. b(x) 5 0 x 2 2 0 1 4 25. (0, 27) c. The distance d(t) (in ft) that the car travels t seconds after motion begins is given by d(t) 5 5t2, where 0 # t # 8.8. d(t 1 h) 2 d(t) . One makes $1200 and the other makes $1500. 3 3 3 3 1 1 1 1p 2 4 8 16 3 i21 16. 18 b. (0, 3) f. Determine the first five terms of the arithmetic sequence {an} with a1 5 4, and d 5 8. k(x) 5 e 3x for x , 1 23x for x $ 1 65. 3 1 p 1 k(k 1 1) 5 k(k 1 1)(k 1 2) 3 (Inductive hypothesis). Evaluate a Finite Arithmetic Series Consider the finite arithmetic sequence 1, 4, 7, 10, 13. y b. 5 4 3 2 1 21 21 22 y 47. c 24 212 216 24 13 2 36 3 1 43. Therefore, P(4 consecutive hits) 5 (0.279)(0.279)(0.279)(0.279) < 0.006 If Albert Pujols has four times at bat, there is less than a 1% chance that he will get a hit all four times. Vertices: (23, 22), (23, 12) Foci: A23, 5 1 174 B, A23, 5 2 174 B y 5 75x 1 465 and y 5 275x 1 45 y 21 18 F 15 12 9 6 C(23, 5) 3 21521229 26 23 23 F 26 3 6 x 9 12 29 27. If the probability of an event is 87 90 , is the event likely to occur or not likely to occur? [3, 5) 57. In the case where c . h(7) 43. x2 5 1.8 m 57. • The set of y values in the ordered pairs is called the range of the relation. Substituting 5 into the equation would result in division by 0. £ 5 3 22.3 d 6.5 25 27 12 b. E4 6 2i 12F 43. 29 y 5 k(x) 1 24 25 x 1 x b. y 5 f(x) 1 2 1 2 3 4 5 6 28 27 26 2524 2322 21 21 22 y 5 p(x) y 5 r(x) 1 2 7 8 x 23 24 25 71. (2`, `) 29. Find the function and write the domain in interval notation. (0, 22) e. taken r at a time can be computed by r! Expanding Your Skills 87. 8 1 12 1 16 1 20 1 24 1 28 1 32 1 36 1 40 1 44 51. a b(x) 5 2 ; (2`, 23) ´ (23, 0) ´ (0, 1] p x 1 3x p x2 1 3x ; (2`, 1) 25. That is, n(E) 5 5C2 5 10 The sample space S consists of all possible ways in which 2 people can be selected from 8 people without regard to order. Does the equation define y as a function of x? Vertices: A 12, 2B, A 112, 2B c. e2x c. 0.58 9z 39. { } a.{(3, 5, 0)} b. 10, 13, 16, 19, 22 8. Up to the left and up to the right; As x S 2`, f (x) S `, and as x S `, f (x) S `. a (ai 6 bi) 5 a ai 6 a bi i51 i51 i51 A single sum or difference can be regrouped as two sums or differences. Find all x for which f(x) 5 21. n/a, $12,214.03 29 47. Suppose that 1 two hikers are located at 25 24 23 22 21 21 points A and B. 0.4(c 1 2) c. 283 d. y r (x, y) (h, k) x Figure 2-11 The radius of a circle is often denoted by r, where r . y 5 4 3 2 y 5 4 3 2 y 5 f(x) 1 24 23 22 21 21 22 81. A sequence of payments made at equal intervals over a fixed period of time is called an . 1 (a 1 b)0 5 1 1 (a 1 b)1 5 1a 1 1b 1 (a 1 b)2 5 1a2 1 2ab 1 1b2 1 (a 1 b)3 5 1a3 1 3a2b 1 3ab2 1 1b3 4 4 3 5 5 4 2 2 1 3 2 3 4 1 3 6 1 4 1 4 (a 1 b) 5 1a 1 4a b 1 6a b 1 4ab 1 1b 3 2 1 2 3 1 4 5 (a 1 b) 5 1a 1 5a b 1 10a b 1 10a b 1 5ab 1 1b 5 10 10 Figure 8-9 5 1 Section 8.5 733 The Binomial Theorem From the expansion of (a 1 b)n, we note the following patterns. Determine the area in the second quadrant enclosed by the equation y 5 2x 1 4 and the x- and y-axes. an 5 31. y 5 f a xb 2 6 5 y 5 f(x) 4 3 2 1 28 27 26 25 24 23 22 21 21 22 1 2 3 4 x 23 24 25 26 Solution: a. E E2 E2 y1 b 5 2Dx 2 F 1 2 C 4C 4C E 2 F E2 C ay 1 b 5 2D ax 1 2 b 2C D 4CD 2 2 E D E F ay 1 b 5 2 cx 2 a 2 bd 2C C 4CD D Assuming that C fi 0 and D fi 0, this is the standard form of an equation of a parabola opening to the left or right with vertex E2 F E a 2 , 2 b. 42. (22, 0) ´ (2, `) f. e a2 , 2 b f 8 40 46 23 4y 1 8 ea , yb ` y is any real number f 39. f (x) 5 5x 1 9 b. At x 5 22, the function has a relative minimum of 24. The main objectives of this college algebra textbook and our digital content are threefold: • To provide students with a clear and logical presentation of fundamental concepts that will prepare them for continued study in mathematics. How many 4-letter arrangements are possible assuming that the letters may not be repeated? Therefore, the sequence is geometric with common ratio 1r . (k 1 1)! 5 (k 1 1) ? Write a function based on the given parent function and transformations in the given order. A2 2 i 13 B 2 2 4A2 2 i 13 B 1 7 5 0 ✓ (a 1 bi)(c 1 di) 5 ac 1 adi 1 bci 1 bdi2 5 ac 1 (ad 1 bc)i 1 bd(21) 5 (ac 2 bd) 1 (ad 1 bc)i The second step does not follow because the multiplication property of radicals can be applied only if the individual radicals are real numbers. Given a circle with radius r, diameter d, circumference C, and area A, a. The point (21, 2) is graphed as an open dot, because the point is not part of the function. We can plot several strategic points as an outline for the new curve. 1 y52 x22 2 1 y5 x22 3 y50 106. 25 33. g(t) 48. To meet the graduation requirements, a student must take 2 English classes out of 10 available, 3 math classes out of 6 available, and 2 history classes out of 7 available. Apply the Slope-Intercept Form of a Line The slope formula can be used to develop the slope-intercept form of a line. Therefore, P1 is true. (2`, 1] 37. Doctors know that certain restrictions apply when considering the administration of blood to a patient. Constant 2 1 2 1 x1 b. This means that the average increase in BAC is greater over the first hour than over the second hour. After a 5-yr slump in the real estate market, housing prices stabilize and even begin to appreciate in value. Graph f (x) 5 0 x 0 for x , 0. For Exercises 113–114, evaluate the floor and ceiling functions for the given value of x. ` e. {41} 31. c d 0 3 0 0 5.6 3 c. To find the slope, select any two points on the line such as (2, 1) and (2, 3). EXAMPLE 2 Using Mathematical Induction Use mathematical induction to prove that 1 1 1 n 1 1 1p1 5 . a , 24 12b a. 36 4 z2 x2 1 5 1; This represents the graph of an ellipse in the xz-plane. 6121 2 2 1 1p 3 9 55. 2.61 a. In how many ways can a statistician select a sample of 15 people from a population of 90 people? y 12. 110 min 29. x2 1 y 5 9 52. The first job pays $50,000 the first year. 0 2x 2 3.8 0 2 4.6 5 7.2 b. 2 ac 2 3ab2 85. 3k(k 2 3)(k2 1 3k 1 9) 87. f(x) 5 1x 2 2 84. 0 A 0 5 0. 6 5 36 (Figure 8-11). The exponent on b is one less than the term number. (2, 219) 6 2 157 6 1 157 , 0b and a , 0b d. For example, consider the functions defined by g(x) 5 x2 1 2 and h(x) 5 x2 2 4, pictured in Figure 2-25. (See Example 3) 22. (x 1 1)2 1 y2 5 24; The solution set is { }. (2`, 23) g. 3 1 10 1 17 1 24 1 ... 1 437 36 68 29. 500,500 The three arithmetic means between 4 and 28 are 10, 16, and 22. {21, 7} or P52 24. q(x) 5 x2 2 8 79. 0 a. Shift the graph upward 3 units. (3, 7, 22) and (0, 25, 1) d z2 – z1 P(x1, y1, z1) x2 – x1 86. c d ; This matrix represents the reflection of the 1 21 0 triangle across the x-axis, followed by a shift to the left 1 unit and a shift upward 2 units. The proofs of properties 1 and 3 are examined in Exercises 89 and 90. The line that models each set of data is called a regression line and is found by using techniques taught in a first course in statistics. Therefore, it is important to learn how to create and interpret meaningful graphs. There are infinitely many such polynomials. 4 3 22 25 10 10 28 23 113. Number of combinations 5 TIP The number of combinations nCr is equal to the number of permutations nPr divided by r!. Replace y by 2y. 60 p 1 [3(60) 1 5] a (3i 1 5) 5 [3(1) 1 5] 1 [3(2) 1 5] 1 [3(3) 1 5] 1 5 8 1 11 1 14 1 p 1 185 i51 The individual terms in the series: 8, 11, 14, ... , 185 form an arithmetic sequence {an} with a common difference of 3. Each wheel has 11 stops, denoted by 0 through 9, and bar. 22 e. Using the values of a b for the coefficients, r we have a formula for the expansion of the binomial (a 1 b)n. y 5 m(x) 1 25 24 23 22 21 21 22 1 2 3 4 b. Write the diameter d of the sphere as a function of the radius r. 1 3 12. 2$65 e. P1 is true because 5 5 [3(1) 1 7]. w(x) 5 3 21 x 2 x 11 44. 90–94 R.1. R.4. 1. f 21(x) 5 3 B x 5280 b. jointly k ks 2 C 5 kr 13. How much interest will have been earned? The y 5 21.5x 1 165 9 graph of the car's speed y (in mph) versus x 0 0 20 40 60 80 100 120 the time x (in sec) after leaving the first red Time (sec) light is shown in Figure 2-32. {5}; The value –2 does not check. log5 a 3 b x ln 51 f ; x < 2.0206 61. x 5 24 d. (4y 1 5)4 In Example 4, we expand a difference of terms. 22 (multiplicity 2), 612 33. Find the difference quotient . a2`, d ´ [5, `) 5 3 2 2 3 3 47. Therefore, this image is symmetric with respect to the x-axis. y 5 2 x 1 1; x 1 3y 5 3 3 216 Chapter 2 Functions and Relations Solution: Avoiding Mistakes From the slope-intercept form, y 5 12x 2 4, the slope of given line is 12 . Skill Practice 2 Evaluate. For Exercises 37–38, find a counterexample to show that the given statement is not true. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of McGraw-Hill Education, including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning. 215, 219, 223, 227, ... , 2679 11. g(x) 5 20 x 0 14. 3 20. Domain: (2`, `); Range: (0, `) 9 26 25 24 23 22 21 21 y 5 f(x) 1 1 2 7 6 5 4 3 2 f(x) 5 3x 1 2 5 4 3 2 1 9 8 69. y 5 x2 y 5 x4 y 5 x6 y 5 x3 y 5 x5 y 5 x7 c. 216w3 5 1 3 101. In fact, an arithmetic sequence is a linear function whose domain is the set of positive integers. A 5 x a b 45. ln b 55. 3x 2 2 5 4 17. {(18, 217)} 51. P(x) 5 3x 119. 0 15. Compute the actual value of the expression. 3 4Q R.3. b 5 62a2 2 1c 2 92 2 B 3 c. 2 x 2 9 8 21 21 1 1 1 y b. 213w 1 16 R.2. x2 1 18x 1 81 R.3. (2p 2 5)(p 1 3) 42x R.5. (5n 2 2)(n 2 2)(n 1 7) R.6. (a 2 2)(a 2 5) linear 3. y 5 g(x) 25 24 23 22 21 21 22 23 y 5 f(x) 2 1 25 24 23 22 21 21 22 69. (2`, 24) ´ (24, 7) ´ (7, `) c. 0x 0 for x , 0 c. Use Stirling's formula to approximate the given expression. Figure 2-9 The table shows eleven x-y pairs but more can be accessed by using the up and down arrow keys on the keypad. {(4, 21), (24, 1)} 19. y 5 2800x2 1 600x on [25, 5, 1] by [21000, 500, 200] For Exercises 93–94, graph the equations on the standard viewing window. (See Example 6) 57. hr 5 18.3 hr 25. n, which terms are positive and which are negative? 120 65. 377–382 8 R.1. a2`, 2 d 9 R.5. 7w 1 6 R.4. (w 1 2)(3w 1 2) d. (a 1 c) 1 (a 2 c) 5 2a 21028 26 24 22 22 24 26 28 210 15. Factor. What is the probability that this individual's blood can be used for a transfusion for a person with type B1 blood? n The expression a b r will also be used in Section 8.6 when we study counting n principles. Equivalently, a e n(n 1 1) n11 n11 i51 i(i 1 1) We have shown that the statement Pn is true for n 5 1, 2, 3, and 4, but what about values of n thereafter? Evaluate the function at the given values of x, if possible. q(x) 5 2 2x For Exercises 47–50, use the graphs of y 5 f (x) and y 5 g(x) to graph the given function. Domain: (2`, `); Range: [23, `) 95. 1 5 120 6! 5 6 ? Next, assume that Pk is true for k $ 4, and show that Pk11 is true. —Julie Miller or all the students who keep apologizing for asking too many questions. Find a Specific Term in a Binomial Expansion Consider the first four terms of the binomial expansion of (a 1 b)n. Evaluate (d + r)(30) and interpret the meaning in the context of this problem. SA-41 Student Answer Appendix 79. 1 [B 15. 706 Sum of the first n terms of an arithmetic sequence (nth partial sum): n Sn 5 (a1 1 an) 2 where a1 is the first term of the sequence and an is the nth term of the sequence. binomial, trinomial 7. The solution set is (23, `). See Complex fractions Compound inequalities, 146–148, 159 Compound interest, exponential functions to compute, 418–420 Computer, 307 Conditional equations, 85–86, 158 Conditional statement, 167 Conic sections, 681. The expression represents the greatest integer, less than or equal to x. Reference SECTION 2.4 Linear Equations in Two Variables and Linear Functions Let A, B, and C represent real numbers where A and B are not both zero. 2 3 4 5 27 d 231 45. x, x 1 2 24 0 8 5 64 13. Write a formula for the nth term of the sequence. If the nth partial sum Sn of an infinite series approaches a number L as n S `, we say that the series converges and we call L the sum of the series. Determine if the function is linear, constant, or neither. n(x) 5 1x 2 1 a. (2`, 1) ´ (1, `) b. Given x 1 y 1 14x 2 10y 1 70 5 0, a. f (x) 5 2 (x 2 4)2 1 6 3 89. Given n(x) 5 70 x 0 1 3x 2 1, find n(2x). Let Y be the event that the student answered "Yes." Let O be the event that the student had "No Opinion." Y and O are mutually exclusive events (do not overlap). 174 Chapter 2 Functions and Relations For Exercises 19–22, determine if the given points form the vertices of a right triangle. Use the model in part (a) to approximate the average height of 11-yr-old girls. 427 million d. Determine the Slopes of Parallel and Perpendicular Lines 3. 2y 5 a 95. Students and instructors can enjoy access to SmartBook anywhere, anytime (now available offline) with a new and improved mobile interface. TIP The Greek letter D ("delta") written before a variable represents an increment of change in that variable. Based on these results, what is the probability of selecting a voter at random from the district and getting a. Substitute a5 5 40.96. A combination of n items taken r at a time is a group of r items taken from a group of n items in no particular order. (24, 1) ´ (3, `) 20. Find the Probability of Sequential Independent Events When a coin is tossed, the probability that it lands heads up is 12 . Determine the x-intercept(s). Determine the number of ways that 6 people can be arranged in line at a ticket counter. 0.00 d. i, 21, 2i, 1, i, 21, 2i, 1 111. x(x 1 1); x2 1 x d. f(x2) EXAMPLE 10 I For all x1 and x2 on I, f(x1) 5 f(x2) Determining the Intervals Over Which a Function Is Increasing, Decreasing, and Constant Use interval notation to write the interval(s) over which f is a. All functions are relations. 21 5 1176 Skill Practice 9 The coach of a co-ed softball team must select 4 women and 5 men from a group of 7 women and 10 men to play in a game. We learned that if P dollars is invested in an account at interest rate r, compounded annually for t years, then the amount A in the account is given by A 5 P(1 1 r)t Answers 7 9 10. r EXAMPLE 2 Computing Binomial Coefficients Evaluate. • The graph of the equation is symmetric to the origin if substituting 2x for x and 2y for y results in an equivalent equation. e f 10. (f + g)(0) 107. Additional thanks to Julie Kennedy and Carey Lange for their tireless attention to detail proofreading pages. 22 21 The domain is 12`, 222 ´ 122, 212 ´ 121, 12 ´ 11, 22 ´ 12, `2. For A and C of opposite signs and k fi 0, the denominators and A C have opposite signs, indicating that the terms on the left side of the equation have opposite signs. These prep products can be used during the first 3 weeks of a course to prepare students for future success in the course and to increase retention and pass rates. (m 2 n)(22) p c. 24(3p 2 2)(p 1 3) 91. Write the sequence corresponding to the sum of the numbers in each row of Pascal's triangle for the first nine rows. Furthermore, each time at bat is independent of the time before. Graph the circle. (4C1) 5 480 67. 225u 1 16v 107. For example: an 5 (21)n bn 5 (21) Answers 1. Past history indicates that for a certain route, the probability that an individual passenger will not show up is 0.04. Students today thrive on efficiency, mobility, and motivation. 2. 1T + C21182 5 $308.83; The total cost to buy 18 tubes of paint is $308.83. P(E) 5 0.75 14. {24, 22} b. The business will lose $322. g(x) 5 x3 2(x 2 1)3 Objective 3: Graph Piecewise-Defined Functions For Exercises 47–50, evaluate the function for the given values of x. 123 mi Cassandra invested $8000 in the Treasury note and $12,000 in the bond. x2 1 x2y1 1 x2y2 1 x2y3 15. {(23, 5)} 19. 25 b. 0.2 b. m 5 (v0t)2 1 t 3 1 17 3 2 17 10. 5! (3 ? arithmetic 25. Expand (ex 1 e2x)3. y y 23. Center: (23, 5) e. 1 16. (2`, 28 4 ´ 3 2, `) 51. Evaluate the functions at the given values of x y if possible. Library of Congress Cataloging-in-Publication Data Miller, Julie, 1962College algebra / Julie Miller, Daytona State College, Donna Gerken, Miami Dade College. The expression a b (read as r "n choose r") is called a binomial coefficient and is defined by n n! a b5 r!(n 2 r)! r n Note: The notation nCr is often used in place of a b. x 5 20 y 0 2 4 11. EXAMPLE 6 Computing the Probability of A or B Suppose that one card is selected at random from a standard deck of cards. • The x-coordinate is the location of the relative maximum or minimum within the domain of the function. x8 c. y 6 5 y 5 f(x) The graph of f has the following "strategic" points that define the shape of the function: (24, 22), (22, 4), and (2, 22). 5 3(x 1 2)2 2 7 (vertex form) b. a (6i 2 7) i51 i51 For Exercises 95–98, determine whether the statement is true or false. y 5 1.2x 2 1.48 11. Endpoints of minor axis: (0, 5), (0, 25) (5, 0), (25, 0) f. a23, b and a4, b 5 10 32. • Create learning goals with due dates that align with your textbook/syllabi and to pace student learning • Implementation services and training help make setup simple and timely • 100% mobile-ready allows you to manage your classes from anywhere • LMS integration offers single sign-on and gradebook sync capabilities ALEKS Reporting provides detailed data on student progress, allowing you to quickly identify intervention needs and to better understand student learning behaviors. e 1 6 157 f 4 4. 4 For Exercises R.3–R.4, solve the system. 25 24 23 22 21 22 24 26 26 28 210 28 210 y 10 8 6 4 2 2 24 d. For example, explain why 4, 16, ... can be arithmetic, geometric, or neither. 3 27 5 3 1 5 1 23. The estimate from each model for systolic blood pressure for a 55-year-old rounds to 132 mmHg. TIP In Example 8(d), the value of the function at x 5 55 can also be found by selecting the CALC menu and selecting the VALUE function. Because there is no y variable and because the slope is undefined, an equation of a vertical line cannot be written in slopeintercept form. Ay 1 34 B 2 5 (x 2 3) 3 b.Vertex: A3, 24 B; Focus: A 134, 234 B; Focal diameter: 1 53. (2`, 2) ´ (2, `) i. 2 Solution: 1 The graph of n(x) 5 2 (x 2 2)2 1 3 is the same as the graph of f(x) 5 x2, with four transformations in the following order. 61, 6 , 6 , 6 , 22, 23; From part (c), the value 2 itself is not 3 3 3 a zero of f (x). By the reflective property of an ellipse, any shot passing through one focus is reflected through the other focus. { } 17. Day Number d 2 24 25 103. Use the model from part (a) to estimate the wind speed for a Barometric Pressure (mb) hurricane with a pressure of 900 mb. 0 and r fi 1 is an exponential function whose domain is restricted to the set of positive integers. {215} 3 ln 87 19 17. Suppose that a1, a2, a3 , ... is a geometric sequence with r . The endpoints of a diameter are (7, 3) and (5, 21). 712 If the first term of a geometric sequence is a1, and the common ratio is r, then the nth term of a geometric sequence is given by an 5 a1rn21. {0, 17} a. q(x) 5 2 1x 1 2 For Exercises 17–18, determine the solution set to the equation. (r 2 p)(x) 20. e 2 , 211 f 2 71. Kaplan RF. EXAMPLE 3 Applying the Vertical Line Test The graphs of three relations are shown in blue. Center: (4, 22); Radius: 9 11. c d ?A5 c d 0 21 21 23 0 1 21 0 2 23 23 0 e. an 5 2n 1 1 3 4 3 1 2. 9a2 1 6ab 1 b2 2 c2 1 18. y2 2 y1 2 2 (26) 8 8 5 52 5 x2 2 x1 21 2 4 25 5 y 2 y1 5 m(x 2 x1) Apply the slope formula. This mapping defines the set of ordered pairs: {(1, 2), (3, 2), (5, 4)}. 0, 24, ; each of multiplicity 1 27. s(t) 5 24.9t2 1 98t b. A proper rational expression is a rational expression in which the degree of the numerator is less than the degree of the denominator. Solve the equation 6x 2 2(x 1 2) 2 5 5 0 and verify the solution graphically on a graphing utility. y 9 8 7 6 5 4 3 2 an 5 8 ⎛ 12 ⎞ 9 8 7 6 5 4 3 2 n ⎝ ⎠ 1 22 21 21 f(x) 5 8 ⎛ 12 ⎞ x ⎝ ⎠ 1 1 2 3 4 5 6 7 8 n Figure 8-1 22 21 21 1 2 3 4 5 6 7 8 x Figure 8-2 The graph of {an} consists of a discrete set of points that correspond to points on the graph of f (x) 5 8A 12 B x for positive integers x. 227 (multiplicity 1), 0 (multiplicity 4), 27 (multiplicity 1) 39. What is the difference between a sequence and a series? 4! ? 5 b. a1 5 5, r 5 2 14. y 2x 1 3y 5 6 Solve the equation for y. • To help students develop logical thinking and problem-solving skills that will benefit them in all aspects of life. Applying the Pythagorean theorem produces d2 5 0x2 2 x1 0 2 1 0y2 2 y1 0 2, or equivalently d 5 2(x2 2 x1)2 1 (y2 2 y1)2 for d $ 0. 50, 24, 2 6 2i 136 SA-6 17. By the inductive hypothesis, [3 1 7 1 p 1 (4k 2 1)] 1 [4(k 1 1) 2 1] 5 k(2k 1 1) 1 (4k 1 3) 5 2k2 1 5k 1 3 5 (k 1 1)(2k 1 3) as desired. a2`, b 113. 5 1 5 2?3 2 6 3 1 1 1 1 1 3 Call this statement P3. For Exercises 41–54, write the equation in the form (x 2 h)2 1 (y 2 k)2 5 c. y 5 2x 1 4 5 21 89. SA-24 Student Answer Appendix 69. and the width is approximately 1.94 in. Is m(2x) 5 2m(x)? Graph c 79. f 21(x) 5 log3(x 2 1) Domain: (1, `); Range: (2`, `) Domain: [25, `); Range [0, `) b. A3 1 117, 3 1 117B and A3 2 117, 3 2 117B y y 65. h(x) 5 • 1 for 22 # x , 0 1x for x $ 0 g(x) 5 0 x 2 2 0 105. (3w 1 8)(3w 2 8) 2(10u2 1 3v3)(10u2 2 3v3) 41. 10 g. Likewise, from part (d), the value 24 itself is not a zero. f(x) 5 5x 2 15x 1 3 2 4 10 8 h. (2`, 24] ´ [21, `) 7. The range is (2`, 21]. 2, 3, , , ... 2 4 Solution: a2 3 5 a1 2 n21 an 5 a1r 3 n21 an 5 2a b 2 r5 Dividing any term by its predecessor, we have a common ratio of 32 . (y 2 2)2 x2 1 5 21; No solution. 8 7 6 5 4 3 2 1 1 25 24 23 22 21 21 22 60,000 Amount in Bonds 3 4 Problem Recognition Exercises, p. 34–37 1. 120. f (x) 5 0 x 0 b. 83. 0! 36. (m 1 n)10; seventh term 30. The two equations form a system of linear equations in two variables. h(x) 5 3 0 x 0 17. x-intercept: (29, 0); y-intercepts: (0, 3), (0, 23) y 8. 21 2. 736–738 R.1. 25v2 1 20v 1 4 R.3. R.5. 1. an 5 4. This implies that 5k 2 3 5 2a and that 5k 5 2a 1 3 for some positive integer a. 124 5 i 19 ? x 5 y2 1 3 14. Graph the data in a scatter plot. For example: x 1 y 5 2 2x 1 y 5 21 1 81. From the slope formula, we have: y2b 5m x20 y 2 b 5 mx y 5 mx 1 b Slope formula Multiply by x. Suppose that one flight has 160 passengers and only 156 seats. 2 (2, 22) becomes a 1 , 22b 5 (4, 22). 5 4 3 2 25 24 23 22 21 21 22 y 1 25 24 23 22 21 21 22 1 2 3 4 5 1 2 3 4 5 53. 403 5 64,000 69. b 29. 3x 1 4y 5 4 4y 5 23x 1 4 3 y52 x11 4 3 b. k(25) 44. 12 1 16 1 20 1 ... 1 84 63. 1x 2 2 Chapter R Test, pp. Suppose that a drama class has 22 students. The road sign shown in the figure indicates the percent grade of a hill. 240 2 42i 17 2 i 15 65. Furthermore, 0 itself is not a zero of f(x) because x is not a factor of f(x). The multiple-choice questions each have five possible answers of which only one is correct. 200 0 80 80 c. c 8 212 4 26 213 2 216 d 1 20 230 c. 243 • The graph of the equation is symmetric to the y-axis if substituting 2x for x results in an equivalent equation. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 y 95. Real Numbers Use Inequality Symbols and Interval Notation Find the Union and Intersection of Sets Evaluate Absolute Value Expressions Use Absolute Value to Represent Distance Apply the Order of Operations Simplify Algebraic Expressions Write Algebraic Models The numbers used in day-to-day life such as those used to determine fuel consumption come from the set of real numbers, denoted by R. Vertices: (0, 2), (0, 22) Foci: A0, 2 110 B, A0, 22 110 B y 5 13x and y 5 213x 17. If an ordered pair (a, f(a)) corresponds to a relative minimum or relative maximum, we interpret the coordinates of the ordered pair as follows. Center: (6, 0) b. Create Models Using Linear Regression y 2 y1 5m x 2 x1 a Slope formula y 2 y1 b(x 2 x1) 5 m(x 2 x1) Clear fractions. an 5 a1 1 (n 2 1)d 49 5 a1 1 (15 2 1)d 49 5 a1 1 14d an 5 a1 1 (n 2 1)d 85 5 a1 1 (27 2 1)d 85 5 a1 1 26d Substitute a15 5 49 and a27 5 85 into the formula for the nth term. y 5 22920t 1 29,200 b. P(x) , 0 (the company experiences a loss) c. f(x) 5 The domain is restricted to the real numbers that make the radicand greater than or equal to zero. (2a 1 5) 2 5 Replace 7k by 2a 1 5. Minimum value: 37,000 SA-34 Student Answer Appendix 13. A Special Thanks to All of the Event Attendees Who Helped Shape College Algebra. C(x), or equivalently P(x) . h(x) 5 x3 a. Denote the sample space as S 5 {R1, R2, B1, B2, B3, G1, G2, G3, G4, G5}. a 67. If bn 5 2180, what is n? h(22.5) e. Round the slope to 1 decimal place and the y-intercept to the nearest whole unit. Notice that if we were to switch the first and third letters (both "N's") we would get the same arrangement. Consider a set of data points (x1, y1), (x2, y2), (x3, y3), ... , (xn, yn). 32 12. Answers 7. Find a1 and r for a geometric sequence given that a3 5 18 and a6 5 486. {25} d. At that time, the health department declares a flu epidemic. [6, 8] 275 Key Concepts 125. Therefore, x ? (6, `) 28. SECTION 2.4 For Exercises 37–40, graph the equation and determine the x- and y-intercepts. upward; minimum; k 7. Find (k + m)(x). 23} or in interval notation: (23, `). Yes; after 60 min, the cake will be approximately 95.28F. { } 3 3. a A5 1 12iB i51 31. 4 67. (24, 5) Chapter 3 Cumulative Review Exercises, p. x 2 2y 1 3z 5 21 y 1 4z 5 211 z 5 22; Solution set: {(21, 23, 22)} 3. y 4 3 2 1 2 3 4 5 6 x y 67. Finally, the rate of new cases dropped more slowly toward the end of the outbreak. For Exercises 45–48, find a1 and r for a geometric sequence {an} from the given information. In this case, the monthly income is a constant $3000. If n items are arranged in order, then each arrangement is called a of n items. This means that 15 is irrational. SA-47 Student Answer Appendix By the inductive hypothesis, 1 C 1 1? If the slope of a line is 23 , a. x 5 4, y 5 10 c. p)(x). b. 48 hr c. 160–162 7 40 1 3. {3} e. The x- and y-axes divide the plane into four quadrants. (0, 258); The average consumer spending on television services for the year 2004 was $258. Y1 5 2x 2 3 5 Y2 5 x 2 1 25 x-coordinate of the point of intersection (2, 1) 5 25 In Example 9 we solve the equation 6x 2 2(x 1 2) 2 5 5 0. 252 • f is increasing on I if f (x1) , f (x2) for all x1 , x2 on I. a. Answers 1. {(3z 1 5, 24z 1 3, z) 0 z is any real number} 19. 21 1 2 3 4 5 x 258 Chapter 2 Functions and Relations 23 for 24 # x , 22 67. A is the set of all points in a plane equidistant from a fixed point called the 2. an 5 (21)n(n 1 4) n! b. 9 16 3 b. Does this relation define y as a function of T? 25x # 20 and 32[2 2 (x 2 4)] , 2x 1 5 1. Given a line defined by y 5 22, what is the slope of the line? Assume that all distances are in miles. This may give the graph a jagged look (Figure 2-10). 2504 ft 21. Expression; 4x2 2 12x 1 1 b. a7 1 7a6b 1 21a5b2 1 35a4b3 1 35a3b4 1 21a2b5 1 7ab6 1 b7 6 a. 24 b. 387–391 A IR 3V R.2. h 5 2 R.3. E 5 R.4. {18} Pt K πr directly 3. 5n 2 1 is divisible by 4. Let Pn be the statement that n2 2 n is even. 5 a3 2 3 2 3 b. 25 24 23 22 21 21 22 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 b. e , 215 f e 4 2 2 {0}; The value 23 does not check. 12 73. m(x) 5 2x 2 4x 1 1 34. —Julie Miller and Donna Gerken Applications Index Agriculture & Gardening Corn plants per acre for maximum yield, 398 Costs for farmer to run tractor, 426 Crop acreage and maximum profits, 556 Dimensions and area of corrals/chicken coops, 293, 297, 394 Dimensions and area of garden in yard, 297 Dimensions of garden based on area, 380 Dimensions of triangular portions of garden, 163 Fencing and pens enclosed by farmer, 132 Height of tree and age, 481 Length of garden from footage of fencing used, 155 Nursery's inventory and profits, 555 Plant fertilizer makeup, 515 Seeds selected from package, good versus defective, 749 Sunflower height, 16 Animals & Pets Animal's mass in relation to tidal volume, 413 Animal's mass in relation to weight of heart, 396 Deer population, 94, 101, 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rainfall amounts in Miami, 162 Snow needed to exceed monthly average snowfall, 151 Temperatures and average rate of change, 210 Wind pressure on wall, 398 Review of Prerequisites Chapter Outline R.1 Sets and the Real Number Line 2 R.2 Integer Exponents and Scientific Notation 18 R.3 Rational Exponents and Radicals 27 R.4 Polynomials and Multiplication of Radicals 38 Problem Recognition Exercises: Simplifying Algebraic Expressions 47 R.5 Factoring 47 R.6 Rational Expressions and More Operations on Radicals 59 Algebra for Calculus 72 A thletes know that in order to optimize their performance they need to pace themselves and be mindful of their target heart rate. (2`, `) 5 g(x) 5 2 1 ln x 4 d. The point (21, 1) is a closed dot to show that it is part of the function. Undefined a. 220.04t , where t is the number of months since the outbreak began. Not possible SA-37 Student Answer Appendix 19 57. 4 10 210 Y1 5 6x 2 2(x 1 2) 2 5 10 210 Section 2.4 207 c. [5, 10] Section 2.4 211 Linear Equations in Two Variables and Linear Functions Objective 5: Solve Equations and Inequalities Graphically For Exercises 91–98, use the graph to solve the equation and inequalities. The x-intercepts are (24, 0) and (4, 0). Recall that i 5 121. 9 The solution set is c , `b. 12, 5, 22, 29, 216, ... EXAMPLE 2 b. Write a linear cost function representing the cost to the studio C(x) to hold x private lessons for a given month. Q e. 5, 2 , , 2 , ... 3 9 27 13. {(0, 2, 3)} 9. ln(a 1 4) 2 4 4 1 39. and is often denoted by r. A sales person working for a heating and air-conditioning company earns an annual base salary of $30,000 plus $500 on every new system he sells. (See Example 1) 16. h(x) 5 (x 1 3)2 13. 222–228 3 3 x 1 3; Slope 5 , y-intercept is (0, 3) 5 5 Undefined R.4. 0 R.5. C 5 450 1 850m 1 250n y 2 y1 5 m(x 2 x1) 3. Explain why the graph of g(x) 5 0 2x 0 can be interpreted as a horizontal shrink of the graph of f (x) 5 0 x 0 or as a vertical stretch of the graph of f (x) 5 0 x 0 . an 5 64A214 B n (Exercise 9) (Exercise 10) For Exercises 115–116, use a graphing utility to find the sum. C 5 640m 1 200n 1 500 b. For a trip from Houston, Texas, to Dallas, Texas, a motorist travels 36 mi of city driving and 91 mi of highway driving. P(Y or O) 5 P(Y) 1 P(O) 28 128 1 5 265 265 5 TIP As an alternative to computing P(N) 1 P(F) 2 P(N ¨ F), count the number of elements in the event (N ´ F), being careful not to count the elements common to N and F twice; that is, count 162 females plus the 7 males who answered "No" for a total of 169 elements in event (N ´ F). 28a2b3 1 7.3ab2 2 2.9b 65. Reflect over x-axis n(0) 5 212 (0 2 2)2 1 3 5 1 ✓ n(2) 5 212 (2 2 2)2 1 3 5 3 ✓ n(4) 5 212 (4 2 2)2 1 3 5 1 ✓ 1 2 3 4 5 x 6 (4, 22) Shift upward 3 units 5 4 3 24 23 22 21 21 22 25 24 25 y 1 (2, 3) n(x) 5 2 2 (x 2 2)2 1 3 2 (0, 1) 1 23 24 25 4 5 6 x (4, 1) 1 2 3 4 5 6 x 1 y 5 2 2 (x 2 2)2 1 3 (2, 3) 2 (0, 1) 1 23 (x 2 2) 24 24 23 22 21 21 22 3 24 25 23 5 4 3 1 2 y 2 1 2 24 23 22 21 21 22 23 y 5 4 3 1 22 (4, 2) 1 Shift right 2 units 24 25 24 23 22 21 21 (0, 22)22 5 4 1 2 y 5 2 (x 2 2)2 3 (0, 2) 2 (4, 1) 1 2 3 4 5 6 x 238 Chapter 2 Functions and Relations Skill Practice 7 Use transformations to graph the function defined by m(x) 5 23 0 x 2 2 0 2 4. Center: (6, 22); Radius: 6 21. Then substitute arbitrary values of x into the equation and solve for the corresponding values of y. Ocean: 93.8 m 77. logarithmic Section 4.5 Practice Exercises, pp. (x 1 3)(x 2 1)(x 1 2i)(x 2 2i) 109. Assume that k! . In such a case, we use the extended principle of mathematical induction. A small business makes cookies and sells them at the farmer's market. y 65. The point (1, 23) is graphed as an open dot, because the point is not part of the rule f (x) 5 23x. Cumulative Number of Flu Cases 25 (4, 33) Number of Cases 30 Number (1000s) 2 x y 100. (23, `) 19. 24 23 22 21 21 3 4 1 2 3 4 5 6 x 25 C(1, 26) 26 27 28 29 210 x 23 F 12 10 8 F 21421221028 26 24 22 22 F 24 26 28 4 3 2 C(6, 0) 1 2 4 6 x 24 1 2 F 3 4 5 6 7 8 59. Assume that Pk is true; that is, assume that 2 is a factor of 7k 2 5. 4 defective seeds can be selected. The slope is 25 and means that consumer spending on television services rose $25 per year during this time period. (23, 26, 22) For example: (0, 6, 0), (4, 5, 1), (8, 4, 2) For example: (0, 0, 1), (0, 2, 0), (3, 0, 0) a. {(23, 1, 4)} 1 9 a. f (x) 5 x 1 1 for x , 2 54. 3n 7. symbol can be accessed by selecting • If the calculator is in "Classic" mode, the sum can be evaluated by entering S (nth term, variable, lower limit, upper limit) • If the calculator is in "Mathprint" mode, then the user is prompted to enter the nth term, the variable, and limits of summation in text fields. an 5 (22)n 7. What is the probability that a given offspring will have yellow peas? i51 k11 Show that a 1 5 (k 1 1). Domain: (2`, `); Range: (21, `) c. Decreasing Solution: a. Passes through (2.2, 4.1) and m 5 2.4. 11. {(5.35, 41.71, 4.45)} R.1. 1 4 3§ ✓ 24 15. Draw the circle through the points. Domain: (2`, 21) ´ (21, `); Range: (3, `) 103. Write a linear cost function representing the cost C(x) to produce x dozen cookies per month. f (x) 5 8x3 2 22x2 2 7x 1 3 31. C(x) (the company makes a profit) P(x) y 5 P(x) x 730 59. BC 5 c 7 d 221 2 26 $7922 d ; QP is the matrix representing the total revenue from $9843 these four items for each theater. (x 2 2)2 1 (y 2 1)2 5 25 y b. Write the sum 4 2 For Exercises 9–11, find the sum. {(0, 23), (7, 4)} 12. 5! (2n 2 3)! 13. f(c) 5. f (x) 5 0 for x 5 24 and x 5 4. Determine Whether a In the physical world, many quantities that are subject to change are related to other variables. (0, `) b. Y1 , Y2 for x , 2 Then display the table values for Y1 and Y2 for x 5 2 and for x values less than Y1 5 Y2 for x 5 2 and greater than 2. 12 mi 73. 42x 6 2 3x21 10. • New applications appear in Chapter 7 to provide students more real-world context for conic sections. g(x) 5 1x 1 4.3 2 8.4 2 55. (2`, 5] 5 b. C(4) 5 12.99(4) 1 99 5 150.96 The base price $99 is the fixed cost with zero additional family members added. 2 6 5i, 617 b. 30 5 38 19 38 38 3 1 33 11 29. log ° 2b 1 2b2 2 4ac 2b 2 2b2 2 4ac ¢ 1 log ° ¢ 2a 2a 5 log ° 2b 1 2b2 2 4ac 2b 2 2b2 2 4ac ? y 6 6 8 7 6 0 0 6 5 85. Skill Practice 10 An artist shops online for tubes of watercolor paint. Admission to the event is $10 per person. Enter the equation Y1 5 0.511x 1 104 into the equation editor and hit the GRAPH key. Evaluate the function for the given values of x. 1 5 2 27 y 3 4 x 7 6 5 4 26 5 4 3 2 2 5 y 27 26 25 24 23 22 21 21 25 24 23 22 21 21 22 87. Why do the probabilities from parts (a) and (b) not add up to 1? Solution: Let A be the event that an ace is drawn: {A ,A ,A ,A }. 8! b. Use Factorial Notation We now introduce factorial notation to denote the product of the first n positive integers. y 5 x 1 2.99 c. 60. Passes through (1.6, 4.8) and (0.8, 6). Find the Probability of Sequential Independent Events TIP The word "die" is the singular of the word "dice." That is, we roll one die but we roll two dice. 754 767 Review Exercises Two events are mutually exclusive if they share no common elements. In the New York state lottery game "Lotto," a player wins the grand prize by choosing the same group of 6 numbers from 1 through 59 as is chosen by the computer. Therefore, x2 1 4 . (0, 1) Factor out the leading coefficient of the x2 term from the two terms containing x. 544 105. For Exercises 52–53, find the sum. S(x) 5 0.12x 1 400 for x $ 0 b. d1 5 2, d2 5 2, d3 5 5, d4 5 5 b. What is the probability of randomly selecting a jury of all men? 25 24 23 22 21 0 1 2 3 4 x 5 There are no fractions or radicals that would restrict the domain. V(x) 5 2x3 1 3x2 2 x b. Let h, k, and a represent positive real numbers. This is the approximate distance at which the driver makes a decision to stop or go.) b. An nth-degree polynomial has at most n 2 1 turning points. See also Polynomials explanation of, 38 factoring quadratic, 49–51 perfect square, 51–52, 115–116 substitution method to factor, 55 Turning points, of polynomial functions, 307 U Undefined rational expressions, 373 Uniform motion applications, 97, 134–135, 499–500 Union of sets, 5–6, 73 of two events, 755–757 Upper and lower bound theorem, 338–339 Upper bounds, 337–340 V Variables, 2 Variation in applications, 385–387 constant of, 383, 384, 393 direct, 383, 385–386 inverse, 383, 386 joint, 384, 387 review of, 393 Variation models, 383–384 Vertex form explanation of, 286 quadratic function written in, 287–288, 391 Vertex formula, 289–290 Vertical asymptotes explanation of, 236–237, 393 method to identify, 347–348 Vertical lines equation of, 201 slope of, 200, 201 Vertical line test, 185, 275 Vertical shifts, 276 Vertical shrink/stretch, 232–233, 236 Vertical translations, of graphs, 230–232, 236, 276 Vertices of ellipse, 635 of feasible region, 549 I-9 of hyperbola, 651 of parabola, 289–290, 667–672 Volume application involving, 126 of cube, 42 W Wallis, John, 4 Whole numbers, 2, 73 Wiles, Andrew, 730 Work applications, 98 X x-axis explanation of, 166 reflections across, 234–236, 276 x-coordinate, 166, 276 x-intercepts explanation of, 170 of function defined by y 5 f(x), 171, 188 method to find, 171, 188, 275, 290 Y y-axis explanation of, 166 reflections across, 234–236, 276 y-coordinate, 166 y-intercepts explanation of, 170 of function defined by y 5 f(x), 171, 188 graphs of line and, 201–202 method to find, 171, 188, 275 Z Zero exponents, 18–20 Zero product property to solve polynomial equations, 133 to solve quadratic equations, 113–114, 120, 158 Zeros division involving, 10 irrational, 329 of multiplicity, 305, 339–340 nonreal, 336 of polynomial functions, 303–306, 391–392 of polynomials, 321–324, 329–340, 392 rational, 329–332 rational expressions equal to, 373 simplifying expressions with, 18–20 0 x 2 1.7 0 1 4.95 # 11.15 For Exercises 113–114, graph the lines in (a)–(c) on the standard viewing window. EXAMPLE 12 Estimating Function Values from a Graph The graphs of f and g are shown. h(t) 5 12 2 t 22t$0 2t $ 22 t#2 Domain: (2`, 2] 3 5 2 5 5 Domain: a2`, b ´ a , `b 2 2 b. e f 14. Number of Permutations of n Elements, Some Indistinguishable Consider a set of n elements with r1 duplicates of one kind, r2 duplicates of a second kind, ... , rk duplicates of a kth kind. horizontal shrink 11. g(x) 5 Œx 2 3œ 1 83. 1, then the graph of y 5 af (x) is the graph of y 5 f (x) stretched vertically by a factor of a. Average Rate of Change of a Function Suppose that the points (x1, y1) and (x2, y2) are points on the graph of a function f. For example, a home with a $60,000 taxable value in a municipality with a 19 mil tax rate would require (0.019)($60,000) 5 $1140 in property taxes. 0 g. 3 13. y 17. Solution: y f(x2) 2 f(x1) Average rate of change 5 x2 2 x1 (22, 3) f(0) 2 f(22) 21 2 3 5 5 5 22 0 2 (22) 2 5 4 3 2 f (x) 5 x2 2 1 1 25 24 23 22 21 21 22 The average rate of change is 22. 5 4 3 2 m5 1 25 24 23 22 21 21 22 23 24 25 y2 2 y1 323 0 5 5 50 x2 2 x1 422 2 1 2 3 4 5 x y2 2 y1 321 2 5 5 x2 2 x1 222 0 (undefined) By inspection, we see that between any two points on the line, the change in x is zero. When a function is defined by an equation, we often use function notation. {21} b. Wind Speed (mph) Wind Speed vs. 2k11. 2, 15, 16, 17 1, 8, 27, 64 15. See also specific functions absolute value, 229 algebra of, 262–265, 277 average rate of change of, 203–204 composition of, 266–270, 277 constant, 202, 301 continuous, 249 cub, 229 cube root, 229 decomposition of, 269 determining intercepts of, 188 domain of, 188–190, 263–264, 267–268, 275 evaluation of, 187, 263 even, 245–246 explanation of, 184, 186 exponential, 414–422, 483 floor, 249–250 graphs of, 190–191, 202–204, 229–230, 276–277 greatest integer, 249–250, 277 with horizontal stretch/shrink, 233–234, 236 identity, 229 increasing, decreasing, and constant behavior of, 251–252 inverse, 402–409, 482 linear, 202, 216–218, 229, 301 logarithmic, 427–437, 483 objective, 547–548 odd, 245–246 one-to-one, 403–405, 482 performing operations on, 262–264 piecewise-defined, 247–251, 276–277 polynomial, 300–310, 391–392 power, 301–302 quadratic, 229, 286–294, 301, 391 range of, 188–190 rational, 345–361, 393 reciprocal, 229 relations vs., 184–186 relative minima and maxima of, 253–255, 277 square root, 229 step, 249–250 transformations of, 230–238 with vertical stretch/shrink, 232–233, 236 Fundamental principle of counting, 739–740, 743, 766. bn 5 2n3 1 5 10. In Example 8, we find the domain and range from the graph of a function. q(x) 5 2x 2 4 8 4 20. x 2 2 2 1 2 2 27. (22, 3) c. Parabola c. By finding an equation of the line, we produce a model that relates the two variables. {1} 101. Let Pn be the statement that 2 is a factor of 7n 2 5. Domain: (22, `); Range: (2`, `) c. x 5 22, x 5 1, and x 5 3 7. {(2z 1 3, 2z 1 1, z) 0 z is a real number} 39. Write P as a function of d. y 5 g(x) 1 (25 24 23 3 22 21 211 222 2 3 4 x 5 The range is shown on the y-axis in red tint. Use this information for Exercises 81–82. n 5 1 1 2 ; am 1 b 81 9 41. { } 5 4 3 2 y 23 1 25 24 23 22 21 21 22 x 4 8 12 5 4 3 2 5x # 6y 25 24 23 22 21 21 22 5 4 3 2 5 19. g(x) 5 1 x 92. {21.4408, 2.8584} 129. The graph of y 5 2f (x) is the graph of y 5 f (x) -axis. 715 nth partial sum of a geometric sequence: n a1(1 2 r) 12r where a1 is the first term of the sequence and r is the common ratio, r fi 1. x 5 8 y 5 29 z 5 32 25. The height of the object t seconds after launch can be modeled by s(t) 5 216t2 1 400t 1 4, where s(t) is the height measured in feet. {x 0 x # 1.5} y y 33. State whether the graph of the parabola opens upward or downward. E211 6 5 15F 45. 20.014 b. 21 and 2 6 3i (each multiplicity 1) 85. 4, 21 13 31 , , ,p 4 2 4 20. 7 6 5 4 3 2 1 25 24 23 22 21 21 22 28 27 26 25 24 23 22 21 21 22 23 24 8 7 6 5 4 3 2 x y b. Suppose that a line has a slope m and y-intercept (0, b). Passes through (3, 21) and is parallel to the line defined by 23x 1 y 5 4. 400 deer were present when the park service began tracking the herd. Explain why a b is undefined. {x 0 x , 21 or x $ 0} f. 184 The vertical line test tells us that the graph of a relation defines y as a function of x if no vertical line intersects the graph in more than one point. To find a5, substitute 5 for n. 1 b. If a1, a2, a3, a4, ... is a geometric sequence with common ratio r, show that a11, a12, a13, a14 p is also a geometric sequence and determine the value of r. Note that the inequality symbols can be found in the TEST menu. Skill Practice 9 Given r1x2 5 1 2 x 5 and t1x2 5 2 , find 1r + t2 1x2 x11 x 29 and write the domain in interval notation. 3 4 5 d 2 1 b. e a2 , 2 b f 41. 6 h. a b 2 5 10. 2x2 1 3x 2 20 4 2 2 4 29. x approaches 5 from the left 5. Given bn 5 b. R; (2`, `) 69. {(213, 11, 10)} 65. Sandy has a personal trainer who encourages her to get plenty of cardiovascular exercise. Not collinear The points (x1, y1) and (x2, y2) define the endpoints of the hypotenuse d of a right triangle. A > B 5 B 4. 61, 63, 67, 621, 6 , 6 , 6 , 6 2 2 2 2 7 c. z 5 4x2; This is an equation of a parabola in the xz-plane. Write a linear model representing the amount of gas G(t) left in the tank t hours into a trip. y 5 4 3 2 13 2 F 1 22 21 21 22 23 24 25 1 2 F 3 4 5 6 C(3, 0) 7 8 x x SA-42 31. Neither even nor odd d. 555 ft The pole is 7.2 ft long, and the snow is 4.8 ft deep. For example, a square matrix with a row or column of all zeros does not have an inverse. e f 2 1 1 a. (f 1 g)(1) 5 f (1) 1 g(1) 5 4 1 (23) 51 c. {0, 1} or 19. The card is an ace or a spade. {22, 24} 3. Avoiding Mistakes It is important to use parentheses when substituting (k 1 1) into a statement for n. 2 (6y)4 or A 2 6yB 4 11 4 11 b. (4, 26) and (21, 2) (x1, y1) and (x2, y2) m5 Label the points. 2 1 2 1 2 2 4 8 16 32 84. By the inductive hypothesis, [2 1 4 1 ... 1 2k] 1 2(k 1 1) 5 [k (k 1 1)] 1 2k 1 2 5 k2 1 3k 1 2 5 (k 1 1)(k 1 2) as desired. y 5 2x 2 3 30. 21 23 3 Section 4.3 Practice Exercises, pp. Compare the results to the result of Exercise 58. y 5 21 y 31. Section 8.3 Geometric Sequences and Series 713 Skill Practice 1 Determine whether the sequence is geometric. an 5 57. This contradicts the definition of a function. (0, 23) e. To write h as a composition of two functions, we have h(x) 5 (f + g)(x) 5 f (g(x)). Evaluate f (2). 1 5 ? (g + f)(0) g. log a 3 b 63. 3n , 2n 28. Therefore, n(E3) 5 36 and n(E3) 36 18 5 5 < 0.9474. Prove that a c 5 cn. e 21, 5 1 b. Explain how the distance formula is developed from the Pythagorean theorem. Use the data points (44, 8.5) and (620, 35) to write a linear function that defines longevity L(x) as a linear function of the length of the gestation period x. Section 2.1 The Rectangular Coordinate System and Graphing Utilities Select the GRAPH feature. a0, 2 b 2 7 6 5 8 10 3 x 2 2 5 x 22 x 21 1 6 4 2 1 x 8 10 10 8 6 85. The odd-numbered terms are negative, and the even-numbered terms are positive. (See Example 6) 51. 5 38. $1958.88 45. 0 b. Cube root function: f (x) 5 1 x 5. 2x 2 2 2x2 2 y2 97. Circle c. an 6 4 2 1 2 3 4 5 6 7 8 9 n an 9 8 7 6 5 4 3 2 1 21 22 23 24 94. (2`, 23) ´ (23, `) b. Now let event A be the event that an ace is drawn, and let S be the event that a spade is drawn (Figure 8-13). In each case, add like terms or like radicals by using the distributive property. Sn 5 n2(a1 1 an) 5 n2(1 1 n) b. Algebra. A chess tournament has 16 players. 89,000 700 0 3 4 y 12 10 8 6 4 CHAPTER 5 0 2 24 25 x b. 3x 2 y 5 6 53. The variables Ymin, Ymax, and Yscl relate to [215, 15, 3]. If a polynomial has real coefficients, then all nonreal zeros must come in conjugate pairs. Suppose that an object is dropped from rest from an airplane. 2 y , 15 5 Functions and Relations Chapter Outline 2.1 The Rectangular Coordinate System and Graphing Utilities 166 2.2 Circles 177 2.3 Functions and Relations 183 2.4 Linear Equations in Two Variables and Linear Functions 197 2.5 Applications of Linear Equations and Modeling 213 Problem Recognition Exercises: Comparing Graphs of Equations 228 2.6 Transformations of Graphs 229 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 243 2.8 Algebra of Functions and Function Composition 262 E ach year the IRS (Internal Revenue Service) publishes tax rates that tell us how much federal income tax we need to pay based on our taxable income. 23 26 y x 25. The length is 20 in., the width is 8 in., and the 5 height is 4 in. s(x) 5 0 x 1 3 0 83. (26C6) < 1.367 3 1011 c. P(10) 5 341 means that in the year 2020, the U.S. population will be approximately 341 million if this trend continues. 3.2 c. (g + f)(x) 5 10x2 2 15x 1 1 10. The computer password is a sequence of five characters. an 5 (21) 4. 21. The fundamental of indicates that if one event can occur in m different ways, and a second event different ways. 0.24 87. See also Parabola in applications, 126–129, 159 completing the square to solve, 115–118 discriminant and, 120–121, 158 explanation of, 113, 158 on graphing utility, 292 quadratic formula to solve, 118–121, 158 solved for specified variable, 122 square root property to solve, 114–115, 120, 158 zero product property to solve, 113–114, 120, 158 Quadratic factors, irreducible, 344, 518, 519, 522–524 Quadratic form explanation of, 139 exponential equations in, 456 solving equations in, 139–140 Quadratic formula explanation of, 118 to solve quadratic equations, 118–121, 158 Quadratic functions in applications, 286, 291–294 explanation of, 286, 301, 391 on graphing utility, 294 graphs of, 229, 286–291 (See also Parabola) in vertex form, 286–288, 391 Quadratic inequalities, 369 Quadratic models applications involving, 127–129 use of regression to create, 293–294 use of system of linear equations to create, 513 Quadratic trinomials, method to factor, 49–51 Quartic polynomial functions, 301 Quotient property of logarithms, 444, 445 of radicals, 30–32 Quotients difference, 264–265, 277 explanation of, 317 R Radical equations explanation of, 137 method to solve, 137–138, 159 Radical expressions multiplication of, 32, 42–43 rationalizing the denominator of, 66–67 Radicals addition and subtraction of, 33 division property of, 105 method to simplify, 30–32 multiplication of, 32, 42–43, 74 multiplication property of, 105 nested property of, 30 product property of, 30, 32 properties of, 30, 74 quotient property of, 30–32 simplifying special case products involving, 43 solving equations containing two, 138 Radical sign, 28 Radicand, 28 Radius, of circle, 177 Range of functions, 188–190 of relation, 183, 275 Rate of change, average, 203–204, 276 Rational equations explanation of, 86 method to solve, 86–88, 134–135 Rational exponents evaluation of, 27–29 explanation of, 27, 74 factoring expressions containing, 55–56 simplifying expressions with, 29 solving equations containing, 139 Rational expressions addition and subtraction of, 62–64, 74 division of, 61, 62, 74 equal to zero, 373 explanation of, 59, 74 I-7 improper, 522–523 method to simplify, 59–61, 74 multiplication of, 61, 74 proper, 523 restricted values for, 59 undefined, 373 Rational functions in applications, 360–361 domain of, 345 explanation of, 345–346, 393 graphs of, 353–360, 373 horizontal asymptotes of, 349–352 slant asymptotes of, 352–353 vertical asymptotes of, 346–348 Rational inequalities explanation of, 372–373, 393 method to solve, 373–376 Rationalizing the denominator explanation of, 31–32 of radical expression, 66–67, 74 Rational numbers approximation of, 3 explanation of, 2, 73, 329 Rational zeros, 329–332 Rational zero theorem explanation of, 329 to find zeros of polynomials, 330–332, 336 Ratios, of integers, 2 Real number line, 3, 8 Real numbers absolute value of, 7–8, 73 associative properties of, 10 commutative properties of, 10 distributive property of multiplication over addition and, 11, 12 identity properties of, 10 inequality symbols and interval notation and, 3–5 inverse properties of, 11 order of operations and, 8–10 sets and, 2–3, 73 summary of properties of, 10–11 union and intersection of sets and, 5–6 Real part, of complex numbers, 106 Reciprocal functions, 229 Rectangles area of, 42 golden, 132 reference, 653 Rectangular coordinate system, 166, 275 Recursive formula, 702, 764 Reduced polynomials, 330 Reduced row-echelon form explanation of, 566, 568, 569 on graphing utility, 577 Reference rectangle, 653 Reflections, across the x- and y-axes, 234–236, 276 Regression to create exponential model, 474 to create logarithmic model from observed data, 475 to create quadratic models, 293–294 multiple, 516 I-8 Subject Index Regression line explanation of, 197 least-squares, 220–221 Relations domain and range of, 183, 275 explanation of, 183–184, 275 functions vs., 184–186 inverse of, 403 Relative maxima explanation of, 253–254, 277 on graphing utility, 254–255 Relative minima explanation of, 253–254, 277 on graphing utility, 254–255 Remainder, 317 Remainder theorem to evaluate polynomials, 321 explanation of, 320, 392 to identify zeros of polynomial, 321–322 Restricted values, for rational expressions, 59, 61 Richter, Charles, 436 Richter scale, 436 Rigid transformations, 232 Roots, 303. (See Example 9) 3 4 78. • Mixed Exercises do not refer to specific examples so that students can dip into their mathematical toolkit and decide on the best technique to use. (1, 0) and (5, 0) d. y x 71.

Transformation Effect on the Graph of f Changes to Points on f Vertical translation (shift) y 5 f (x) 1 k y 5 f (x) 2 k Shift upward k units Shift downward k units Replace (x, y) by (x, y 1 k). y (1, 3) (23, 21) x L 88. {29, 2} 41. rk! Note: The factors of r1!, r2!, ... , rk! in the denominator remove the repetition of arrangements that arise from the indistinguishable elements. Show that P1 is true. Equation in quadratic form and a polynomial equation b. The graph shows the number of views y (in thousands) for a new online video, t days after it was posted. 1 1 496e21.1x Increasing 19. Consider a sequence representing the salary for job A for year n. The customer will wait more than 150 sec. a5 5 2 and r 5 2 . 5 4 3 2 1 97. y y We have used mathematical induction to prove that a statement is true for all positive integers n. Each equation represents an ellipse centered at the origin with a major axis of length 24 units and minor axis of length 12 units. (x 2 1)2 1 (y 2 2)2 5 8 x2 2 2x 1 1 1 y2 2 4y 1 4 5 8 x2 1 y2 2 2x 2 4y 2 3 5 0 Standard form (center-radius form) Expand the binomials General form General Form of an Equation of a Circle An equation of a circle written in the form x2 1 y2 1 Ax 1 By 1 C 5 0 is called the general form of an equation of a circle. Fernando invested $4500 in the 3-yr CD and $2500 in the 18-month CD. x 5 22 g. Suppose that one parent pea plant has genotype YY and the other has genotype Yy. Parent 2 a. z2n 1 2wmzn 1 w2m 69. The maximum profit is $13,400. 28.7128; 428.7128 < 5.68 3 1026 1 1 89. 228 55. 36 1 30 1 25 1 28. Using the entries of the seventh row of Pascal's triangle as the coefficients, the expansion of (a 1 b)6 is: 1 1 1 5 2 3 4 10 1 3 6 1 4 10 1 5 1 1 6 15 20 15 6 1 (a 1 b)6 5 1a6 1 6a5b 1 15a4b2 1 20a3b3 1 15a2b4 1 6ab5 1 1b6 Skill Practice 1 Expand. 3 9 27 Because 0 r 0 5 @ 43 @ $ 1, the sum does not exist. A clean, modern, mobile-ready interface allows students to easily navigate their learning, track their progress and manage their assignments from anywhere. Describe the general shape of the graph of y 5 xn where n is an odd integer greater than 1. (2, 0) and (22, 0) d. 60 11. 23(2x2 2 4x 2 3) 24x2y(3xy 1 2x2y2 2 1) 17. Every point (x, y) on the bird has a mirror image (x, 2y) below the x-axis. If three batteries are selected at random, determine the number of ways in which a. 4050 yd2 2 7. 4! 41. x 5 1 h. 4 Answers 5 9. a2 , b 2 2 2 2 25 2 133 25 1 133 , 0b and a , 0b d. {(3, 1), (3, 21), (23, 1), (23, 21)} F 20. Round to the nearest pixel. t 5 g Ag 111. Foci: (4, 26), (22, 26) y e. 0, the graph of the equation is a circle with radius r 5 1c. 627–630 1. 0.158 31. a1 5 36 and an 5 12an21 for n $ 2 24. In calculus, we can show that the slope of the line drawn tangent to the curve y 5 x3 1 1 at the point (c, c3 1 1) is given by 3c2. g(6) 5 6 2 4 5 2. (2`, 18)) 18 1 33. 119 79. x2 1 y2 2 8y 1 3 5 0 28. 3x2/3 (3x 1 2)2y3 A 5 x2 2 y2; A 5 (x 1 y)(x 2 y) 91. Let Pn be the statement a 1 5 n. Write an expression for the nth term of the sequence where n represents the day number. A 1aB m or 1am 5. [n 2 (n 2 r)]! (n 2 r)! ? a1 5 24, d 5 6 b. The value g(1) 5 23, but f (23) is undefined. What is the slope of a line with equation x 5 22? The statement is false for n 5 11. AD 1 47. Passes through a 3 5 , 2 b and is perpendicular to the 11 4 y-axis. 256y4 1 1280y3 1 2400y2 1 2000y 1 625 4. Then x 2 20,000 represents the amount in sales over $20,000. (f + f 21)(x) 5 4a x y 5 f –1(x) (f 21 + f)(x) 5 210 212 11. The distance d between the points is labeled in Figure 2-3. CHAPTER 2 Cumulative Review Exercises y 1. x2 2 2x 2 8 5 0 2 12x 2 11x 1 2 5 0 127. P1 is true because 1 ? a 6(2)i21 52. Write the first four terms of an arithmetic sequence with first term 8 and common difference 23. a b 0 6 b. • Applications and real-world data have been updated, where appropriate, to ensure that content remains relevant and current. • The value of r is the quotient of any term after the first and its predecessor. Write the first five terms of the sequence defined by an 5 2n 1 3. y 5 f (2x) 80. 2x 2 5 3 2 1 95. How can this expression be evaluated 118! by hand? The slopes are different. x3 2 2x2 2 25x 2 4 b. v(x) 5 2x5 0x 0 1 2 43. f (x) 5 • x2 1 3 for 21 # x , 4 5 for x $ 4 a. 2508F c. greater than 1 3 1 3 7. T(a) 5 a 1 0.06a 5 1.06a The total cost is the sum of the cost of the songs plus the sales tax. 125. 56C12 < 5.584 3 1011 3! ? 52C5 5 Chapter 8 Review Exercises, pp. 25 24 23 22 21 21 22 25 2 24 f(x) 5 26 28 210 3 2 1 24 53. Skill Practice 4 Find the tenth term of the arithmetic sequence in which a1 5 12 and a30 5 128. 1 f + f 21x2 5 ; 12`, 252 ´ 125, 242 ´ 124, 42 ´ 14, 52 ´ 15, ` 2 x22 5 5 ; 12`, 22 ´ a2, b ´ a , `b 22x 1 5 2 2 3 3 83. Solution: Let Pn be the statement: n! . 0.1436 c. A6 1 i 13B 2 2 12 A6 1 i 13B 1 39 5 0 ✓ 1 2 3 4 5 x y R.3. E24 6 i 13F Remainder: r(x) 7. A human face is symmetric with respect to a vertical line through the center (Figure 2-29). The numerator and denominator share a common factor of x 1 2. y 5 23x and y 5 223x 3 2 1 F 25 24 23 22 21 21 22 23 24 25 19. 4 13 h. 0 2x 2 3.8 0 2 4.6 # 7.2 110. No 51. 55, i, 2i6 103. 5, 1 6 15 13. The yearly salary for job B is $56,000 for year 1 with an annual raise of 6%. 5, x ? Determine whether the sequence ln 1, ln 2, ln 4, ln 8, ... is arithmetic or geometric. E1 5 {R1, R2} The number of red marbles is 2. $46 $23.60 $7.50 b. $1440 43. Therefore, use a different variable for the index of summation. The first equation represents an ellipse centered at the origin, whereas the second equation represents a line with slope 249 and y-intercept (0, 4). Write d as a function of r. • Alternatively, the least-squares regression line is a model that utilizes all observed data points. The proof involves the use of mathematics that did not exist in Fermat's time, and for this reason mathematicians believe that Fermat did not have a simpler proof. The customer is male or paid by check. g(x) 5 1x 1 15 2 2 c. 2 5 (3x 2 y) 15P3 59. Assume that each employee is assigned to exactly one task. {25} b. f (x) 5 3 for all x on the interval [23, 1] and for x 5 145 . d(t) 5 60t b. 115. If the sales tax rate on a purchase is 6%, write a function to represent the total cost T(a) for a first-time visitor who buys a dollars in songs. Use the graph of y 5 f (x) to c. 2.3 , t , 17.7 sec 33. 1.2% f. Graph. 2 1 2 ? The graph of all solutions to an equation is called the graph of the equation. None of these 19. The sums equal the length of the major axis. • References to even-numbered exercises appear in the margin next to each example for the instructor to use as Classroom Examples. There are 36 slots that are not green. f (1) 5 21 can be interpreted as (1, 21). n Sn 5 (a1 1 an) 2 60 S60 5 (8 1 185) 2 S60 5 5790 Substitute n 5 60, a1 5 8, and a60 5 185. A linear equation in the variables x and y is an equation that can be written as Ax 1 By 5 C. 1 Fk 1 Fk11 5 F[(k11)12] 2 1 5 Fk13 2 1. x 5 3 7 h. For Exercises 21–26, refer to the functions f, g, and h defined here. Yes; r 5 2 13. z Expanding Your Skills A point in three-dimensional space can be represented in a three-dimensional coordinate system. (2, 23) 3. y 5 a. 14 m/sec 123. The sum of the first n terms of a sequence is called the nth integers. 36. f(x) 5 24x 1 5 Write the relation using function notation. (730, `) a. i 26 7 38 2 34i 4. 25. Term: 1 2 3 4 5 2 3 4 5 6 2 1 2 1 1 4 9 16 25 5 a (21) i51 i11 ? For a recent year, the rate for first class postage was as follows. Instead, the probability can be approximated through observations. {27, 22, 2} 5 3 15. f (x) 5 x3 1 2x 2 5 62. The center is in quadrant IV, the radius is 4, and the circle is tangent to both the x- and y-axes. Then by definition the distance between (h, k) and (x, y) must be r. In each case, multiply by using the distributive property. For Exercises R.3–R.4, solve the inequality. h(21.7) d. • A linear model can be made from two data points that represent the general trend of the data. g(x) 5 1x 2 2 c. Greatest integer less than or equal to 2.5 is 2. k(x) 5 x3 2 2 18. 2 1 1 84. Downward e. 220 2 48i 37. (See Example 8) 18 55. 22, 1, and 3 3. Maximum: 6480 a. y 5 26 17. There is no way that this can be derived theoretically. Use the model in part (b) to predict the height of the volcano in the year 2030 assuming that the linear trend continues. Vertices: (0, 3), (0, 23) Endpoints of minor axis: e. a (3i 2 4) 58. 752 Chapter 8 Sequences, Series, Induction, and Probability The number of outcomes in an event is a nonnegative number less than or equal to the number of outcomes in the sample space. Show that 1 1 2 1 22 1 p 1 2k21 1 2(k11)21 5 2k11 2 1. z 5 0.80x 1 1.10y 7. • Expanding Your Skills Exercises challenge and broaden students' understanding of the material. 10 2 21028 26 24 22 22 24 28 210 F 29. d. 11, 10.2, 9.4, 8.6, 7.8, ... 19. a , b b. 20 h. 0 143. 9k11 2 1 5 5 5 5 5 9 ? y 87. x 5 3 2 24 2 (y 1 2)2 x 5 3 1 24 2 (y 1 2)2 y 5 22 2 24 2 (x 2 3)2 y 5 22 1 24 2 (x 2 3)2 69. 21 2 i Stephan borrowed $6000 at 5% and $2000 at 4%. y 3 4 5 x 25 24 23 22 21 21 22 y 5 f21(x) 23 23 24 25 24 25 b. (See Examples 8–9) 91. f (x) 5 22(x 2 1)2 1 8 The parabola opens downward. 1 2 Chapter R Review of Prerequisites SECTION R.1 Sets and the Real Number Line OBJECTIVES 1. To write a rule defining this function we use a piecewise-defined function in which we define each "piece" on a restricted domain. 211.2 2 4.6(c 2 3) 1 1.8c 5 0.4(c 1 2) b. $17,097 1. Ax 2 72 B 2 5 26(y 1 1) b. Note: An open interval is an interval in which the endpoints are not included. (21, 118) and (51, 130) (x1, y1) and (x2, y2) 130 2 118 m5 5 0.4 51 2 21 y 2 y1 5 m(x 2 x1) y 2 118 5 0.4(x 2 21) y 5 0.4x 1 109.6 Label the points. 2A 115 1 111B x11 5 1 4 12 10 13x 1x 2 15 79. (fg)(0) 5 f (0) ? y 23 22 21 21 22 23 10 25 210 5 1 2 3 4 5 6 7 x y 21028 26 24 22 22 24 210 25 22 5 2 4 6 8 10 x r(x) 5 1 2 x2 2 33. No e. h(1.02) 5 24.9(1.02)2 1 10(1.02) 1 100 Frac Notice that the terms of the sequence given in Example 1(b) alternate in signs. y 5 2f (x 2 4) 2 1 10 290 83. Inserting k equally spaced values between c and d, yields the arithmetic sequence c, x1, x2, x3, x4, p , xk, d. (0, 25) 2 y e. Window b is better. One weakness of the point-plotting method is that it may be slow to execute by pencil and paper. f (x) 5 x 13. 1 1 2 1 3 1 4 1 5 80. 0 6 2 2π 0 or 0 2π 2 6 0 ; 2π 2 6 75. From the list of permutations given in Example 5, we can strike through the redundant cases that arise from the order of the two individuals in the group. In Example 7, we use the formula for the nth partial sum of an arithmetic sequence to find the sum of the first 50 positive even integers. • The graph of y 5 2f (x) is the graph of y 5 f (x) reflected across the x-axis. x 5 0 5y 0 61. Other functions that share the characteristics of a parent function are grouped as a "family" of functions. The truck is 6 ft by 6 ft by 8 ft. (2`, 4) ´ (4, `) y a. x2 1 y2 1 6x 2 2y 1 6 5 0 42. No No 21. y 5 2x2 2 3x 1 1 c. 80 Skill Practice 8 Find the sum. Number of Years Since Height (m) 1960, x y SECTION 2.6 68. 0.02x 1 0.06y 5 0.06 60. Given (a 1 b)17, the 12th term is given by a baubu. Given g(x) 5 2x8 1 0 3x 0, find g(2x). Solving the equation f (x) 5 0 to find the x-intercepts results in imaginary solutions: 0 5 2x2 1 4x 2 5 x5 Therefore, there are no x-intercepts. These exercises are highlighted with blue circles in the exercise sets and mirror the related examples. Since f (2) and f (3) have opposite signs, the intermediate value theorem guarantees that f has at least one real zero between 2 and 3. y A(4, 3) x L 228 Chapter 2 Functions and Relations 89. Write the expansion of (c 2 d)3. ` `50 23 4 1 20.4 1 23 7 b. However, French mathematician Pierre de Fermat (1601–1665) posed the statement that the equation x n 1 y n 5 z n has no such solutions for positive integers n . 56 1 2 1 126 41. (23, 2), (5, 2) c. Use a graphing utility to graph the regression line and the observed data. h(x) 5 1x 1 4 12. h(f (1)) 50. 5.3 days 73. {8, 2} 117 1 if 31. 4 [A 2. If the sequence is geometric, find r. How long will it take to pay off a debt of $3960 if $50 is paid off the first month, $60 is paid off the second month, $70 is paid off the third month, and so on? $3563.16 7.2% simple interest results in less interest. If q is r minus seven, and s is the square root of q, write s as a function of r. Skill Practice 3 A homeowner has kept records of the average monthly electric bill for 4 yr. The annuity pays 6% annual interest compounded monthly. Find the Probability of the Union of Two Events We now study the probability of the union of two events. What is the slope of a line parallel to the x-axis? (0, 24) 2 2 1. (2`, 24] ´ {1} c. 6, 4, 2, 0 b. 1 2 3 4 5 210 25 24 23 22 21 21 22 21. Recall that for k . 2 51 5 7 b. 56–58 1. That is, count 13 spades plus the 3 aces that are not spades. Show that a b 5 1 and a b 5 1. , where m represents the slope and (0, b) represents the 7. SA-22 Student Answer Appendix 101. y 5 4 3 2 2 45 40 1 1 2 3 4 5 x 23 24 25 34. The base is 9 ft and the height is 12 ft. 7 6 (0, 5) 5 4 x 1 2 x 23 (1, 22) 24 25 (24, 24) For Exercises 75–78, determine if points A, B, and C are collinear. 2 15 y i. 5 19. [21, `) [0, `) f 21(x) 5 x2 2 1; x $ 0 The range of f is [0, `). x-intercept: (5, 0); y-intercept: (0, 2) 77. Endpoint of minor axis: (0, 2), (0, 22) (1, 0), (21, 0) f. Explain why a person with type O2 blood is called a universal donor. x 5 0 y 77. Using function notation, these are the points (x1, f (x1)) and (x2, f (x2)). Understanding how points are located relative to a fixed origin is important for many graphing applications. The remaining 4 questions are yes/no questions. c. y 5 11.5 2 x 30. x2 1 y2 2 20y 2 4 5 0 46. 1 2 3 4 5 6 7 8 9 x B 12 x2 18 144 51 Chapter 7 Cumulative Review Exercises, p. an an 6 5 4 3 2 10 8 21 22 24 26 28 210 93. 3 y5 2 x1 2 1 2 3 4 5 x 23 24 25 103. Ax 2 15B Ax 1 15B(x2 1 7) b. Values of a between 0 and 1 stretch the graph horizontally away from the y-axis. (2`, 0) ´ (0, `) e. Exercise Sets The exercises at the end of each section are graded, varied, and carefully organized to maximize student learning: • Prerequisite Review Exercises begin the section-level exercises and ensure that students have the foundational skills to complete the homework sets successfully. Graph B SA-27 5. Determine the solution set for the equation (x 2 3)2 1 (y 1 12)2 5 0. Not possible 43. 80 Figure 2-23 From Figures 2-22 and 2-23, we can draw the following conclusions. 169 Thus, P(N ´ F) 5 265 . If one CD is selected at random from the box, determine the probability that a. A function is decreasing on an interval in its domain if the graph "falls" from left to right. Y Parent 1 y b. y 5 24x 1 1 on [210, 10, 1] by [210, 10, 1] 91. a 11 b 5 9 14. Yes 5 41. In such a case, the graph has no x- or y-intercept. m 5 23 26 23 33. 5 1 p 1 (2k 2 1)(2k 1 1) 1 1 [2(k 1 1) 2 1][2(k 1 1) 1 1] 5 k 1 1 2(k 1 1) 1 1 5 2kk 11 13 . π 2 3 65. Find the frequency for C two octaves above middle C. 5 4 222 219 1 x 3 2 1 24. Second Die Solution: 1 2 3 4 5 6 1 (1, 1) (2, 1) (3, 1) (4, 1) (5, 1) (6, 1) 2 (1, 2) (2, 2) (3, 2) (4, 2) (5, 2) (6, 2) 3 (1, 3) (2, 3) (3, 3) (4, 3) (5, 3) (6, 3) 4 5 6 (1, 4) (2, 4) (3, 4) (4, 4) (5, 4) (6, 4) (1, 5) (2, 5) (3, 5) (4, 5) (5, 5) (6, 5) (1, 6) (2, 6) (3, 6) (4, 6) (5, 6) (6, 6) Figure 8-11 a. 124. P(B) 5 EXAMPLE 8 1 1 1 ? (25, 23) ª (21, 2) b. Write the first four terms of the sequence. a 4 k51 696 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Finite Series A graphing utility can be used to evaluate a finite series if the nth term of the corresponding sequence is known. Suppose that the professor picks 3 questions from the review sheet to put on the test. No c. 6P4 32. x1 y2 52 To find the x- and y-intercepts from an equation in x and y, follow these steps. Determine the probability that a patient will not survive the surgery or 30 days after the surgery. (See Examples 7–9) m(x) 5 2x 1 8 n(x) 5 x 2 5 p(x) 5 x2 2 9x q(x) 5 1 r(x) 5 0 2x 1 3 0 x 2 10 65. 2k for k $ 7. Domain: (1, `); Range: (2`, `) c. Avoiding Mistakes A statement of the form "if p, then q" is called a conditional statement. 1 can be graphed by 94. Y b. 22 d. However, function g must not have an input value of 24. EXAMPLE 5 Graphing a Function with a Horizontal Shrink or Stretch y The graph of y 5 f (x) is shown. Determine the theoretical total amount spent from the initial $200 million if the money can be respent an infinite number of times. 1 25 24 23 22 21 22 24 23 12 4.4 in. a 2 2 5 33 f. a1 2 1 1 1 1 ba1 2 2 ba1 2 2 b p a1 2 b 2 2 3 4 1n 1 12 2 n12 5 2(n 1 1) For Exercises 17–24, use mathematical induction to prove the given statement for all positive integers n. x2 1 2xh 1 h2 1 4x 1 4h 39. The sequence of salaries for the first 5 yr is Year 1 $75,000 Year 2 $79,000 Year 3 $83,000 Year 4 $87,000 Year 5 $91,000 Notice that each term after the first results from adding a fixed constant ($4000) to its predecessor. (x 1 0.04)2 1 (y 2 0.02)2 5 0.01 SECTION 2.3 Functions and Relations OBJECTIVES 1. (24, `) d. The sum of the numbers on the dice is 12. x-intercept: A 25, 0B; y-intercept: (0, 1) 25 24 23 22 21 21 22 13. (2`, `) 49. 4 c. e f ; t < 25.3618 49. f (x) 5 2 77. f (x) 5 24x2 2 5x 1 2 58. y 2 y1 5 2 (22) 7 5 5 x2 2 x1 2 2 (23) 5 A line with a positive slope "rises" upward from left to right. In how many ways can the commercials be aired? The function is written as f (x) 5 a(x 2 h)2 1 k, where a 5 22, h 5 1, and k 5 8. Cube function: f (x) 5 x3 5 4 3 2 f(x) x 5 4 3 2 y 5 4 3 2 x 1 25 24 23 22 21 21 22 23 24 25 1 x 1 2 3 4 5 x f(x) 22 2½ 21 21 2½ 22 ½ 2 1 1 2 ½ 5 4 3 2 1 25 24 23 22 21 21 22 23 24 25 1 x 230 Chapter 2 Functions and Relations Notice that the graph of f (x) 5 1x gets close to (but never touches) the y-axis as x gets close to zero. 2πr(r 1 h) 4 π(R 2 r)(R2 1 Rr 1 r2) 95. g(4) c. viii Key Features Supplement Package Supplements for the Instructor Author-Created Digital Media Digital assets were created exclusively by the author team to ensure that the author voice is present and consistent throughout the supplement package. Therefore, to find P(A or K), we have TIP In Example 6(a), since A and K are mutually exclusive, then P(A ¨ K) 5 0. 620 y 20 18 (0, 18) 16 14 12 (4, 10) 10 8 6 4 2 (12, 0) 0 2 4 6 8 10 12 14 16 18 20 x x SA-35 Student Answer Appendix 1. For Exercises 53–56, match the function with its graph. Does the function have a relative minimum or maximum at a? f (x) 5 1 x and 2 g(x) 5 2x 1 1 95. 20.24 ft/sec c1b2 5 1b 1 82 2 127. The graph is symmetric with respect to the y-axis only. f (t) b. and 23 g. 9 d. The person is between 31 and 60, inclusive, or has elevated cholesterol. a b(x) 5 h h(x) x 2 4x 1x 2 1 x(x 2 4) 5 The domain of k is [1, `). a2`, 2 d ´ 33, `) 3 2. Section 8.4 Mathematical Induction 725 PROBLEM RECOGNITION EXERCISES Comparing Arithmetic and Geometric Sequences and Series For Exercises 1–10, determine if the nth term of the sequence defines an arithmetic sequence, a geometric sequence, or neither. h)(3) 108. 250% f. Assume that Pk is true; that is, assume that F1 1 F2 1 ... 1f + g21x2 5 3 1 4; x21 Domain: (2`, 1 ) ´ ( 1, `) b. (21, 0) d. x-axis, y-axis, and origin 13. 207–212 R.1. x-intercept (7, 0); y-intercept (0, 242) 3 4 5 23 24 25 24 25 2 x 25 24 23 22 21 21 22 17. x 5 e. Round to 3 decimal places. 36 25 c. The y-coordinate of the vertex is f (4). No f(x) 5 x 2 2 read as "f of x equals x 2 2." Section 2.3 187 Functions and Relations With function notation, Avoiding Mistakes The notation f (x) does not imply multiplication of f and x. h(x 1 h) 51. 2n 145. The tick marks on the axes are 1 unit apart. g(0) 5 (4)(24) 5 216 f (23) is undefined. E22 6 2 17F 27. 2 1 2x 1 13. (6 2 6)! 6! ? The CD has classical music. f (x) 5 e 0x 0 for x , 2 2x 1 4 for x $ 2 62. y 6 The graph of p (shown in blue) is the graph of f shifted to the right 3 units and downward 2 units. 2 1A + A21x2 5 11.0452 x represents the amount of money in the account after 2 yr compounded annually. The distribution of blood types for people living in the United States is given in the table. Suppose that 15 lightbulbs are in a cabinet and that 4 are defective. m 5 1.25. 29 77. v(x) 5 2 0 x 0 2 78. (x 2 2)2 1 (y 1 1)2 5 0; The graph is a single point: (2, 21). 22 f. Determine the probability of each event. y 5 20 x 0 2 4 9. Find the center and radius of the circle. 3 0 1 214 For example: c d 61. The person is a smoker or has elevated blood pressure. No 2. Write two functions f and g such that h(x) 5 (f + g)(x). Section 8.7 755 Introduction to Probability 3. x2 2 x1 Secant line y 5 f(x) (x2, f(x2)) (x1, f(x1)) m 5 x1 f(x2) 2 f(x1) x2 2 x1 x2 x h is taken to be a positive real number, implying that h ? d 5 0.16 c. For Exercises 91–94, match the sequence with its graph. a s b1x2 v1x2 5 1x 1 3 29. (16C2) ? £ 4 2 61. feasible 5. 25 1 2 1 9 1 p 1 (7n 2 12) 5 (7n 2 17) 2 1 55. 0.655 5 A0e24k c. An arithmetic sequence is a linear function whose domain is the set of 5. 25 Scenario 2: The salesperson sells over $20,000. Graph a. a cai 5 c a ai i51 A constant factor can be factored out of a summation. The function g is defined by a g b(x) 5 . I 5 a 2CL The right side of the equation is not equal to zero. 4x2 2 7x 2 15 5 0 R.3. Solve. 216 d. a2 5 18 and a5 5 144 46. f (x) 5 2(x 2 3)2 2 2 b. 6x R1x2 5 x16 4 3 2 1 24 23 22 21 21 2 x b. constant; variation a. (6x 1 5)3 19. The value of the series is equal to the 60th partial sum of the sequence of terms. Assuming negligible air resistance, the vertical acceleration is 32 ft/sec2. $168,000 57. k)(4) k c. {2}; The value 24 does not check. 22 41. n(x) 5 3x 2 7; x , 0 c. (3, 22) d. (0, 215) y e. The person is a nonsmoker. 2 d 24 24 d ; This matrix represents the reflection of the 2 21 0 4 triangle across the y-axis. (21 1 19)(21 2 19); 80 3 Expand the square of any binomial. (2 1 i)3 54. 4 2 21221028 26 24 22 22 3 4 5 23 24 y 6 25 25 24 23 22 21 21 22 23 24 25 23 2x17 2 1 28 27 26 25 24 23 22 21 21 n(x) 5 1 4 3 2 2 1 y 4 3 2 1 2 4 x c. E 5 {(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)}. 3n for positive integers n $ 7. Steps for Graphing Multiple Transformations of Functions To graph a function requiring multiple transformations, use the following order. Evaluate P(60) and interpret the meaning in the context of this problem. £ 3 0 3 27. 104. • Instructors will find helpful notes within the margins to consider while teaching. Write the nth term of a sequence representing the cost to tile an n by n square foot area where n is an integer and n $ 1 ft. 2 (x 1 2)(x 2 2) 1 2 3x 17 2 13 3 6. k(x 1 h) 50. 5 3y 5 22x 1 6 x y 4 3 2 4 23 2x 1 3y 5 6 2 y52 x12 3 1 0 2 In the table we have selected convenient values of x that are multiples of 3. For example: 2. (f + g)(x) EXAMPLE 8 b. 50.6826 < 3 83. T 21(x) 24 represents the taxable value of a home (in $1000) based on x dollars of property tax paid on the home. , 23 (each multiplicity 1), and 1 (multiplicity 2) 2 7 e. h(21) EXAMPLE 6 c. Suppose that a jury pool consists of 18 women and 16 men. £ 1 0 1 5 1 4 22 23 † 1 § 1 2 0 2. c , 5 d 5 1 b 2 c b. None 2 22 1 110 22 2 110 t5 and t 5 25. 157 2. (2`, 23) ´ A 12, 5B 8. e ax, , b ` x is any real number f or 2 2 22 2 2y 22y , y, b ` y is any real number f or ea 3 3 E(2z 1 6, 2 2 3z, z) @ z is any real numberF 16. 121 b. Similarly, we may refer to a y-intercept as the y-coordinate of a point of intersection that a graph makes with the y-axis. If the employee invests $500 per month in the annuity at 5% interest, find the value of the annuity after 36 yr. 10 210 10 210 10 Also notice that the calculator display may not show the upper and lower semicircles connecting. (2`, 232] 113. 40 3. • If b2 2 4ac , 0, the graph of y 5 f (x) has no x-intercept. y 5 2x 2 5 for 0 # x # 4 {(2.359, 5.584)} {(1.538, 6.135), (21.538, 6.135), (3.693, 25.135), (23.693, 25.135)} {} x 23 x 22 2 12 y 1 4 # 5 1 22 21 21 22 2 1 3 4 y 5 4 3 2 5 4 3 2 2 5 23 25. y 5 x2 with a horizontal shift. 2.366 79. Graph the function. If he anticipates working for the company for 12 yr, find the total amount he would earn from each job. 2 1 Skill Practice 8 Find the sum if possible. This is demonstrated in Example 3. A number greater than or equal to 1 is rolled. $200,000 b. 3n , 2n for positive integers n $ 4. Two adjacent angles form a straight angle (1808). Therefore, the eighth term of (a 1 b)10 is a 1 less than the term number 10 3 7 ba b . In how many ways can the letters in the word FLORIDA be arranged? Round the slope to 3 decimal places and the y-intercept to 2 decimal places. 3 5 60 12! 2 1 5 39,916,799 35. y 5 2.48x 1 31.0 b. 2262; The number of new flu cases dropped by 262 per month during this time interval. paper) 1. 47C5 5 1,533,939 57. t(1) c. Examples: 0.71 (ratio of 71 and 100), 0.6 5 0.666 p (ratio of 2 and 3). The graph shows the height h (in meters) of a roller coaster t seconds after the ride starts. y Solution: Answer 2. List all the combinations of two elements from the set. [26, 7] 107. Compare the graphs of the sequence defined by an 5 8A 12 B n (see Figure 8-1) versus the function defined by f (x) 5 8A 12 B x (see Figure 8-2). d1 5 30; dn 5 13 dn21 2 1 29. y 5 1x 7. y Y YY Yy y yY yy 103 9 8 2 or 0.412 b. Skill Practice 3 Fill in the blank. (2`, 3) ´ (3, `) c. Group the y terms. a b 5 1! ? 12.5 sec b. This is demonstrated in Example 2. The point of intersection is (2, 1). A jack or a queen. y 8 7 6 5 4 3 2 50 24 b. (T + C)(x) 5 T(C(x)) 5 1.06(C(x)) 5 1.06(1.49x 2 1.00) 5 1.5794x 2 1.06 269 Substitute 1.49x 2 1.00 for C(x). {7}; The value 22 does not check. to an equation in the variables x and y is an ordered pair (x, y) that makes the equation a true statement. The probability of rolling a sum of 7 is 16 . 33. xm12 x12mn 121. (2, 0), (21, 0), and (24, 0) 5. c1 5 4; cn 5 12 cn21 1 4 30. 121; Yes 23 21 57 31 ea , bf 35. E3: The ball does not land on a green slot. e f 91. Equation; {3} R.1. a. The dealer spins the wheel in one direction and rolls a small ball in the opposite direction until both come to rest. f (x) 5 22(x 2 1)2 1 8 0 5 22(x 2 1)2 1 8 To find the x-intercept(s), find all real solutions to the equation f (x) 5 0. 243(middle): © Julie Miller; p. Use the binomial theorem to expand (x 1 y 2 z)3. [24, `) 55. c 0 23 6 4 ` d 6 6 6 2 5 † 1§ 234 52 33. The minor is the determinant of the matrix obtained by deleting the ith row and jth column of the original matrix. 44. 2(7). x-axis, y-axis, and origin 16. Write a linear function to model the cost S(x) (in $) of a speeding ticket for a person caught driving x mph over the speed limit. {(1, 3), (1, 23), (21, 3), (21, 23)} (y 2 30)2 x2 29. The y-intercept is (0, 5). f (1) e. a d(2c 2 d) 37. n(E) n(S) Number of elements in the event Number of elements in the sample space The probability of an event is the relative frequency of the event compared to the sample space. f (x) 5 26x 2 5 2 1 x 5 For Exercises 117–118, find the difference quotient, f (x 1 h) 2 f (x) . {81} 99. f (x) 5 2x 2 6 4 19 4 19 a. m 5 21. y 5 f(x) 25 24 23 22 21 21 22 25 26 27 23 y 5 4 3 2 g(x) 5 2 1 22 21 21 22 16. 0 (the company makes a profit) y 58. 50 40 (6, 46) 30 (2, 35) 20 10 0 0 2 4 6 Age (yr) 8 10 12 Millions 64. 1 R.2. 16 R.3. 4 R.4. 5 27 (2`, 215] ´ [25, `) R.6. (2`, 4) ´ (4, `) logarithmic 3. 23 1 25 24 23 22 21 21 22 23 1 2 3 4 5 8 7 6 5 4 3 2 1 x f(x) 5 ⎛ 13 ⎞ 1 2 ⎝ ⎠ 1 23 22 21 21 22 1 2 3 4 5 6 7 x b. Vertices: (1, 22), (7, 22) Foci: (21, 22), (9, 22) y 5 43x 2 223 and y 5 243x 1 103 y 10 8 6 4 2 26 24 22 22 F 24 2 4 x 6 8 10 12 14 F 26 28 C(4, 2 2) 210 25. Pj is true, and 2. Given f (x) 5 4x3 1 2x, find the difference quotient. Standard form: (x 2 h)2 1 (y 2 k)2 5 r2 Simplify. 2 x17y8 109. Perpendicular 35. It probably seems more reasonable that someone would select two different DVDs from the box. f (x) 5 0 x 0 and g(x) 5 2x 2 3 5 97. 3 1. Passes through (22, 27) and m 5 3. Then the value A (in $) of the annuity after t years is given by A5 p. a 12a2 b 3 i51 ` 2 44. If she has time in the summer to read 5 of the 8 books, in how many ways can she select 5 books from 8 books? Use the graph to solve the equation and inequalities. For Exercises 39–44, evaluate nCr. 39. Write the set of ordered pairs that defines the relation. Round to the nearest meter. on [1, 2] 88. To find the sum of the first 50 terms, we need to know the values of a1 and a50. 81: © Stockbyte/Getty RF; p. 360 33. 24 7 2 2 20. a i51 i! 9 87. (f + g)(x) 5 50x2 1 5x 2 1 x23 (x 2 3)2 b. 0.231 c. f (x) 5 x4 2 5x2 1 1 52. Write a formula for the nth term of a sequence that represents the sales person's total income for n units sold. {1, 3} Rational equation b. 6 13. y 5 12 18 17. y 2 1 28 27 26 25 24 23 22 21 21 22 23 24 25 5 x b. E23, 215, 15, 3F a. Complete the squares. Given functions f and g, explain how to determine the domain of (f + g)(x). Hyperbola; D y2 (y 1 3)2 (x 1 1)2 (x 2 2)2 1 51 73. Section 8.6 749 Principles of Counting 61. How many outfits can be made from 4 pairs of slacks, 5 shirts, and 3 ties, if one selection from each category is made? Suppose that y 5 C(x) represents the cost to produce x items, and that y 5 R(x) represents the revenue for selling x items. Shade the area bounded by the given inequalities on a coordinate grid showing 25 # x # 5 and 25 # y # 5. The cards are all of the same suit. A third-degree polynomial has 3 zeros (including multiplicities). Event E cannot happen. 5 1 8 1 11 1 p 1 (3n 1 2) 5 (3n 1 7) 2 ... 7. f is constant on the interval (21, 2). a b(x) p 121. 3 h(x) 5 2x 2 7 a. a30 5 54 1 (30 2 1)(20.8) 5 30.8 To find a30, substitute 30 for n. 563: © Image Source/Getty RF; p. 5 The input value for function m must not be 5. e < 0.56 e. 5 1 4 3 2 25 24 23 22 21 21 22 15. Explain why the relation defined by 2x for x # 1 y5 e 3 for x $ 1 118. (n + p)(x) 66. We must show that 1 1 3 1 5 1 p 1 (2k 2 1) 1 [2(k 1 1) 2 1] 5 (k 1 1)2. If f (a) 5 f (b), then 2a 2 3 5 2b 2 3, which implies that a 5 b. Round the slope to 2 decimal places and the y-intercept to 1 decimal place. (23, 0) and (21, 0) d. 24 34. 2 1 2 17. 5 4 3 2 25 24 23 22 21 21 22 1 2 3 4 5 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 x 2 y 110. (q + p)(x) 118. A review sheet for a history test has 10 essay questions. n(x) 5 12x 2 1 77. If the 6 numbers match the numbers in the drawing, then the player wins the grand prize. 74 8 53. Positive: 6, 4, 2, or 0; Negative: 1 53. 0 x 2 1.7 0 1 4.95 5 11.15 b. 2 R.1. c2 2 8c 1 n R.2. x2 1 x 1 n 7 R.3. Find the distance between (2, 3) and (23, 22). Teach a more informed classroom and provide more personalized guidance. (25, 22] 2 75. Sn 5 EXAMPLE 6 Evaluating a Finite Geometric Series 1 i21 4a a 2b i51 6 Find the sum. 0.10 36 6 36 12 SA-49 18C9 48,620 5 < 0.00093 C 52,451,256 34 9 11,440 16C9 b. 5 37. (f ? 1 1 3 1 32 1 33 1 p 1 3n21 5 (3n 2 1) 2 1 1 1 1 1 n 1 1 1p1 n512a b 2 4 8 2 2 ... 14. The of an experiment is the set of all possible outcomes. R.1. r 5 1. 4! 2 ? 2.7 3 1028 7. The solution set to the inequality f (x) , 0 corresponds to the values of x for which the graph of y 5 f (x) is below the x-axis. e a 2 113 {(x, y, z) 0 2x 2 3y 1 z 5 6} 47. Relative minimum 123. Solve this system using either the substitution or addition method. {(5, 10)} 10x 2 3 6. x2 1 y2 # 9 764 Chapter 8 Sequences, Series, Induction, and Probability Write About It 89. 0.01 b. The graphs have the shape of y 5 0 x 0 but show a vertical shrink or stretch. 2 21. b b2 Therefore, y 5 2b2 or y 5 . In how many ways can four students be selected to take part in a survey? Then factor the trinomial. Let P be an arbitrary point (x, f (x)) on the function f. Decreasing. With the values of a1 and d known, the nth term is represented by an 5 24 1 (n 2 1)(8). Vertices: (3, 1), (3, 21) c. Find an equation of the line tangent to y 5 1x at the point A2, 12 B. Assume that 3k , 2k for a positive integer k $ 4. For Exercises 8–9, write the domain in interval notation. e ln , ln 4 f ; x < 20.6931, x < 1.3863 2 113. Given f (x) 5 1x 1 3, a. R(x) , C(x) (the company experiences a loss) c. , 2 , and 4 (each with multiplicity 1) 4 2 1 71. The sum of the first n terms of the sequence is called the nth partial sum of the sequence and is denoted by Sn. The nth partial sum of a sequence is a finite series. (See Example 6) y 79. 24 Skill Practice 1 Use translations to graph the given functions. The x-intercept(s). Interpret the results from part (a). 10 1 1 23 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 5 4 3 2 25 24 23 22 21 21 22 1 2 3 4 5 x 10 210 1. Then each arrangement is called a 6. a 3 3 y e. The clear, concise writing style and pedagogical features of our textbook continue throughout the online content in ConnectMath, in our instructional videos, and in the adaptive reading and learning experience of SmartBook. Social Security numbers assigned in the United States are comprised of 9 digits of the form _ _ _-_ _-_ _ _ _. False 101. Likewise 0 x2 2 x1 0 2 5 (x2 2 x1)2 and 0 y2 2 y1 0 2 5 (y2 2 y1)2. Use interval notation to write the intervals over which f is increasing or decreasing. Find the sum of the integers from 2102 to 57. If the money were invested at the beginning of the compounding periods, such an investment is called an annuity due and the future value is computed with a different formula. [25] 16 2§ 1 23 1 2 0 69. C(x) 5 1500 1 35x b. bn 5 22n 1 8 d. The slope-intercept form of a line can be used as a tool to define a linear function given a point on the line and the slope. 25m2 2 30m 1 9 25 9 45. f(x) 5 x2 b. 16 9 , 24, 3, 2 , ... 3 4 1 1 27. The x-intercepts are (1, 0) and (21, 0). E2: The ball lands on a green slot. Airlines often overbook flights because a small percentage of passengers do not show up (perhaps due to missed connections). There is at least one vertical line that intersects the graph in more than one point. 710 Chapter 8 Sequences, Series, Induction, and Probability For Exercises 35–38, find the number of terms of the finite arithmetic sequence. This book is printed on acid-free paper. g(x) 5 0 x 0 3 c. How many 4-letter arrangements are possible assuming that letters may be repeated? S(8000) 5 1360 means that the salesperson will make $1360 if $8000 in merchandise is sold for the week. To predict the path of a hurricane, meteorologists collect data from satellites, weather stations around the world, and weather buoys in the ocean. k(x) 5 2x 1x 2 1 The domain of g is (2`, `). Therefore, n(E1) 5 18 and n(E1) 18 9 5 5 < 0.4737. (See Example 4) b. x 5 3; The sheet of aluminum should be folded 3 in. Refer to the data given in Exercise 29. R; (2`, `); 27. 9.7385 d. Since the x-coordinate is multiplied by the reciprocal of a, values of a greater than 1 actually compress (shrink) the graph horizontally toward the y-axis. The inequality 0 x 2 3 0 . n(S) 10 It is intuitively obvious that a white marble cannot be selected. above; horizontal 5. 0.78 77. The sum of the first n terms of the sequence is called the nth partial sum and is denoted by Sn. In this case, we have S1 5 1 51 S2 5 1 1 4 55 S3 5 1 1 4 1 7 5 12 S4 5 1 1 4 1 7 1 10 5 22 S5 5 1 1 4 1 7 1 10 1 13 5 35 TIP The sum of the first n terms of an arithmetic sequence is called a finite arithmetic series. 28 9. in any order in any order 5 8C3 ? 1 11. 156 71. This is the same as the fee paid to the gym in the absence of fixed costs. 35, 25, 15, 5, 25, ... a2 2 a1 5 25 2 35 5 210 a3 2 a2 5 15 2 25 5 210 a4 2 a3 5 5 2 15 5 210 a5 2 a4 5 25 2 5 5 210 b. { } 15. odd 7 216 2 213 17. a 5 3 c. 150 dB b. 0 67. r 5 0 95. And the last 30 sec is represented by a linear function with a negative slope, y 5 21.5x 1 165. 4 x 23 24 25 99. Yes 39. Since r2 5 0, the solution set is {(0, 7)}. Find the Value of an Annuity In Section 4.2, we studied applications of exponential functions involving compound interest. y2 x2 1 51 4 9 2. A circle is the set of all points in a plane that are equidistant from a fixed point called the center. p(x) 5 0 x 2 3 0 2 1 16. a21 3 x13 8 x3 2 x 2 2 2 107. n 5 c a ai i51 Answers n 7. 62 mph 39. 0, 23, 213 [Z d. n i51 n 103. Circle; Center: (3, 27); Radius: 5 5. 24 (2x 2 6) 1 4 1 provided x ? a 12a b 3 n51 5 ` 5 19. The bounding line would be 1 x dashed and the graph would be 24 23 22 21 1 2 3 4 5 6 21 shaded strictly below the line. 0 B 0 5 (10)(213) 5 2130 and, therefore, 0 A 0 ? 3 f (x) 5 2x 1 1 g(x) 5 x2 h(x) 5 2x 83. (p 2 r)(x) 21. x 5 26 14. $32,000 $166,451.73 87. 120 40 120 Chapter 8 Cumulative Review Exercises, pp. C 23 D b. [x 2 (11 2 i)][x 2 (11 1 i)]Ax 2 13B Ax 1 13B c. (0, 24) y e. 3 4 y 5 g(x) 24 25 m(x) 5 24x 4 3 2 1 1 2 For Exercises 111–116, refer to the functions m, n, p, and q. If one card is drawn at random from a standard deck, what is the probability that it is an 8 or a club? on [1, 3] c. p3 a6 v4 37. That is n(S) 5 38. (See Example 6) 48. 218 Chapter 2 Functions and Relations e. 0 y y 67. 2x3 2 128 15. 8 2 4(1 2 x) 2 7 2 2x 5 0 b. in the first second, 8 in. y y 5 Quadrant II 4 3 2 Quadrant I y units x units Origin 1 25 24 23 22 21 21 22 23 Quadrant III 24 25 1 2 y 7 5) (1, 6 d |9 2 5| 5 4 5 4 3 2 |4 2 1| 5 3 1 24 23 22 21 21 1 2 3 4 5 22 Figure 2-3 6 7 5 x (22, 0) 1 25 24 23 22 21 21 22 (24, 23) 1 2 23 3 4 5 x (4, 22) 24 25 Figure 2-2 2. 2y 5 4 y52 The solutions to this equation must have a y-coordinate of 2. and the length is 42.4 in. [24, 21] c. Yes; (24)2 5 16 . The graph shows the number of students enrolled in public Number of Students Enrolled in Public Colleges 20 colleges for selected years (Source: U.S. National Center for Education Statistics, www.nces.ed.gov). c ad 2 bc 2c 3. x 5 19. m 5 1 8 y 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 24 25 43. 23(x 1 2) 1 1 $ 2x 1 5 (2, 25) Y1 5 2x 2 3 96. If x is the population at a certain fixed time, then P(x) 5 0.98x represents the population 1 yr later. Using the endpoint (21, 0) as (x1, y1) and the center (1, 2) as (x2, y2), apply the distance formula. Substitute 258 for m and (4, 26) for (x, y). (22, 2) a. Examples: π and 12 Section R.1 Point of Interest Computers have approximated π to over 1 trillion digits, but for most applications, the approximation 3.14159 is sufficient. [1, 4] c. Determine the center of the circle. Determine whether the graph of the parabola opens upward or downward. 33 mi 107. 2113 5 7 1 (n 2 1)(24) 2113 5 7 2 4n 1 4 2113 5 11 2 4n 4n 5 124 n 5 31 To find the number of terms n, substitute a1 5 7, d 5 24, and an 5 2113 into the formula for the nth term. Solve Equations and Inequalities Graphically In many settings, the use of technology can provide a numerical and visual interpretation of an algebraic problem. f (0) 5 22(0 2 1)2 1 8 56 The y-intercept is (0, 6). Graph B represents Equation 1. conic 3. m 5 x2 2 x1 9. (See Example 2) b. A probability computed in this way is called an empirical probability. Coefficients 2. (2`, 23] ª [21, `) 105. A(23, 24) 5 7 Ba , b 3 4 C(21.2, 3.8) D(π, 25) E(0, 4.5) FA 15, 0B 10. Shift the graph of f to the right 2.1 units, shrink the graph vertically by a factor of 13 , and shift the graph upward 7.9 units. 2268x12 y9 37. Write the equation in slope-intercept form. Given f (x) 5 22x2 1 7x 2 3, find 1 b. Hit ENTER. 653: © Bruce Dale/ National Geographic/Getty; p. (x 2 4)2 1 (y 1 2)2 5 81 10. The weather was rainy during intervals of increasing depth. (1, 0) y x 25 24 23 22 21 1 2 3 4 5 21 m(x) 5 3(x 2 1)2 22 23 0 0 18. 0.81 78. Given a function defined by y 5 f (x), the difference quotient is given by . Determine the slope of the line containing the points (24, 22) and (24, 27). 2 y y i. f 21(x) 5 y 5 4 3 2 y 5 f(x) 4x 1 3 x21 1. By the inductive hypothesis, [2 1 6 1 p 1 (4k 2 2)] 1 [4(k 1 1) 2 2] 5 2k2 1 (4k 1 2) 5 2(k2 1 2k 1 1) 5 2(k 1 1)2 as desired. f (x) 5 25x2 2 4x 1 2 41. 0.5 7 6 5 4 3 x h(x) 5 ⎛ 13 ⎞ 2 ⎝ ⎠ 1 f(x) 5 3x 25 24 23 22 21 21 1 2 c. That is, R(x) . Events A and K have no elements in common (a single card cannot be both an ace and a king). y 5 4 3 2 1 F 25 24 23 22 21 21 1 2 3 4 5 4 6 8 10 x 22 23 24 25 39. (See Example 11) 85. {12, 10, 6, 16} d. 6x f. 14.4 ft 14. Solution: In this situation, the order in which the group of 6 numbers is selected does not matter. The digits in the password may be selected from 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. If two nonvertical lines are perpendicular, then the slope of one line is the opposite of the reciprocal of the slope of the other line (Figure 2-21). Domain: (2`, `); Range: (2`, 2) c. • The graph of f is a parabola with vertex (h, k). Simplify the rational expression. x 5 4 j. The solution set to the inequality 2x 2 3 $ x 2 1 includes equality, so the left endpoint would be included: [2, `). Given g1x2 5 1x 2 5, the domain is restricted so that x $ __________. $92,408.18; The value of the annuity doubles. a3 5 45 and a6 5 2243 25 47. • Graphing calculator screenshots have been updated to reflect the TI-84 Plus C. {x 0 22 # x , 7} c. Age (yr) 17 21 27 33 35 38 Systolic blood pressure (mmHg) 110 118 121 122 118 124 125 43 51 58 60 64 70 130 132 138 134 142 a. The data in the graph show the wind speed y (in mph) for 200 Hurricane Katrina versus the barometric pressure x (in millibars, mb). The graphs of Y2 and Y3 are close approximations of Y1 5 ex near x 5 0. P3 is true because F1 1 F2 1 F3 5 1 1 1 1 2 5 4 and F312 2 1 5 F5 2 1 5 5 2 1 5 4. The function has relative minima of 3 ft and 3.5 ft at approximately 8 days and 18 days after recording began. Skill Practice 2 a. a (4)i21 i51 3 46. an 5 3n 2 4 6. a35 5 2460 35. Down left and down right. 152–156 R.1. {x 0 x > 21}; (21, `) R.2. {x 0 x # 5}; (2`, 5] R.3. {x 0 23 , x # 4}; (23, 4] R.4. {12} R.5. e 2 2 f 13 R.6. {27} 1. [215, `) b. Graph a Quadratic Function Written in Vertex Form 1. 5 5 5 25 25 5 25 5 25 5 25 25 25 25 5 5 Section 2.6 Practice Exercises, pp. 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 x y 94. Number of Absences (x) Average in Class (y) Answers 8. How much more will Cherise earn than Jacob over the 20-yr period? (2`, 25) ª (25, `) e. 45 c. a b(x) 5 f (x 2 3)(x 2 4) 1 ; Domain: 35, 142 ´ (14, `) 26. 8.6 3 100 c. f (x) 5 3x2 2 4x 1 9 119. EXAMPLE 5 Writing an Equation of a Line Given a Point and the Slope Write an equation of the line that passes through the point (2, 23) and has slope 24. (g + f)(x) for all functions f and g. Center: (24, 7); Radius: 3 6. Find (T + C)(4) and interpret its meaning in the context of this problem. (See Example 6) 6 5 5 57. 2x 1 1 , 2x 1 4 Y1 5 2x 1 1 22 c. From Examples 2 and 3, we see that a line may have a positive slope, a negative slope, a zero slope, or an undefined slope. Foci: A 121, 0B, A2121, 0B f. 8 y 2 (26) 5 2 (x 2 4) 5 Substitute y1 5 26, x1 5 4, and m 5 285 . Graph G 3. How many different routes are available for Gaynelle to travel from home to school to work? m 5 2 20 7 3 5 35. The sum of the numbers on the dice is greater than or equal to 8. P ¨ Q b. Estimate the times and values of any relative maxima or minima on the interval (0, 20). 12! 15! 5 5 5 2730 15P3 5 (15 2 3)! 12! 12! Skill Practice 7 Suppose that 20 people enter a raffle. 231 11. 2 (2, 22) becomes A 2, 22B 5 (1, 22). 3 1 6i b. 33 b. This represents a vertical stretch. No horizontal asymptote b. No 1 c 16 212 1 6 5 d 12 0 5 £ 1 23 21 21 21 51. Solution: a. Figure 2-32 Notice that the graph can be segmented into three pieces. One strategy is to begin with the formula for the nth term of the geometric sequence and substitute the known values for terms 2 and 5 of the sequence. (0, 9); The pot should be placed 9 in. R; (2`, `) 65. AB2 75. 1 x14 2x 2 3 x x22 w22 w13 A A B C Bx 1 C 11. dn 5 (n 1 3)! ; find d3 3n For Exercises 49–56, find the nth term an of a sequence whose first four terms are given. The nth partial sum Sn of the first n terms of a geometric sequence is a (finite/infinite) geometric series. An introduction to modeling is presented here in Chapter R along with the standard order of operations used to carry out these calculations. 0 (multiplicity 3), 5 (multiplicity 2) 2 29. The sales tax for online purchases depends on the location of the business and customer. Prior to her work at DSC, she worked as a software engineer for General Electric in the area of flight and radar simulation. a1 2 ba1 2 ba1 2 b p a1 2 b 2 3 4 n11 1 5 n11 16. A 1 5 £1 1 0 212 212 3 31. [23, 2] 5 8. Then write the equation using function notation where y 5 f(x). Cash 30 # x , 60 a. an 5 6A 12 B n11 10. 2, , 2 , 3 , ... t t t 18. The IRS takes into account exemptions, deductions, and tax credits among Schedule X—If your filing status is Single other things. 81 2 x2 23 7 222 161 94 3 75. Parabola; Vertex: (22, 5); Focus: A294, 5B; Directrix: x 5 274 ; Axis of symmetry: y 5 5 4. 726 1. y 5 0x0 2y 5 0 x 0 y 5 20 x 0 y 24 23 22 21 21 22 y 5 0x0 y 5 0 2x 0 y 5 0x0 5 5 5 5 0x0 0 2x 0 0x0 20 x 0 Test for symmetry with respect to the y-axis. 1.0% error 65. 26 0 31. y 5 4 3 2 5 4 3 2 5 4 3 2 1 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 24. 10 2 10i 47. i b. Using calculus, we can show that the series a k! k50 approaches e as n approaches infinity. 7.75 mph 12 $11,145.60 49. f (g(24)) b. i51 n i51 n b. {(1, 5)} 29. Five questions are true/false and five questions are multiple-choice. Ellipse c. e , 2 f {3, 27} 9. Learn more how customers reviews work on Amazon © 1996-2014, Amazon.com, Inc. Fixed cost: $5625 Variable cost per item: $0.40 Price at which the item is sold: $1.30 224 Chapter 2 Functions and Relations 57. An infinite is a function whose domain is the set of positive integers. a b y2 z2 b. Answers 5. c d b. The center is in Quadrant II, the radius is 3, and the circle is tangent to both the x- and y-axes. a and c x The variable P varies directly as the square of v and inversely as t. x-intercepts: (8, 0), (28, 0); y-intercept: (0, 28) 79. From Example 2(b) and 2(c), notice that event E3 consists of all elements in the sample space not in event E2. 694 i51 ` The sum of all terms in an infinite sequence is an infinite series: a ai 5 a1 1 a2 1 a3 1 p p. 52. 6 18. For Exercises 69–78, use translations to graph the given functions. (g + f)(5) 5 g(f (5)) 5 g(35) 5 31 Evaluate f (23) first. Evaluate a (2i 1 3). f (x) 5 x13 3 99. n 5 49; (x 1 7)2 33. {(10, 100)} 67. Identify the slope. 49 77. p)(x) and write the domain of m ? a1(1 2 rn) Sn 5 Divide by (1 2 r). 0 # 0 x 1 7 0 2 6 16. m 5 2.75 means that the average height of girls increased by 2.75 in. Find the x-intercept(s). no other program matches ALEKS." —Professor Eliza Gallagher, Clemson University, SC Learn More: Successinmath.com x THE ALEKS Instructor Module includes intuitive customization and management features that help save you valuable time and effort. log4 C 2 pAq 1 4B D 65. Answer true or false. An estimated 150,000 people attended the Coconut Grove art festival over a 3-day period. Domain: (2`, `); Range: [28, `) 8 4 23 22 21 24 28 212 1 2 3 4 5 6 7 x 216 220 224 5 2 33 5 33 19. 2k. To visualize the infinite series, suppose that we add 12 of a pie plus 14 of a pie plus 18 of a pie and so on. However, we must also exclude values of x that make the denominator zero. R(x) 5 1.50x c. 2,610,000 c. A set is a collection of items called elements. Shift the graph of f to the left 5 units, shrink the graph horizontally by a factor of 12 , stretch the graph vertically by a factor of 2, and reflect the graph across the y-axis. If event. For an infinite geometric sequence with 21 , r , 1 (equivalently 0 r 0 , 1), the value of rn will become smaller as n gets larger. (x 2 4)2 R.2. (5x 2 3y)(x 1 4y) 3 2 15 R.4. (4x 1 5)2 R.5. 4p(p 2 6q)2 2 2b 6 2b2 2 4ac 5. 150,000 b. {23, 21, 1, 3} e ,2 f 2 5 3125 43. a , 2 b 2 4 15 2 1165 15 1 1165 , 0b and a , 0b d. (2`, `) g. For Exercises 44–47, use the data in the table categorizing the type of payment used at a grocery store according to the gender of the customer. The vendor will lose $45. r(x) 5 (x 2 4)2 3 22. Identify Specific and General Terms of an Arithmetic Sequence In this section and Section 8.3, we study two special types of sequences. Interchanging two rows in an augmented matrix represents interchanging two equations in a system of equations. [21, `) c. R.2. a. T(a) 5 1.06a 1 10.99 c. Therefore, the graph of f (x) 5 x3 2 27 has only one x-intercept. Equation 1: e 5 4 , Equation 2: e 5 53 b. Solution: The total amount spent can be represented by the infinite geometric series where all values are in $ millions. x 5 4 g. 103 5 17,576,000 b. Easily move from one to another. T(x) 5 24x 1 108 b. f (x) 5 3x3 2 5x2 1 12x 2 20 37. (2`, 21] ´ [0, `) 7 7 21. a number that is divisible by 4? Suppose that a single cell of bacteria divides every 20 min for 4 hr. R 35. Passes through (2, 5) and is parallel to the line defined by 2x 1 y 5 6. 58.5 ft 144 1296 2 113 ft 22. { } 2) 2 6 5 5 13 41. The kth term of (a 1 b)n is a EXAMPLE 5 n ban2(k21)bk21 k21 Finding a Specific Term of a Binomial Expansion Find the eighth term of (2x 1 y4)10. x2 1 y 2 3 5 4 a. 3 27. h(x) 5 x 1 5 5 3 83. If the nth term of a sequence is (21)n11 , which terms are positive and which are negative? {(2z 1 4, 3z 1 1, z) 0 z is any real number} 1 22 3 8. 43. Consider a horse race with 8 horses. Vertex: (0, 0); p 5 21; c. Therefore, there are no real zeros of f(x). 0.00625 m or 6.25 mm 1681 m < 0.28 m 73. A geometric sequence a1, a2, a3, ... has a common ratio r. 1250 gal of E5 13. (approximately 42.4 in.) from the center along the major axis. Vertical asymptote: x 5 22; Horizontal asymptote: y 5 3 f. Solution: The sample space has 38 outcomes. Write the range in interval notation. k 5 2 t 9. 24 5 156,250,000 23. 4 3 2 To graph y 5 f (2x), divide each x value by 2. {32} 53. 66.4 in. The graph of f is shown in Figure 3-4. 3 22 11x 1 58. Evaluate 21C4 and interpret its meaning. There are 100 members of the U.S. Senate. Write a function that represents the number of revolutions r(t) in t minutes. n 5. 773 Cumulative Review Exercises 21. 5 acx 2 a 2b 2 4ac 2 b2 bd 1 2a 4a f (x) 5 a(x 2 h) The vertex is a 2 1 k f (x) is now written in vertex form. 4x2 1 4y2 2 20y 1 25 5 0 52. an 5 n 3 4. EXAMPLE 7 Finding the x- and y-Intercepts of a Function Find the x- and y-intercepts of the function defined by f (x) 5 x2 2 4. It would take Michael Jordan 0.5 sec to reach his maximum height of 4 ft. (b, c) c. c 24, 15. Because 129 and 124 are imaginary numbers, the correct logic for simplification would be 129 ? ea , 2 bf 10 30 25 125 125 67 1 1. R.5. {7}; The value 22 does not check. a a b n51 3 69. (24, `) SECTION 2.3 Use the function f pictured to find: f (22). 5 4 3 2 1 1 1 25 24 23 22 21 21 22 22 21 22 5 4 3 2 5 4 3 2 1 98. Center: (24, 1); Radius: 2 17. From the graph, the data appear to follow a linear trend. 4x8y2 5 1y5 1y2 49. The distance is 24 mi. y 68. a2 5 26 and r 5 . 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 (2, 23) From the graph, we see that the graph of f (x) 5 24x 1 5 does indeed pass through the point (2, 23) and has slope 24. The common difference is d 5 210. 260x 2 50 73. (4x 2 1)4 21. 62.5 lb of 7 cement and 225 lb of gravel 25. 1s 1 t2 1x2 30. A vertical line drawn through one point also intersects the other point (Figure 2-14). (23, 28) and (4, 6) 27. (p ? P1 is true because 3 5 1[2(1) 1 1]. 4k 2 13 5 13(4 ? y 5 107 x and y 5 2107 x 105. (See Example 10) y 89. Answers y 1. 3 1 7 1 11 1 p 1 (4n 2 1) 5 n(2n 1 1) n 54. (2`, 25) ´ (25, 3) ´ (3, `) 107. 3.8% compounded continuously for 30 yr results in more interest. 2 48. (Source: American Cancer Society, www.cancer.org) If two women with stage I breast cancer are selected at random, what is the probability that they both survive 5 yr? 12 y2 y2 x2 c2 c2 2 5 1 2 51 y5b 21 2 2 2 2 B a b a b a2 c2 2 a2 b y5b y 5 2c2 2 a2 a B a2 Recall that c2 5 a2 1 b2 or equivalently b2 5 c2 2 a2 and b . The weather was dry on the intervals of decreasing depth and water from the pond evaporated. e 2 f 5. a 10 10 10. (2`, 0) ´ (0, `) c. A2 5 c 21 0 2i 0 1 0 d , A3 5 c d , A4 5 c d ; The entries 0 21 0 2i 0 1 along the main diagonal in matrix An are the same as the value of in. 8 7 7 6 5 4 3 2 y 5 f(x) y 5 f(x) (3, 4) 1 24 23 22 21 21 (1, 1) 1 2 3 4 5 6 x (1, 6) 6 5 4 3 2 (5, 2) 1 22 24 23 22 21 21 23 22 1 2 3 4 5 6 x 210 Chapter 2 Functions and Relations 81. (h + f)(23) 56. x 5 y 2 4 2 2 60. a a b i51 4 ` 3 k21 67. 5! 1 n 5 6 and r 5 1. Objective 4: Find the Value of an Annuity For Exercises 85–86, find the value of an ordinary annuity in which regular payments of P dollars are made at the end of each compounding period, n times per year, at an interest rate r for t years. x 5 23 59. 15.3 sec b. Assume that the units shown in the grid are in meters. Skill Practice 1 Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. t5 210 2b 5 < 1.02 2a 2(24.9) The stone will be at its maximum height approximately 1.02 sec after release. Therefore, at x 5 21, the function has a relative minimum of 25. For example, computer game developers use a rectangular coordinate system to define the locations of objects moving around the screen. (3, 0), (23, 0) 3 F 2 d. {6, 26} b. E A1, 12 B, A1, 212 B, A21, 12 B, A21, 212 B F 21. The graphs have the shape of 12. (y 2 2)2 (x 1 2)2 1 51 4 9 38. Polynomial function a. Then to find the solution set for the system of inequalities, take the intersection of the solution sets to the individual inequalities. The ball lands on a number that is a multiple of 5 (do not include 0 and 00). For example, h(x) 5 (x 2 3)2 can also be written as h(x) 5 f(g(x)), where g(x) 5 x2 2 6x and f(x) 5 x 1 9. 6 5 336 8P3 5 (8 2 3)! 5! 5! TIP The alternative formula for nPr indicates that we multiply n times the consecutive integers less than n until a total of r factors is reached. The ball will be at a height of 52 ft at times 1.25 sec and 2.5 sec after being kicked. 10 d. Use the formula Sn 5 n2(a1 1 an) to show that the sum of the first n positive integers is Sn 5 n2(1 1 n). Sketch the graph. In how many ways can 4 more senators be selected to serve on the committee? Test for Symmetry 1. ` b2 c2 b1 c1 b1 `; ` `; ` b3 c3 b3 c3 b2 15. x2 1 y2 5 20 14. 3x 5 4y 56. {(1, 21, 0, 2)} 2 False. 2 4 26 29 23. R 26. (See Example 6) f (x) 5 x3 2 4x g(x) 5 12x h(x) 5 2x 1 3 47. Write A as a function of d. 0 B 0 5 0 AB 0. Evaluate a Difference Quotient In Section 2.4, we learned that if f is defined on an interval [x1, x2], then the average rate of change of f between (x1, f (x1)) and (x2, f (x2)) is given by m5 f(x) f (x2) 2 f (x1) . Maximum: e. 1?2 2?3 3?4 n(n 1 1) n11 1. 10 ? If Iglesias is at bat three times in a game, what is the probability that he will get a hit all three times? a b(x) n For Exercises 119–120, find two functions, f and g such that h(x) 5 (f + g)(x). (2`, 23] ´ (2, `) 3 3 3 23. g(x) 5 2x2 2 5 and f (x) 5 0 x 0 h(x) 5 (f + g)(x) 5 f (g(x)) 5 0 g(x) 0 5 0 2x2 2 5 0 270 Chapter 2 Functions and Relations 3 Given m(x) 5 1 5x 1 1, find two functions f and g such that m(x) 5 (f + g)(x). 1 23 23 d. Chapter 5 Test, pp. Marta bicycles 18 mph and runs 6 mph. Horizontal 13. x 5 0 y 1 7 0 2 3 6. (2`, 2] j. temperature L(x) (in 8F) for day x. [214, 10] 30. 25 21. 2 51 4 3 16 20 2 2 (y 1 3) (x 2 2) 12 134 2 51 26. Yes 28. EXAMPLE 3 Writing an Equation of a Line Parallel to Another Line Write an equation of the line passing through the point (24, 1) and parallel to the line defined by x 1 4y 5 3. Each croissant cost €2.4 (euros). 0 x 2 3 0 2 y 5 4 a. c 13 38 36 § 69 11 d 5 22 9 28 210 d 2173 8 2 13 2 45 0 47. r 5 1.5; a1 5 36; an 5 36(1.5)n21 1093 6. The volume of the sphere as a function of its radius is 4 given by V1r2 5 πr3. f (x) 5 22x4 1 5 0 x 0 f (2x) 5 22(2x)4 1 5 0 2x 0 f (2x) 5 22x4 1 5 0 x 0 Determine whether the function is even. 162 27. Assume that the money can be respent an infinite number of times. x 5 y2 2 4 x-axis. 0.3 15. Yes x2 1 3 171 z 6. x 5 y2 2 4 Solution: The graph of y 5 0 x 0 is one of the basic graphs presented in Section 2.6. From our familiarity with the graph we can visualize the symmetry with respect to the y-axis. Then either f (u) , f (v) or f (v) , f (u). Solution: Enter the equations using the Y5 editor. h(22) , , , , x for 0 2x for 1 50. {(1, 2, 3)} 19. a (2i 1 6) j51 i51 162 141 59. (2, 21), (22, 21) 25 24 23 22 21 1 2 3 4 5 21 F d. (21, 0) and (25, 0) f. c 61. See page SA-46. Then the velocity vn (in ft/sec) after n seconds is given by vn 5 v0 1 an. N W Z Q H R 11 [N 0, 11 [W 216, 0, 11 [Z 0.83, 2197 , 0.39, 216, 0, 11, 0.444 [Q 13, 0 .2020020002 p [H 13, 0.83, 2197, 0.39, 216, 0, 11, 0.2020020002..., 0.444 [R Skill Practice 1 Given set B, determine which elements belong to the following sets. p(x) 5 2x 1 1 b. Let Pn be the statement 34 1 163 1 p 1 43n 5 1 2 A 14 B n. 6 b. a 6a b 2 6 2 i21 42. k11 k12 k11 k12 k12 n 17. Write a linear function W that represents the water level W(t) (in ft) t days after a drought begins. 725 million 33. (See Examples 1–2) 7. B ¨ C 5 { } [0, 11] 20. 5040 35. a a b k51 2 ` 4 n21 68. Passes through (2.2, 6.4) and is perpendicular to the line defined by 2x 5 4 2 y. The table gives a partial list of data from the graph. x 5 22 y 7 6 5 g(x) 5 (x 1 2)2 2 1 x51 Vertex (1, 8) 4 3 2 1 25 24 23 22 21 21 22 f(x) 5 22(x 2 1)2 1 8 1 2 3 4 5 x Figure 3-2 Skill Practice 1 Repeat Example 1 with g(x) 5 (x 1 2)2 2 1. a1 5 3 45. 3n 26. EXAMPLE 4 Determining if an Equation Represents the Graph of a Circle Write the equation in the form (x 2 h)2 1 (y 2 k)2 5 r2, and identify the solution set. Wait Time, x 120 # x , 150 x , 30 90 # x , 120 60 # x , 90 5 2 15 32 21 41. y 5 24 2 (x 2 2)2 y50 107. Suppose that player A is located at (36, 315) and player B is located at (410, 53). polynomial; 2 3. 23y 2 9 # 15 R.4. Solve. Center: (23, 1); Radius: 111 c. z(x) 5 • 1 for 21 , x # 1 3 for 1 , x # 3 3 for 24 , x , 21 69. In how many ways can the books be arranged on the book shelf? a b(23) h d. The ball does not land on the number 8. 230 67. The second notation is the length of the line segment with endpoints P and Q. e a , y, zb ` y and z are any real numbers f or 2 {(x, y, z) 0 2x 1 3y 1 4z 5 12} 12 2 3y 2 4z Section 6.2 Practice Exercises, pp. a (3i 1 5) i51 Solution: Avoiding Mistakes When we apply the formula n Sn 5 (a1 1 an) to find the 2 n sum a an, the index of i51 summation, i, must begin at 1. 1 1 1 1 1 x x 1 2 (x 1 2)2 (x 1 2)3 x2 1 2x 1 7 (x2 1 2x 1 7)2 21. 1 2 3 4 5 6 7 8 n Estimate the first four terms of the sequence. The real zeros are approximately 27.6, 21.5, and 1.6. d. f (x) 5 20.32x2 1 4.2x 1 8.2 b. y 5 x 1 9 b. a2`, 2 b ´ a2 , `b 5 5 (2`, 28) ´ (14, `) 28. A sales person makes a base salary of $400 per week plus 12% commission on sales. Distance Formula The distance between points (x1, y1) and (x2, y2) is given by d 5 2(x2 2 x1)2 1 (y2 2 y1)2 d 5 2(x1 2 x2)2 1 (y1 2 y2)2. (See Example 2) For a given spin of the wheel, find the probability of the following events. Therefore, the order in which the 3 students are selected is not relevant. 725 The principle of mathematical induction: Let Pn be a statement involving the positive integer n, and let k be an arbitrary positive integer. 719 PC A1 1 nr B nt 2 1D r n SECTION 8.4 Mathematical Induction Reference Mathematical induction is a technique of mathematical proof that is often used to prove that a statement is true for all positive integers. 125 2 4x 95. 90C15 < 4.58 3 1016 81. x2 1 (x 1 1)2 5 113 b. • If a , 0, the parabola opens downward, and the vertex is the maximum point. (x 2 4)2 1 (y 1 3)2 5 4 3 2 10. At a parking garage in a large city, the charge for parking consists of a flat fee of $2.00 plus $1.50/hr. 2 Display the graphs of Y1 and Y2 and use the Intersect feature to determine the point of intersection. Morris, Houston Community College Dorothy Muhammad, Houston Community College Linda Myers, Harrisburg Community College Julie Nation, Mississippi State University Mandri Obeyesekere, Houston Community College Victor Obot, Texas Southern University Charles Odion, Houston Community College Donald Orr, Miami Dade College Victor Pambuccian, Arizona State University–West Stan Perrine, Georgia Gwinnett College David Platt, Front Range Community College Wendy Pogoda, Hillsborough Community College John Polhill, Bloomsburg University of Pennsylvania Jonathan Poritz, Colorado State University Didi Quesada, Miami Dade College Brooke Quinlan, Hillsborough Community College xvi Acknowledgments Carolynn Reed, Austin Community College–Rio Grande Denise Reid, Valdosta State University Nancy Resseguie, Arapahoe Community College Shelia Rivera, University of West Georgia Ken Roblee, Troy University Haazim Sabree, Georgia Perimeter College Haazim Sabree, Georgia Perimeter College Fatemeh Salehibakhsh, Houston Community College Fary Sami, Harford Community College Linda Schott, Ozarks Technical Community College Mary Schuster, University of Cincinnati Lisa Shannon, Meridian Community College Giorgi Shonia, Ohio University Andrew Siefker, Angelo State University Jennifer Siegel, Broward College–Central Randell Simpson, Temple College Premjit Singh, Ohio University Sounny Slitine, Saint Philips College David Slutzky, University of North Georgia Mary Ann Sojda, Montana State University Shannon Solis, San Jacint College Scott Sorrell, University of Louisiana Lafayette Malgorzata Surowiec, Texas Tech University Vic Swaim, SE Louisiana University Paula Talley, Temple College Rae Tree, Oklahoma State University Chris Turner, Pensacola State College Phil Veer, Johnson County Community College James Wan, Long Beach City College Walter Wang, Baruch College Emily Whaley, Georgia Perimeter College Changyong Zhong, Georgia State University Author Acknowledgments: An editor once told us that publishing a book is like making a movie because there are so many people behind the scenes that make the final product a success. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 y 101. Aa 2(x 2 c)2 1 y2 B 2 5 (a2 2 xc)2 a2 C(x 2 c)2 1 y2D 5 a4 2 2a2xc 1 c2x2 a2x2 2 Cx2 2 2xc 1 c2 1 y2D 5 a4 2 2a2xc 1 c2x2 a2x2 2 2a2xc 1 a2c2 1 a2y2 5 a4 2 2a2xc 1 c2x2 a2x2 2 c2x2 1 a2y2 5 a4 2 a2c2 Aa2 2 c2B x2 1 a2y2 5 a2 Aa2 2 c2B 21. 15 19. If the interest rate is 6%, find the value of the annuity after 20 yr. Determine whether the sequence is arithmetic, geometric, or neither. 10c2 1 21 45. f (x 1 h) 2 f (x) h p. 621–624 1(23) 1 0(5) 1 0(26) 0(23) 1 1(5) 1 0(26) 0(23) 1 0(5) 1 1(26) 23 5 26 0.29 20.09 71. (25, 0) d. {(23z 2 2, 24z 1 1, z) 0 z is any real number} 7 21 2 54 53 18. R.2. Solve 27x 2 8y 5 1 for y. an an 5 4 5 4 5 4 5 4 3 2 1 3 2 1 3 2 1 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 22 21 21 22 23 24 25 1 2 3 4 5 6 7 8 x 22 21 21 22 23 24 25 1 2 3 4 5 6 7 8 n 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 n Objective 2: Write Terms of a Sequence Defined Recursively For Exercises 25–30, write the first five terms of the sequence defined recursively. 23.7797 b. 0.048 51. y x 26 25 24 23 22 21 21 22 23 24 25 24 25 b. Show that [1 ? 8C5 41. 6 5 7 6 5 4 3 f(x) 5 ex 2 2 1 1 2 13 25 23 † 1 § 2 6 3 2 4. Determine the distance 23 between the hikers. Modeling and Applications One of the most important tools to motivate our students is to make the mathematics they learn meaningful in their lives. Inspect the data visually to determine if the data suggest a linear trend. 18. 4 cups b. 1, 2, 4, 8, 16, 32, 64, 128, 256 b. 80 60 40 20 25 24 23 22 21 220 240 1 2 3 4 x 5 260 280 f(x) 5 1 1 2 3 4 5 22 23 24 25 3 2 1 23 22 21 21 5 4 3 2 1 m(x) 5 2 x2 1 3 25 24 23 22 21 21 Chapter 3 Test, pp. 772–774 1. The dimensions of the cargo space are 6 ft by 7 ft by 12 ft. 6y 117. 24 69. 24 0 x 6 2 § £ y § 5 £ 23 § 5 z 213 Chapter 6 Test, pp. 6.1% 10. 60x5y2z4 2c3(c 2 d) 31. From this observation, we might make the following hypothesis, which we call Pn. Pn : 5 1 1 1 1 1 n 1 1 1 1p1 5 1?2 2?3 3?4 4?5 n(n 1 1) n11 In words, the hypothesis Pn suggests that the sum of the first n terms of the sequence n n 1 n 1 f is 5 . g(x) 5 x (x13 2x 2 5 The variable x has the restriction that 2x 2 5 ? Suppose that x represents the age of an adult (in yr), and y represents the systolic blood pressure (in mmHg). Write a rule for the graph of the function. (1, 22) 11 1 ,2 b 10 10 For Exercises 25–30, identify the set of values x for which y will be a real number. y 5 3x 1 1 b. 3.1536 3 10 sec b. He borrowed $20,000 at 3% and $4000 at 5.5%. No 23. x-intercept: (24, 0); y-intercept: (0, 3) 55. (1, 8) d. k(x) 50 40 30 20 k(x) 0 30 20 10 24 23 22 21 210 220 10 25 24 23 22 21 210 220 67. TIP The linear equation found in Example 7 was based on two data points. 1 real solution 105. Consider a sequence representing the salary for job B for year n. Is (k + m)(x) 5 (m + k)(x)? $2214.03 c. $238,884.21 b. f (3) For Exercises 96–98, graph the function. A(28.9) 5 5 means that after 28.9 yr, the amount of 90Sr remaining is 5 μg. EXAMPLE 5 Finding Permutations of n Items Taken r at a Time Suppose that 5 students (Alberto, Beth, Carol, Dennis, and Erik) submit applications for scholarships. Therefore, the equation A C D E is in the standard form of an ellipse with center a2 , 2 b. (See Example 8) a. The northbound boat travels 8 mph and the 3 southbound boat travels 14 mph. 3A 5 £ 18 26 § 3 9 35. {22} 39. y 5 f (2x) 5 4 3 2 5 4 3 2 y 5 f(x) 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x y 5 g(x) For Exercises 51–54, use the graphs of y 5 f (x) and y 5 g(x) to graph the given function. 24(x 2 5) 1 3x $ 23x 1 1 y 5 4 Y1 5 2x 2 2 3 2 45 15 Y2 5 2x 2 5 1 25 24 23 22 21 21 22 1 2 3 4 5 x 210 Y1 5 24(x 2 5) 1 3x Y2 5 2x 1 5 Y1 5 23(x 1 2) 1 1 Y2 5 23x 1 1 25 10 215 25 15 (1, 23) 23 24 25 97. 24 The domain is (2`, 24) ´ (24, `). A committee of 4 men and 4 women is to be made from a group of 12 men and 9 women. lna 2 59. 24x2 2 8xh 2 4h2 2 5x 2 5h 1 2 59. At x 5 0, the function has a relative maximum of 0. f (x) 5 (x 1 3)2 2 4 d. per year during this time period. Center: (24, 7) e. {25, 1} SA-25 Student Answer Appendix CHAPTER 4 Section 4.1 Practice Exercises, pp. {(23, 4), (4, 23)} y 2 3 4 24 25 24 25 1 2 23 23 24 25 25 24 23 22 21 21 22 1 y 24 18 12 6 1 23 7. (x 1 y 1 z)(x 1 y 2 z) (x 1 y 1 z)(x2 1 2xy 1 y2 2 xz 2 yz 1 z2) 63. x2 1 ay 2 b 5 17 2 278 Chapter 2 Functions and Relations For Exercises 11–14, information about a circle is given. A24 1 15, 0B and A24 2 15, 0B 24 25 1 CHAPTER 3 1 b. The graph of y 5 f (x) 2 c is the graph of y 5 f (x) shifted (up/down/left/right) c units. 0 5 4x2 1 y2; This is an equation of a degenerate ellipse. Domain: {8, 3, 11, 5} c. Formula for the nth term of an arithmetic sequence an 5 54 1 (n 2 1)(20.8) Substitute 54 for a1 and 20.8 for d. If the third and fourth terms of an arithmetic sequence are 12 and 16, what are the first and second terms? Find the 19th term of an arithmetic sequence with a1 5 211 and a30 5 163. n(E3) 0 5 5 0. 769: U.S. Air Force photo by Master Sgt Michael A. For Exercises 26–27, expand the binomial by using the binomial theorem. Write P as a function of s. z 5 0.62x 1 0.50y 9. Determine the axis of symmetry. origin 9. (2`, 24] ª [7.8, `) c. Find (g + f)(x). Jean runs 8 mph and rides 16 mph. He did this by intersecting two perpendicular number lines with the point of intersection called the origin. (See Example 5) 29. Graph is stretched/shrunk vertically by a factor of a. 7 65. y3 2 13y2 2 42y 2 24 33. Use the graph and the average rates of change found in parts (a) and (b) to discuss the pattern of the number of new flu cases. 7k11 2 5 5 7 ? 77. {(26, 24, 3)} 57. y 5 212x 1 20 2 x18y10 22 1 ln 22 37 Neither 10. 22 21 21 22 0 3 22 21 3 e. R.1. 10. Make a scatter plot of the data using age as the independent variable x and systolic pressure as the dependent variable y. Easily manage your courses and track student progress, all through one simple interface. Write an equation for g21(x). y Determine the distance between each pair of points. (0, 24) Graphing by the point-plotting method should only be considered a beginning strategy for creating the graphs of equations in two variables. {5}; The value 2 does not check. p)(1) Solution: a. 2000 10 23 11. x 5 7, y 5 5 b. The height y (in meters) of a volcano in the southeast Pacific Ocean is recorded in the table for selected years since 1960. [225] c. 3 3 2 b. 1.392 71. Expression; 15y 2 38 5. 14 3x 2r1r2 2 17 2 85. Instead the measures of the angles would be even integers. Chapter 4 Test, pp. Positive: 0; Negative: 4, 2, or 0 Positive: 0; Negative: 0 57. 3 4 R.3. y 5 4 3 2 25 24 23 22 21 21 22 10 10 R.2. y 5 4 3 y 5 23x 2 1 2 24 25 y 5 f(3x) 1 2 3 4 5 x 5 x SA-13 Student Answer Appendix 39. E(a) 5 20.476a 1 37.0a 2 44.6 b. f (0) 5 220 3 21 R.5. Domain (24, 4]; Range [21, 4] R.3. {22, 26} R.4. 2 4 1. If someone does not know the code and tries to guess, how many guesses are possible? Center: a , 2 b; Radius: 2 4 7 17. They are the same. The equation y 5 0.4x 1 109.6 relates an individual's age to an estimated systolic blood pressure for that age. In this expression n 5 3 and r 5 5. A car starts from rest and accelerates to a speed of 60 mph in 12 sec. No 3. R.2. 3 23, `2 R.3. 12`, 32 R.5. k1x 1 32 5 x2 1 4x 1 6 f (x 1 h) 2 f (x) f (x); g(x) 3. y 5 2t2 1 1 103. The system of equations reduces to a contradiction. There are many other cases to consider regarding the number of male and female jurors: for example, 4 male, 5 female, etc. SECTION 8.7 88. Mixed Exercises 72. R.3. 6x 2 2y 5 10 2x 2 10y 5 22 R.4. 0.3x 2 0.4y 5 21.6 0.9x 1 0.1y 5 23.5 Concept Connections 1. 2x 2 1 for x , 21 for 21 # x , 2 f(x) 5 • 23 1x 2 2 for x $ 2 5 25 5 25 Notice that the individual "pieces" of the graph do not "hook-up." For this reason, it is also a good practice to put the calculator in DOT mode in the menu. i51 i51 2 73. a10 5 48 5. 87. Write a rule for a linear function y 5 f (x), given that f (0) 5 4 and f (3) 5 11. 1r + t21x2 5 5 ; x2 2 4 Domain: 12`, 232 ´ 123, 222 ´ 122, 22 ´ 12, 32 ´ 13, `2 Solution: a. Definition of a Relation A set of ordered pairs (x, y) is called a relation in x and y. y 3. 16 113 in. 5k 2 3 5 5(2a 1 3) 2 3 Replace 5k by 2a 1 3. 5 ? See Figure 8-9 on page 732. The experiment involves 4,295,000 individuals of age 20. (0.88)(0.88) 5 0.7744 200 50 6 2 12 1 1 1 < 0.007874 b. 180 Chapter 2 Functions and Relations • If c . 1 53. If x is the amount of money initially invested, then A(x) 5 1.045x represents the amount of money in the account 1 yr later. b1 5 23; bn 5 3bn21 1 4 26. EXAMPLE 4 Graphing a Function with a Vertical Stretch or Shrink Graph the functions. The diameter d of a sphere is twice the radius r. In how many ways can the word WRONG be misspelled? If the money is later respent in the community over and over again at a rate of 70%, determine the total amount spent. 14.6 ft 43. 29 11. 2a 4a 4ac 2 b2 and is often hard to remember. h(k(3)) 100. {5000} 22 21. 5 4 3 2 1 1 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 x For Exercises 111–112, a. For example, a circle can be described by the algebraic equation (x 2 h)2 1 (y 2 k)2 5 r 2. For Exercises 123–126, determine whether the curve is (a) concave up or concave down and (b) increasing or decreasing. 1, 4, 9, 16, 25, ... Writing the Terms of a Sequence a. 14m6 2 21m3 1 28m2 27. 24, indicating that P4 is true. Parallel lines m2 5 3 5 m2 5 2 53 3 ft Perpendicular lines 3 ft m1 5 5 ft 3 m1 5 5 5 ft 3 ft 3 ft 5 ft 5 ft Figure 2-20 Figure 2-21 Slopes of Parallel and Perpendicular Lines Answer 2. x by the inductive hypothesis. A(P) 5 a b or A(P) 5 d. 5 4 3 2 8 7 6 5 y 5 f(x) 25 24 23 22 21 21 22 1 2 3 4 5 y 5 f(x) x 23 24 23 22 21 21 22 p(x) 5 1x 2 2 24 25 1 2 3 4 5 6 x y 5 4 3 2 y 103. Given an arithmetic sequence with first term a1 and nth term an, the nth partial sum is given by the formula . a 2 b 9. Upward e. The difference in distances equals the length of the transverse axis. 9 a. Reference SECTION 2.8 Algebra of Functions and Function Composition Given functions f and g, the functions f 1 g, f 2 g, f ? In many applications in the sciences, the change in a variable is denoted by the Greek letter D (delta). {3, 23, 4, 22, 1} d. None f. R.1. f (2a) 5 27a 2 2 R.3. Interval notation: [22.4, 5.8) 1 24 25 y 5 f(x) x 5 4 3 2 1 23 x Section 2.7 Practice Exercises, pp. {(0, 0)} 35. 1 2 3 4 5 b. B ´ C 5 {x 0 x , 2 or x $ 4} f. • There are 26 black cards (spades and clubs) and 26 red cards (hearts and diamonds). (3, 0) and (5, 0) d. 7 1 1 n(2n 1 1) n(n 1 1)(4n 1 5) 5 6 11. {1, 6, 11, 16, ...} (See Example 7) 53. 1 3 4 1 15. 2 A 73, 53 B F 29. How many license plates can be made if there are no restrictions on the letters or digits? 1 24 25 25 24 23 22 21 1 2 3 4 21 (1, 21) 22 Answers (1, 1) 25 24 23 22 21 21 22 y 5 4 y 5 Î2x 1 2 3 2 y 5 Îx 1 2 1 x Shift left 2 units 23 shift left reflect across y-axis 5 x 1 x 25 24 23 22 21 1 2 3 4 5 21 22 v(x) 5 2Î2x 1 2 23 23 24 25 24 25 Skill Practice 8 Use transformations to graph the function defined by 3 r(x) 5 12x 1 1. y 5 f(x) 1 b. The code has no restrictions. In Example 1(c), it is impossible to draw a white marble from the box. Summarize Transformations of Graphs 6. The zeros are 12 , 3i, and 23i. What is the probability that an individual from the population can donate blood to a person with type O2 blood. Figures 2-9 and 2-10 show a table and a graph for y 5 x2 2 3. There were 600,000 organisms approximately 9 hr and 39 hr after the culture was started. 4% 65. In Examples 4 and 5, we practice evaluating the difference quotient for two functions. a b 3 C For Exercises 60–64, expand the binomial by using the binomial theorem. d(2) 5 36; Joe rides 36 mi in 2 hr. x 5 0, x 5 2 8. However, if c 5 0, or if c , 0, the graph will be a single point or nonexistent. 1 71. (S1 2 S2)(x) 5 x2 1 4x 2 πx2 and represents the area of the 8 region outside the semicircle, but inside the rectangle. g(x) 5 12x Section 2.6 SECTION 2.6 229 Transformations of Graphs Transformations of Graphs OBJECTIVES 1. (2`, `) 17 6 1 i 13 13 8. Section 2.8 EXAMPLE 7 Algebra of Functions and Function Composition Composing Functions and Determining Domain Given f (x) 5 2x 2 6 and g(x) 5 the domain in interval notation. {(5y 2 2z 21, y, z) 0 y and z are any real numbers} or {(x, y, z) 0 x 2 5y 1 2z 5 21} 21. Expand the binomial. (x 2 y)9; sixth term 33. Suppose that a function H gives the high temperature H(x) (in 8F) for day x. i d. π 6 b. The points must all line up. 2x(5x 1 8y)2 (2c2 2 5d3)2 37. g(x) 5 2 02x 0 1 8 1 (x 2 2.1)2 1 7.9 3 1 60. f (23.7) 73. Because a parabola is symmetric with respect to the vertical line through the vertex, the x-coordinate of the vertex must be equidistant from the x-intercepts. Therefore, the factor a is raised to the n 2 (k 2 1) power. Section 8.7 Introduction to Probability 761 Scientist Gregor Mendel (1822–1884) is often called the "father of modern genetics" and is famous for his work involving the inheritance of certain traits in pea plants. 24 25 y y 5 2Î2x 1 2 1 24 23 22 21 21 1 2 3 4 5 6 x 22 23 m(x) 5 23|x 2 2| 2 4 24 25 26 2 3 4 (2, 0) 5 x 23 y 5 4 3 2 Reflect over the x-axis 1 7. 23. The table lists four Olympic athletes and the number of Olympic medals won by the athlete. f (25) For Exercises 81–84, graph the function. 69. No 1 0 21 c. x2 1 y2 5 49 73. The spectators can see the shell between 1 sec and 6.75 sec after launch. {13} b. The formal definition of a continuous function will be studied in calculus. on [22, 0] 87. The graph of g(x) 5 21x has the shape of the graph of y 5 0 x 0 the shape of the graph of but is reflected across the x-axis. 3! ? provided x ? 10x2 1 10y2 2 80x 1 200y 1 920 5 0 (Hint: Divide by 10 to make the x2 and y2 term coefficients equal to 1.) 48. 1 23 f. Apply the square root property. 6 1 1. Day 10: $5.12; Day 20: $5242.88; Day 30: $5,368,709.12 c. 0, 0 x 0 5 k is equivalent to x 5 k or x 5 2k. If four seeds are selected at random, determine the number of ways in which a. 80 20 Chapter 2 Cumulative Review Exercises, pp. y¿ 5 79. {(1, 3, 0)} No solution; The system is inconsistent. The minimum cost is $1860. Find a43. formula 8. Is the point (2, 7) on the circle defined by (x 2 2)2 1 (y 2 7)2 5 4? TestGen is a computerized test bank utilizing algorithmbased testing software to create customized exams quickly. Concave down b. Increasing b. g(x) 5 e 110. 0.6826 c. Assume that the "money" is respent an infinite number of times without being detected. Yes 33. (The wavelength is the distance between two consecutive wave crests.) a. 57. y 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24

25 24 25 1 2 3 4 5 x d. a i51 i 1 1 18 83. (g + f)(5) 54. In addition, suppose that each person spends an average of $10 on food, drinks, and rides. See also Systems of linear equations in two variables explanation of, 197, 275 graphs of, 197–198 slope of line in graphs of, 198–202 Linear factorization theorem, 333, 344 Linear functions in applications, 216–218 explanation of, 202, 301 graphs of, 229 Linear inequalities in applications, 151 explanation of, 144–145, 202 graphs of, 536–539 method to solve, 144–148 in one variable, 144–146, 159 solution set to, 536–537 in two variables, 536–540, 557 Linear models, 219, 276 Linear profit functions, 217–218 Linear programming in applications, 548–552 constraints and, 548–549 explanation of, 547, 557 objective functions and, 547–548, 557 Linear regression, creating models using, 220–221 Linear revenue functions, 217–218 Lines equation of, 201, 202 horizontal, 200, 201 parallel, 214–215 perpendicular, 214–216 regression, 197 secant, 203 slope-intercept form of, 201–202 slope of, 198–201 vertical, 200, 201 Literal equations explanation of, 88 methods to solve, 88–90, 466–467 Logarithmic equations in applications, 461 explanation of, 457, 484 exponential form to solve, 458–459 on graphing utility, 457, 462 methods to solve, 457–460, 484 Logarithmic expressions expanded form of, 445–446 written as single logarithm, 446–447 Logarithmic form, 427–429 Logarithmic functions in applications, 436–437 common, 430–431, 454, 483 domain of, 435–436 explanation of, 427–429, 483 on graphing utility, 431 graphs of, 432–435 modeling with, 466–475, 484 natural, 430–431, 483 Logarithmic models, 475 Logarithms applying change-of-base formula to, 448–449 applying properties of, 447 basic properties of, 432, 483, 484 evaluation of, 429–431 on graphing utility, 449 logarithmic expressions written as single, 446–447 power property of, 444, 445 product property of, 443, 445 I-5 quotient property of, 444, 445 to solve exponential equations, 454–455 Logistic curve, 472 Logistic growth models, 472–473 Long division, 316–318, 352, 356 Lower bounds, 337–340 M Main diagonal, 567 Major axis, of ellipse, 635 Mathematical induction explanation of, 725–726, 765 extended principle of, 729–730, 765 principle of, 726, 765 to prove binomial theorem, 734 uses of, 727–729 Matrices addition and subtraction of, 587–588, 626 additive inverse of, 588 applying operations on, 594–595 augmented, 564–570 coefficient, 607–608 cofactor of element of, 615 column, 586 determinants of, 612–617 elementary row operations on, 565–566, 625 explanation of, 564 on graphing utility, 571, 590, 593, 605, 606 identity, 602–603 inverse of, 607–608, 626 invertible or nonsingular, 605–607, 616–617 multiplication of, 590–594, 602–603, 626 notation for, 586, 612 order of, 585–586 product of scalar and, 588–590 review of, 626 row, 586 in row-echelon or reduced row-echelon form, 566–569 row equivalent, 565 singular, 605, 606, 626 to solve systems of linear equations, 564–570, 625 square, 586, 602–603 Mendel, Gregor, 761 Method of diagonals, 616 Midpoint, 168, 275 Midpoint formula, 168 Minor, of element of matrix, 612–615, 627 Minor axis, of ellipse, 635 Mixture applications, 96, 498–499 Modeling with exponential and logarithmic functions, 466–475, 484 for exponential growth and decay, 467–472 linear, 219 with linear equations in three variables, 513 linear regression to create, 220–221 variation, 383–384 I-6 Subject Index Monomials, 38. The graph of a step function is a series of discontinuous “steps.” One important step function is called the greatest integer function or floor function. 7 5 3,276,000 Each multiple-choice question has 4 choices 2 ? { } 41 41 45. 2(x 1 c)2 1 y2 1 2(x 2 c)2 1 y2 5 2a c. “My father is a medical researcher, and I got hooked on math and science when I was young and would visit his laboratory. 2 1 2 x24 x 1x14 x 12 x 13 4 23 4 25 2x 2 5 1 1 41. x2 1 ay 1 b 5 9 2 e. 0.72 m c. If three people are selected at random, find the probability that they all have the Rh factor. x2 2 x c. 279 57. r! ? Not a polynomial function. Yes {(1, 4, 22)} 11. 0; 0 7. Circle; Center: (21, 26); Radius: 4 8. ? Find the locations and values of the relative maxima and relative minima of the function on the standard viewing window. e , 27 f 2 Linear equation b. $2,142,857 20. Yes 25 19. Find all x for which f (x) 5 0. g(x) 5 1x 1 5 20. 22x 1 2h 1 22x 22x 1/2 x (5x 1 3) 13. This is because the calculator has a rectangular screen. 552–556 R.1. a. 23 5 27,600 21. Cost for 0 # x , 80 for x . Mixed Exercises 41. (See Example 1) 9. 5 9 5 S5 a1 10 5 5 12r 1 2 101 5 10 9 10 5 59 718 Chapter 8 Sequences, Series, Induction, and Probability b. Interest compounded annually b. p(x) 5 20 x 0 1 x Section 2.7 247 Analyzing Graphs of Functions and Piecewise-Defined Functions 3. 1520 at (8, 6) b. Maximum value: 8 9 f(x) 5 22x 1 4x 1 6 8 i. 120. A0 < 0.81 μg/dL e. The systolic blood pressure for a healthy 55-year-old would be approximately 132 mmHg. Skill Practice 8 The data given represent the class averages for individual students based on the number of absences from class. 1 45. c 13. Center: (23, 2); Radius: 4 19. (0, 3) y 9 8 7 6 c. Ellipse; Center: (21, 0); Vertices: (21, 4), (21, 24); Endpoints of minor axis: (22, 0), (0, 0); Foci: A21, 115 B, A21, 2115 B; Eccentricity: 115 4 6. 10 offices d. a number that is a multiple of 5? a prime number? (4) 2,598,960 52C5 95. Technology Connections For Exercises 128–131, use a graphing utility to graph the piecewise-defined function. Concept Connections 1. • For the instructor, references to an even-numbered exercise are provided next to each example. 26 1 121 , 0b 3 26 2 121 , 0b or approximately 3 (20.47, 0) and (23.53, 0). 8P5 33. The viewing window between x 5 216.1 and 216.1 16.1 x 5 16.1 is divided by the number of pixels 210 displayed horizontally to get the values of x used to graph the equation. Using the rounded values from part (a), the screen is approximately 949 pixels by 632 pixels. Answer Skill Practice 5 Find the seventh term of (3c 1 d 5)9. 10 y y i. • Values of x that make a radicand negative within an even-indexed root. f(x) 5 x2 2 4 0 5 x2 2 4 x2 5 4 x 5 62 The x-intercepts are (2, 0) and (22, 0). Therefore, an x-intercept is a point (a, 0) where a graph intersects the x-axis (Figure 2-7). 253 • f (a) is a relative maximum of f if there exists an open interval containing a such that f (a) $ f (x) for all x in the interval. Based on the data given, if a customer is selected at random, find the probability that Number of Customers vs. 1?2 2?3 3?4 n(n 1 1) n11 Solution: Let Pn denote the statement 1 1 1 1 n 1 1 1p1 5 . f (x) 5 (3x 2 2)(5x 1 1)(x 2 4) 29. (22, 0) ´ (3, `) d. She wants to get a head start by reading several of the books during the summer. 5, 7, 9, 11 b. x 1 y # 18 65. {24} 5e2.1 1 86; n < 16.1662 77. Extended Principle of Mathematical Induction Let Pn be a statement involving the positive integer n. y 5 4 3 y 5 22x 1 1 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x Skill Practice 4 Write an equation of the line passing through the point (28, 24) and perpendicular to the line defined by y 5 16 x 1 3. This relation is not a function because it fails the vertical line test. (2P2)] ? quadratic 3. (1, 2), (3, 0), and (23, 22) 21. (1, 0) d. f (0) 5 2(0)2 1 4(0) 2 5 5 25 The y-intercept is (0, 25). Summation Notation Given a sequence a1, a2, a3, … , the nth partial sum Sn is a finite series and is represented by n is the upper limit of summation. 27 (((m + p)(x) 5 m(p(x)) 5 2 27 Skill Practice 8 Given f (x) 5 1x 2 1 and g(x) 5 x 21 3 , find (g + f)(x) and write the domain of g + f in interval notation. {9} {22} ´ [0, 3] ´ [5, `) 17. EXAMPLE 2 Writing Terms of a Sequence Defined Recursively Write the first five terms of the sequence defined by a1 5 4 and an 5 2an21 1 1 for n . Performing a horizontal shift first means that we replace x by x 1 2. C 5 2 and D 5 3 83. a m b(0) When combining two or more functions to create a new function, always be sure to determine the domain of the new function. Let Pn be a statement involving the positive integer n, and let k be an arbitrary positive integer. 1 1 n 1 1 5 which is the same as 5 5 . (g + f)(0) 2 24 25 f 5 {(2, 4), (6, 21), (4, 22), (0, 3), (21, 6)} and g 5 {(4, 3), (0, 6), (5, 7), (6, 0)} 1 23 For Exercises 103–110, refer to the functions f and g and evaluate the functions for the given values of x. Evaluate G(4.5) and interpret the meaning in the context of this problem. 11 3 7 4 2 3 17. 0, the graph of y 5 f (x) has two x-intercepts. 32 yr 89. 2x 1 3y 5 6 b. (x 2 h)2 1 (y 2 k)2 5 r2 5. i 119 24i 13. Most importantly, we want to give special thanks to all the students and instructors who use College Algebra in their classes. At a restaurant, if a party has eight or more people, the gratuity is automatically added to the bill. a (23k3) 4 m11 m m51 n21 n n51 68. A 13, 2 16 B and A313, 416 B 3. View a daily breakdown of how students learn in ALEKS, including the exact problems they attempt and their answers. x Figure 2-5 Midpoint Formula The midpoint of the line segment with endpoints (x1, y1) and (x2, y2) is M5a x1 1 x2 y1 1 y2 , b 2 2 average of x-coordinates EXAMPLE 3 Avoiding Mistakes average of y-coordinates The midpoint of a line segment is an ordered pair (with two coordinates), not a single number. The x-intercepts of the graph of f. Figure 2-34 y 6. (h + k)(22) g. Therefore, 4! . {(4, 23)} 23 57. This conflicts with the definition of a one-to-one function. [215, `) c. [2, 4] (Hint: t 5 2 and h 5 2) d. e 3 1 5 2 6 i 12 16. The easement is 8 ft. † 22 1 0†50 b. (x2 1 3y)(x2 1 3y 2 1) x13x2 2 22 3a2 93. x 3. c 1 0 3 1 5 c 23 4 2 d 1 c 2 24 2 6 d 21 22 2 24 1 6 6 6 6 6 0 6 0 6 2 3 4 6 0 6 0 6 5 6 7 8 1 21 21 21 21 21 21 1 21 1 21 21 1 21 5 5 5 5 5 5 b1 b2 a1 a2 d 1 c d a3 a4 b3 b4 b1 1 a1 a1 1 b1 a2 1 b2 d 5 c 5 c a3 1 b3 a4 1 b4 b3 1 a3 5B1A 2a1 2a2 a1 a2 d 1 c d 89. 38: © Frederic Charpentier/Alamy RF; p. (23, 22) and (2, 5) (x1, y1) and (x2, y2) m5 y m5 6 Label the points. 24, 216, 323 , 2649 , 128 27 t n21 1 23. Round to 2 decimal places. 25 73. The plane flying to Seattle flies 440 mph, and the plane flying to New York flies 500 mph. a (i2 1 3i) 92. Predict the average monthly bill for year 6 if this trend continues. f (32) 5 5 c. 2.0 3 104 115. (g + f)(x) 5 4x2 1 16x 1 16 c. (h, k) 5 (24, 6) and r 5 2 [x 2 (24)]2 1 (y 2 6)2 5 (2)2 (x 1 4)2 1 (y 2 6)2 5 4 y b. TIP The equation y 5 20.4x 1 109.6 can also be expressed in function notation. {(1, 1)} 5. y 106. 40 210 10 220 c. Suppose that the employee begins contributing at age 28. (0, 0) g. The equation cannot be written in the form ax 1 b 5 0. Undefined p6 1p 3n1/3 4 4 3 2 47. 7 23 y2 2 x 2 2 5 0 24 25 210 y 8 7 6 1 43. C(x) 5 x b. Let Pn be the statement 1 1 4 1 p 1 4n21 5 13 (4n 2 1). 2 r(x) 5 (x 2 4)2 3 2 1 27. The rabbit population will approach 2000 as t increases. 6 25 24 23 22 21 22 24 26 1 2 3 4 5 x 28 210 212 214 10 11 5 1 i 5. 5 2 117 63. Find the 400th term. 631–632 45. f 1x2 5 where x fi 25 x14 c. Then back substitute to find the third variable. Each row begins and ends with a 1, and each entry in between is the sum of the two diagonal entries from the row above. The average rate of change of f on the interval [1, 3]. e 6 , f 5 2 6. x 5 22 and x 5 2 c. This is called a counterexample. The solution set is {3}. { } {5}; The value 24 does not check. Yes; d 5 4 15. {(21, 4), (2, 3), (3, 4), (24, 5)} Solution: TIP A function may not have the same x value paired with different y values. Then to perform the reflection across the y-axis, we replace x by 2x to get y 5 12x 1 2. Write an equation of the circle with center (3, 21) and radius 4. Determine if the statement is true or false. Sales 5000 Income ($) 4000 3000 y 5 0.05x 1 2000 y 5 3000 2000 1000 0 0 20,000 40,000 Sales ($) 60,000 Figure 2-35 Skill Practice 9 A retail store buys T-shirts from the manufacturer. partial 2 3 a. 203 f (x2) 2 f (x1) x2 2 x 1 The x-coordinates of the points of intersection between the graphs of y 5 f (x) and y 5 g(x) are the solutions to the equation f (x) 5 g(x). [0, 2] (Hint: t 5 0 and h 5 2) c. f(x) 5 23x 1 8 39. 9.8 c. The tree diagram shows 16 different sundaes: Mi nt ch ip Ho Butters Hot cotch e fudg Butters cotch t nu number of syrups late oco dg t fu a Pe number of custards cotch e Ch VHN, VHG, VBN, VBG, CHN, CHG, CBN, CBG, MHN, MHG, MBN, MBG, PHN, PHG, PBN, and PBG. a , 0b and (23, 0) 5 c. 5 4 3 2 1 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 y 3 1 x 5 x 1 x 23 21. 12`, 2 4 3. C 5 3.6s 1 50p 1 250n b. x-intercepts: (21, 0), (9, 0); y-intercepts: (0, 23), (0, 3) 47. 1 16, 8, 4, 2, … , 16 12. 4 5 85. Center: (22, 24); Vertices: A22 1 17, 24B, A22 2 17, 24B Foci: A22 1 3 12, 24B, A22 2 3 12, 24B y2 (y 2 7)2 (x 2 2)2 x2 23. f (x) 5 x2 y a. a 15. Graph three circles whose centers are located at the study areas and whose radii are the given distances to the earthquake. 6 5 4 3 2 5 b(x) 5 ⎛ 23 ⎞ 25 24 23 22 21 21 1 2 25. 6 24 y 5 2x 1 2 SECTION 2.1 Practice Exercises Prerequisite Review R.1. R.2. R.3. R.4. Simplify the radical. Dividend: 22x4 1 x3 1 4x 2 1; Divisor: x2 1 x 2 3; Quotient: 22x2 1 3x 2 9; Remainder: 22x 2 28 249 21. 11 1 11 1 11 1 11 1 11 700 Chapter 8 Sequences, Series, Induction, and Probability 1 1 1 1 2 1 2 3 9 27 81 83. (f + g)(4) f. Determine the number of ways that the airline can select 4 people at random to place on a different flight. Suppose that a box contains 4 chocolate chip cookies, 8 molasses cookies, and 12 raisin cookies. 4 29. 0 is true for all values of x excluding 3. Find the value(s) of x for which f (x) 5 6. Sketch the function. to keep the amount of aluminum to at most 90 in.2. 3 25 24 23 22 21 23 26 2. 23t(t 2 1) 5 2t 1 6 14. (8, 40) 33. 24x 1 π 105. [24, 1] ´ [3, `) 31. {32} 81. If two points align vertically then the points do not define y as a function of x. (See Example 5) 45. In how many ways can the word EXACTLY be misspelled? a1 5 7, d 5 10 b. 4a 2b , and then Therefore, it is usually easier to evaluate the x-coordinate first from 2a 2b b. See Empty sets Number line. True 57. 100: © BananaStock/Jupiter Images RF; p. How much profit will the vendor make if 50 cups of lemonade are produced and sold? 2 4 781 40 18. a , 0b, a , 0b 2 2 11. 7 1 a2 , d 6 3 (23 ; {x 0 23 , x # 7} 7 ; {x 0 x # 6.7} 43. (f + g)(0) d. a 25. a 2 b 1 a 2 b 1 a 2 b 1 a 2 b 1 a 2 b 1 p 1 3 2 4 3 5 4 6 5 7 3 c. (7, 2238) 27. 489 R.4. R y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x 1 x-intercept: (1, 0); slope: m 5 ; y-intercept: (0, 21) 5 y-intercept: (0, 4) system 3. Vertex: A 72, 21B; Focus: A 72, 252 B; Focal diameter: 6 51. 10) fi (log 10)(log 10) (The left side is 2 and the right side is 1.) 97. TL 5 £ $2688 § $1657 $46 77. {213, 25} b. 490 m d. Explain. 24(x 2 5) 1 3x # 23x 1 1 c. Vertical Translations of Graphs Consider a function defined by y 5 f(x). 2x 1 h 1 4 41. f 21(x) 5 3 2 x; x $ 3 x14 3 63. Find all x for which f (x) 5 3. Given the series 1 1 1 1 1 1 1 1 p , 111. We are already familiar with the graph of f (x) 5 x2 (Figure 3-1). Identify the center and radius. Graph iii 113. 80, 20, 5, , … 4 b. 2! ? If the money is spent over and over again an infinite number of times, each time at a rate of 75%, determine the total amount spent. p2(p 2 6)5 (r 2 2)2(2r 2 1)4 R.4. R.5. 5 4 (r 2 2) (2r 2 1) p (p 2 6)2 Concept Connections 1. We call each arrangement a permutation of n elements taken r at a time and denote the number of such permutations as nPr. Number of Permutations of n Elements Taken r at a Time The number of permutations of n elements taken r at a time is given by r factors n! , or equivalently, nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1) nPr 5 (n 2 r)! Note: nPr counts the number of permutations of n items taken r at a time under the assumption that no item can be selected more than once, and that each of the n items is distinguishable. 4 h(24x 2 2h 1 4) Factor numerator and denominator, and simplify the fraction. 1 29. 215 210 Section 7.3 Practice Exercises, pp. e 4 6 i, f 3 4 b. An average score in league play between 140 and 220, inclusive, would produce a handicap of 72 or less. Use the points (0, 166) and (40, 650) to write a linear function that defines the height y of the volcano, x years since 1960. $26,997.18 b. 8 7 22 23 a(x) 5 !x 1 1 2 3 10 8 6 4 16. For Exercises 35–42, find the indicated term of a geometric sequence from the given information. 1 2 3 4 5 6 7 8 x g(x) 5 √x 2 2 Consider a function defined by y 5 f (x). A parenthesis is used if an endpoint to an interval is not included in the set. (x 1 5a)(y 1 2c) 29. Foci: A3, 113 B, A3, 2113 B d. Which of the following can represent the probability of an event? Horizontal asymptote: y 5 2 10 8 6 x 4 6 4 2 x y 83. This is demonstrated in Example 4. 16 days Let Pn be the statement 6 1 10 1 p 1 (4n 1 2) 5 n(2n 1 4). a a b i51 2 5 54 15. 2 1 i 29 29 a. Check the condition that a2 1 b2 5 c2. an 5 2 n 2 5 3 n21 3. 30 30 25 20 20 17. (See Example 7) Normal Cholesterol Elevated Cholesterol Total 30 and under 14 4 18 31–60 52 28 80 61 or older 22 80 102 Total 88 112 200 59. This is the characteristic that makes this sequence arithmetic. Use the model from part (b) to predict the amount of cholesterol for a hamburger with 650 calories. (See Example 1) 5. f(25) is not defined. The time at which the stone will be at its maximum height is the t-coordinate of the vertex. Add and subtract C 12(4)D 2 5 4 within parentheses. If the measure of one angle is x degrees, write a relationship representing the measure of the other angle S(x) as a function of x. Writing a Relation from Observed Data Points Table 2-1 shows the score y that a student earned on an algebra test based on the number of hours x spent studying one week prior to the test. However, the ellipse represented by the first equation has foci on the y-axis, whereas the second equation represents an ellipse with foci on the x-axis. Approximate the probability by dividing the number of times a player wins to the number of games played. 4, 6, 7, 152 , 314 5, 15 , 5, 15 , 5 31. In a “Numbers” game, a player wins a prize for matching a 3-digit number from 000 to 999 with the number randomly selected during the drawing. EXAMPLE 6 Graphing a Piecewise-Defined Function Graph the function defined by f (x) 5 e y Solution: 5 4 3 2 1 25 24 23 22 21 21 22 23x for x , 1 3 1 117 c. an 5 e 14. Then access the Maximum feature from the CALC menu. 36z 2 12 15z 1 5 87. y 5 4 3 2 25 24 23 22 21 21 22 1 y 5 f(x) x 5 4 3 2 3 x 88. Passes through (1.1, 5.3) and (20.9, 7.1). a b 0 3 b. 10 11. A5 c 4 5 23 d 9 21 C5 £ 3 2 B5 c 4 6 25 0 1§ 7 41. y d. x 5 612 Chapter 1 Review Exercises, pp. 480 deer 29. x 1 3 2(x 1 7) y2 5 12 26. 1 2 3 4 5 6 7 8 x (21, 0) and (3, 4) (x1, y1) and (x2, y2) The center is a 21 1 3 0 1 4 , b 5 (1, 2). Denominator of the complex fraction is zero for x 5 3. The solution set is {(h, k)}. f (x) 5 1x 2 2 f (6) 5 16 2 2 f (6) 5 2 x 5 6 is on the interval x $ 2. Apply a vertical shrink (multiply the y values by 12). x51 f(x) 5 3x2 2 6x 1 1 f. 3, 12, 48, 240, … a3 a2 12 48 5 5 4, 5 5 4, a1 a2 3 12 a4 240 55 5 a3 48 The sequence is geometric because the ratio between each term and its predecessor is the same constant. (2`, 2) 7. (4, 8), (216, 8) d. Twenty batteries have been sitting in a drawer for 2 yr. a b 4 4 c. Vertices: (1, 4), (21, 4) Foci: (3, 4), (23, 4) y 5 2 12x 1 4 and y 5 22 12x 1 4 85. TIP The graph of a vertical line will have no y-intercept unless the line is the y-axis itself. A row matrix is a matrix with only one row. There are 10 choices for each digit. Write the answer in slope-intercept form and in standard form. (g + f)(2) 106. Write About It 83. The outer ellipse c. 1 5 6 EXAMPLE 3 4! 5 4 ? R(x) 5 100x c. y 5 log3(x 1 2) 1 83. b32 5 2303, b54 5 2567; Find b214. (Informally, a line is tangent to a circle if it touches the circle in exactly one point.) 30. 0, 23 [W c. 294–299 2 f. 0 which means that x fi 62. 2, 22, 3i, 23i c. 12! n(n 2 1)(n 2 2) 3 p n(n 2 1)x2 1 x 1 , for 0 x 0 , 1. EXAMPLE 9 Finding the Probability of Independent Events In baseball, a player’s batting “average” is the quotient of the number of hits to the number of “at bats.” It can also be interpreted as the probability that the player will get a hit on a given time at bat. 8 1 4 1 0 1 1 (24n 1 12) 5 22n(n 2 5) 9. (m ? on [22, 0] 86. g(x) 5 x2 1 2 c. Is g a one-to-one function? (0, 23) f. Œ61 (4, 1) P 1 1 25 24 23 22 21 21 (22, 23) 22 2 3 4 x 5 Œ52 23 A 152B 1 A 161B 0 A 1101B 52 1 61 ? Write a rule for a linear function y 5 k(x), given that k(22) 5 10 and k(5) 5 218. Recognize Basic Functions 2. 270 mg c. 27 3. 8 13. 2 15 19. EXAMPLE 1 Identifying a Geometric Sequence and the Common Ratio Determine whether the sequence is geometric. 1 1 1 5 1 1 1 5 2?3 3?4 4?5 2 6 12 20 5 1 For the first four terms, the numerator is the same as the term number n and the denominator is one more than the term number. 4k 2 1 5 4 ? Sn 5 a1 1 (a1 1 d) 1 (a1 1 2d) 1 p 1 an Ascending order p Sn 5 an 1 (an 2 d) 1 (an 2 2d) 1 1 a1 Descending order 2Sn 5 (a1 1 an) 1 (a1 1 an) 1 (a1 1 an) 1 p 1 (a1 1 an) 2Sn 5 n(a1 1 an) n Sn 5 (a1 1 an) 2 nth Partial Sum of an Arithmetic Sequence The sum Sn of the first n terms of an arithmetic sequence is given by Sn 5 n (a1 1 an) 2 where a1 is the first term of the sequence, and an is the nth term of the sequence. 61k 2a 3 3 5 1 13. x1 5 76 vehicles per hour; x2 5 97 vehicles per hour b. 10 210 210 1 1 1 2 5 x 25 24 23 22 21 21 22 3 y 5 5x 1 2 1 2 3 4 5 23 24 25 24 25 3. £ 0 1 21 † 30 § x2 2 x3 5 30 0 0 0 0 f. An online survey is used to monitor customer service. Show that (k 1 1)! . A 1x 1 512 B A31x 2 12 B 22 9. d SA-14 Student Answer Appendix 57. 1 4 12 7 12. y 5 25x 1 26; 5x 1 y 5 26 3 38 y 5 x 1 ; 3x 2 7y 5 238 7 7 y 5 0.5x 1 5.3; 5x 2 10y 5 253 45. (f + f)(21) 109. 111. g(x) 5 2x 45. 6.4 days b. It travels 45 27 y 5 2.25x mph for 1 min (60 sec), and then decelerates 18 for 30 sec to stop at another red light. Section 2.5 Applications of Linear Equations and Modeling 217 Linear functions can sometimes be used to model the cost, revenue, and profit of producing and selling x items. It is important to realize that for nonterminating decimals, a calculator or spreadsheet will only give approximate values, not exact values. f (x) 5 23x 2 3 15. h(x) 5 (x 2 2) 3 72. The intercepts (1, 0), (21, 0), and (0, 21) are consistent with the graph of the equation y 5 0 x 0 2 1 found in Example 4 (Figure 2-8). 46. 1 5 1 3 4 For Exercises 63–64, determine if the function is linear, constant, or neither. (0, 2) c. EXAMPLE 1 Adding Two Functions Given f (x) 5 225 2 x2 and g(x) 5 5, find (f 1 g)(x). 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 b. y 92. 1 9. g(2) 5 5 The function values represent the ordered pairs (22, 23), (21, 21), (0, 1), (1, 3), and (2, 5). (See Example 3) 28. Expanding a Binomial (a 1 b)6 1 1 1 Solution: 1 The expansion of (a 1 b)6 will have 7 terms (one more than the exponent of 6). Determine the solution set for the equation (x 2 17)2 1 (y 1 1)2 5 29. h 1x 1 h 1 3 1 1x 1 3 1 c. c d 22 41 26 55. (25 24 23 22 21 0 1 2 x x 14 Domain: (2`, `) 2 d. If we place the y-axis along this line, a point (x, y) on one side has a mirror image at (2x, y). If a student may receive both scholarships, determine the probability that both students are freshmen. {(0, 0, 0)} 23. c d a3 a4 ta3 ta4 sta2 a1 a2 d 5 (st) c d 5 (st)A sta4 a3 a4 93. y 5 4 3 2 1 25 24 23 22 21 22 1 2 3 4 5 x By inspection, we see that between any two points on the graph, the vertical change is zero, so the slope is zero. The population growth rate for Australia is greater. y 5 23x 2 3 b. (2`, 213] ´ [21, `) 5 1 18. y 69. There is no real number x to which we add 1 that will equal the same real number x to which we add 2. Apply the point-slope formula with x1 5 2, y1 5 23, and m 5 22. Division by zero is undefined. Reduced row-echelon form is the same format as row-echelon form with the added condition that all elements above the leading 1’s must be 0’s. Write an Equation of a Circle in Standard Form 1. Answer 4. 2 16 b. 5 4 3 2 25 20 15 10 y 5 f(x) 1 5 26 25 24 23 22 21 25 210 215 220 225 4 2 y 5 f(x) 1 2 3 4 25 24 23 22 21 21 22 x f(x) 5 3x4 1 7x3 2 12x2 2 14x 1 12 10. So the constant b is 99. The axis of symmetry is x 5 22. For Exercises 29–30, determine the domain and range of the function. 31 90 However, rather than making a one-time lump sum payment of P dollars, many individuals will invest smaller amounts at regular and more frequent intervals. We need to count the number of permutations of n 5 15 students taken r 5 3 at a time. EXAMPLE 9 Writing a Repeating Decimal as a Fraction a. 4 44. P(x) 5 25x 2 1500 d. The sequence defined by an 5 n 2n 1 is not defined for n 5 1 because the denominator would be zero. h(x) 5 4 3 2 The graph extends infinitely far downward and infinitely far to the left and right. (3, 0), (23, 0), (1, 0), (21, 0) d. 2 is a factor of 7n 2 5. Solution: 1 p(x) 2 5 First note that function p has the restriction that x $ 2. C(x) 5 2.88x 1 790 b. t(3) 52. c ax c 2 ax or y 5 2 b b b 3. Count Combinations Consider the situation in Example 5 in which 5 students are selected for 2 scholarships. 1?3 3?5 5?7 (2n 2 1)(2n 1 1) 2n 1 1 Mathematical induction can be used to prove the following useful summation formulas involving powers of the first n positive integers (Table 8-3). 3.4454 14. More than 8.36 in. 23x 2 11 x 1 7 e ax, , b ` x is any real number f or 2 2 52y 22y 2 11 , y, b ` y is any real number f or ea 3 3 5(2z 2 7, 23z 1 5, z) 0 z is any real number6 R.1. $120 1. y e. Pair up two equations in the system and eliminate a variable. 0 41. (k 2 h)(1) e. an 5 a1 1 (n 2 1)d 164 5 24 1 (22 2 1)d 164 5 24 1 21d d58 Therefore, an 5 24 1 (n 2 1)(8). x 5 22 y 10 8 6 f(x) 5 3x2 1 12x 1 5 4 2 27 26 25 24 23 22 21 22 24 26 Vertex 28 (22, 27) 210 1 2 3 Figure 3-3 Skill Practice 2 Repeat Example 2 with f (x) 5 3x2 2 6x 1 1. We have shown that P4 is true, and that if Pk is true, then Pk11 is true. y 96. 22x2 2 x 2 14 1 4 5 x b. P 5 $200, n 5 12, r 5 5%, t 5 30 yr 86. 1.763 3 1012 7 2 7 7 2 7 2 41. (21, 7) d(M, P) 5 2[4 2 (22)]2 1 [1 2 (23)]2 5 152 Q8 7 6 d(P, Q) 5 2(21 2 4) 1 (7 2 1) 5 161 2 2 d(M, Q) 5 2[21 2 (22)] 1 [7 2 (23)] 5 1101 2 5 4 3 2 2 Œ101 The line segment MQ is the longest and would potentially be the hypotenuse, c. If f is defined on the interval [x1, x2], then the average rate of change of f on the interval [x1, x2] is given by the . k(x) 5 x3 2 2 a. CHAPTER 2 130. Barometric Pressure 61. A 113, 0B, A2113, 0B 4 7. Identify Specific and General Terms of a Geometric Sequence 2. The solution set is {x 0 x , 3 or x . Parent function: f (x) 5 63. c 4 3 2 1 22. T 21(x) 5 c. Graphing utilities include graphing calculators, spreadsheets, specialty graphing programs, and apps on phones. The total number of handshakes for n people at the meeting is given by an 5 12n(n 2 1). What is the total distance that the object will fall in 8 sec? 24 47. Given A 5 £ 0 1 2 1 0 21 3 §, find A21. 5 4 3 2 1 25 24 23 22 21 21 22 2 3 4 5 x 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 1 2 y f. 5n , 3n For Exercises 29–32, use mathematical induction to prove the given statement. To graph a piecewise-defined function, graph each individual function on its domain. {x 0 3 , x , 11}; (3, 11) ((3 11 97. A farmer depreciates a $100,000 tractor. Find the 500th term of an arithmetic sequence with a1 5 6.9 and d 5 0.3. 774 Chapter 8 Sequences, Series, Induction, and Probability 58. Number of Attendees by Week 80 60 Number 47. 96 ft3 of sand 15. 0.98 b. There are approximately 3 144 turtles in the pond. 233 • Reflection y 5 2f (x) y 5 f (2x) p. by 12 in. The speed v(L) (in m/sec) of an ocean wave in deep water is approximated by v1L2 5 1.22L, where L (in meters) is the wavelength of the wave. on [1, 2] 89. If two DVDs are selected from the box with replacement, determine the probability that both are comedies. In Example 6(b) for instance, the index of summation ranges from 3 to 6. I2 5 c R.4. a 1 d 5. 5 4 3 2 5 4 3 2 1 1 1 23 24 25 1 2 3 4 y 5 f(x) 5 x 25 24 23 22 21 21 22 1 2 3 4 23 y 5 f(x) 24 25 5 x 1 2 3 4 5 x y 94. No 61. $199,149.07; The value of the annuity more than doubles. f(x) 5 x2 5 d. 3 5 90 79. It will be drawn in the text as an open dot for reference only. 421: © Corbis; p. 12 1 6 1 0 1 1 (26n 1 18) 5 23n(n 2 5) 1 10. For Exercises 28–30, find the sum. Introduction to Probability OBJECTIVES 1. R.3. 24t 1 5 , 13 R.4. 6p 2 2 $ 5p 1 8 R.5. Given the function defined by g(x) 5 2x2 1 3x 1 2, find g(21). For example, the equation y 5 x 2 2 defines y as a function of x. No x-intercept d. 3.1 2 2.2(t 1 1) 5 6.3 1 1.4t b. (23, 4) e. 8 31. The value g(x) represents the number of years since the year 2010 based on the number of applicants to the freshman class, x. In the regression model y 5 ax 1 b, the values for the coefficients a and b are placed on the home screen. Review Exercises CHAPTER 8 SECTION 8.1 For Exercises 13–14, write the sum using summation notation. R 2. If the number of reported cases increases by roughly 30% each week thereafter, find the number of cases 10 weeks after the initial report. The braces { and } are used to enclose the elements of a set. Cherry has 13 g of fat and Mint Chocolate Chunk has 17 g of fat. A21 5 c a 1 d 0 b 5 6 65. (2`, 21.5) c. f(x) Relative maximum f(a) ≥ f(x) for all x “near” a y 5 f(x) (a, f(a)) Relative minimum f(b) ≤ f(x) for all x “near” a y 5 f(x) (b, f(b)) ( ) a ( ) x b Figure 2-37 • The function has a relative maximum of f (a). 290 Chapter 3 Polynomial and Rational Functions Solution: a. 3 2 41. y x y Ordered pairs 0 0 (0, 0) 1 1, 21 (1, 1), (1, 21) 5 4 3 2 4 2, 22 (4, 2), (4, 22) 1 9 3, 23 (9, 3), (9, 23) 21 21 22 y2 5 x 1 2 3 4 5 6 7 8 9 x 23 24 25 This relation is not a function. If k $ 2, then (k 1 3) . Annotated Instructor’s Edition • Answers to exercises appear adjacent to each exercise set, in a color used only for annotations. 36 (0, 40) 24 (36, 12) 12 (36, 0) (0, 0) 0 12 24 36 48 Dining Room Tables 19. 101. (22, 2) 13 3 3 m 15. 0.64 76. Write a nonrecursive formula for the nth term of the arithmetic sequence {an} based on the given information. Linear; {216} d. a6 5 972 39. 139. e a22, b f 4 22 2 3x x 2 6 15. (6, 24, 21) and (2, 3, 1) 85. See Stretch/shrink Simple interest application involving, 94–95 formula for, 95, 420 Simplification applying distributive property for, 12 of expressions of forms a1/n and am/n, 28–29 of expressions with exponents, 18–20 of imaginary numbers, 104–105 of nth roots, 28 of numerical expressions, 9–10 of radicals, 30–32 of rational expressions, 59–61 of special case products, 40–41 Singular matrix, 605, 606 Slant asymptotes, 352–353 Slope explanation of, 198–199, 201 formula for, 199 method to find, 199–200 of parallel lines, 214–215 of perpendicular lines, 214–216 writing equation of line given point and, 202 Slope-intercept form explanation of, 201, 275 to graph a line, 201–202 system of linear equations in, 497 use of, 213 Solutions to equations, 82, 86, 169 extraneous, 137 to inequalities in two variables, 536–539 to systems of linear equations, 492–493, 556 to systems of nonlinear equations, 527 Solution sets of equations, 86, 169 of inequalities, 145–151, 205 of linear inequalities, 536 of systems of linear equations, 492 Special case products identifying and simplifying, 40–41 involving complex numbers, 109 involving radicals, 43, 74 Square. f (x2) for all x1 , x2 on I. Arithmetic; d 5 2 1 16. 2 1110 in.2 97. Therefore, a y-intercept is a point (0, b) where a graph intersects the y-axis (Figure 2-7). c 1 5 1 232 ` 2d 6 24 SA-39 Student Answer Appendix 5. 3k for a positive integer k $ 7. 3.5 3 105 b. SECTION 2.3 19. x2 1 y2 1 22x 2 4 5 0 47. Find f (x 1 h) 2 f (x) . x) Horizontal shrink (if a . Even function y f. Decreasing 79. Center: (0, 25); a. 2x4 2 5x3 2 5x2 2 4x 1 29 b. Times LT Std. Now if u fi v, then either u , v or v , u. The book is gorgeous. inequality 3. Minimum value: 29 e. {(1, 2)} y 5 4 3 2 y 5 23x 1 5 1 y Hours Studying History 5 210 23 24 25 e. Each swing (one way) thereafter makes an arc of 98% of the length of the previous swing. Suppose that a tennis tournament has 64 players. Linear c. Notice that a point (x, y) on the graph of f corresponds to the point (2x, y) on g. a.–b. 16x2 2 25 1 4 39. (3, `) b. ; Furthermore, < 2.78 is on the interval [2, 3]. 1 1 51. If one marble is selected at random, find the probability of the event. y 5 3 b. 9P3 5 9 ? c 249 1 3 2 9 244 47 28 41 43. Endpoints of minor axis: (0, 2), (0, 24) d. Domain: (2`, `); Range: (2`, 1] y 3 2 1 29 28 27 26 25 24 23 22 21 21 22 23 24 1 2 p(x) 5 22(x 1 4) 1 1 5 25 26 27 c. 5 log6 p 2 log6 q – 3 log6 t 1 1 1 2 2 33. Then the probability of event E, denoted by P(E), is given by P(E) 5 Avoiding Mistakes The probability 12 does not mean that exactly 1 out of every 2 rolls of a die will result in an even number. Center: (2, 4); Vertices: A2, 4 1 15 B, A2, 4 2 15 B; Foci: A2, 4 1 114 B, A2, 4 2 114 B (y 1 5)2 51 b. reflected across the Objective 1: Recognize Basic Functions For Exercises 9–14, from memory match the equation with its graph. Place the tacks at A 111, 0B and A2111, 0B. Answers 1. (9C3) ? 3 51. 2 2 • To find an x-intercept (a, 0) of the graph of an equation, substitute 0 for y and solve for x. 16, 0, 28, 1.45, 19, 2 , 3π 3 3. formula S 5 7. 5 h 1 Answers 4. Given f (x) 5 1 x12 12 , x a. The center is (3, 1) and another point on the circle is (6, 5). 397–398 y 16. {(210, 3)} 6. 21 35. (0, 1) e. c 3d 3 3 13 216 22 13 2 63 2 39. Write an Equation of a Circle In addition to graphing equations by plotting points, we will learn to recognize specific categories of equations and the characteristics of their graphs. For example: (0, 0, 22), (0, 3, 0), and (6, 0, 0) a. 4 3 52 k k 111. The right side of the equation is graphed as Y2 5 x 2 1. y 5 x3 2. d 5 2[7 2 (25)]2 1 (23 2 1)2 Apply the distance formula. 4 mg/L d. Section 8.2 711 Arithmetic Sequences and Series 69. Explain why the function is discontinuous at x 5 1. 9 The solution set is a2`, d . The points (24, 0) and (4, 0) represent the points where f (x) 5 0. Write About It 59. A ´ C d. y 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 2 3 4 5 R.1. 27 1 24i R.2. a. Suppose that line L is tangent to the given circle at the point (4, 3). Athlete (x) Number of Medals (y) Dara Torres (swimming) 12 Carl Lewis (track and field) 10 Bonnie Blair (speed skating) 6 Michael Phelps (swimming) 16 25 24 23 22 21 22 y 21. 5 4 3 2 8 7 6 5 4 3 2 22 1 2 3 4 5 x 1 2 3 4 5 23 b. h. Graph t (x) 5 • 2x 1 1 for x . f 21 represents the conversion from x feet to f 21(x) miles. 26. 7 same as exponent on b The eighth term of (2x 1 y4)10 is a 10 b(2x)3(y4)7 5 120(8x3)(y28) 5 960x3y28. {(4, 0, 2)} {(5z 1 3, 22z 1 6, z) 0 z is any real number} 12 2 3y 2 4z ea , y, zb ` y and z are any real numbers f or 2 {(x, y, z) 0 2x 1 3y 1 4z 5 12} {(23z 1 5, z 1 4, z) 0 z is any real number} {(24z 1 7, 2, z) 0 z is any real number} 37. {26.2} 19. Suppose that we place the origin at the center of the flower. (See Example 1) 10. • f is constant on I if f (x1) 5 f (x2) for all x1 and x2 on I. 1 x 23 24 25 21 21 22 23 3 4 5 6 7 1 21 21 22 23 3 2 2 3 2 y 5 2 1 log3 x 1 22 21 21 22 1 b. A(100) 5 0.909 means that after 100 yr, the amount of 90Sr remaining is approximately 0.909 μg. Suppose that two fair dice are rolled. y a. 0 y 0 55. y 5 2g(x) y y 47. 1 2 x x24 x x x 17 3 7x 1 1 1 2 28. { }; The value 295 does not check. The domain of k is [1, `). not the same Replace x by 2x. How many codes can be formed if there are no restrictions? 1 2 50. Note that 0 2x 0 5 0 x 0. xk21 for x . 4x3 2 20x2 1 13x 1 4 x24 5x 15. EXAMPLE 3 Applying the Fundamental Principle of Counting A quiz has five true/false questions and five multiple-choice questions. In Example 3, we write an expression for the nth term of a geometric sequence given the first four terms. If P(A) 5 0.431, what is the value of P(A)? {(1, 24)} 25. Domain: (2`, `); 6 4 33 2 Range: c 2 , `b x 24 23 22 21 1 2 3 4 5 6 4 22 35. (2`, 22) ´ (0, 3) b. t(3t 1 4)3(t 2 2) 29. y 2 0 x 0 5 2 38. (r + n)(x) 75. q(x) 5 12x 1 2 x 2 For Exercises 33–40, use the graphs of y 5 f (x) and y 5 g(x) to graph the given function. 2 15. 3 x x 5 21 is on the interval 21 # x , 2. x 1 3x h 1 3xh 1 h 1 2x 1 2h 2 5 63. 1 2 3 4 5 6 7 x 23 q(x) 5 √‾‾‾‾‾‾‾‾ x1225 26 4. h b. {24, 7.8} 10 210 210 210 80 40 0 10 10 120 10 210 b. 7 27. 74. x 5 4, y 5 2, z 5 10 25. e f 9. 5x 0 x $ 92 6 b. 0 10 Y1 5 4 2 2(x 1 1) 1 12 1 x Y1 5 8 2 4(1 2 x) 2 7 2 2x Y2 5 0 22 25 210 20 Y2 5 0 10 210 Write About It 99. The x variable can be any real number. x 5 18; 28 39. 2 109. True 67. {0, 4, 6, 7, 8, 12} 51. With C 5 A and completing the square, the equation Ax2 1 Cy2 1 Dx 1 Ey 1 F 5 0 becomes Ax2 1 Ay2 1 Dx 1 Ey 1 F 5 0 D E F x2 1 y2 1 x 1 y 1 5 0 A A A E 2 D2 E2 F D 2 b 1 ay 1 b 5 21 22 ax 1 2A 2A A 4A 4A D 2 E 2 D2 1 E 2 2 4AF ax 1 b 1 ay 1 b 5 2A 2A 4A2 This is the standard form of an equation of circle with center D E 2D 2 1 E 2 2 4AF a2 , 2 b and radius provided 2A 2A 2A 2 2 D 1 E 2 4AF . To compute this numerically, select any two points on the line such as (2, 3) and (4, 3). Discriminant is 296; no x-intercepts 71. In either case, f (u) fi f (v), and f is one-to-one. f (6) 79. < 0.3916 2(3n 1 1)(3n) 13C4 4 16 5 60. Skill Practice 3 Determine if the given relation defines y as a function of x. Maximum: 1 h. 5 1 p 1 (2k 2 1)(2k k 2k 1 1 1 (2k desired. E1: A red marble is selected. [0.48, 0.54]; The candidate is expected to receive between 48% of the vote and 54% of the vote, inclusive. 50 lux 1 The intensity is 100 as great. Credit Card Check Male 19 24 13 Female 14 30 20 64 Total 33 54 33 120 b. 5 9 b. The graph shows the wait times (in seconds) for a sample of customers. Answers 1 2 3. We begin by presenting the definition of a circle. 560–561 23 1 6 6 ` d 4 2 11. Given a geometric sequence whose nth term is an 5 6(0.4)n, are the terms of this sequence increasing or decreasing? On a given spin of an American roulette wheel, find the probability of the event. 2, 4, 6, 8, 10, … Solution: The sequence is arithmetic because each term is 2 more than its predecessor. 22x 2 28 17. Graph y 5 f(2x) 1 3. (g + f)(1) 58. x15 5. EXAMPLE 10 Identifying Characteristics of a Function Use the function f pictured to answer the questions. A Coulter Counter is a device used to count the number of microscopic particles in a fluid, most notably, cells in blood. 2x 2 3 . See Graphing utilities Cardano, Gerolamo, 344 Cartesian coordinate system. 2 85. 20 Y1 5 2.38(1.5)x 4 2 21028 26 24 22 22 2 4 6 8 x 5 0 24 26 0 6 28 210 212 f. 30 23 22 21 230 260 290 2120 1 2 3 4 5 6 7 x 2150 2180 2210 2240 2270 f(x) 5 x5 2 8x4 1 13x3 13. 1 1 1)(2k 1 3) 1 1) D 1 [2(k 1 1 1) 2 1][2(k 1 1) 1 1] 5 2 3k 1 1 (2k 1 1)(k 1 1) k 1 1 5 (2k2k 111)(2k 1 3) 5 (2k 1 1)(2k 1 3) 5 2k 1 3 as Answers 3 Let Pn be the statement that 2 is a factor of 5n 1 1. r n2r 55. Second, it is generally preferable to write a model that is based on all the data points, rather than just two points. Parent function: y 5 x3 1. Determine the solution set for the equation (x 1 1)2 1 (y 2 5)2 5 0. Input x Apply function g to x. Write an expression S1(x) that represents the area of the rectangle. Expanding Your Skills 42. (23, `) g. 213 • If m1 and m2 represent the slopes of two nonvertical parallel lines, then m1 5 m2. y 5 f(x) b. Determine if the graph of the equation is symmetric to the y-axis, x-axis, origin, or none of these. Determine the number of seats in row 32. 262 are defined by (f 1 g)(x) 5 f (x) 1 g(x) (f 2 g)(x) 5 f (x) 2 g(x) (f ? (0, 16) y f. Simplify the complex fraction by multiplying numerator and denominator by the LCD x2 2 1. 0, b ? gA212 B d. g)(x) 5 f (x) ? $10 and $24 a. QA154.3.M54 2017 512.9–dc23 2015027054 The Internet addresses listed in the text were accurate at the time of publication. Linear; {22} 73. Equation; e , 210 f 3 11 6 2233 f 2 7 b. They are organized in Connect hosted by ALEKS by chapter and section. y 5 23 a. Evaluate the greatest integer function for the following values of x. 2 3 4 1 1. The graph is not smooth. (q + q)(x) 76. Assuming that the linear trend continues, use the model from part (a) to predict the number of students enrolled in public colleges for the year 2020. 3x for x , 1 f (x) 5 e 3 for x . x 5 23 j. For Exercises 45–50, write an equation of the line that satisfies the given conditions. C(x) 5 90 2 x 121. SECTION 8.2 For Exercises 18–20, determine whether the sequence is arithmetic. Therefore, the bookstore’s price to the student, P(x) (in $) after a 7.5% sales tax, is given by P(x) 5 1.075(x 1 0.40x), where x is the cost of the book from the publisher. False; a aibi 5 a1b1 1 a2b2 1 p 1 anbn i51 fi (a1 1 a2 1 p 1 an)(b1 1 b2 1 p 1 bn) 99. Jacob has a job that pays $48,000 the first year. (See Example 1) For Exercises 9–10, evaluate the given expressions. For a large number of terms, adding the terms individually would be a cumbersome process, so instead, we observe the following pattern. What type of symmetry does an odd function have? 0 c. 1 25. Therefore, the two line segments in the graph meet at (20,000, 3000). For k $ 4, the expression (k 1 1) . 3c 28c2d3 1 c2 250d3 2 2d22c4d 2u21 2 w21 4u22 2 w22 Polynomial and Rational Functions Chapter Outline 3.1 Quadratic Functions and Applications 286 3.2 Introduction to Polynomial Functions 300 3.3 Division of Polynomials and the Remainder and Factor Theorems 316 3.4 Zeros of Polynomials 329 3.5 Rational Functions 345 Problem Recognition Exercises: Polynomial and Rational Functions 368 3.6 Polynomial and Rational Inequalities 369 Problem Recognition Exercises: Solving Equations and Inequalities 382 3.7 Variation 383 M eteorology and the study of weather have a strong basis in mathematics. Cumulative review exercises. 65. Skill Practice 9 Suppose the probability that a person will catch a winter “cold” is 0.16. h5 4ac 2 b2 2b and k 5 2a 4a 2b 4ac 2 b2 , b. Therefore, the graph of f(x) 5 2x2 1 4x 2 5 has no x-intercept (Figure 3-4). A retirement account initially has $500,000 and grows by 5% per year. Ax 1 i 13 B Ax 2 i 13 B 113. 14 Section R.5 Practice Exercises, pp. In an ordered pair, the first coordinate is called the x-coordinate, and the second is called the y-coordinate. Show that 5 1 8 1 p 1 (3k 1 2) 1 [3(k 1 1) 1 2] 5 (k 1 1)(3k 1 10) k11 [3(k 1 1) 1 7] 5 . { } 12 4 53. h)(5) 5 12a 1 3 5 3(4a 1 1) Therefore, 3 is a factor of 4k11 2 1 as desired. 0.61 h. nonzero 1 1 (2`, 5) ´ (5, `) 9. f)(21) g d. x2 1 y2 2 14y 1 49 5 0 Solution: x2 1 y2 2 14y 1 49 5 x2 1 (y2 2 14y) 5 x2 1 (y2 2 14y 1 49) 5 x2 1 (y 2 7)2 5 0 249 249 1 49 0 Group the y terms and complete the square. 5 k2 1 (2k 1 2 2 1) 5 k2 1 2k 1 1 5 (k 1 1)2 as desired. 188.9 cm/sec 61. Because the principal is invested pretax, the individual potentially has more money available to invest. y 5 f(x) 75. The function f 1 g is defined by (f 1 g)(x) 5 1 f f 2. This approach was used in the complex proof of Fermat’s last theorem. Skill Practice 6 Refer to the graph in Example 6. h(x) 5 19. An equation to represent this relationship is y 5 x 1 2. 91. Determine Theoretical The Centers for Disease Control publishes National Vital Statistics Reports every year that provide data for birth rates and mortality rates based on gender, race, age, and other factors. 3 1 log5 z 9. The code may not contain repeated digits. 110. 178 Chapter 2 Functions and Relations Standard Form of an Equation of a Circle Given a circle centered at (h, k) with radius r, the standard form of an equation of the circle (also called center-radius form) is given by (x 2 h)2 1 (y 2 k)2 5 r2 where r . [24, 23] ´ [2, 3] 2 117. Let k 5 1 2 F and assume that k fi 0. {7, 21} 59. A fire is located at distances of 17 km, 15 km, and 13 km, respectively, from the observation towers. Let n represent the row number in Pascal’s triangle. (n 1 1)! Sometimes we are presented with several terms of a sequence and are asked to find a formula for the nth term. paper) — ISBN 1–259–57046–0 (alk. The survey has 6 yes/no questions and 4 multiple-choice questions each with 3 possible responses. m6 4n18 2y4 x7 61. Ax 1 13 B Ax 2 13 B b. Write a formula for the nth term of an arithmetic sequence that represents the distance dn (in ft) that the object will fall in the nth second. f (0) 3 4 e. 25a4b 1 70a2b2 1ab 1 49ab4 89. 2 107. 23, 323, 4323, p Technology Connections For Exercises 113–114, use a graphing utility to find the first four terms of the sequence. Determine the values of x for which a. Mathematical induction is a two-part process to prove all the statements in the sequence. 2x 1 2x 1 h 2 2x 2 1 12. 25 2 1 2 12 i51 [Hint: Rewrite the expression within the summation so that the base of 2 appears to the (i 2 1) power.] ` 1 n21 71. 25 x ? Move to the left 4 units. The domain is (25, `). 4, 20, 100, 500, … 7 7 7 11. minor c1 ` c2 x y 1 55. above the center of the dish. Find the sixth term. { } 3 99. Find 2k(x). 758 Probability of a sequence of independent events: Two events are independent if the probability of one event does not affect the probability of the second event. The model cannot continue indefinitely because the population will become too large to be sustained from the available resources. log8 a 3 2 b Ax 2 1 np x 29 (x 1 2)3 x6 3 61. Instead we can compute the coefficients of a binomial expansion using the following formula. Suppose that a cell tower is located at a point A(4, 6) on a map and its range is 1.5 mi. (23, 0) f. (2`, 4) c. 2x 1 1 $1 x14 19. 24 81. 2 b. x 5 2 y or y 5 2 x for 245 # x # 45 4 135 135 b. In Example 2, we demonstrate that the fundamental principle of counting can be applied for a sequence of many events. a 17 b 15 13. Give the exact distance and an approximation to 2 decimal places. Same equation: Test for symmetry with respect to the x-axis. x y 69. 26 c. < 83. c 1 23 4 3 4 5 23 d 1 c 2 21 22 0 0 3 23 21 23 d 21 2 d 1 1 3 5 d ; This matrix 21 24 22 represents the reflection of the triangle across the x-axis. 230x $ 20y 1 600 2x 1 5y . 5 25 5 25 5 25 SECTION 2.7 255 Analyzing Graphs of Functions and Piecewise-Defined Functions 5 25 Practice Exercises Prerequisite Review R.1. Given the function defined by f (x) 5 7x 2 2, find f (–a). Every point in the plane can be uniquely identified by using an ordered pair (x, y) to specify its coordinates with respect to the origin. a 18a b 3 n53 n54 (Hint: Evaluate the infinite sum from n 5 1 to infinity. He receives a 4% raise each year thereafter. 103. {(5, 0)} b. C(x) 5 34.5x 1 2275 b. • The graph of y 5 f (x 1 h) is the graph of y 5 f (x) shifted h units to the left. 236 b. These consist of: • • • • Tip boxes that offer additional insight to a concept or procedure. In the formula, A, C, and h are called variables and these represent values that are subject to change. a i 5 21. (See Example 4) 51. Graph does not cross y 5 0. (0, 9); m 5 1 2 66. Shift 5 units to the left. There are 13 spades in the deck out of 52 cards. e 25. 1 5 720 7! 5 7 ? (3x 1 1)5 16. 221.7370 < 0.3 25.4800 7 85. 12 ft a. Therefore, we can replace (k 1 1) by 2 and maintain the . 16 R.1. L 5 2 210 b. (2`, 2] 77. g(f(3)) Week Number, x a. 5k 1 1 5 5(2a 2 1) 1 1 5 10a – 4 5 2(5a 2 2). (See Example 11) y y y 98. (21, 23); m 5 0 74. h(22) b. Odd 23. (x 1 3)(x 2 1)(x2 1 4) b. 6110, 63i 29. (x 2 1) 5 16(y 2 2) (y 1 3)2 (y 2 3)2 (x 2 4)2 (x 2 4)2 1 51 24. In each case, determine if the relation defines y as a function of x. Domain: (0, `); Range: (2`, `) c. (21, 23) and (3, 27) 13. 772 Chapter 8 Sequences, Series, Induction, and Probability 40. n4 49k2 12d8 c 3 1 p14 21. 1T + C21x2 5 16.88x 1 4.99 represents the total cost to buy x tubes of paint. The value 2 is a factor of 2(5a 2 2), and therefore a factor of 5k11 1 1 as desired. x Section 2.4 203 Linear Equations in Two Variables and Linear Functions Skill Practice 5 Write an equation of the line that passes through the point (21, 24) and has slope 3. 4 4 5 1 There are 4 kings in the deck out of 52 cards. f (x) 5 x 1 1 for 21 # x , 2 y a. Compose and Decompose Functions P(x) 5 R(x) 2 C(x) As this example illustrates, the difference of two functions makes up a new function. {(3, 24), (22, 0), (5, 3), (1, 0)} Domain: {3, 22, 5, 1} Range: {24, 0, 3} Yes b. Find the sum of the first 40 terms of the sequence. a12 5 52, a51 5 208; Find a172. A graph of an equation is symmetric with respect to -axis if replacing x by 2x results the in an equivalent equation. (x 2 4)2 1 (y 1 1)2 5 25; Center : (4, 21); Radius: 5 1 x (x2 1 10x 1 25) 1 (y2 2 6y 1 9) 5 225 1 25 1 9 (x 1 5)2 1 (y 2 3)2 5 9 Group the x terms. 20.25x b. Passes through (3.6, 1.2) and is perpendicular to the line defined by 4x 5 9 2 y. Infinite geometric series 5 4 3 4 ft 2 1 2 ft 1 ft 1 2 ft Time Determine the total vertical distance traveled by the ball. 1 25 24 23 22 21 21 22 1 2 3 4 5 g. 10 b. Determine Empirical Probabilities Suppose that the Centers for Disease Control wants to measure the 1-yr survival rates for Americans for specific ages. 1 5 12 77. Passes through (5, 4) and is perpendicular to the line defined by x 2 2y 5 7. Test whether h(2x) 5 2h(x). Write C as a function of r. 2019 35. Q11R 12 56. Upward 57. x (22 21 0 1 2 3 4 5 6 7 8 Skill Practice 3 Given m(x) 5 x 1 3, n(x) 5 x2 2 9, and p(x) 5 1x 1 1 a. Find (n + d)(t) and interpret the meaning in the context of this problem. (x 1 8i)(x 2 8i) a. Find the 500th term. • If 0 , a , 1, then the graph of y 5 af (x) is the graph of y 5 f (x) shrunk vertically by a factor of a. Domain: (2`, `); Range: (2`, 1] x R.1. {26, 3} 3 4 5 6 7 8 9 210 f(x) 5 2(x 2 4)2 1 1 218 9. Simplify without using a calculator. Graph c(x) 5 e 1x 2 1 for x $ 1 For Exercises 61–70, graph the function. Putting the time and effort into the basics here in Chapter R will be your foundation for success in later chapters. 24 ? Absolute value function: f(x) 5 0 x 0 f(x) 2 1 0 1 2 3 4 5 2 3 4 5 2 3 4 5 5 4 3 2 1 25 24 23 22 21 21 22 x 23 24 25 4 3 2 1 1 25 24 23 22 21 21 22 1 x 23 8. The plural of maximum and minimum are maxima and minima. £ 26 § 5 59. y 21221028 26 24 22 21 22 y 5 f ⎝ 3 x⎠ 2 4 6 8 10 12 5 4 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 49. Use the graph of y 5 f (x) to a. 47. g, and f and g are defined by (f 1 g)(x) 5 f (x) 1 g(x) (f 2 g)(x) 5 f (x) 2 g(x) (f ? a1 5 16 and a2 5 212. a2 5 215 and r 5 . False b. The cost C (in dollars) to rent an apartment is $850 per month, plus a $450 nonrefundable security deposit, plus a $250 deposit for each dog or cat. Student-Friendly Learning Experience ALEKS is designed to meet the needs of today’s students. f (24) b. f (x) 5 4x3 1 3 46. (Hint: There will be a total of five terms. a 10 10 3 33 y g. Suppose that the genes controlling the color of peas are Y for yellow and y for green. Section 8.6 747 Principles of Counting 5. Write a formula for the nth term of a sequence that represents the resale value of the tractor n years after purchase. P(d) 5 2 12d h. f (x) 5 x 3(x 2 4)2 46. , b. Find the average rate of change in the number of new flu cases between months 4 and 6, and between months 10 and 12. Suppose that both parent pea plants are hybrids with genotype Yy. Parent 2 a. 2112 b. 5 (Fk11 1 Fk12) 2 1 Replace Fk11 1 Fk12 by Fk13. To find d, substitute a1 5 24, n 5 22, and a22 5 164 into the formula for the nth term. x-intercept: (4, 0); y-intercept: (0, 22) 85. f (22) e. 5 10a 1 12 5 2(5a 1 6) Therefore, 2 is a factor of 5k11 2 3 as desired. (g + f)(x) 5 ; Domain: (2`, 0) ´ (0, 3) ´ (3, `) 2x2 1 3x 1x 1 2 ; Domain: 3 22, 0) ´ (0, `) 4. 2 1 2 1 5 25 125 625 Several important properties of summation are given in Table 8-2. x 1 7 91. 3 1 p 1 n(n 1 1) 5 n(n 1 1)(n 1 2) . In how many ways can the letters in the word MAMMOGRAM be arranged? The card is a 2 or a 10. Apply the Point-Slope The slope formula can be used to develop the point-slope form of an equation of a line. 2x(2x 2 5y)2 85. 2.32 b. f (x) 5 x2 and g(x) 5 3 c. 19 b. A security company requires its employees to have a 7-character computer password that must consist of 5 letters and 2 digits. The billboard is 12 ft by 24 ft. Y1 . (See Examples 6–7) 61. The endpoints of a diameter are (22, 4) and (6, 22). 24ab d. {22, 10} 131. Week number Weight (lb) 1 2 3 4 5 0.6 0.88 1.16 1.44 1.72 a. Therefore, at x 5 2, the function has a relative maximum of 1. 23 b. 106. h(x) 5 μ 0 for 21 # x 21 for 0 # x a. State the definition of a circle. Then, • A function defined by f (x) 5 mx 1 b is a linear function. 37,200,000 mi Ellipse; B 69. 24x 2 2h 1 7 d. P(t) 5 10,000e0.1386t b. 9 36 2 2 y z 1 5 1; This represents the graph of an ellipse in the yz-plane. a2`, 2 b ´ a2 , `b 22. Suppose that the Barry home has 3200 ft2 of living area with tile floor. (g + f)(x) Solution: a. particular order. (r ? k(1) e. f (x) 5 1 (x 1 1)2 13 b. 0, d ? (0, 0) f. f (5) 5 (5)2 1 2(5) 5 35. 12 b. on [21, 0] b. Using this method, we can expand several powers of (a 1 b). h h Solution: a. 5 1 3 ? 5 25 x Relative minimum g(4) 522 24 25 26 For the graph shown, 3 25 5 25 x Section 2.7 The calculator asks for a guess. 2 nonreal solutions 7. [210, 10, 1] by [210, 10, 1] c. Constant x x2 x1 b. E2 6 5i, 617F 4 b. 7 10 21. a 6a b 3 n21 n51 ` 4 i21 20. 5 A1x 2 2B 2 ? 5! 8! 5 5 56 a. 234 Chapter 2 Functions and Relations b. If one cookie is selected at random, find the probability of the following events. C(x) 5 mx 1 b C(x) 5 12.99x 1 99 b. (3, 26), (21, 26) d. 5 4 3 71. f (2) 5 (2)2 1 2(2) 5 8 b. 2x 2 4y 5 8 52. t 5 or n ln A1 1 nr B n ln 1l 2 nr 2 a. If the x term is linear, then the parabola opens horizontally. Assume that Pk is true; that is, assume that 2 is a factor of 5k 2 3. Apply the Fundamental Many states have lotteries as a means to raise income. The expansion of (a 1 b)n is given by pp. Determine Whether a Relation Is a Function 1. h(x) 5 12 x15 a. Assume that A 32 B k . 3 4 SECTION 2.7 86. The feasible region for a linear programming application is found by first identifying the constraints on the relevant variables. Conditional equation; {28} 3 x ? Evaluate 15P6 12P2 and interpret its meaning. 9 19 c. Write C as a function of A. Suppose that 50 people buy raffle tickets. 3(22x 1 4x 1 3) b. y 5 1x 1 11 2 x17 27. y 30,000 15,000 x 15,000 30,000 45,000 60,000 Amount in Stocks 69. 41.6 ft 51. Determine the slope and y-intercept. What does A2(x) 5 πx2 represent? Write a piecewisedefined function to model the water level L(x) (in inches) as a function of the number of days x since the beginning of the drought. 5 R.1. g(x) 5 ; g(15) R.2. f (x) 5 5; f (4) x R.3. h(x) 5 x2 1 3x; h(3) For Exercises R.4–R.5, simplify the rational expression. 4.5433 b. f(x) has no variation in sign, nor does f (2x). 0.02x 1 0.05y 5 0.1 18. y 5 2 45. y 5 f 1 12x2 81. For example, the ordered pairs (3, 1) and (3, 24) do not make up a function. 25a b e. 2! (30C6) ? If the third angle is x degrees, write a relationship that represents the measure of one of the equal angles A(x) as a function of x. { } 4. 661–666 R.1. 7 R.2. y 5 28x 2 56 10 8 x2 9 9 5. 81. 260 Chapter 2 Functions and Relations Mixed Exercises For Exercises 105–110, produce a rule for the function whose graph is shown. Graph C 9. Determine the minimum or maximum value of f. TIP Dividing the x values by 21 is the same as multiplying the x values by 2. The number of observed outcomes where an individual lives to the age of 21 is 4,291,113. Use the inverse matrix from Exercise 47 to solve the system of equations. y 5 0 x 0 2 9 SECTION 2.2 Circles OBJECTIVES 1. 5 (k 1 1)2 (k 1 1)(k 1 2) Factor the numerator. 36 36 6 36 4 165 4C3 11C3 91. Find a18. Refer to the data given in Exercise 66. The values 481 and 521 are called constants because their values do not change in the formula. Explain how the graph of f (x) 5 21x 2 1 1 3 is related to the graph of y 5 1x. 80x 1 400y 1 480z 5 9280 50x 1 350y 1 400z 5 7800 75x 1 525y 1 600z 5 10,500 b. Section 2.6 SECTION 2.6 239 Transformations of Graphs Practice Exercises Prerequisite Review For Exercises R.1–R.3, graph each equation. 70 True 23. 3 The distance between grid A(22, 3) 2 lines is 1 mi. Determine the total 100. 21000 d. y2 (x 1 4)2 1 51 9 4 1 2 3 4 5 x 23 24 25 SECTION 2.2 For Exercises 9–10, determine the center and radius of the circle. Determine the number of private lessons that must be held for the studio to make a profit. The speed of the plane in still air is 420 mph and the speed of the wind is 60 mph. h(a) 5 5 8 1 Za 2 2Z 1 116 2 t 1 3 1 t25 1 5 1 x23 2 195 196 Chapter 2 Functions and Relations 107. 0 x 0 1 0 y 0 5 4 13. h(x) 5 1 2x 1 1 95. EXAMPLE 9 Applying Multiple Principles of Counting Suppose that a committee of 3 women and 2 men must be formed from a group of 8 women and 7 men. Which blood type is most common ? A function may also be stretched or shrunk horizontally. Let a1 represent the original cost for year 1; that is, a1 5 24,000. 4x 1 4h 2 2 b. for 0 # x # 20,000 for x . The graphs have the shape of y 5 0 x 0 with a vertical shift. (2`, `) i. 10, 02 and a , 0b 2 7 49 y e. n(E1) 2 1 5 5 . y 112. {9} 9. The value of the common difference is negative (d 5 20.8), indicating that the progression of points slopes downward. (See Example 4) 35. 2 g 59. 1, $12,166.53 b. Write a formula for the nth term of the sequence representing the sum of the numbers in row n. Show that x(k11) . 6 5 4 Y1 5 2x2 2 3x 1 1 3 2 1 21 22 1 2 3 4 5 6 7 8 9 10 x 23 24 7 4 b. 3.425 80. e , 1 f 39. 225 mg b. If a fire is located at point C, determine the distance to the fire from each observation platform. 0.12 e. (6 2 1)! 1! ? f(x) f(x) f(x) f is increasing f is decreasing f(x2) f(x1) f(x1) f(x2) x x2 x1 f is constant f(x1) 5 f(x2) x2 x1 I x I For all x1 , x2 on I, f(x1) , f(x2) For all x1 , x2 on I, f(x1) . y 47. x(k11)21 or equivalently, xk11 . CHAPTER 2 Section 2.1 Practice Exercises, pp. What is the probability that a jury of 9 people taken at random from the pool will consist only of women? 16 1 16 b. As x S 2`, f(x) S `, and as x S `, f(x) S `. a(x) 5 1x 1 1 2 3 24. f (x) 5 x2 2 3 a. 2 3 4 5 a. Every year thereafter, expenses increase by $1000 plus 3% of the cost of the prior year. Between 5 and 6; 5.7482 f. Parent function: y 5 x2 1. For example, the graph of f (x) 5 x4 1 1 has no x-intercepts. P1 is true because 2 is a factor of (7)1 2 5 5 2. If m is one-third of n, and p is two less than m, write p as a function of n. If the equations in a system of linear equations represent the same line, then the solution set is the set of points on the line. (29, 3] Compound inequality b. nonlinear y 3. (x 1 6) 5 24(y 1 1) 67. Foci: A0, 5 13 B, A0, 25 13 B g. 4. 22 23 24 25 1 2 1 2 26 28 26 28 3 2 3 6 4 x 21028 26 24 22 22 24 21028 26 24 22 21 5 4 5 4 5x23 2x27 10 8 2 1 12 2 3 4 5 6 8 10 5 4 3 p(x) 6 4 y 79. If so, identify the common difference d. The lowest barometric pressure ever recorded for an Atlantic hurricane was 882 mb for Hurricane Wilma in 2005. {(4, 2)} 6 5 39. Answers 2 Let Pn denote the statement 1 1? $674 9. y5 3 24 x11 To graph the line, first plot the y-intercept (0, 1). day 20? y 5 29,200(0.8) t c. Determine f (3). p(x) 5 02x 0 32. (x 2 h)2 1 (y 2 k)2 5 r2 (y 2 k)2 (y 2 k)2 (x 2 h)2 (x 2 h)2 3. r 2! ? k 5 972 25. 25e2x 27 9. f (x) 5 3x2 1 12x 1 5 5 3(x2 1 4x)15 5 3(x2 1 4x 1 4 2 4) 1 5 Complete the square within parentheses. g(x) 5 • 1 for 22 # x , 0 x2 1 1 for x $ 0 For Exercises 13–17, solve the equation or inequality. 5 1 p 1 (2n 2 1 1 ? (0, 0) c. 1 22 21 21 22 3. q)(x) q 23. For Exercises 33–36, consider the sample space when two fair dice are rolled. Find the difference between a50 and a32. 2 i 83. Skill Practice 3 Write the nth term of the geometric sequence. 2 73. e f 11. 12x2 1 12xh 1 4h2 2 3 b. Given an equation in the variables x and y, find the y-intercept by substituting for x and solving for Objective 1: Plot Points on a Rectangular Coordinate System For Exercises 9–10, plot the points on a rectangular coordinate system. g(3) 5 3 2 4 5 21 Evaluate g(0) first. In how many ways can the questions on the test be answered? Equation; { }; The value 2 does not check. 66 7 [4, 10] 12. Title. Determine the number of lawn maintenance calls needed per month for the company to make money. m 5 b. A quiz has 6 multiple-choice questions and each question has 5 possible responses of which exactly one is correct. y 5 23.27x 1 98.1 b. P(B). This is because the “prizes” are indistinguishable; that is, the outcomes AB and BA are the same because student A and student B would each receive $500. 240 b. To show that 4 is a factor of any expression, we need to write the expression as the product of 4 and some positive integer that we call a. In a recent year, census results indicated that 199,500,000 Chinese were over the age of 60. Graph K 13. 768 Chapter 8 Sequences, Series, Induction, and Probability 23. 5050 c. None of these 13. 6 5 4 3 2 1 1 25 24 23 22 21 21 22 Section 5.5 Practice Exercises, pp. 8t12 2 36t8 v 1 54t4 v2 2 27v3 From the observed pattern, the kth term has a factor of b raised to the k 2 1 power. There are many other cases to consider regarding the number of defective and good lightbulbs: for example, 2 good, 1 defective, etc. {2.0960} Section 4.6 Practice Exercises, pp. P < 2π 16 units y2 y2 x2 c2 c2 93. Round the slope and y-intercept to 1 decimal place. Graph the equation using the slope and y-intercept. x 5 3 27. Absolute value inequality 3. Learn More: Successinmath.com xi Connect Math Hosted by ALEKS Built By Today’s Educators, For Today’s Students Fewer clicks means more time for you... Solution: In this example, we need to find two unknown quantities. t(0.04) 5 17.3; t(0.06) 5 11.6; t(0.08) 5 8.7 a. • All terminating and repeating decimals are rational numbers. 2k5n2 2 10m2n 14. There are no values for x, y, and z that can simultaneously meet the conditions of this problem. 1 2 x 10 8 6 h(x) 5 24 26 28 210 2 4 2x 2 4 x 13 6 8 8 25 24 23 22 21 21 22 x 21 7 x 1 1 0 x13 2 3 f(x) 5 1 2 3 4 5 x 23 24 25 26 y 89. Donna’s bachelor of science in mathematics and master of science in mathematics are both from the University of Miami. 12 10 8 6 4 2 9. By how much do the results of part (c) differ from the result of Exercise 62(d)? Therefore, the upper and lower semicircles may not “hook up.” Section 2.2 SECTION 2.2 181 Circles Practice Exercises Prerequisite Review For Exercises R.1–R.2, find the value of n so that the expression is a perfect square trinomial. Therefore, A 32 B k11 . Thus, the probability of all boys is 81 . a (26i 2 4) i51 n51 n51 125 … 1 6 26. g, and g are all real numbers f in the intersection of the domains of the individual functions f and g. Show that A 32 B k11 . Technology Connections For Exercises 71–74, use a graphing calculator to graph the circles on an appropriate square viewing window. x fi , x fi 0, x fi 23 49. 1 1 5 1 1 5 2?3 3?4 2 6 12 4 1 1 1 1 1 1 1 4 Call this statement P4. x 1 14x 1 64x 1 96 57. 311–315 R.3. 2 R.4. 1 2 3 4 5 x R.5. b. The height of the stone can be modeled by h(t) 5 24.9t2 1 10t 1 100, where h(t) is the height in meters and t is the time in seconds after the stone is released. (x 1 3i)(x 2 3i) a. 2x 1 4 , 2x 1 1 c. Then the series . 172 Chapter 2 Functions and Relations TECHNOLOGY CONNECTIONS Using the Table Feature and Graphing an Equation In Figure 2-9, we first enter the equation into the graphing editor. 2117 , 4.3, 0, 23, 213, 4.9 [Q e. r! n2r By the commutative property of multiplication, n! n! 5 . [24, `) h. f 21(x) 5 x2 2 5; x $ 0 Domain: [0, `); Range: [25, `) y y 9. y 5 0 x 2 2 0 Objective 4: Identify x- and y-Intercepts For Exercises 45–50, estimate the x- and y-intercepts from the graph. f(x) 5 2 (x 2 3)2 1 8 2 1 76. 13 b. All x on the interval [23, 21] e. 3yw4 2 3y2z2 10 1 x 2 a. (0, 25) and (4, 3) b. For n 5 1, the sum equals Answer 1. E 17, 217F {4i, 24i} 25. ln(x 1 h) 2 ln x 1 1 x1h 101. and a d. 22 1 12i or 22 1 i 12 2 1 13i or 2 1 i 13 2 2 a. e 19 13. 1 37. Skill Practice 4 Write the equation in the form (x 2 h)2 1 (y 2 k)2 5 r2, and identify the solution set. Given the equation of the circle x2 1 y2 1 12x 2 4y 1 31 5 0, a. < 0.36264 455 455 15C3 15C3 c. 1 k 2. logistic 5. Hours of Study, x Test Score, y 8 92 3 58 11 98 5 72 8 86 Solution: Table 2-1 a. x2 1 ay 2 b 5 0; Degenerate case (single point): e a0, b f 2 2 3 2 25 1 3 5 1 2 53. • Core Exercises are presented next and are grouped by objective. Note: A linear equation Ax 1 By 5 C has variables x and y each of first degree. See Quadratic equations Semimajor axis, of ellipse, 636 Semiminor axis, of ellipse, 636 Sequences alternating, 691, 764 in applications, 702–703, 718–720 arithmetic, 701–705, 765 common difference of, 701, 702 explanation of, 690, 692, 764 Fibonacci, 692–693 finite, 690 geometric, 712–715, 765 on graphing utility, 691 graphs of, 692 infinite, 690, 694, 764 nth partial sum of, 694 nth term of, 690–692, 694, 702 Series in applications, 707–708, 718 arithmetic, 707–708 finite, 690, 694, 695 infinite, 694, 695 in summation notation, 695–697 Set-builder notation, 2, 4–5, 145 Sets of complex numbers, 105, 333 empty, 2, 85 explanation of, 2, 73 identifying elements of, 3 in interval notation, 4–5 of real numbers, 2–3 union and intersection of, 5–6, 73 Shrink. dn 5 64A214 B n 11. f 119. He made eight free-throws, six 2-point shots, and two 3-point shots. x(k11) 5 xk ? f (x) 5 2 x 4 3 b. 2.) In interval notation the solution set is (2, `). Assume that 1 1 k 1 1 1p1 5 . Write the first five terms of the arithmetic sequence with a1 5 10 and a20 5 67. At x 5 0, the function has a relative minimum of 22. 6 (k 1 1)[(k 1 1) 1 1][2(k 1 1) 1 1] 5 6 2k3 1 9k2 1 13k 1 6 . (n 2 m)(x) 5 x2; Domain: (2`, `) x2 2 4x n ; Domain: (2, `) 113. 2h(x), the function is not an odd function. 3 5 1 42. [23, `) 16. f (x) 5 ax2 1 bx 1 c (a fi 0) b b2 b2 5 a ax2 1 x 1 2 2 2 b 1 c a 4a 4a Factor out a from the x terms, and complete the square within parentheses. 249 Suppose that I is an interval contained within the domain of a function f. How many 5-letter palindromes are possible from a 26-letter alphabet? f (x) 23. gA 13 B 42. 1 2 3 4 5 B(1, 23) The position of an object in a video game is represented by an ordered pair. y 5 3.3x 1 8.5 b. Write an equation of the circle in standard form. t30 1 6t25u3 1 15t20u6 1 20t15u9 1 15t10u12 1 6t5u15 1 u18 65. Find the Vertex of a Parabola by Using the Vertex Formula Completing the square and writing a quadratic function in the form f (x) 5 a(x 2 h)2 1 k is one method to find the vertex of a parabola. Odd 95. Use the data in the table to find the least-squares regression line. The value x is equidistant between c and d, 2 so the sequence c, x, d is an arithmetic sequence. The graph of the profit function P is consistent with this result. x 25 24 23 22 21 21 22 1 2 3 4 5 x 24 25 23. x 5 2, y 5 8 b. (See Example 3) Determine the probabilities for the following events. The line may be slanted, horizontal, or vertical depending on the coefficients A, B, and C. That is, p(a) 5 p(b) 5 3, but a fi b. In many cases, we can also graph families of functions by relating them to one of several basic graphs. Horizontal y 17. (See Example 9) 70. This provides us with a tool for visually examining two different models at the same time. 3 dead batteries can be selected. The composition of two functions creates a new function in which the output from one function becomes the input to the other. Section 3.1 291 Quadratic Functions and Applications 4. y 5 f (x) 34. 5 yr 67. order; rows; columns 3. No 1 2 x SA-33 Student Answer Appendix 41. f (x) 5 x3 1 14. 0.0906 d. Odd 37. This is a point slightly to the right of the relative maximum. 10 (14, 13.0) (4, 11.2) a. The minimum value is 21. 2 1 3i 2 1 2 13i or 2 1 2i 13 7 14 9 9 39. (f + g)(18) 52. That is, a logistic growth model has an upper bound restricting the amount of growth. Positive: 3 or 1; Negative: 2 or 0 12. (n 1 1)! Solution: bn 5 n2 Substitute (n 1 1)! 6 for n. e 6 , 2 f 11. 5 Chapter 2 Test, pp. 5 4 3 2 5 4 3 2 1 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 y 5 f(x) 23 259 Analyzing Graphs of Functions and Piecewise-Defined Functions 1 2 3 4 5 x 23 24 25 24 25 Objective 5: Determine Relative Minima and Maxima of a Function For Exercises 97–102, identify the location and value of any relative maxima or minima of the function. f (x) 5 2x 2 4 77. w21(x) 5 ; The inverse gives the 21.17 21 barometric pressure w (x) for a given wind speed x. a i 5 a (j 1 1) 5 a (k 2 1) 2i i51 i51 17. ax 2 b 1 ay 1 b 5 2 4 49 1 2 3 2 25 16. At x 5 2, the function has a relative maximum of 2. Vertex: (0, 0); p 5 214 ; Focus: A214, 0B; Focal diameter: 1 b. See also Polynomials Multiple regression, 516. If your taxable income is In Chapter 2, we will look at over— but not over— The tax is of the amount over— mathematical relationships involving $0 $8925 $0 $0 1 10% two or more variables, including $8925 $36,250 $8925 $892.50 1 15% the relationship between taxable $36,250 $87,850 $36,250 income and federal income tax. a ? x 5 xk as desired. x 5 24 g. 134 133. The vertex is given by 2b 2b bb. a r b(x) p 25. Parent function: f (x) 5 1x. In how many ways can the word SPACE be misspelled? 2 2 y 5 4 3 2 y 5 f(x) 1 24 25 y 1 1 25 24 23 22 21 21 22 23 83. ; (4, `) 4 41. a b 1 5 c. a 4 69. Determine the pitch of the roof from point A to point C. For Exercises 94–99, use the data in the table categorizing smokers and nonsmokers according to their blood pressure (BP) levels. (2100, 216) and (84, 30) 3 5 33. e 2 6 f 49. e , 21 f 27. Evaluate (D + C)(12) and interpret the meaning in the context of this problem. {3 6 i} e 2 1 3 7 7 6 i 111 f 63. an 5 2n 2 1; find a10 18. 156.9925 a. 38 5 59,280 83. What is the probability that a player will win the grand prize by playing 1 ticket? shift right shift up 1 n(x) 5 2 (x 2 2)2 1 3 2 reflect over x-axis y 5 x2 vertical shrink y y (0, 4) 5 4 3 (4, 4) 2 1 24 23 22 21 21 22 y 5 (x 2 2)2 1 2 23 3 4 5 x 6 Vertical shrink: y-coordinates half of original value y5 Avoiding Mistakes As a means to check the graph of y 5 n(x), substitute the x-coordinates of the strategic points (0, 1), (2, 3), and (4, 1) into the function. 5 225 2 x2 1 5 Skill Practice 1 Given m(x) 5 2 0 x 0 and n(x) 5 4, find (m 1 n)(x). 2 3 2 b. 9 ? {216, 38} 77. 724 Chapter 8 Sequences, Series, Induction, and Probability 101. What is the probability that all three will be good? 1 49 y2 x2 51. matrix 3. A cell phone plan charges $49.95 per month plus $14.02 in taxes, plus $0.40 per minute for calls beyond the 600-min monthly limit. Stretch vertically by a factor of 2. EXAMPLE 8 Evaluating an Infinite Geometric Series Find the sum if possible. a b(25) h 282 Chapter 2 Functions and Relations Test CHAPTER 2 1. a (21)k a b k a. 957 mb x 83. The car will stop within 250 ft if the car is traveling less than 50 mph. The steps are the same with the following exception. Yes a. (a 1 b) 8y3y20 d. [24, 2)) 24 6 39. The population will reach 300,000 approximately 35 hr after the culture is started. Write the standard form of an equation of the circle with center (24, 6) and radius 2. Write a linear profit function representing the profit for producing and selling x dozen cookies in a month. j(x) 5 x16 x2 1 2 c. 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 y 23. Section 2.3 Practice Exercises, pp. [23, 4] {26} b. 14 15 1n 1 2 13 1 1 1p1 a. 2x3 2 4x2 2 62x 2 56 The remainder is 39. • The point (1, 1) on the graph of f corresponds to (1 1 3, 1 2 2) 5 (4, 21) on the graph of p. {3, 7} 17. (See Example 5) 46. $600,000; $1,800,000; $5,400,000 772.4 99. f (x) 5 x3 2 x 19. Use this scenario for Exercises 65–66. 706 Chapter 8 Sequences, Series, Induction, and Probability By adding the terms in ascending and descending order, we double the sum but create a pattern that is easily added. a (3i 2 7) i51 15 50 56. In this case, we say that entire sample space, and P(E2) 1 P(E3) 5 19 19 events E2 and E3 are complementary events. 10,400 ft 33. {25}; The value 25 does not check. Passes through (2.3, 5.1) and (1.9, 3.7). In how many ways can 4 people who bought tickets be selected if the first person wins a $10 gift certificate, the second person wins a $25 gift certificate, the third person wins a $50 gift certificate, and the fourth person wins a $200 camera? 5 4 3 2 5 4 3 2 y 5 log3 x 1 21 21 22 1 1 2 3 4 5 6 7 8 9 x 21 21 22 23 23 24 25 24 25 1 2 3 4 5 6 7 8 y 5 log1/3 x 9 x Student Answer Appendix 69. [218, `) 12. P1 is true because 8 5 22(1)(1 2 5). What is the slope of a line perpendicular to a line with equation y 5 1? 4a 2(x 2 c) 1 y 5 4a 2 4xc 2 2 3 2 1 F 25 24 23 22 21 21 F x 5 22 23 24 25 23. 449: © Julie Miller; p. • If P(E) 5 1, then the event E is called a certain event. [1, 2] b. 0 y 0 5 x 1 1 Testing for Symmetry Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. 12 yr Contradiction; { } 41. i51 i51 n 19. If there are 128 men in the tournament, estimate the probability that a. Therefore, the empirical probability is given by P(E) 5 4,291,113 < 0.9991 4,295,000 Skill Practice 5 Suppose that of approximately 4,224,100 individuals of Answers 4. A Democrat? Write the first six terms of the sequence defined by a1 5 22, a2 5 3, an 5 an22 1 an21 for n $ 3. 575,757 b. (x 2 3)2 1 (y 1 1)2 5 41 a. 2w 3w 1 7 x y 2 3 5 4 5. 731–732 R.1. x2(x2 1 1) R.4. 1. n(E2) 3 Therefore, P(E2) 5 5 . Passes through (4, 26) and m 5 3. Likewise, the values of h(x) are 4 less than the values of f(x) and the graph is shifted downward 4 units. Suppose that 9 horses run a race. a3 1 3a2b 1 3ab2 1 b3 37. 3, 12, 60, 360, … 14. Vertical b. The range is (2`, 5]. We can arrive at the same conclusion by applying the fundamental principle of counting. As written, g(x) 5 0 2x 0 is in the form g(x) 5 f (ax) with a . (2`, 3.2] 3.2 b. , 23, 12, 212 3 3 y h. a1 5 1, d 5 22 13. a b 2 5 d. Therefore, test whether g is an odd function. [(3P3) ? 1 85. II. Reflection y 5 2f (x) y 5 f (2x) Reflection across the x-axis Reflection across the y-axis Replace (x, y) by (x, 2y). 4, 2, 0, 22, 24 b. f (x) 5 24x3 1 x 91. Answers 2 23 Solution: a. The person is 60 or under. If the employee invests $200 instead of $100 at 6%, find the value of the annuity after 20 yr. Write a linear revenue function representing the monthly revenue R(x) for x maintenance calls. Minimum degree 3 b. g(22) b. 2(x 2 4)(x 1 4)(x 1 16) 14. 36 2 57i 61. Graph Equations Using a 1. There are no real numbers x and y that would make the sum of two squares equal to 21. Therefore, P(A ¨ S) 5 521 . Passes through (0, 5) and m 5 2 . Complete the square: C 12(214)D 2 5 49. x1 1 x2 5 b. R.2. C 5 110 1 70x R.3. e 2 1 12 2 5x x, b ` x is any real number f or 3 3 5(3y, y, 4 2 5y) 0 y is any real number6 or 35. x 3 4 5 x y 5 4 3 2 23 21 24 f (x) 5 2!x 1 3 1. Section 8.7 Introduction to Probability 751 Theoretical Probability of Event E Let S represent a sample space with equally likely outcomes, and let E be a subset of S. The minimum value is 22. Determine the distance remaining after 122 mi. 116. {2} linear a. [23, 9] 20. 1, then the graph of y 5 f (ax) is the graph of y 5 f (x) shrunk horizontally by a factor of 1a . 66; If 12 people are present at the meeting, then there will be 66 handshakes. 1 23 220 225 230 63. 66. Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions Skill Practice 6 f (x2 5 e 249 Graph the function. y 5 2 x 1 5 5 212 214 c. The maximum value of f is 21. Not a real number 1 1 c. The endpoints of a diameter of a circle are (22, 3) and (8, 25). Home > College > Mathematics > Mathematics > College Algebra Customer Reviews, including Product Star Ratings help customers to learn more about the product and decide whether it is the right product for them. Equivalently, 5k 5 2a 2 1. For example: 5. The lengths of the sides of the lower triangle are 6 ft, 8 ft, and 10 ft. Solution: We must find the number of ways that 3 horses can be selected from 8 horses in a prescribed order (first, second, third). A function f is a linear function if f (x) 5 y-intercept. If José anticipates working for the company for 6 yr, find the total amount he would earn from each job. 514–517 264 f 5 plane 3. Equation; {27, 25} b. 1 25 24 23 22 21 21 22 y 5 f 21(x) 24 25 x 24 25 3 2 23 23 ⎝ ⎠ 1 b. ac 5 b 10,000 log5 125 5 3 19. Find the sum of the first 100 positive integers. Between 6 and 7; 6.0960 c. 36 2 12 1 4 2 n53 4 1 p 3 47. x F 67. Write the nth term of a sequence defining the number of minutes that Sandy spends

on the treadmill per day for her nth week at the gym. 1002 m b. quadrilateral (4 sides) 70. Find all points on the line y 5 2x that are 4 units from (24, 6). a10 5 3 6 2 27. What is the slope of a line perpendicular to the x-axis? (3n 1 1)(3n) 3. For a recent year, 31.9% of Americans living below the poverty level were not covered by health insurance. Determine the speed of the car 6 sec, 12 sec, 45 sec, and 80 sec after the car begins motion. For example, any polynomial of the form f (x) 5 a(x 2 2)(x 2 3)(x 2 4) has the required zeros. The first is for $1000 and the second is for $500. 189 • Values of x that make the denominator zero. Center: (1, 26) b. 15 y 5 2x2 1 12 Answer 220 173 20 y 5 |x| 2 15 7. (2`, 13) ´ (13, `) e. However, finding taxable income is not always trivial. 2 1 23 22 21 21 22 23 24 25 26 27 28 Vertex: (2,21) 1 2 3 4 5 6 7 x f(x) 5 2x2 1 4x 2 5 x52 Figure 3-4 Skill Practice 3 Repeat Example 3 with f (x) 5 2x2 2 4x 2 7. Use the graph to find the solution set to the inequality 3x 2 (x 1 4) 2 1 # 0. 23, 2 , , 3; each of multiplicity 1 2 2 37. (2x 2 3)5 B A F E 62. (x 2 3) 5 4(y 1 1) b. 2 c. x t(x) 8 3 4 6 0.05 5 2 5 30 10 1 3 4 230 240 250 25 24 23 22 21 25 210 2 x 24 26 77. e f ; t < 2.4925 e f 9 ln 6 log 128,100 2 3 ln 1020 f ; x < 2.3528 21. an 5 2n b. n! (n 1 2)! 1 1 8 ? Downward b. e 59. ¢t 13 2 13 3 2 51. 1 2 1 c. (7x 1 3)3 18. In the 2010 Wimbledon Championships, John Isner from the United States and Nicolas Mahut from France played a first-round tennis match that became the longest match in tennis history. AB 5 c d 18. Australia: 2026; Taiwan: 2078 21. False; log(10 ? For Exercises 15–16, (a) write the equation of the circle in standard form and (b) identify the center and radius. Write C as a function of d. 4 3 4 24 25 Skill Practice 5 Evaluate the function for the given values of x. f(x) 5 x2 2 3x 2 28 b. 6x 2 2(x 1 2) 2 5 5 0 6x 2 2x 2 4 2 5 5 0 4x 2 9 5 0 9 x5 4 To verify the solution graphically enter the left side of the equation as Y1 5 6x 2 2(x 1 2) 2 5. The formula Ln 5 a 2 2 the nth Lucas number. 2x 1 1 5 2x 1 4 46. [1, 5) h (5, `) 20. An ace, 2, or 3. The cards consist of four aces. 2x 2 y 5 6 x2 1 y 5 9 x b y5 1z 1 log2 16 34. (24, `) 121. y 5 7; m 5 0; y-intercept: (0, 7) y b. 5 4 3 2 1 1 1 2 3 4 5 x 23 24 25 24 25 53. (2`, 4] 8. {(2, 21, 0)} 4. 0, 19 c. Therefore, the graph of a quadratic function is a parabola with vertex at (h, k). 1 25 24 23 22 21 21 22 1 2 3 4 5 23 24 25 e. an 5 22a b 2 16 3 n21 n 29. determinant 4 3§ 24 21. f (0). {5}; The value 22 does not check. 2 2 c. Linear; {10} 11. (2`, 21) c. Compare the results to the fifth and sixth rows of Pascal's triangle. p(x) 5 |2x| 1 1 22 2 3 4 5 x 1 3 f(x) 3 4 5 x y 25 24 23 22 21 21 3 2 1 22 23 5 1 2 5 4 3 2 1 y 5 3f(x) 4 y5 23 37. TIP 2(4) 6 2(4)2 2 4(21)(25) 2(21) x52 6 i For more accuracy in the graph, plot one or two points near the vertex. g(x) 5 3x2 1 c. See also specific geometric shapes analytic, 178 applying operations on polynomials to, 42 applying quadratic functions to, 292–293 Golden ratio, 132 Golden rectangle, 132 Graphing utilities binomial coefficients on, 734 change-of-base formula on, 449 circles on, 180 combinations on, 746 complex numbers on, 110 determinants on, 616 exponential equations on, 462 exponential functions on, 422 graphing equations with, 171–173 hyperbola on, 657 inconsistent systems on, 575 least-squares regression line on, 220–221 logarithmic equations on, 457, 462 logarithms on, 431, 457, 462 matrices on, 571, 590, 593, 605, 606 parabolas on, 672 permutations on, 744 piecewise-defined functions on, 248 polynomials on, 310, 340 quadratic equations on, 292 reduced row-echelon form on, 577 relative minima and relative maxima on, 254–255 scientific notation on, 24 sequences on, 691 systems of inequalities on, 537, 543 systems of linear equations on, 496 systems of nonlinear equations on, 530, 531 verifying solutions to equation on, 206 Graphs applying reflections across the x- and y-axes of, 234–236 of circles, 177–180 concave up and concave down, 261 of constant functions, 202 of ellipse, 637–640 of equations, 169–173, 276 of exponential functions, 415–418, 422, 433–434 of functions, 190–191, 202–204, 229–230, 270, 276 of greatest integer functions, 249–250, 277 horizontal translations of, 230–232, 236 of hyperbola, 651, 653–657 of inverse functions, 402, 404, 405, 408, 409 of linear equations in two variables, 197–202 of linear functions, 202 of linear inequalities, 536–539 of logarithmic functions, 432–435 of nonlinear inequalities, 369, 539–540 of piecewise-defined functions, 247–251, 276–277 plotting points on, 169–170 of quadratic functions, 229, 286–291 of rational functions, 353–360, 373 of relations, 185 symmetric, 243–245, 276 of systems of inequalities, 537, 542 transformations of, 230–238, 276 use of matrix operations to transform, 595 vertical and horizontal shrinking and stretching of, 232–234, 236 vertical translations of, 230–232, 236, 276 Greatest common factor (GCF), 47–48, 54 Greatest integer functions, 249–250, 277 Grouping, factoring by, 49 Grouping symbols, 9 Growth functions, exponential, 416 H Half-life, 421, 471 Horizontal asymptotes determining where graph crosses, 351–352 explanation of, 349, 393 method to identify, 349–351 Horizontal lines, slope of, 200, 201 Horizontal line test, 403, 404, 482 Horizontal shift, 230, 276 Horizontal shrink/stretch, 233–234, 236 Horizontal translations, of graphs, 231–232, 236, 276 Hyperbola in applications, 660–661 eccentricity of, 658–659, 682 explanation of, 651–652, 682 on graphing utility, 657 graphs of, 651, 653–657 latus rectum of, 666 standard form of equation of, 652–653, 657–658, 682 I Identities, 85, 86, 158 Identity element of addition, 10 Identity element of multiplication, 10 Identity functions, 229 Identity matrix, 602–603 Identity property of addition, 10 of matrix addition, 588 of multiplication, 10 Imaginary numbers (i). (28, 1) and (0, 23) 77. 32(2k) 5 3k for k $ 7. Evaluate f for several values of x. EXAMPLE 10 Applying Function Composition At a popular website, the cost to download individual songs is $1.49 per song. The function given by y 5 f(x) shows the average monthly temperature (in 8F) for Cedar Key. Find (D + C)(x) and interpret the meaning in the context of this problem. What does a negative rate of change mean? 3069 51. What is the total arc length that the pendulum travels? (2`, 1] ´ (2, `) f (21) 5 0, f (1) 5 0, and f (2) 5 4 x53 f. For a recent season, the batting average for baseball player Jose Iglesias was 0.306. Even 7 7 9. The textbook is filled with robust applications and numerous opportunities for mathematical modeling for those instructors looking to incorporate these features into their course. 5n , 3n for positive integers n $ 3. Therefore, the function is an even function. Answers 10. 56. 3(3k) Since k $ 7, then (k 1 1) . y2 2 x 2 2 5 0 41. Center: (0, 0) e. S(x) 5 e 2000 1 0.05(x 2 40,000) for x $ 40,000 a. In how many ways can the letters in the word XRAY be arranged? The person is a nonsmoker or has normal blood pressure. Find (T + C)(x) and interpret the meaning in context. (q + m)(x) 73. Any point on the x-axis has a y-coordinate of zero. y (2x, y) (x, y) 25 24 23 22 21 21 22 1 2 3 4 x 5 23 24 25 Solution: a. [2, 4) ´ (4, `) 85. (x 2 3)2 1 (y 1 1)2 5 16 y b. Graph the equation by plotting points. Find a10. The domain. y 5 x 2 3 6. All three digits in the code must be the same. Skill Practice 4 Given 2x 1 4y 5 8, a. 5 5 1 5 4 2 93. {Tom Hanks, Jack Nicholson, Sean Penn, Dustin Hoffman} c. origin 7. 24795 29. 2690 e. TIP The slope-intercept form of a line can also be used to write an equation of a line if a point on the line and the slope are known. 2y 2 1 y; Leading coefficient 21; Degree 2 15. (See Examples 4–5) 31. $0.20 per mile d. EXAMPLE 7 Graphing a Piecewise-Defined Function f (x) 5 e Graph the function. 1 x2 d. Suppose that 4 senators currently serve on a committee. 22, 1 5. 24x 2 16 y , 214x 1 114 73. The equation x 5 h 1 2r 2 2 (y 2 k)2 represents the graph of the corresponding right-side semicircle, and the equation x 5 h 2 2r 2 2 (y 2 k)2 represents the graph of the left-side semicircle. Determine the slope of a line perpendicular to the given line. AB, BA, AC, CA, BC, CB b. [4, 6] (Hint: t 5 4 and h 5 2) e. 1x 1 h 1 3 2 1x 1 3 1 a. Evaluate (g ? Expanding Your Skills 108. Then for every value a and b in the domain of f such that a , b we have f (a) , f (b). 19.8 yr b. f (x) 5 e 24x 2 3 for x , 0 x2 for x $ 0 d. y $ 0 x 0 and y # 4 87. (2`, 27.6) ´ (21.5, 1.6) SA-23 Student Answer Appendix 123. [24, `) 113. y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 Answers 5. Apply the point-slope formula. 6 11. 5 4 3 2 1 25 24 23 22 21 21 22 24 25 26 27 28 45. (0, 4) c. 22.013 log2 a b4 ln 53 7 28. Undefined 2 3 b. $4991.25 1 25% To fully appreciate the connection $87,850 $183,250 $87,850 $17,891.25 1 28% among several variables, we will $183,250 $398,350 $183,250 $44,603.25 1 33% investigate their relationships $398,350 $400,000 $398,350 $115,586.25 1 35% algebraically, numerically, and $400,000 -------- $400,000 $116,163.75 1 39.6% graphically. 3 2 1 29 28 27 26 25 24 23 22 21 21 1 x Skill Practice 1 a. Write About It 39. (d + r)(30) 5 17,280 means that the bicycle will travel 17,280 ft (approximately 3.27 mi) in 3 30 min. Down to the left and up to the right; As x S 2`, f (x) S 2`, and as x S `, f (x) S `. (0.85) < 0.614 79. x 5 21 g. We use the same process to write a quadratic function f(x) 5 ax2 1 bx 1 c (a fi 0) in vertex form f (x) 5 a(x 2 h)2 1 k. 5% 69. x f (x) 5 Œ xœ 21.7 22 Greatest integer less than or equal to 21.7 is 22. E A 79 45 , 45 B F 29. Skill Practice 6 Suppose that one card is drawn at random from a standard deck. The fixed distance from any point on the circle to the center is called the radius. Suppose that n represents the number of distinct elements in a group from which r elements will be chosen in a of n items taken at a time. 10 5 210 25 10 210 5 7. £ 1 0 214 5 4 1 2 1 25. Round to 3 decimal places when necessary. (5c3 2 d2)4 D 81. From the table, we see a pattern and from the pattern, we form the graph. The graph of g(x) 5 20 x 0 has 14. 4! 5 24 4! ? (22, 7) and (24, 11) 12. 4 32 128 8 1 1 1 p is a geometric series with a1 5 2 and r 5 43 . m is undefined For Exercises 29–36, determine if the lines defined by the given equations are parallel, perpendicular, or neither. Reports are also available to both students and instructors that track progress and show each student's strengths and weaknesses. (4, `) 2 4. (x2 1 x)2 2 14(x2 1 x) 1 24 5 0 c. 3.1 2 2.2(t 1 1) , 6.3 1 1.4t 111. Find the average slope of the hill. 1.587 53. Write a relationship for a function whose f (x) values are 3 more than the principal square root of x. 1 2 7 2 7 R.5. R.6. 2 c or A 1 cB 343 1. 5, 7, 9, 11, 13 b. (5i) 1 25 5 0 ✓ b. Domain: (2`, `); Range: (2`, 23] x 25 24 23 22 21 1 2 3 4 5 21 2 22 g(x) 5 2x 1 2x 2 4 23 24 25 26 27 28 29 33 b. (24, 1) and (2, 22) EXAMPLE 3 Finding the Slope of Horizontal and Vertical Lines Find the slope of each line. C 1 23 22 21 21 22 13. a (j 1 6) j51 40 58. y 5 4 3 2 39. ALEKS is a registered trademark of ALEKS Corporation. d(s) 5 12s 2 12 d2 g. {x 0 x , 211}; (2`, 211); 5. After a nationally televised trial, a poll of viewers indicated that 68% thought the defendant was guilty, 22% thought the defendant was not guilty, and the rest were undecided. Write the range of the relation. (f + g)(3) 5 f (g(3)) 5 f (21) 53 f. 2 n n12 1 1 1 1 1 1 1 1 1 1 1 b. No 19. Sequences and Series Write each sum using summation notation. R; (2`, `) 63. This is the interval where the blue line is above the red line. Graph d 95. x2 1 y 5 1 a. For a parabola opening upward, such as the graph of f (x) 5 x2, the minimum value is the y-coordinate of the vertex. 24 25 b. A ball is dropped from a height of 12 ft. 1 22. An instructor may project the slides in class or post to a website in an online course. (Source: www.cdc.gov) Solution: Let E represent the event that a 20-yr-old lives to age 21. x2 1 3x 1 9 2x 1 x 2 3 25 5 2 1 8 1 x 1 x1 1 2 4 8 2x 2 1 a. Chapter test. log 1,000,000 5 6 25. linear; Ax 1 B A B A B A B 5. (y 1 1)2 (x 2 3)2 41 5 e5 55. y 5 12x 2 2; m 5 12 ; y-intercept: (0, 22) y b. D2 E2 24. How many days will it take Johan to read a 920-page book if he reads 20 pages the first day, 25 pages the second day, 30 pages the third day, and so on? 5 7 1 15! 15! 15 ? For an integer k, if k $ j, the truth of Pk implies the truth of Pk11. Section 2.4 197 Linear Equations in Two Variables and Linear Functions Expanding Your Skills 125. y 5 4 3 2 b. For Exercises 1–2, simplify the expression. (c 2 2d)(d 1 4) (p 1 9)(p 2 7) 25. Singular matrix 24 x 21 dc d 5 c d 1 y 14 20.27 0.27 ¥ 0.25 20.01 41. [29, `) x24 b. , 3, 1 6 2i (each with multiplicity 1) 2 5 77. y 5 0 x 1 4 0 2 3 59. Then apply the power property of logarithms to write the product of x and the logb 4. Finally, for each custard-syrup arrangement, there are 2 toppings. No 6. Show that n2 2 n 1 1 is odd for all positive integers n. n(x) 5 x2 2 0 x 0 1 1 c. 5 10 15 20 , , , , p 4 9 16 25 Objective 4: Use Summation Notation For Exercises 57–70, find the sum. 294 ft 30. Therefore, given y 5 f (x), the x-coordinate of the vertex is 4 because 4 is midway between 2 and 6. h(x) 5 x2 3 Section 2.6 233 Transformations of Graphs Vertical Shrinking and Stretching of Graphs Consider a function defined by y 5 f (x). Increasing on (22.500, 0.667); Decreasing on (2`, 22.500) ´ (0.667, `) SA-15 Student Answer Appendix Section 2.8 Practice Exercises, pp. Vertical stretch/shrink y 5 a[f (x)] Vertical stretch (if a . Graph y 5 2f (x 1 2) 2 4. Let B represent the event that a coin lands heads up on the second toss. Therefore, 7! . 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 y d. 3C 2 A 43. Average Monthly Temperature for Cedar Key, Florida Value of $5000 with Continuous Compounding at 5% y 100 Temperature (°F) (25, 17,452) 20,000 Value ($) y y 5 f(x) 24,000 (20, 13,591) 16,000 12,000 (10, 8244) 8,000 4,000 0 (5, 6420) 0 5 10 15 20 25 Number of Years 30 x 83. {c, f, h} b. f (22) g c. 11 6 i, 613 b. Write a relationship for a function whose f (x) value is 4 less than two times the square of x. 8, 5, 2, 21 b. x2 1 y2 1 10x 2 2y 1 17 5 0 26. (f + g)(x) 5 2x2 1 4 b. f(x) 23 Answer 7. m 5 1 b. a400 5 2399 Now add to get 2 S5. an 5 10n 2 3 b. a b(x) 5 p 1x 2 2 1 ; Domain: (2`, 21) ´ (21, 5) ´ (5, `) 115. Previous editions © 2014. Therefore, to find P(A or S), we have: P(A ´ S) 5 P(A) 1 P(S) 2 P(A ¨ S) 4 13 1 ace of spades 5 1 2 52 52 52 16 4 5 or 52 13 There are 4 aces in the deck out of 52 cards. The decimal form of an irrational number is nonterminating and nonrepeating. a2 5 a1 ? Find a Specific Term in a Binomial Expansion (a 1 b)2 5 a2 1 2ab 1 b2 The expression a2 1 2ab 1 b2 is called the binomial expansion of (a 1 b)2. Yes 20.10 0.12 0.00 0.03 Section 6.5 Practice Exercises, pp. Notice that the number of outcomes is easily found by multiplying the number of choices from each group: dg t fu number of toppings Total outcomes: (4)(2)(2) 5 16 bu t te r e Ho dg t fu Butters cotch Nuts Granola Nuts Granola Nuts Granola Nuts Granola Nuts Granola Nuts Granola Nuts Granola Figure 8-10 Skill Practice 1 A pizza can be made from either thick or thin crust, and a choice of 6 toppings. Foci: A 141, 0B, A2141, 0B 4 2 5 5 F F d. In how many ways can a jury of 12 people be selected? 1) Horizontal stretch (if 0 , a , 1) p. h(x) 5 0 2x2 2 3 0 96. 4 ? h(x) 5 6 3 4 Section 8.1 Practice Exercises, pp. Section 5.2 Practice Exercises, pp. Shrink horizontally by a factor of . Figure 8-7 Example 4 illustrates that a geometric sequence with a negative common ratio is an alternating sequence. 28 y 8 7 6 5 4 3 2 2 (y 1 4) (x 1 2) 2 51 7 11 b. Denominator always positive (never zero) c. |x| # 3 y 5 4 3 2 1 25 24 23 22 21 21 22 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 y $!x 5 4 3 2 1 1 3 4 5 6 7 3 4 5 x 2 2|y| . At a ballroom dance lesson, the instructor chooses 3 men and 3 women to demonstrate a new pattern. 239 b. horizontal; (a, 0); (2a, 0); R.3. y 5 2 1. x2 1 y2 5 4 5 4.7 in.; Minor axis: 4 in. 4 y 5 |x| 3 2 y 2y 2y y 1 1 2 3 4 x 23 Same equation: Graph is symmetric with respect to the y-axis. Five seeds are defective (will not germinate). Given functions f and g, explain how to determine the domain of QgR(x). The foci should be located 630 12 in. 2 1 2 5 1; This is an equation of an ellipse in the xy-plane. The graph of y 5 f A 13 xB is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). 78–79 1. Teaching multiple sections? This means that the graph is shifted to the left. Objective 4: Investigate Increasing, Decreasing, and Constant Behavior of a Function For Exercises 89–96, use interval notation to write the intervals over which f is (a) increasing, (b) decreasing, and (c) constant. 24 33. r 5 0.01 c. 4 5 32,768 Section 8.6 Principles of Counting 741 Skill Practice 3 A quiz has four true/false questions and six multiplechoice questions. 1 real solution 83 10. (23, 21] uw 2w 1 u 5 R.2. a. 66 43. f (x) 5 2b(x 1 c) 1 a 49. Graph three circles whose centers are located at the observation towers and whose radii are the given distances to the fire. f (x) 5 x2 and g(x) 5 x 2 4 d 15t 121. 23 1 1 0 21 2 1 23 0 0 ¥ 0 1 4 x 27 21 § £ y § 5 £ 1 § 1 z 0 41. Evaluate the difference quotient for x 5 2, and the following values of h: h 5 0.1, h 5 0.01, h 5 0.001, and h 5 0.0001. 1 25 24 23 22 21 21 22 x 77. Write an equation that represents the boundary of the area that can receive a signal from the tower. Passes through (24, 8) and (27, 23). Assume that a1 2 b a1 2 b p a1 2 b5 2 3 k11 k11 (Inductive hypothesis). r(x) 5 400 2 x 117. Therefore, we need to compute the number of combinations of n 5 53 numbers taken r 5 6 at a time. 5.01 3 1023 mol/L 83. { } 4x 2 2y 5 22 1 2 3 4 5 x 23 24 25 e. {6115y4} 1 1 22. Solution: By definition a geometric sequence follows the pattern a1, a1r, a1r2, a1r3, … . a2 5 21 and a7 5 5103 2243 8 48. 8 29. All rights reserved. y 5 x5 b. y 5 g(2x) 53. y 5 4 3 2 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 22 23 23 24 25 24 25 24 25 x Section 2.4 209 Linear Equations in Two Variables and Linear Functions 43. 690: © David Lees/Getty Images RF; p. y 5 x 1 3 32. In this case, the slope can be interpreted as the following two ratios: Move down 3 units. Foci: A 17, 0B, A217, 0B g. 21 4 73. The sum of the numbers on the dice is less than or equal to 5. g(c) 5 1c 1 20 2 1 c. 413: © Malcolm Schuyl/Alamy RF; p. Parent function: f (x) 5 x2. (2`, 21) ´ a21, b ´ a , `b 4 4 (2`, `) 13. Instead we will use the principle of mathematical induction. (0, 0) d. This implies that k2 2 k 5 2a for some positive integer a, and that k 5 k2 2 2a. {(2, 0, 4)} 1.5 22 5 22 5. [0, 2] c. 2282242202162122824 26 212 218 x 230 236 5 4 3 2 5 4 3 2 3 4 5 224 17. Find (g ? Skill Practice 6 Evaluate the function defined by f (x) 5 2x2 1 4x for the given values of x. t 5 ln(1 1 r) ln (1 1 r) 15. Therefore, the points do not define y as a function of x. That is, the first DVD would not be replaced before the second DVD is selected. Would it be reasonable to use the model from part (a) to estimate the wind speed for a hurricane with a pressure of 800 mb? 0 14. P 5 $300, n 5 12, r 5 4%, t 5 32 yr 51. 36 1 29 1 22 1 15 1 … 1 (2419) 41 4 16. 170 mph d. The antigens of the blood donor and recipient must be compatible. 81.25 mg 67. By how much do the results of part (c) differ from the result of Exercise 61(c)? a1 5 215 and a4 5 2 . For Exercises 41–46, find the sum of the geometric series, if possible. Show that 3 1 7 1 p 1 (4k 2 1) 1 [4(k 1 1) 2 1] 5 (k 1 1)[2(k 1 1) 1 1] 5 (k 1 1)(2k 1 3). Y2. The cost is $16 for each 14-mL tube. a i3 5 i51 n2(n 1 1)2 4 24. Endpoints of minor axis: (211, 2), (3, 2) d. 1 x 1. The price P(x) (in $) to a customer after a 6.5% sales tax is given by P(x) 5 1.065(x 1 0.32x), where x is the cost of the drill from the manufacturer. {log 13}; x < 1.1139 117. 30 scoops of each type of protein powder should be mixed to maximize protein content. Center: (2, 23); Radius: 5 67. Replace x by 2x and y by 2y. If he receives an average of 22 emails each day, write the nth term of a sequence defining the number of unread emails in his box at the end of day n of his vacation. Explain how you can determine from a linear equation Ax 1 By 5 C (A and B not both zero) whether the line is slanted, horizontal, or vertical. (2`, 24) ´ (1, `) 14 a2`, b 30. 736 Chapter 8 Sequences, Series, Induction, and Probability kth Term of a Binomial Expansion Let n and k be positive integers with k # n 1 1. A graph of an equation is symmetric with respect to the if replacing x by 2x and y by 2y results in an equivalent equation. 3 1 p 1 k(k 1 1)] 1 (k 1 1)[(k 1 1) 1 1] k(k 1 1)(k 1 2) 5 1 (k 1 1)(k 1 2) 3 3 2 k 1 3k 1 2k 5 1 k2 1 3k 1 2 3 k3 1 6k2 1 11k 1 6 5 as desired. Find an equation of line L. The point (25, 23) is not included in the function as indicated by the open dot. How many outcomes are there if a fair coin is flipped 10 times? Up to the left, up to the right; As x S 2`, f (x) S `, and as x S `, f (x) S `. If the third and fourth terms of an arithmetic sequence are 26 and 29, what are the first and second terms? Both types of functions represent simple curves that can be used for modeling in a wide range of applications, including predictions for the path of a hurricane. The values of x for which f (x) 5 2. The frequency for middle C on a piano is 256 Hz. The C above middle C (one octave above) is 512 Hz. The frequencies of musical notes follow a geometric progression. [22, `) e. A 3-digit code is to be made from the set of digits {4, 5, 6, 7, 8}. To do so, we use the Minimum and Maximum features. TIP It is important to note that the notation 1f + g21x2 represents the composition of functions, not multiplication of f, g, and x. One property of summation indicates that a c 5 . 15 11. Upward b. 2c d 57. , 5n The signs are positive for oddnumbered terms. y 5 x b. x2 5 36y for 212 # x # 12 b. 23 24 25 SECTION 2.8 For Exercises 105–109, evaluate the function for the given values of x. Objective 1: Apply the Fundamental Principle of Counting For Exercises 9–14, consider the set of integers from 1 to 20, inclusive. g(x) b. Let Pn be the statement 4n , (n 1 2)! for n $ 2. y 5 1 x For Exercises 9–18, graph the functions by plotting points or by using a graphing utility. 45 yd by 90 yd b. 30. Write About It 123. Therefore, A is singular (does not have an inverse). a2`, Linear Equations in Two Variables and Linear Functions 5 d 2 5 c. y 97. Find all x such that f (x) 5 0. Yes b. a12 5 4096 81 3 39. 58.28 in. The sample space has the following properties (Figure 8-12). { } (x 1 3)2 1 (y 2 1)2 5 4; Center: (23, 1); Radius: 2 1x 2 112 2 1 1y 1 32 2 5 1; Center: (11, –3); Radius: 1 x2 1 (y 2 10)2 5 104; Center: (0, 10); Radius: 2 126 (x 2 4)2 1 (y 1 10)2 5 24; Center: (4, 210); Radius: 2 16 (x 2 2)2 1 (y 2 9)2 5 24; Degenerate case: { } 5 2 5 51. So one natural choice for g and f would be: g(x) 5 x 2 3 Function g subtracts 3 from the input value. 680–681 1. This has also been updated in all of the digital materials accompanying the text. A number between 4 and 10, inclusive, is rolled. a , 5 d 23. a and b 17. Starting with an easily viewable, intuitive interface, students will be able to access key information, complete homework assignments, and utilize an integrated, mediarich eBook. f (x) 5 4Ax 2 14 B(5x 1 1)(x 1 2) or f (x) 5 (4x 2 1)(5x 1 1)(x 1 2) 33. 2x(3x 2 1)(5x 1 2) 28. If she anticipates working for the company for 5 yr, find the total amount she would earn from each job. maximum x value minimum y value maximum y value 10 [210, 10, 1] 210 by [210, 10, 1]. 6, 18, 54, 162, … 5 15 45 135 , , , ,… a2 a4 a6 a8 For Exercises 19–24, write the first five terms of a geometric sequence {an} based on the given information about the sequence. 5000 y 5 4 3 2 0.02x 1 0.05y 5 0.1 1 2x 5 3y 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 3 10 1 29. Lily borrowed $1000 from her friend, $7000 from the credit union, and $2000 from the bank. 6 c. a 4a b 2 i51 6 ` 1 6 18. Ax 2 15B Ax 1 15B Ax 1 17iB Ax 2 17iB 111. Solution: 6 1 i21 1 1 1 a 4a 2 b 5 4 1 2 1 1 1 2 1 4 1 8 i51 The individual terms in the series form a geometric sequence with a1 5 4 and r 5 12 . 3x 2 4 1 1 x12 x25 x11 (x 1 1)2 2 1 25 a. 6! n 5 6 and r 5 0. f(x) 5 0 x 0 b. {x 0 x $ 2} b. 3x 5 81 R.4. For h(x) 5 16x find h(0), h(1), and h(21). What is the probability that the player will not get a hit for a given time at bat? {(1.6, 2.3)} 49. (x 1 3)2 1 (y 2 1)2 5 16 11. The number of unique arrangements of these letters is 11! 5 1,663,200 2! ? f (x 1 h). 7a2b(3b4 2 2ab3 1 5a2) (x 2 6y)(5z 1 7) 11. c 6 2 2 x 25. 716 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 7 Evaluating a Finite Geometric Series Find the sum of the finite geometric series. 191 85. (x 2 3)2(x 1 5) b. Ellipse; 16 9 (y 2 2)2 x2 1 51 11. w6 4 9 7 d. 2 24 25 25. If the two players move directly toward each other at the same speed, where will they meet? 9, a ? There is a 6% sales tax on the cost of merchandise and $10.99 for shipping. Real part: 0; Imaginary part: 2 1 1 1 i 33. y 5 37. B 5 E2117, 159, 4.3, 0, 23, 213, π, 4.9 F a. No, the tree will eventually die. Explain how you can determine from a linear equation Ax 1 By 5 C (A and B not both zero) whether the line passes through the origin. We first need to show that the statement is true for n 5 1. 23x 1 1 # 2x 2 3 1 2 3 4 5 x 25 24 23 22 21 21 22 23 y Y1 5 4x 2 2 (1, 2) 1 23 24 25 2 3 4 5 23 22 21 21 22 x 1 2 3 4 5 6 x 7 Y2 5 23x 1 1 23 24 25 26 27 Y2 5 23x 1 5 24 25 Y2 5 2x 1 1 94. The student's average would be approximately 78.5. 3 7 1 11 2 14 2 5 88 67 96 62 90 56 97 82 a. 701 an 5 a1 1 (n 2 1)d where a1 is the first term of the sequence and d is the common difference. Then we plot the points to form a general outline of the curve. Provide an informal explanation of a relative maximum. (22, 23) c. (x 2 1)(x4 1 x3 1 x2 1 x 1 1) n21 b. A tax rebate returns $100 million to individuals in the community. • The graph of y 5 f (2x) is the graph of y 5 f (x) reflected across the y-axis. (10, 32] 19. (2, 2), (4, 3), and (8, 5) 76. i21 a. 4k , 4 ? (q + p)(x) 71. 5 25 b. f (x) 5 1 x 3 b. 16x2y 2 4xy2 2 85. This user-friendly program enables instructors to search for questions by topic, format, or difficulty level; to edit existing questions, or to add new ones; and to scramble questions and answer keys for multiple versions of a single test. In addition, a first-time visitor to the website has a one-time coupon for $1.00 off. y 5 2 29 x2 5 5 • If m1 and m2 represent the slopes of two nonvertical parallel lines, then m1 5 m2. 2n for n $ 7. Objective 1: Perform Operations on Functions For Exercises 5–8, find (f 1 g)(x) and identify the graph of f 1 g. y 5 34.9e c. Answer 1 4. No Section R.6 Practice Exercises, pp. a 2 nb 3 Objective 3: Find a Specific Term in a Binomial Expansion For Exercises 29–40, find the indicated term of the binomial expansion. 25 23. For what value of x will R(x) 5 C(x) or P(x) 5 0? y 5 2f (x) 50. f (x) 5 e 2.5x 1 2 for x # 1 x2 2 x 2 1 for x . The speeds are 8 m/sec and 5 m/sec. Given a line defined by x 5 4, what is the slope of the line? 5 4 3 2 5 4 3 2 y 5 f(x) 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 24 25 y y 5 f(x) 25 24 23 22 21 21 22 23 113. 0.3, 0.33, 20.9, 212, 114 , 6 e. 194 Chapter 2 Functions and Relations Objective 3: Determine x- and y-Intercepts of a Function Defined by y 5 f(x) For Exercises 75–84, determine the x- and y-intercepts for the given function. The general shape of y 5 xn is similar to the graph of y 5 x3 for odd values of n greater than 1. different y values This relation is not a function. (2, 1.5), (4, 2), and (8, 3) 77. or its affiliates File loading please wait... We will quickly enhance this method with other techniques that are less cumbersome and use more analysis and strategy. Graph the functions on the viewing window [24, 4, 1] by [210, 10, 1]. It appears that the triangle was rotated approximately 308 counterclockwise. EXAMPLE 5 Using a Linear Function in an Application A family plan for a cell phone has a monthly base price of $99 plus $12.99 for each additional family member added beyond the primary account holder. 5 d. Identify x- and y-Intercepts y When analyzing graphs, we want to examine their most important features. Avoiding Mistakes Slope-Intercept Form of a Line An equation of a vertical line takes the form x 5 k, where k is a constant. [24, `) 15. x 5 4, x 5 24 b. 15x 2 7 12x 2 4 20. (0, `) h. Given m(x) 5 4x2 1 2x 2 3, find m(2x). 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x The operation Œx œ may also be denoted as int(x) or by floor(x). a (3i 1 1) i51 Answers 6. P(E) 5 0.003 15. 1 Section 8.5 EXAMPLE 3 The Binomial Theorem 735 Applying the Binomial Theorem Expand by using the binomial theorem. 532–535 y R.1. 1 2 3 4 5 x 27 26 25 24 23 22 21 21 23 1 2 x 3 22 24 25 b. (10, 0) b. {(22, 1, 3)} 13. a (22j2) 5 1 j61. Mixed Exercises 89. Yes 27. bn 5 4n ; find b3 (n 1 1)' 47. 8! 64. 2 2 a. If A and B are mutually exclusive, then P(A ´ B) 5 P(A) 1 P(B). y 5 11.9x 1 169 c. Geometric; r 5 15 8. Interpret the meaning of the slope in the context of this 25 0 5 10 15 20 problem. 361–367 R.1. R.3. 1. E7 6 155F 85. That is, 2A 5 [2aij]. x 5 0 y 0 1 y2 67. 4! 5 4 ? Completing the square gives 31. Given the sequence defined by bn 5 n3 2 3n2, find the fourth partial sum. Neither 20. Write a linear cost function representing the monthly cost C(x) for x maintenance calls. 9C9 44. The slope is 0.4. This means that the average increase in systolic blood pressure for adults is 0.4 mmHg per year of age. These lines form a rectangular coordinate system (also known in his honor as the Cartesian coordinate system) or simply a coordinate plane. The CD does not have jazz music. (h, k 1 a); (h, k 2 a); 37 13 (h 1 b, k); (h 2 b, k) 9. y 5 213x 1 1; m 5 213 ; y-intercept: (0, 1) y b. p 5 5 b. x y b. a20 5 83 23. 23 24 17 y R.3. R.1. 1. k < 0.058 b. (7C3) 5 2940 59. 3 6 9 12 , , , , p 5 25 125 625 For Exercises 3–5, 6. How many 3-digit codes can be formed with the given restrictions? bn 5 19. 2 14. d(x) 5 1 22 x 1 21 x14 240 Chapter 2 Functions and Relations Objective 3: Apply Vertical and Horizontal Shrinking and Stretching For Exercises 27–32, use transformations to graph the functions. Use the points (21, 118) and (51, 130) to write a linear model relating y as a function of x. See Linear equations in one variable Floor functions, 249–250 Florida Lotto, 738, 745 Focal diameter, 669, 670 Focus of ellipse, 634 of parabola, 667–669 I-3 Fourth-degree equations, 344 Fourth-degree polynomial functions, 301 Fractions clearing, 84, 213 complex, 64–66 solving linear inequalities containing, 146 writing repeating decimals as, 717–718 Function notation, 186–188, 219 Functions. 5 49. Yes y b. x-coordinate: c. Skill Practice 2 Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. 81t2 2 16 69. y 24 23 22 21 21 22 3 4 22 23 24 25 4 87. equivalently as a11, a11 A 1r B, a11 A 1r B 2, a11 A 1r B 3, p . 2.26 73. The slope m of the line through the points is the ratio between the change in the y values (y2 2 y1) and the change in the x values (x2 2 x1). 15, π6 f. To visualize the composition of functions (f + g)(x) 5 f (g(x)), consider Figure 2-41. (d + r)(t) 5 576t represents the distance traveled (in ft) in t minutes. We have: Fibonacci sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, p Point of Interest The Fibonacci sequence is of particular interest because it is often observed in nature. f(x 1 h) 56. 20 e. 0 y 0 # 3 and 0 x 0 # 2 88. Therefore, it would be natural to take the absolute value of g(x) 5 2x2 2 5. (n 2 r)! rr! Comparing Combinations and Permutations a. x}, B 5 {x 0 x # 1} 13. (2x 2 5)4 20. See Greatest common factor (GCF) General form of equation of circle, 179–180, 275 of equation of conic section, 680 General solution, of systems of linear equations, 498 General term of sequence. N and F are not mutually exclusive (the events overlap). 0 x 0 1 y 5 3 39. 1 0x 0 2x for x , 2 for x $ 2 In computer programming, the greatest integer function is sometimes called the "floor" function. No x-intercepts e. (f + g)(5) f b. a y 17. To determine whether the shift is to the left or right, we can locate the x-intercept of the graph of g(x) 5 (x 1 3)2. 0 83. [35, 38]; If the refrigerator is set to 36.58F, the actual temperature would be between 358F and 388F, inclusive. Passes through a2 , b and is perpendicular to the 9 3 x-axis. 5 5 25 Answers 11. For example: (2, 1, 1), (0, 0, 2), (4, 2, 0) 39. e 6 if 6 6 16. 22, 3 6 i 5 3 27. Determine the number of ways that the letters in the word RIFFRAFF can be arranged. 0.03x 1 0.07y 5 0.21 19. y 5 0 y 43. An employee invests $500 per month in an ordinary annuity. (2`, 25] a. The discriminant b2 2 4ac enables us to determine the number of real solutions to the equation and thus, the number of x-intercepts of the graph of the function. Write a function that represents the number of gallons of gasoline n(d) used for d miles traveled. If the money is respent over and over again in the community an infinite number of times, at a rate of 64%, determine the total amount spent. A 12, 0B and (3, 0) e. ln 1.5 < 0.4010 22 4 25 125. In how many ways can 3 students from a group of 15 students be selected to serve on a committee, if the students will hold the offices of president, vice president, and treasurer? 23x 5 12 2. 5 4 3 2 5 4 3 2 1 25 24 23 22 21 22 1 y 5 f(x) 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 x Mixed Exercises For Exercises 115–122, write a function that represents the given statement. 1 21 31 1 2 1 2 x x23 x x x 1 5x 1 1 (x 1 5x 1 1)2 27 2 6 24 24. It falls 16 ft in the first second, 48 ft in the second second, 80 ft in the third second, and so on. There are four letters available for the first choice in the arrangement. (x2 1 2)(x 1 3)(x 2 3) (x3 1 16)(x 1 2)(x2 2 2x 1 4) 59. We begin by investigating the functions defined by y 5 f (x) and y 5 a ? [10, `) 31. If the "money" is respent over and over again each time at a rate of 76%, determine the total amount spent. I think that applications and hands-on experience made math come alive for me, and I'd like to see math come alive for my students." Donna Gerken is a professor at Miami Dade College where she has taught developmental courses, honors classes, and upper-level mathematics classes for decades. Undefined d. ln a 1 ln b 2 ln c 2 5 ln d 2 3 3 4 y 1z 4 55. {(9.32, 217.48, 12.93)} 73. 2x 5 3y 20. 27.37 45. The sum of the numbers showing on the dice is 7. h(x) 5 x2 2 4 1 25 24 23 22 21 21 22 24 TIP g(x) 5 x2 1 2 5 4 3 2 1 2 3 4 5 x 23 24 25 Figure 2-25 The graphs of g and h both resemble the graph of f(x) 5 x2, but are shifted vertically upward or downward. 0 y 63. 7 Alternatively, we can apply the formula for the kth term of a binomial expansion with n 5 10, k 5 8, a 5 2x, and b 5 y4. Find the shortest distance from the origin to a point on the circle defined by x2 1 y2 1 4x 2 12y 1 31 5 0. 1 4x8y2 b. So we say that the function f is increasing on the interval (0, 40). m 5 2 47. x n xn 33. 2 11. y 5 2x 2 10 y57 65. a1 5 11; an 5 4an21 1 3 28. (6 2 5i)4 n n 58. x 1 28 1 26. 0.43 µg/dL a. f (x) 5 x2 2 3x x 272 Chapter 2 Functions and Relations For Exercises 37–44, find the difference quotient and simplify. p p c. 9! 5 362,880 33. Objective 2: Determine Empirical Probabilities 45. 61, 62, 64, 68, 6 , 6 , 6 , 6 , 6 , 6 , 6 2 3 3 3 3 4 6 12 1 1 5 15. 756 Chapter 8 Sequences, Series, Induction, and Probability Probability of (A or B) Given events A and B in the same sample space, P(A or B) is given by P(A ´ B) 5 P(A) 1 P(B) 2 P(A ¨ B) Note: If A and B are mutually exclusive, then P(A ¨ B) 5 0 and we have P(A ´ B) 5 P(A) 1 P(B). C 5 5x b. Number of Permutations of n Distinguishable Elements The number of permutations of n distinct elements is n!. 10 215.7 28 210 12 10 8 6 71. 3 4 c(x) 5 x 23 1 1 14 12 8 210 x 16 26 10 2 29. u 6 13. 56 3. Find the difference between b88 and b20. ceil(x) is the smallest integer not less than x. x2 2 4 Vertices: (1, 25), (21, 25); Foci: A 15, 25B, A215, 25B Ax 2 32 B 2 (y 1 2)2 2 51 a. (f + g)(x) 5 x23 x24 1x 2 1 2 2 b. in the second second, 12 inches in the third second, and so on. 0 x 0 5 0 y 0 2 57. Ex 0 x $ 275 F b. 5 35. mutually; exclusive 0; P(A) 1 P(B) 9. a0, b B B B B SA-11 Student Answer Appendix 109. 5 15 15 9 15 14 21 13C5 1287 < 0.000495 2,598,960 1287 13C5 < 0.001981 5 (4) b. 1 1 1 2 Call this statement P2. In all cases the quotient is the same ratio r. The y-intercept is (0, 21). We need to show that P1 is true. 0 5 10 9 11 i12 3 3 3 13. (That is, the blue line is above the red line for x . a15 5 86, a34 5 200; Find a150. Endpoints of minor axis: A3, 14 B, A3, 154 B d. 1 5 2x 2 2 5 The domain is (2`, 1) ´ (1, `). 5 < 0.00022 C 52,451,256 34 9 c. e 5 57. 23x 2 5y 5 60 55. The variable costs include labor, gasoline, and taxes and amount to $36 per lawn. g(1) 5 3 e. How many 4-letter palindromes are possible from a 26-letter alphabet? e2 37. One year later 3887 of these individuals had died and 4,291,113 had lived. By completing the square we can write an equation of a circle given in general form as an equation in standard form. A number less than 3 is rolled. Consider a set of n elements of which one element is repeated r times. Copyright © 2017 by McGraw-Hill Education. from x1 5 1 to x2 5 2. Vertex: A23, 32 B; p 5 12 ; Focus: (23, 2); Focal diameter: 2 b. This gives a total of 16 elements in event (A ´ S). 24 hr b. Evaluate a (21)i if n is even. 5x 1 3 4x 2 9 1 x16 272 25x3 1 10x2 2 23x 1 38 1 x12 SA-20 Student Answer Appendix 4x4 2 13x3 2 97x2 2 59x 1 21 x4 2 2x3 1 4x2 2 8x 1 16 37. 178 An equation of a circle written in the form x2 1 y2 1 Ax 1 By 1 C 5 0 is called the general form of an equation of a circle. The population of a city was 320,000 in the year 2000. Evaluating a Function Evaluate the function defined by g(x) 5 2x 1 1 for the given values of x. Infinitely many solutions 65. Section 8.1 Skill Practice 7 a. Absolute value equation b. {a, b, c, d, e, f, g, h, i, o, u} a. 4 5 288 17. 5 10 e. 3 5 c. Use the binomial theorem to find (1.01) . x 24 25 26 24 25 , , , , x x x x #1 #2 #3 # 3.5 2000 for 0 # x , 40,000 87. Skill Practice 11 In Example 12, we have the graphs of two functions, and we apply function addition, subtraction, multiplication, and composition for selected values of x. P1 is true because 34 5 1 2 A 14 B 1. 23 [N b. The expression 0 4 1 a 0 is a real number for all real numbers a. At x 5 22, the function has a relative maximum of 2. (See Example 5) 22 0x 0 2 3 for x # 22 48. y 5 0 y h. [x 2 (23 1 2i)][x 2 (23 2 2i)](4x 1 1)(x 2 1)(x 1 4) 1 c. Reflect across the x-axis. y 5 2log3 x 1 2 3 4 5 6 7 8 9 x 23 103. What does this mean for you? Find the equation of the least-squares regression line. Use the arithmetic mean for Exercises 103–104. Solution: TIP We denote the distance between points P and Q as d(P, Q) or PQ. Given an arithmetic sequence with a15 5 86 and a37 5 240, find the 104th term. y 5 2x 2 5 on [210, 10, 1] by [210, 10, 1] 90. y 5 34x; m 5 34 ; y-intercept: (0, 0) y b. r 5 54 $ 1, so the sum does not exist. Directrix: x 5 22; Axis of symmetry: y 5 0 c. 2n 147. 5 e. Not likely 87. The golfer would need to score less than 84. y y 5 61x 1 1 21 0 y 5 61(21) 1 1 5 0 0 61 y 5 61(0) 1 1 5 61 (21, 0) (0, 1), (0, 21) 1 612 y 5 61(1) 1 1 5 612 (1, 12), (1, 2 12) < 1.4 5 4 3 2 y2 2 1 5 x 1 22 21 21 22 3 62 y 5 61(3) 1 1 5 62 (3, 2), (3, 22) 23 8 63 y 5 61(8) 1 1 5 63 (8, 3), (8, 23) 24 25 Skill Practice 5 Graph the equation by plotting points. [225] 9 5 67. The steps shown in the solutions match the style and methodology of solved examples in the textbook. 1024 ft a. A21 5 c 2 3 27. Center: (1, 0); Vertices: A 12, 0B, A 32, 0B; Endpoints of minor axis: A1, 13 B, A1, 213 B; Foci: A1 2 2 2 25 6 , 0B, A1 1 25 6 , 0B y x 1 51 17 98 2 2 3) (y 2 1)2 (x 2 4)2 51 49. Find (n 2 m)(x) and write the domain of n 2 m in interval notation. 2800 yr a. 112 1 5y2 12y 93. 54 1 36 1 24 1 16 1 … 27. a b(0) f h 18. Then, by completing 4A 4C the square, Ax2 1 Cy2 1 Dx 1 Ey 1 F 5 0 becomes D 2 E 2 D2 E2 Aax 1 b 1 C ay 1 b 5 1 2F 2A 2C 4A 4C D 2 E 2 b 1 C ay 1 b 5k Aax 1 2A 2C 2 E 2 D b ay 1 b ax 1 2A 2C 1 51 k k A C a. Find the difference quotient. a a 2b2 . Hyperbola; 2 51 144 25 y F SA-43 SA-44 Student Answer Appendix 25. The initial swing (one way) of a pendulum makes an arc of 4 ft. h)(x) 5 x 5. Yes; 4 3 1 21 17 53. 31 36 754 Chapter 8 Sequences, Series, Induction, and Probability Solution: Let E represent the event that two women are chosen. 3; 4 23. Mixed Exercises 77. f (x) 5 0 x 0 and g(x) 5 3 6. 0! 6! ? No horizontal asymptote 4 b. 53C6 5 53! 53! 5 5 22,957,480 6! ? (23, 0) and (3, 0) d. x 2 24 91. g (x) 5 5 30. The maximum profit is $138,000. x1 1 x2 5 180 1 220 c. The range of an exponential function is the set of positive real numbers; that is, 2x is nonnegative for all values of x in the domain. (g + f)(x) 5 g(f (x)) 5 1 f (x) 1 4 1 f (x) ? Notice that a point (x, y) on the image has a corresponding point (2x, 2y) on the image. In how many ways can 6 people in a family be lined up for a photograph? Horizontal asymptote: y 5 3 31. 4 e. 5 4 3 2 1 25 24 23 22 21 22 y 49. Explain how to find the x- and y-intercepts from an equation in the variables x and y. 2 x1x 1 32 x(x 2 y) 1 1 57. Answer 1 3. y 5 123x 1 75 b. The terms in the given sequence a1, a2, a3, … If two fair dice are thrown, find the probability that the sum is between 6 and 8, inclusive. If 42 maintenance calls are made for a given month, how much money will the lawn service make or lose? 22 c. The graph of g (x) 5 1 2x has the shape of the graph of has the shape of the graph of 3 y 5 1x but is reflected across y 51 x but is reflected the y-axis. e2x 1 2 1e22x or e2x ex 1 e2x 2 ex 2 e2x 2 77. An x-intercept of a graph has a y-coordinate of . 315 a. y 5 0 a. The remainder theorem states that if f (c) is equal to the remainder obtained after dividing f (x) by (x 2 c). Assume that (xy)k 5 xkyk (Inductive hypothesis). (p + p)(x) For Exercises 77–80, find (f + g)(x) and write the domain in interval notation. Use these data to find the least-squares regression line. r (x) 5 0 x 2 8 0 82. The maximum profit is $34,400. Depth of Retention Pond vs. The bottom row has 15 cups. {0} c. y(20) 5 140.3 means that with 20,000 plants per acre, the yield will be 140.3 bushels per acre; y(30) 5 172 means that with 30,000 plants per acre, the yield will be 172 bushels per acre; y(60) 5 143.5 means that with 60,000 plants per acre, the yield will be 143.5 bushels per acre. (23, 1) 12. 212 b. Find a12. (29, `) 101. 5. x-intercepts: (4, 0), (2, 0); y-intercept: (0, 2) 29. Find the total earnings for job B over 20 yr. A third point can be used to verify that the line is graphed correctly. This implies that 7k 2 5 5 2a and that 7k 5 2a 1 5 for some positive integer a. 45 a. For example, one five-letter palindrome is: ABCBA. {80} c. For example, consider the function h defined by h(x) 5 (x 2 3)2. (y 1 3)2 (x 1 6)2 1 51 16 4 Mixed Exercises y 63. 7 x27 4ac 2 2 16 19. g(x) 5 1x 2 2 b. 68. Is h(2x) 5 2h(x)? The money is then respent over and over again, each time at a rate of 70%. (g + g)(6) 108. 240 ft c. g(x) 5 61. That is, 0 # P(E) # 1. r 5 π Aπ 12sg 2s or t 5 109. 3200 ft2 a. e a , , b f 157 157 471 2 2 2 3y 2 z 1 6 , y, zb ` y and z are any real numbers f or 45. 2 x 113. Therefore, we are arranging 6 different (distinguishable) items in various orders. vii Graphing Calculator Coverage Material is presented throughout the book illustrating how a graphing utility can be used to view a concept in a graphical manner. Joe rides his bicycle an average of 18 mph. e f 2 4 6 113 f { }; The value 23 does not check. Yes; d 5 Section 8.3 Practice Exercises, pp. (g + f)(5) h(x) 5 1 x11 g 107. The table of points reveals that for corresponding x values, the values of g(x) are 2 more than the values of f(x). Assume that the money is respent an infinite number of times. This is approximately 12.65 units. 7, 16, 25, 34, … , 574 37. 5 2 6 1x 2 12 a 2 2 2b x 21 Therefore, x fi 61. For each birth, the probability that the child is born a boy is 12 . Find the shortest distance from the origin to a point on the circle defined by x2 1 y2 2 6x 2 12y 1 41 5 0. a 8a b 2 3 n21 18. x2m17 115. y 5 x2 33. {x 0 x , 23} e. Make a chart showing Y y the possible genotypes of Y the offspring. Therefore, the graph of f(x) 5 3x2 1 12x 1 5 has two x-intercepts (Figure 3-3). 1 f + g21x2 5 9 25 2 x2 81. 3 is an element of the set of natural numbers. (h4 2 1)12; middle term 39. The initial swing (one way) of a pendulum makes an arc of 24 in. y 3 x 24 25 9 8 1 2 4 5 y 3 2 1 1 2 3 5 4 25 24 23 22 21 21 25 24 23 22 21 21 x y 5 4 3 2 7 6 5 4 7 1 25 24 23 22 21 22 24 y 25 24 23 22 21 22 5 6 10 8 6 4 7 6 35. f (x) 5 0 x 0 12. How many passwords can be made if a. f 21(x) 5 log(x 2 1) 1 3 93. f (x 1 h) 2 f (x) h 284 Chapter 2 Functions and Relations 6. When money is infused into the economy, a percentage of the money received by individuals or businesses is often respent over and over again. r1d2 5 c. Write a relationship that represents the amount of wire remaining w(x) as a function of the number of feet of wire x already used. Given r(x) 5 2 , x 2 5x 2 14 a. 2x 1 y 5 1 (standard form) Write the equation in standard form by collecting the x and y terms on one side of the equation. y 5 x 2 1 31. C 5 110 1 60x b. 12`, 22 ´ 12, `2 b. Let Pn be the statement (xy)n 5 xnyn. m(x) 5 • 2x for 21 # x , 3 1x 2 3 for x $ 3 24 for 23 , x , 21 for 21 # x , 2 70. How much will the individual earn on day 10? 5! 1 ? Parabola; Vertex: (1, 23); Focus: A1, 212 B; Directrix: y 5 2112 ; Axis of symmetry: x 5 1 7. 3 17. 1 Show that 1 1? Every player plays every other player exactly once. abc 73. The corresponding points to the right of the axis of symmetry are (3, 22) and (4, 25). Detailed Chapter Summaries are available at www.mhhe.com/millercollegealgebra. {22} 4 4 55. If the slope of a line is how much vertical change will be present for a horizontal change of 52 ft? Applying the Pythagorean theorem, we have d 2 5 (x2 2 x1)2 1 (y2 2 y1)2 d 5 2(x2 2 x1) 1 (y2 2 y1) 2 TIP 167 Since (x2 2 x1)2 5 (x1 2 x2)2 and (y2 2 y1)2 5 (y1 2 y2)2, the distance formula can also be expressed as 2 We can drop the absolute value bars because 0 a 0 2 5 (a)2 for all real numbers a. f 4 2 7 16 8 17. quadratic; m1y3 R.4. 5y(2y 1 3)2 1 5. Odd 47. For Exercises 65–76, refer to functions m, n, p, q, and r. 2 3 4 5 6 3 4 5 x 23 y 5 4 3 2 x y 23 22 23 0 1 23 2 23 4 25 24 23 22 21 21 22 x 5 23 1 2 x 23 24 25 y can be any real number. The trainer must have more than 120 sessions with his clients for his average cost to drop below $16 per session. f (x) 5 3x2 1 12x 1 5 0 5 3x2 1 12x 1 5 212 6 2(12)2 2 4(3)(5) x5 2(3) 5 212 6 184 6 Answers e. If 150 dozen cookies are sold in a given month, how much money will the business make or lose? How many 6-number groups are possible? Directrix: x 5 7; Axis of symmetry: y 5 21 c. Comparing the results in parts (a) and (b), what does a positive rate of change mean in the context of this problem? (2x 1 3)4 Solution: The expression (2x 1 3)4 is in the form (a 1 b)4 with a 5 2x and b 5 3. (2`,22) ´ (22, 2) ´ (2, `) c. < 0.000062 a. A(n) its predecessor. Assume that 1 1? x2 1 y2 5 9 Solution: Answers 1. 5 5 20 b. The numbers are 5 and 2. For example: y y5f 1 2 6 5 x (24, 22) becomes a 4 3 2 (22, 4) becomes a 1 28 27 26 25 24 23 22 21 21 22 1 2 3 4 x 24 1 2 22 1 2 , 22b 5 (28, 22). a6 5 and r 5 2 . f (x) f (x 1 h) b. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 13. Furthermore, no taxes are paid on either the principal or interest until the money is withdrawn. The cost to rent the booth is $120. (2`, `) c. Let Pn be the statement F1 1 F2 1 … 3.1536 3 1011 gal 2 3 104 songs 97. 216 26. ceil(5.5) b. 1}; 12`, 26 4 ´ (1, `) b. x 5 23 d. If P(E) 5 0, then E is called an P(E) 5 1, then E is called a 4. d1 5 4 234 b. Now suppose that the coin is flipped two times in succession. left 9. The elements above the leading 1 in the third column are not all zero. Yes 23. 27 28 29 Avoiding Mistakes y 8. 22: NASA, ESA, and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration RF; p. x 5 10, y 5 30 b. {23} 45. (a 1 b)7 Determining the coefficients of a binomial expansion using Pascal's triangle would be cumbersome for expansions of higher degree. x 5 0 y 0 1 1 40. Vertices: (4, 0), (24, 0) 8 6 c. 22. The value 4 is a factor of the expression 4(9a 1 2). x 5 , x 5 23 2 43. y 1 1 2 23 24 Figure 2-31 3 4 Test for symmetry with respect to the y-axis. 7 41. y # 4 y f. 5 4 3 2 1 25 24 23 22 21 21 22 TIP y 5 4 3 2 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 x 5 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 This is a function. , 617 23. The common difference is 2. P(50) 5 1.50(50) 2 120 5 245 Substitute 50 for x. 227 8. (4x 2 5)2 (x2 2 9)3y2 6x(3x 1 1) 5 c. (3, 21) b. a b 1 6 c. 22.3 yr 32. Strand Vice President, General Manager, Products & Markets: Marty Lange Vice President, Content Design & Delivery: Kimberly Meriwether David Managing Director: Ryan Blankenship Senior Brand Manager: Caroline Celano Director, Product Development: Rose Koos Senior Product Developer: Emily Windelborn Marketing Communications Manager: Audrey Otto Marketing Specialist: Cherie Harshman Director of Digital Content Development: Robert Brieler Digital Product Analyst: Michael Lemke Associate Digital Product Analyst: Adam Fischer Director, Content Design & Delivery: Linda Avenarius Program Manager: Lora Neyens Content Project Manager: Peggy J. R(x) 5 C(x) (the company breaks even) b. The table gives the average gestation period for selected animals and their corresponding average longevity. y 5 4x and y 5 24x x 7. Graph r(x) 5 e 2 2x for x . To Ryan Blankenship, Marty Lange, and Kurt Strand, we are forever grateful for the amazing opportunities you and McGraw-Hill have given us. The graph of an odd function is symmetric with respect to the origin. f(x) f(x) Minimum value Maximum (h, k) point a¬0 k (h, k) x Minimum point x xh Maximum k value a⬆0 xh In Example 1, we analyze and graph a quadratic function by identifying the vertex, axis of symmetry, and x- and y-intercepts. 21 45. The average rate of change between P and Q is the slope of the secant line and is given by: m5 f (x 1 h) 2 f (x) (x 1 h) 2 x f (x 1 h) 2 f (x) (Difference quotient) h The expression on the right is called the difference quotient and is very important for the foundation of calculus. 2 nonreal solutions b. (x 1 12)2 1 (y 1 9)2 # 256 b. Determine the time at which the stone will be at its maximum height. provided that fi 0. 21 b 2 65. y will be 9 times its original value. 4 d. AI3 5 £ 9 11 23 5 26 4 1 3§ £0 24 0 0 1 0 69. h(x) 5 1x 1 3 The graph of a function will be shifted to the right or left if a constant is added to or subtracted from the input variable x. x-intercept: (8, 0); y-intercept: (0, 8) 83. x 5 60, y 5 0 c. Otherwise, the series . By how much do the results of part (c) differ from the result of Exercise 64(d)? m5 23 24 25 y b. 1.2 d. Are they exactly the same? n 5 4 Let Pn be the statement n! . x 2 1 Solution: TIP The solution set to the inequality 2x 2 3 # x 2 1 includes equality, so the right endpoint would be included: (2`, 2]. Down left and up right. 9k 2 1 9 ? p)(1) 5 m(1) ? Any point on the y-axis has an x-coordinate of zero. a1 5 12 and a2 5 28. A card numbered between 5 and 10, inclusive. x 5 12, y 5 36 c. The manufacturer should produce 600 grill A units and 500 grill B units to maximize profit. (See Example 3) r(x) 5 23x p(x) 5 x2 1 3x q(x) 5 11 2 x 19. Solve the inequality 2x3 2 5x2 2 28x 1 15 , 0. For Exercises 20–23, determine if the relation defines y as a function of x. (Assume that the color of the light is defined as the color when the car is 100 ft from the intersection. A 59. Undefined d 1 a. y 5 2 73. {(x, 25x 2 6) 0 x is any real number} y16 or e a2 , yb ` y is any real number f 5 b. 173–177 R.1. 4 13 R.2. 24 km B F 1 25 24 23 22 21 21 22 1 7. For this reason, the two events are called independent events. Assume that 1 ? The solutions can be verified numerically by using the Table feature on the calculator. b6 5 (6)2 36 36 1 5 5 5 (6 1 1)! 7! 7?6?5?4?3?2?1 140 Skill Practice 4 Given the sequence defined by cn 5 2n , find c4. e f 2 {21, 4} 61. See the proof in the online appendix at www.mhhe.com/ millercollegealgebra. {x 0 x $ 24} b. Dylan invested $3000 in the risky stock, $7000 in the second stock, and $5000 in the third stock. y y 5 4 3 2 y 5 f(x) y 5 f(2x) 1 25 24 23 22 21 21 22 x y 5 f(x) 1 TIP For a given point (x, y), notice that (2x, y) is on the opposite side of and equidistant to the y-axis. 10 210 2 3 4 5 6 7 8 9 x 10 y 5 x3 Section 2.2 Practice Exercises, pp. Arithmetic Sequence An arithmetic sequence {an} is a sequence of the form a1, a1 1 d, a1 1 2d, a1 1 3d, a1 1 4d, p • The value a1 is the first term, and d is called the common difference of the sequence. P 5 $150, n 5 12, r 5 4%, t 5 16 yr 50. Consider (a 1 b)n, where n is a whole number. This is represented by y 5 3000 1 0.05(x 2 20,000) for x . Cumulative Review Exercises For Exercises 1–4, consider sets A and B and determine if the statement is true or false. (8.5, 6.2) and (25.1, 7.9) 30. {664} Absolute value inequality b. Suppose that three geological study areas are set up on a map at points A(24, 12), B(11, 3), and C(0, 1), where all units are in miles. 5 36 b. e a1, , 2b f 49. 3 665 17. y 5 0 x 0 35. By mathematical induction, we conclude that n! . • To motivate students by demonstrating the significance of mathematics in their lives through practical applications. (See Example 7) 94. y 5 22x 1 1 (slope-intercept form) Write the equation in slope-intercept form by solving for y. None of these 89. a1 5 2 and a4 5 16. If AB 5 In and BA 5 In, then the matrices are inverses. 3 1 2 ? cn 5 5n 2 4; find c157 20. (0, 0) 3 g. In each case, replacing x by 2x results in an equivalent term. 3 Reflect across the x-axis. Find an equation of the line tangent to y 5 x3 1 1 at the point (22, 27). If the slope of a line is 58 , how much horizontal change will be present for a vertical change of 216 m? Never increasing g. How much interest will be earned? For example, given the event E 5 {2, 4, 6}, n(E) 5 3. 22 (multiplicity 2) d. Therefore, the sequence is arithmetic. (3x 1 y2)7; Term containing y6. f(x) 5 2 x b. m (x) 5 47. (2`, 0] ´ {3} 13. The Instructor's Solution Manual provides comprehensive, worked-out solutions to all exercises in the section exercises, review exercises, problem recognition exercises, chapter tests, and cumulative reviews. y 11. y 5 f(x) 1 25 24 23 22 21 21 22 d. e 2 87. Time 0.10 f(x) (2.5, 0.095) 0.08 BAC (%) a. {64, 62} 9 12. One solution Infinitely many solutions a. Yes 1 2 4 e. 333.2 ft b. P(E2) 5 n(S) 38 19 c. y 5 2 x 1 2 2 1 b. y 5 24x 2 10 24 6 1 12 square units 59. x, x Yes 9. 21 TIP TIP The function in Example 6 has no "gaps," and therefore we say that the function is continuous. The graph of a constant function defined by f (x) 5 b is a (horizontal/vertical) line. g(21) 5 2(21) 1 1 Substitute 21 for x. (a 1 b)(a 1 b)2 5 (a 1 b)(a2 1 2ab 1 b2) 5 a3 1 2a2b 1 ab2 1 a2b 1 2ab2 1 b3 5 a3 1 3a2b 1 3ab2 1 b3 Similarly, to expand (a 1 b)4, we can multiply (a 1 b) by (a 1 b)3. No a. The rectangle is 10 m by 8 m. Determine x- and y-Intercepts of a Function Defined by y 5 f(x) Recall that to find an x-intercept(s) of the graph of an equation, we substitute 0 for y in the equation and solve for x. The sum S of such a sequence is called an infinite series and is represented by S 5 a1 1 a2 1 a3 1 ??? g(x) 5 2 a. Quadratic equation 47. 22376 22. For Exercises 69–70, assume that the units shown in the grid are in feet. 5P2 2! 5 20 5 10 2 To generalize, suppose that n represents the number of distinct elements in a group from which r elements will be chosen in no particular order. Find the 46th term of an arithmetic sequence with a1 5 210 and a60 5 2262. The numbers are 9 and 12 or 29 and 212. g(x) 5 2 0 x 0 c. 75% of 200 75% of 150 200 1 150 1 112.5 1 p We have a1 5 200 and r 5 0.75. f (g(6)) b. The numbers are 12 and 12. (2`, 2) ´ (3, `) d. Answers y 5. Suppose that y 5 d(t) represents the distance that an object travels in time t. 300 km $336 33. The calculator asks for a left bound. A(d) 5 2 Section 2.4 Practice Exercises, pp. C-1 Subject Index A Abel, Niels, 344 Absolute value bars, 7 Absolute value equations explanation of, 135 method to solve, 135–136, 159 Absolute value functions, 229 Absolute value inequalities in applications, 151–152 methods to solve, 148–151, 159 properties involving, 149 Absolute values of real numbers, 7, 73 to represent distance, 8 Addition associative property of, 10 commutative property of, 10 of complex numbers, 107–108 distributive property of multiplication over, 11, 12 identity property of, 10 inverse property of, 11 of matrices, 587–588, 626 of polynomials, 39 of radicals, 33 of rational expressions, 62–63, 74 Addition method to solve systems of linear equations, 494–497 to solve systems of nonlinear equations, 529–530 Additive inverse of matrix, 588 for real numbers, 11 Algebra of functions, 262–265, 277 fundamental theorem of, 332–335 linear, 497 Algebraic expressions explanation of, 10 method to simplify, 10–12 properties of exponents used to simplify, 20–21 Algebraic models, 12–13 Alternating sequences, 691, 764 am/n, 28–29 a1/n, 28–29 Analytic geometry, 178. Domain: {23, 22, 21, 2, 3}; Range: {24, 23, 3, 4, 5} 89. (A21)21 5 A 5 c 1 3 2 0 d 63. 769 Review Exercises 79. (t 2 9)2 33. p(x) 5 20 x 0 1 12x10 1 5 35. ` `50 b. (4y 1 3)4 5 3 6 63. A > C e. ent Male t is en Par is Female t is Male r Male Parent is 1 bee Female Pa Pa re 1 bee nt en is r Pa Female P 2 bees aren t is Female 3 bees Figure 8-3 3. Round to 4 decimal places. (Hint: Show that vn11 2 vn is constant.) 30. 2x 1 1 $ 2x 1 4 23 24 1 2 3 4 5 x Y2 5 2x 1 4 55. That is, if two exponential expressions with the same base are equal, then their exponents are equal. 62. Yes 31. Explain why a probability of 5 4 is impossible. For Exercise 49–50, find the value of an ordinary annuity in which regular payments of P dollars are made at the end of each compounding period, n times per year, at an interest rate r for t years. 2 2 12 2 6. 8, 0, 28, 216, … 14 16 , , 6, … 3 3 14. Minimum: 2 f. Expanding Your Skills 121. (29, 21) ´ (1, 9) 115. Identify the x-intercepts of the graph of f. Write the expression in terms of log x, log y, and log z. {0} 93. Write the General Form of an Equation of a Circle Definition of a Circle A circle is the set of all points in a plane that are equidistant from a fixed point called the center. Reflect y 5 f (x) across the y-axis. 5 4 3 2 1 2 3 4 5 x 28 27 26 25 24 23 22 21 21 22 23 24 25 24 25 y 5 4 3 2 1 1 2 3 4 5 6 7 8 x 1 2 x 28 27 26 25 24 23 22 21 21 22 25 24 23 22 21 21 22 23 23 24 25 24 25 101. 198 Chapter 2 Functions and Relations In Example 1, we demonstrate that the graph of a linear equation Ax 1 By 5 C is a line. 12 h. Suppose that a line passes through the points (4, 26) and (2, 21). 1 x 2 4 x2 1 x 1 4 x 15 (x 1 5)2 A D Ex 1 F Gx 1 H B C 19. I3 A 5 £ 0 0 0 1 0 4 3§ ✓ 24 0 1 0§ £ 9 1 11 1(1) 1 0(9) 1 0(11) 5 £ 0(1) 1 1(9) 1 0(11) 0(1) 1 0(9) 1 1(11) 1 5 £ 9 11 13. inconsistent a. With each bounce, the ball rebounds to vertical distance traveled by the ball. 1 2 3 4 5 6 7 8 9 x y 5 log3(x 2 1) 2 3 27 b. 31. 1! 2! 3! n! n 5 a i51 1i 1 2 i! We have used n as the upper limit of summation. {1} 61. 2, 4, 8, 16, … 52. y 5 g(2x) 1 39. The cost is $7.99 per shirt for 1 to 100 shirts, inclusive. Apply the Fundamental Principle of Counting 1. x $ 0 y$0 x # 120 y # 90 240x 1 320y # 48,000 c. P(x) 5 R(x) 2 C(x) EXAMPLE 6 Subtract the cost to produce x items from the revenue brought in from selling x items. (2`, 21) ´ (21, `) 3 (x) 5 4 2 9x 43. The center is in Quadrant IV, the radius is 5, and the circle is tangent to both the x- and y-axes. For Exercises 8–9, graph the function. 4 1 12 1 36 1 … 1 78,732 57. Shift upward 3 units. The right side is not factorable. 582–585 y 8 2 R.3. y-axis R.4. x-axis 3 3 True 3. Given a geometric sequence whose nth term is an 5 28(0.2)n, are the terms of this sequence increasing or decreasing? Let Pn be the statement 1 1 2 1 22 1 p 1 2n21 5 2n 2 1. Column matrix 212 3 27. Not applicable 35. Apply Vertical and Horizontal Shrinking and Stretching Horizontal and vertical translations of functions are called rigid transformations because the shape of the graph is not affected. y 9 8 7 6 5 4 3 2 x ⎝ ⎠ 1 x 3 4 5 x y 16 14 12 10 8 6 4 2 1 y 5 f21(x) 2 21. Parabola; (y 2 5)2 5 2(x 1 2) 25 9 y 9. 2 29. 1 f (x) 5 x 2 4 h(x) 5 1x 2 5 g(x) 5 x23 21. TIP 24 23 22 21 21 22 2y 5 4 1 2 3 4 5 x 23 24 25 Skill Practice 1 Graph the line represented by each equation. Is the point (3, 5) on the circle defined by (x 2 3)2 1 (y 2 5)2 5 36? ac 1 bc 59. log2 (x 1 y) 1 log2 z 13. Based on the answers from parts (a) and (b), does it appear that the rate at which annual income increases is increasing or decreasing with time? 34. If h, k, and a represent positive real numbers, then the graphs of the following functions are related to y 5 f (x) as follows. 1 ab 2b 1 a 4 1y 69. (g 1 h)(0) f 15. If rain is the only water that enters the pond, explain what the intervals of increasing and decreasing behavior mean in the context of this problem. At x 5 22, the function has a relative minimum of 0. { }; The value 23 does not check. {(1, 2, 3, 4)} 59. 1 1 2 3 4 5 x b. Quadratic; {0, 22} 75. in the 2. (21, `) c. 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 x 1 2 3 4 5 1 x 25 24 23 22 21 21 22 23 x 23 24 25 24 25 For Exercises 97–110, write the domain in interval notation. Find the number of terms of the arithmetic sequence. 2 2 45. (0.2 1 0.1k)4 26. 0, there are two corresponding y values. The light is green for 80 sec, yellow for 5 sec, and red for 35 sec. e , 2 , 22 f 69. y 5 x 2 7 y y 21. If m1 and m2 represent the slopes of two nonvertical perpendicular lines, then m1m2 5 . c(x) 5 22x 2 10x 1 4 y 2 2 18 15 h. n14 , find b45. 4 kg 97. a i2 5 a (j 1 1)2 5 a (k 2 1)2 i51 j50 k52 89. The coordinates of the relative minimum point are approximately (2.22, 22.11). Yes 61. Suppose that a line has a slope m and passes through a known point (x1, y1). 1 7. Therefore, P(E1) 5 n(S) 10 5 b. vertex 5. What is the probability that four unrelated people will all catch winter "colds"? h(x) 5 5x 2 42. All x for which f (x) 5 3. The formula A 5 481 c 1 521 h gives the amount of gas A (in gal) for c miles of city driving and h miles of highway driving. (0, 26) f. Therefore, the number of permutations of 4 distinct letters is given by 4 ? (22, 23) d. A card numbered between 5 and 10, inclusive, or a black card. (6v 2 7)90 1 216 35. 0 0 0.4 0 1 1 Greatest integer less than or equal to 0 is 0. a.–c. Find the average amount earned per year between the 5th year and 10th year. Therefore, the union of the two events make up the 1 18 1 5 1. 44–47 1. Male Female Total Yes No No Opinion Total 92 7 4 103 36 102 24 162 128 109 28 265 No Opinion Total 28 P(Y) 5 128 265 and P(O) 5 265 . 2 nonreal solutions 57. In an isosceles triangle, two angles are equal in measure. Also note that the graph is symmetric with respect y Axis of symmetry to the vertical line through the vertex called the axis 8 of symmetry. Expression; 35 1 12x 1 x2 1 x2 x 8. n(x) 5 3x 2 7; 22 , x , 2 Objective 5: Interpret a Function Graphically For Exercises 111–114, use the graph of y 5 f (x) to answer the following. 212, 6 d. q2 q q p 15. 23 for x , 1 for x $ 1 17. Yes 17. f (22) b. Graph Equations by Plotting Points 4. x 5 2 e. F 23 24 23 1 b. x 5 24, x 5 0 e. Passes through (261.5, 47.6) and is parallel to the line defined by x 5 212. { } (3. If the ship is located at a point (232, 40) on a map, write an equation for the boundary of the area within the range of the ship's radar. 12 c. Passes through (6, 24) and is perpendicular to the line defined by x 2 5y 5 1. 10 3 4 5 x 25 24 23 22 21 21 19. $550 67. x2 1 y2 , 9, x . 23 5 28 1 b b55 y 5 mx 1 b y 5 24x 1 5 5 4 1 y 5 22 x 1 2 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x We need to find an equation of the form y 5 mx 1 b. Let f be an increasing function. In addition to this textbook, she has authored textbooks in developmental mathematics, trigonometry, and precalculus, as well as several short works of fiction and nonfiction for young readers. Skill Practice 4 Graph the functions. Maximum value: 31 11. State one application of using the point-slope formula. Suppose that 20 good batteries and 6 defective batteries are in a drawer. Let h represent a positive real number. $364.80/yr b. The first five terms are a1 5 a2 5 a3 5 a4 5 a5 5 5 5(22) 5 210 5(22)2 5 20 5(22)3 5 240 5(22)4 5 80 TIP Alternatively, we can use a recursive formula: a1 5 5 and an 5 an21 ? q(x) 5 0 x 1 2 0 2 1 3 69. By the inductive hypothesis, [8 1 4 1 p 1 (24k 1 12)] 1 [24(k 1 1) 1 12] 5 22k(k 2 5) 1 (24k 1 8) 5 22k2 1 6k 1 8 as desired. The number 15 is a real solution to the equation x2 2 5 5 0 and a zero of the polynomial f (x) 5 x2 2 5. (y 1 2)2 5 28(x 1 6) b. y 5 2x 2 4 21. m 5 y 5 2 x 2 ; f (x) 5 2 x 2 3 3 3 3 7 2 3 a. 3 loga 33. 25 25 24 23 22 21 24 28 215 71. y 5 21.22x 1 1273 b. 5 62. 0 f. Square matrix 17. The student answered "Yes" or "No." b. {9} 1 1 rt 19 25. y 5 k 6 2r2 2 (x 2 h)2 59. E 5 kv2 26. The expression an 5 20.8n 1 54.8 resembles the slope-intercept form of a linear function f (x) 5 mx 1 b. a2 1 b2 a. 207 276 Chapter 2 Functions and Relations If f is defined on the interval [x1, x2], then the average rate of change of f on the interval [x1, x2] is the slope of the secant line containing (x1, f (x1)) and (x2, f (x2)) and is given by m5 p. 6375 77. If so, find the value of r. (See Example 8) 81. floor(23.1) e. y 5 21 SA-21 Student Answer Appendix 1 21. 237 265 b. 3 3 3 3 (a 1 b)3 5 a ba3 1 a ba2b 1 a bab2 1 a bb3 0 1 2 3 3 3 3 3 [3x2 1 (25y)]3 5 a b(3x2)3 1 a b(3x2)2(25y) 1 a b(3x2)(25y)2 1 a b(25y)3 0 1 2 3 5 1(27x6) 1 3(9x4)(25y) 1 3(3x2)(25y)2 1 1(2125y3) 5 27x6 2 135x4y 1 225x2y2 2 125y3 Skill Practice 4 Expand by using the binomial theorem. 5 4 3 2 Determining x- and y-Intercepts from an Equation 1 27 26 25 24 23 22 21 21 22 23 24 25 1 2 3 x Given an equation in x and y, • Find the x-intercept(s) by substituting 0 for y in the equation and solving for x. Equation; {7, 4} Section 1.4 Practice Exercises, pp. Each day, you lead by example to unlock our full potential and inspire our best work. If a row of the reduced row-echelon form results in a contradiction (that is, zeros to the left of the vertical bar and a nonzero element to the right), then the system is inconsistent. P1 is true because for n 5 1, the sum is 2 which equals 1(1 1 1). 8 6 4 15. 746–750 R.1. 362,880 R.2. 1 R.3. 42 R.4. 210 1. s(x) 5 e 2x 2 1 for x # 21 1x 1 1 for x . y 5 4 3 2 x y 22 2 0 2 1 2 2 4 2 25 24 23 22 21 21 22 x can be y must any real be 2. Evaluate the given expression. 0 d. Investigate Increasing, Decreasing, and Constant Behavior of a Function The graph in Figure 2-36 approximates the altitude of an airplane, f(t), at a time t minutes after takeoff. (2`, 22) ´ (2, `) b. 2 2 f. Directrix: y 5 1; 22 23 Axis of symmetry: x 5 0 24 x 25 26 27 29. Write a piecewise-defined function to model the monthly cost C(x) (in $) as a function of the number of minutes used x for the month. Two students are selected at random from the group of 12 to receive the scholarships. • Consider a set of n elements with r1 duplicates of one kind, r2 duplicates of a second kind, … , rk duplicates of a kth kind. There are 20 possible ways to select 2 people from 5 people in which the order of selection is relevant. A21 5 £ y 7 6 y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 22 23 24 25 1 2 3 4 5 x 49. For Exercises 91–92, use the fact that a median of a triangle is a line segment drawn from a vertex of the triangle to the midpoint of the opposite side of the triangle. log (m2 1 n) 2 2 3 19. Substitute (x 1 h) for x. Given h(t) 5 24.9t2 1 10t 1 100, the coefficients are a 5 24.9, b 5 10, and c 5 100. Yes 22 23 21 8 22 Chapter 6 Cumulative Review Exercises, pp. False 27. Job A 85. {26} (2`, 26) ´ (26, `) e. The graph of y 5 f (3x) is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). 2 26. , 4b 5 (24, 4). is an arithmetic sequence with common difference 2d. y 2 y1 5 y 2 (23) 5 y135 y5 m(x 2 x1) 24(x 2 2) 24x 1 8 24x 1 5 (slope-intercept Apply the point-slope formula. This indicates a horizontal shrink. (27, 7) c. a1 5 5, d 5 23 For Exercises 19–24, a. e24, f 2 8 89. {0} b. 5 4 3 2 1 25 24 23 22 21 21 22 y 70. x 5 621z 2 162 1 y 115. {(21, 2), (2, 5)} 43. This is the vertical line that passes through the vertex. 4 real zeros; f (x) has 1 positive real zero, no negative real zeros, and the number 0 is a zero of multiplicity 3. 12 unit to the right of the vertex y 27. [215, 211) ´ (211, `) 109. 7C2 5 56 ? (17, 9) and (42, 26) 28. (See Examples 3–4) 15. p 5 q2f 109. a (3i 1 7) 5 3 a i 1 7n i51 i51 n 96. 767–770 1. Determine the average rate of change of blood alcohol level from x1 5 2.5 to x2 5 8. What is the probability that a live birth will not be of twins? 1 5 2 3! 5 3 ? g(x) 5 2 (x 1 2)2 1 3 3 77. EXAMPLE 1 Finding the Distance Between Two Points Find the distance between the points (25, 1) and (7, 23). {(22z 1 16, 3z 2 5, z) 0 z is any real number} 65. Bike Week in Daytona Beach brings an estimated 500,000 people to the town. F1 1 F2 1 … x Section 3.1 Quadratic Functions and Applications 289 3. q)(x) 5 (x2 1 3x) 11 2 x; (2`, 1] q 11 2 x 23. 2! 31. Given a function defined by y 5 f (x), to find the ___________-intercept, evaluate f (0). 32. Yes 65. Write a function that represents the amount D(C) (in $) for C euros spent. s(t) 5 216t2 1 216t b. EXAMPLE 2 Writing an Equation of a Line Given Two Points Use the point-slope formula to write an equation of the line passing through the points (4, 26) and (21, 2). p(x) 5 2x 1 12 81. m 5 2 3 11 3 1 a. The cost of labor, taxes, and ingredients for the cookies amounts to $0.24 per cookie, and the cookies sell for $6.00 per dozen. 4.27 b. If one person from the study is chosen at random, find the probability of the given event. [2, 18) 115. 1. From Example 3, the discriminant of 2x2 1 4x 2 5 5 0 is (4)2 2 4(21)(25) 5 24 , 0. If one person is chosen at random, find the probability of the given event. Graph y 5 f (x). (2`, 22) ´ (22, 0) ´ (4, `) 37. Let a1 represent the original amount in the account; that is, a1 5 500,000. y 5 4 3 2 26 25 24 2322 21 21 22 y 5 4 3 2 1 1 1 2 3 4 x 22 21 21 22 23 22 23 24 24 25 24 25 1 2 x 26 27 28 4 5 6 y 2 1 y 5 2f(x 2 2) 2 3 24 23 22 21 21 22 23 7 x 1 2 3 4 5 6 2 3 4 5 x 24 25 27 28 85. a 5 10 c. (0, `) x f(x) 5 ⎛ 52 ⎞ 1 0 b. 6 Let Pn be the statement 2 is a factor of 5n 2 3. Explain how the graphs are related. 3 1 3 ? 10w6 1 7w3y2 2 6y4 67. Replace (x, y) by (x, y 2 k). 0 27. an 5 0.139(0.01)n21 4. Make a chart showing Y y the possible genotypes of the offspring. 1 51 5 16 2 2 1) 51 57. Each multiple-choice question has 4 possible responses of which exactly one is correct. 40 97. 21, 29, 6i 15. Notice that the graphs of both equations appear. (gf)(5) d. 1 2 3 x 14 12 10 8 6 4 2 22121821521229 26 23 22 3 6 9 x 24 26 2 45. 21 43. a , b 2 4 b. No 1.55 3 1018 N 107. She receives a 4.5% raise each year thereafter. $8260 17. From Figure 8-8, it appears that the sum will be 1 whole unit. (p 2 m)(24) m c. circle; center 3. (Using techniques from calculus, we can show that this sum converges to π.) 8. 2136 c. n! . 2 1 1 23 y 3 4 5 6 7 x 23 24 25 37. Horizontal translation (shift) y 5 f (x 2 h) y 5 f (x 1 h) Shift to the right h units Shift to the left h units Replace (x, y) by (x 1 h, y). SA-17 c. 285 286 Chapter 3 Polynomial and Rational Functions SECTION 3.1 Quadratic Functions and Applications OBJECTIVES 1. 15 ft/sec; 30 ft/sec; 2.7 ft/sec; and 1.4 ft/sec 53. [6, 8] (Hint: t 5 6 and h 5 2) 124. 24x 1 6y 5 11 23x 1 9y 5 1 21. From the graph of a function, how can you determine if the function is even or odd? k(x) 5 • 2x3 1 2x 1 5 for 21 , x , 2 1 for x $ 2 129. 3.96 m b. Minimum: 60 17. 26, 3, 232, 34 11. A voter that is neither Democrat, Republican, nor Independent? How many codes can be formed if the corresponding 3-digit number is to be an even number? 1 2 3 4 5 x 23 24 25 24 25 24 25 25. If students still prefer holding a text as they study, they can order a loose-leaf copy of their textbook for just $15. h(x) 5 2x2 1 x Solution: a. pq 1 p 15. Find (m ? y 5 f(x) 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 y 5 2f(x) 5 x 236 Chapter 2 Functions and Relations Transformations of Functions Consider a function defined by y 5 f (x). y 3 4 p(x) 5 5 (2x)3 1 2 3 4 5 x 1 2 3 4 5 23 24 25 24 25 1 2 3 4 5 x y 5 2f(x) 1 ; Shift the graph of f to the left 1 unit, x stretch the graph vertically by a factor of 3, and shift the graph downward by 2 units. Consider the function pictured in Figure 2-37. 131: © Gaja Snover/Alamy Images RF; p. y¿ 5 2 7. y y If a plant with two yellow genes (YY) is crossed with a plant with two green genes (yy), the Y Yy Yy Parent 1 result is four hybrid offspring with genotypes Yy. The offspring will be yellow, but will carry Y Yy Yy the recessive green gene. g(a) 5 5 8 2 Za 2 2Z c. For a given value of x, the value of h(x) is one-half that of f (x). Yes 49. x-intercept: (24, 0); y-intercepts: (0, 4), (0, 24) b. a i51 4 i x 85. Write the nth term of an arithmetic sequence with a1 5 4 and a5 5 28, and then find a2, a3, and a4.) 82. {(4, 2)} 13. h(23) b. Minimum: 2 5 2 4 4 h. Explain the difference between the principle of mathematical induction and the extended principle of mathematical induction. f (c) 5 14 2 c 10. 1 d. a b(23) f c. {(1, 22, 3)} 25. In Figure 2-2, six points have been graphed. (0, `) 7. { } 53. Using the graph and the results from parts (a) and (b), what does the difference in the rates of change mean? 0, the parabola opens upward, and the vertex is the minimum point. Average rate of change 5 b. 2 3 21 1 1 65. Change assignment dates right from the home page. Yes 41. Words cannot begin to express our heartfelt thanks to all of you, but we'll do our best. (5x 1 4y)6; fifth term 66. an 5 2(1.2)n b. 100 people 30. 2 (multiplicity 2), , 24 25. If a couple plans to have three children, the probability that all three will be boys is 0.125. 108. { } 59. 22 21 21 22 47. 5! 6 6! 5 5 56 b. What is the slope of a line parallel to this line? a2 a3 a4 a5 2 2 2 2 a1 a2 a3 a4 5 5 5 5 53.2 52.4 51.6 50.8 2 2 2 2 54.0 53.2 52.4 51.6 5 5 5 5 20.8 20.8 20.8 20.8 b. Is the point (24, 7) on the circle defined by (x 1 1)2 1 (y 2 3)2 5 25? 141: © Julie Miller; p. The dashed horizontal and vertical line segments form a right triangle with hypotenuse d. The line is perpendicular to the y-axis and the y-intercept is (0, 7). 111 52 p The domain of n excludes any values of x that make n(x) 5 0. The amount of fuel used by this hybrid vehicle is given by 1 1 A5 1362 1 1912 48 52 5 2.5 gal 2. 12. Find the average rate of change of f over the interval [0, 3]. y 5 2 x23 26. In Example 1, the graph of function f is a semicircle and the graph of function g is a horizontal line (Figure 2-38). Table 8-3 Sums of Powers Let n represent a positive integer. a aibi 5 a ai a bi i51 i51 i51 a ai i51 n a bi i51 99. In addition, suppose that each person spends an average of $100 on art, drinks, and food. y (f 1 g)(x) 5 Î 25 2 x2 1 5 g(x) 5 5 f(x) 5 Î 25 2 x2 10 9 8 7 6 5 4 3 2 f(4) 5 3 1 26 25 24 23 22 21 21 1 2 g(4) 5 5 3 4 5 22 Answer 1. 300 ft 5 ft 80 ft 1000 ft rafter rise and the rafter run fraction is typically written with a denominator of 12. t(x) 5 1 0x 0 3 28. x For Exercises 3–7, refer to the functions f, g, and h defined here. Find the number of terms in the arithmetic sequence. {24, 3, 22, 1} 4 e 6, f 14. Increasing. 9 c. x11 5. Plot Points on a Rectangular Coordinate System Graphing Utility Mathematician René Descartes (pronounced "day cart") (1597–1650) was the first to identify points in a plane by a pair of coordinates. P1 is true because 1 5 14(51 2 1). [21, `) 59. 4i 12 91. 1 R.2. Slope: 2 ; y-intercept: (0, 8) 4 R.4. {(24, 1)} 3. $150 is invested 12 times per year for 34 yr. y 5 0.511x 1 104 y 5

0.511(55) 1 104 5 132.105 (55, 132) 0 200 y 5 0.511x 1 104 0 0 80 To approximate the systolic blood pressure for a 55-year-old, substitute 55 for x. (2`, 3) ´ (5, `) 89. 4 2 2(x 1 1) 1 12 1 x , 0 c. Solution: Given m 5 24 and (2, 23). (22, 0) and a , 0b 3 f. 4 1 1 n(n 1 1) n(n 1 1)(n 1 2) 5 3 n 6. x 1 1 b. Never constant 103. Australia: 26.9 million; Taiwan: 24.5 million c. 6x 5 7y 34. A radar transmitter on a ship has a range of 20 nautical miles. 239–243 25 25 9. s(tA) 5 s ? Then the probability that the coin will land heads up on both tosses is P(A and B) 5 P(A) ? 40 30 20 10 24 23 22 21 210 220 1 2 3 4 5 6 x 26. 10 10 216.1 16.1 210 216.1 13. The sum Sn of the first n terms of a geometric sequence is given by Sn 5 Sum of an infinite geometric series: Given an infinite geometric series a1 1 a1r 1 a1r2 1 a1r3 1 … with 0 r 0 , 1, the sum S of all terms in the series is given by S5 Note: If 0 r 0 $ 1, then the sum does not exist. Graph a 19. Therefore, the number of ways that the questions can be answered on the test is given by Each true/false question has 2 choices Answers 2. The format to enter the function is as follows. (22, 4] 14. f (22) c. (n ? Then if the equation represents a circle, identify the center and radius. formula defines the nth term of a sequence as a function of one or more terms preceding it. 1 49. Gauss realized that the sum of the integers from 1 to 100 was the same as 50 pairs of numbers each summing to 101. paper) — ISBN 978–1–259–57046–9 (alk. R. f(c) 5 1c 1 20 b. • Julie Miller constructed over 50 dynamic math animations to accompany the college algebra text. 2 22. 5 3k11 Therefore, (k 1 1)! . • The axis of symmetry is x 5 h. 5 x2 1 0 y 0 5 8 x For Exercises 18–19, determine if the function is even, odd, or neither. dn 5 6n 1 7; find d204 For Exercises 21–24, match the sequence or function with its graph. 23 131. SECTION 8.7 84. {x 0 x $ 5} 24. E3 5 { } Therefore, P(E3) 5 The probability of selecting a red marble is 15 . log1y5 125 5 23 log 1,000,000,000 5 9 23. To calculate the overall star rating and percentage breakdown by star, we donâ€™t use a simple average. P(128) 5 1.50(128) 2 120 5 72 Substitute 128 for x. If events A and B are independent events, then the probability that both A and B will occur is P(A and B) 5 P(A) ? 7! 5 5040 5. 5 4 3 2 1 1 2 3 4 5 x 24 23 22 21 21 22 23 23 24 25 24 25 1 2 3 4 5 6 x x 176 Chapter 2 Functions and Relations For Exercises 71–72, the endpoints of a diameter of a circle are shown. (f + g)(2) 1 23 e. y 5 0 b. 50P4 5 5,527,200 36,000 32 43 5 1 5 0.00012 40. A 5 A5 r n 150C A1 1 0.06 (12)(34) 12 B 0.06 12 2 1D A 5 199,548.50 P 5 $150 r 5 0.06 n 5 12 (the money is invested monthly) t 5 62 2 28 5 34 yr The annuity will be worth $199,548.50 when the employee reaches age 62. x; y 1 {4} 7. SA-8 Student Answer Appendix Chapter 1 Cumulative Review Exercises, p. Assume that 4k , (k 1 2)! for an integer k $ 2. 24x2y 2 12yz2 1 z3 3 2 113. Give an example of two events that are not mutually exclusive. e 1, 2 f 6 7 4 95. f 21(x) 5 (x 2 1)3 1 4 Section 5.1 Practice Exercises, pp. Minimum value: 22 6 5 i. x2 1 y2 5 25 2 3 4 8 2. 13 14 15 1n 1 2 The series consists of n terms where a formula 1 1 1p1 for the nth term is given. 9 8 7 6 5 4 Label the center (h, k) and the radius r. 6x2 1 6xh 1 2h2 4x3 1 6x2h 1 4xh2 1 h3 2 10x 2 5h 53. 52 13 Photo Credits Page. 8 For Exercises 11–16, match the probability with a statement a, b, c, d, e, or f. No 9. 2 1 i51 5 25 125 1 1 1 p 2 8 32 In Example 9, we use the formula for the sum of an infinite geometric series to write a repeating decimal as a fraction. 2A 2 C 5 £ 33. Arithmetic; d 5 27 b. t(x) 5 • 21 for 22 # x , 0 1 for 0 # x , 2 21 for 23 , x # 21 68. 2 103. g(3) 40. 68–72 1. A 12, 3B 1 9 A 2, 2 B d. (x 1 6)2 1 (y 2 2)2 5 9 b. y 5 x 1 1 5 256 Chapter 2 Functions and Relations For Exercises 21–26, use the graph to determine if the function is even, odd, or neither. x 5 < 3.56 2 3 97. s(x) 5 (x 1 2)2 2 3 75. Label the shorter sides as a and b. 70% b. Isner and Mahut would meet in the first round 2 yr in a row. 64.8 in. Next, assume that Pk is true and show that Pk11 is true: Assume that 4 is a factor of 9k 2 1. { } 49. 125 1. Then the number of permutations of the elements of the set is given by u u. 1s ? y 5 2 40. T(x) 5 0.019x 1 172 for x . (See Example 1) 7. 6x2y 1 2y3 49. 23 51. 22 87. (5, 22) For Exercises 4–6, determine the x- and y-intercepts of the graph of the equation. y 5 y 5 f(2x) 4 3 2 The operations of reflecting a graph of a function about an axis and shifting, stretching, and shrinking a graph are called transformations. The numbers in the sequence defined by a1 5 1, a2 5 3, and an 5 an21 1 an22 for n $ 3 are referred to as Lucas numbers in honor of French mathematician Edouard Lucas (1842–1891). n! is true for all positive integers n. View data for individual students up to the multi-campus level. f(x), where a is a positive real number. If three bulbs are chosen at random, 93. 64. 2(k 1 1). j. What is the probability that an individual from the population can donate blood to a person with AB1 blood? y 5 x2 1 3 8. The code must represent a 3-digit number that is a multiple of 5. 1 8! 8! 8 ? 4x8 2 4x4y 1 y2 1 4x8 2 4x4y 1 y2 4. Singular matrix 21 23 5 26 17. e f ; The solution to r (x) 5 0 gives the x-coordinate of the point 3 where the graph of f crosses its slant asymptote. How many first-, second-, and third-place finishes are possible? Furthermore, 3k 5 2k 1 k . Given a function defined by y 5 f (x), to find the x-intercept(s), substitute 0 for __________ and solve for x. 5 For Exercises 85–88, determine if the graph of the equation is symmetric to the y-axis, x-axis, origin, or none of these. h(x) 5 1 9x 2 5 98. (2n)! (2n 1 1)! 44. For example: f(x) 5 x3 1 25 24 23 22 21 21 22 1 2 3 4 23 5 x The point (0, 0) on the graph of f (x) 5 x3 corresponds to (0, 2) on the graph of h(x) 5 x3 1 2. a2 , 2 b 2 4 2 4 29 1 213 29 2 213 c. Between 21 and 0; 20.6198 d. Vertices: (6, 3), (6,23) c. x2 1 y2 1 6x 2 4y 1 15 5 0 y 29. r The value of r is 0.8, the value of a1 is 100, and the nth term is an 5 100(0.8)n21. See Example 5 in Section 2.4. Solution: Label (2, 23) as (x1, y1) and m 5 24. (n 2 m)(26) b. e a 2101 2 3 2§ 1 2 7. EXAMPLE 8 Using Transformations to Graph a Function Use transformations to graph the function defined by v(x) 5 212x 1 2. y-axis y 13. Computing Empirical Probability The empirical probability of an event E is given by P(E) 5 EXAMPLE 5 Number of times the event E occurs Number of times the experiment is perfomed Computing an Empirical Probability Data from the Centers for Disease Control for a recent year indicate that there were approximately 4,295,000 individuals of age 20 in the United States. g)(0) y 5 4 3 2 d. 22 23 24 F F 2 39. Graph the solution set. (f + g + h)(x) 5 2A 1 x B2 1 1 85. a , 0b 79. Given f (x) 5 2x 1 4 and g(x) 5 x2, a. 1023 19. Suppose that a player is located at point A(460, 420) and must move in a direct line to point B(80, 210) and then in a direct line to point C(120, 60) to pick up prizes before a 5-sec timer runs out. The set of all possible outcomes of an experiment is called the sample space of the experiment. • The perimeter of a rectangle is a function of its length and width. In the New York state lottery game “Lotto” a player wins the grand prize by choosing the same group of 6 numbers from 1 through 59 as is chosen by the computer. 18 a. This relation is a function. A finite sequence is a function whose domain is the set of the first n positive integers. y 5 21.2x 1 1250 b. Left semiellipse 87. e 23, 2 f 91. {(2, 1, 23)} 30. The series a ai 5 a1 1 a2 1 a3 1 p i51 is called an infinite series because there are an infinite number of terms. (10C2) ? Notice that the calculator expects the equation represented with the y variable isolated. c d ; This matrix 21 23 22 represents the reflection of the triangle across the x-axis. 1 27 , f 27 8 89. For example, the following ordered pairs are solutions to the equation y 5 x 1 2. True d. The customer paid by credit card or by cash. Center: A 2, 22B; Vertices: A 32, 1B, A 32, 25B; Foci: A 32, 3B, A 32, 27B 2 41. (2`, 4) ´ (4, `) g. Identify Even and Odd Functions A function may be symmetric with respect to the y-axis or to the origin. We have chosen i. False 9. 8! 6! 38. {(7, 6)} 14. Answers y 5 mx 1 b y 5 24x 1 b 23 5 24(2) 1 b 1 4. y2 5 216x 63. Upward c. a. x6 n7 (m 1 n) m 53. A 12u3 1 v4 B 8; third term 37. y 1 2 3 4 5 x 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x 5 4 3 2 1 1 1 25 24 23 22 21 21 22 2 y 42. 1 a. 4 g. Therefore, count the number of combinations rather than permutations. This implies that 4k 2 1 5 3a and that 4k 5 3a 1 1 for some positive integer a. BA 5 £ 22 24 26 § 24. This means that the principal invested each month has not yet been taxed. If neither A nor B is present, then the letter O is used. f (x) 5 0 x 0 2 2 70. 73. 25 81. 9! 2! ? Explain why the sequence a1, a3, a5, ... is also geometric and determine the common ratio. (2 2 x2)1/2 (x 1 1)3/2 (3x 2 1)2/3 2 13x 1 3 75. 5 200 25 200 100 200 25 41 1 1 1 164 5 67. Determine the y-intercept. $129.60 an 5 20.8n 1 54.8 55 50 Water Level (in.) an 5 54 1 (n 2 1)(20.8) an 5 54 2 0.8n 1 0.8 an 5 20.8n 1 54.8 45 40 35 30 0 1 2 3 4 5 6 Day Figure 8-4 7 8 9 10 704 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Finding a Specific Term of an Arithmetic Sequence Find the ninth term of the arithmetic sequence in which a1 5 24 and a22 5 164. Sometimes the values of x must be restricted to produce real numbers for y. Explain why the number of combinations of n items nP r . m 5 2 3 4 5 x 0 0 27. 20,000 # x # 20,000 . Therefore, the intersection of their domains is (2`, `). an 5 5n 2 17 1 7 1 b. Finding Intercepts Using Function Notation Given a function defined by y 5 f (x), • The x-intercepts are the real solutions to the equation f (x) 5 0. Find the sum of the first 60 terms of the sequence. 10 1 37. This is demonstrated in Example 5. The value (n 2 r)! is (3 2 5)! 5 (22)!, which is undefined. 70 mph 65. • The set of x values in the ordered pairs is called the domain of the relation. In how many ways can 5 children be arranged in a line for a photograph? 9a 2 3b 1 c 5 27.28 a 2 b 1 c 5 3.68 100a 1 10b 1 c 5 18.2 c. • Find the y-intercept(s) by substituting 0 for x in the equation and solving for y. q(x) 5 22 0 x 2 1 0 1 4 Mixed Exercises For Exercises 79–86, the graph of y 5 f (x) is given. b 5 2 b. For each value of n, we have a corresponding statement Pn involving the value of the partial sum. 241 mmHg 59. 6 b x 21 5 6 a 2 b22 x 21 2 Substitute 6 for x in k(x). Consider the geometric sequence 12, 14, 18, 161 , p , A 12 B n, p and the corresponding infinite geometric series 12 1 14 1 18 1 161 1 p 1 A 12 B n 1 p . Even 41. • The y-coordinate is the value of the relative maximum or minimum. 167 7. decreases 7. f (x 1 h) 2 f (x) (3x 1 3h 2 5) 2 (3x 2 5) 5 h h 3x 1 3h 2 5 2 3x 1 5 5 h 3h 5 h 53 Clear parentheses. Evaluate (T + C)(18) and interpret the meaning in context. Assuming that the items all match together well, how many different outfits does Debbie have if she selects one item from each category? f (x) 5 22(x 2 1)2 1 8 b. y When the light turns green, the car under54 y 5 45 45 goes a constant acceleration for 20 sec until 36 it reaches a speed of 45 mph. x 2 1220 81. p(x) 5 3(x 2 2)2 2 19 b. Suppose that a circle is centered at the point (h, k) and has radius r (Figure 2-11). {(2, 4), (2, 24), (22, 4), (22, 24)} 8 7 37. If Iglesias is at bat three times in a game, what is the probability that he will not get a hit on any of the three times at bat? 2A 113 2 110B 2t 27. {25, 21, 2, 10} E22 6 16F 5 1 3 3 95. 2 8 8 e. (2`, 22) ´ (22, `) 105. a i2 5 a u 5 a u i51 j50 u u 88. r(x) 5 e x2 2 4 for x # 2 2x 2 4 for x . 40,320 c. What is the slope of a line perpendicular to this line? Find the fifth term. How many codes can be formed if the corresponding 3-digit number is to be a multiple of 5 and there can be no repetition of digits? In Examples 1 and 2, we use mathematical induction to prove a statement involving a summation. 338 million c. In this case, x 5 3 is excluded from the domain. 6 k(k 1 1)(2k 1 1) (Inductive hypothesis). If the slopes of the two lines are the same and the y-intercepts are different, then the lines are parallel. 5 300,000,000 75 75 75 15 16 4 4 13 1 d. 2 y or A 2 yB 4 3y5 33. m 5 27. (g 2 h)(2) 11. n(S) 10 c. Domain: (2`, `); Range: (2`, 0) c. h Use the difference quotient to determine the average rate of speed on the following intervals for t. x 105. Determine f (2). The solution set is a single point (the origin). 264 Chapter 2 Functions and Relations b. Skill Practice 1 Determine whether the sequence is arithmetic. 5 4 3 2 1 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 24 25 x Objective 2: Apply Vertical and Horizontal Translations (Shifts) For Exercises 15–26, use translations to graph the given functions. (g + f)(4) 5 g(f (4)) 5 g(0) 5 24 The open dot at (23, 1) indicates that 23 is not in the domain of f. Apply Reflections Across the x- and y-Axes The graphs of f (x) 5 x2 (in black) and g(x) 5 2x2 (in blue) are shown in Figure 2-26. Examples: 2116 (ratio of 26 and 11) and 9 (ratio of 9 and 1). E2: The ball lands on a red slot. 7 5 504 51. Given the sequence defined by bn 5 (21)n21 ? R.4. Multiply by using the special case products. 6C4 40. Given f (x) 5 4x2 23 0 x 0, find f (2x). 248 277 Review Exercises The greatest integer function, denoted by f (x) 5 Œxœ or f (x) 5 int(x) or f (x) 5 floor(x) defines f (x) as the greatest integer less than or equal to x. 183 bushels 32. 2x 2 3 , x 2 1 c. $705.96 129. a1 5 0, a2 5 23 49. The variables Xmin, Xmax, and Xscl relate to [220, 20, 2]. (x 1 5)2 1 (y 2 3)2 5 9 (y 2 3)2 5 9 2 (x 1 5)2 y 2 3 5 6 29 2 (x 1 5)2 y 5 3 6 29 2 (x 1 5)2 Notice that the graph looks more oval-shaped than circular. 2 1 24. {2} Linear inequality b. g, and f g p. m(x) 5 0 x 1 1 0 21. P1 is true because 3 is a factor of (4)1 2 1 5 3. { } 63. Show that 1 1 4 1 p 1 4k21 1 4(k11)21 5 13 (4k11 2 1). y 5 0 x 1 1 0 1 x 42. 4 b. Reflect the graph across the y-axis. A21 5 c 45 3d 28 1 0 8 b. The range is [27, `). w(t) 5 1t 2 16 c. (0, 24); m 5 69. [25, `) c. Cholesterol Amount vs. 2 51 16 25 9 16 E A4, 3 13 B, A4, 23 13 B, A24, 3 13 B, A24, 23 13 B F The transverse axis is horizontal if the coefficient of the x2 term is positive. Solve the equation 3x 2 (x 1 4) 2 1 5 0 and verify the solution graphically on a graphing utility. The second part involves proving that if any statement Pk in the sequence is true, then the statement that follows is also true (Pk implies Pk11). Then plot points r units to the left, right, above, and below the center. x 2. 2a 2a Using the Vertex Formula Given f (x) 5 2x2 1 4x 2 5, a. The data in Table 8-4 give the 1-yr survival rates for people in the United States for selected ages. A lawn service company charges $60 for each lawn maintenance call. After two half-lives, the amount of substance has been halved, twice. The total area is 44 ft2. a (4i) 5 a u 5 a u i51 k52 j50 k52 Mixed Exercises n n n n 90. Determine the radius of the circle. The resulting equation is not equivalent to the original equation. Interest compounded quarterly c. In the Minnesota Lotto game “Gopher 5” a player wins the grand prize by choosing the same group of 5 numbers from 1 through 47 as is chosen by the computer. 2 66. True SA-28 Student Answer Appendix 99. 720 Chapter 8 Sequences, Series, Induction, and Probability Solution: Point of Interest The contributions made to the investment in Example 11 are tax deferred. Graph y 5 2f (x). Identify the slope in terms of the coefficients A and B. 24 c. n The nth partial sum of a sequence {an} is a finite series and is given by Sn 5 a ai 5 a1 1 a2 1 a3 1 p 1 an p. (x 1 2)2 1 (y 1 1)2 5 100 y b. c 20 d 2143 1 45. This result can also be obtained by using factorial notation: Number of people in the group (5). • Technology Connections require the use of a graphing utility and are found at the end of exercise sets. 2k By the inductive hypothesis, k! . Answer y 5. 2x 2 3 c. (4, 0), A 12, 0B, and A212, 0B (4, 0), A 12, 0B, and A212, 0B 14. Which blood type is most rare? Stretch the graph of f horizontally by a factor of 3, reflect across the x-axis, and shift the graph downward 6 units. by 16 in. 331 cases 35. (x 1 4)2 1 (y 2 1)2 5 9 y y b. f (x) 5 0x 0 1 1 16. 2 2 2.5 2 Greatest integer less than or equal to 2 is 2. 1 24 x 2 w(x) 5 x 2 1 4 7 6 5 4 3 2 x x3 1x2 24x 24 x2 13x v(x) 5 1 210 212 25 24 23 22 21 21 22 214 23 1 2 3 4 2x4 x4 19 5 x x 6 12 18 30 R(x) 3 4 4.5 5 x 5 25 y 5 f(x) 5 b. R 17 6 D; 21. (x 2 2)2 1 (y 1 1)2 5 9 This equation represents the graph of a circle with center (2, 21) and radius 3. {(23, 2), (9, 5), (1, 0), (23, 1)} Section 2.3 y 4 3 2 (3, 1) 1 22 21 21 22 1 2 3 4 5 23 24 (3, 24) 25 6 7 8 x Points align vertically 26 Figure 2-14 185 Functions and Relations A relation that is not a function has at least one domain element x paired with more than one range element y. {0, 2} 73. m(x) 5 3x 2 7 b. Assume that all items fashionably match. Avoiding Mistakes The roles of the men and women on the committee are indistinguishable. • The vertical leg of the right triangle is 0 y2 2 y1 0 or equivalently 0 y1 2 y2 0 . x 1 a. In how receive b. Then, n 1. x 1 x ax a(a 1 bx) e 11 e 12 SA-32 Student Answer Appendix Section 5.4 Practice Exercises, pp. x-axis The graph of x2 1 y2 5 9 is a circle with center at the origin and radius 3. 129. 1 5 48 85. {(3z, 22z 1 5, z) 0 z is any real number} 8. 695 Properties of summation: If {an} and {bn} are sequences, and c is a real number, then p. Find all the zeros of f (x). (x 2 1.5)2 1 y2 5 2.25 13. 264 Difference quotient The composition of f and g, denoted f + g is defined by (f + g)(x) 5 f (g(x)). Find (f + g)(x). {(2, 2), (0, 22)} 1 2 3 4 5 x 9. 4 2 2(x 1 1) 1 12 1 x 5 0 b. (6C3) ? {(6, 3)} 43. f 21(x) 5 65. 175 mph d. Undefined 45. 2h(x) 5 24x3 1 2x c. 23 e. y 5 0 x 0 2 1 5 000 2 1 5 21 y y 5 |x| 2 1 4 3 2 (1, 0) 1 24 23 22 21 0 1 21 (21, 0) 22 23 2 (0, 21) 24 Figure 2-8 3 4 x To find the y-intercept(s), substitute 0 for x and solve for y. 3 3 8. The person is 31 or older. Point of Interest Mathematical induction is one type of mathematical proof, but there are many other techniques, including proof by contradiction. k12 By the inductive hypothesis, replace the sum of the first k terms by k 1k 1 . A both zero. Therefore, at x 5 4, the function has a relative minimum of 22. y 19. Suppose that a jury pool consists of 30 women and 26 men. 2552 307.52 is more circular than the inner ellipse because the eccentricity is closer to zero. 547 1 0 2 47. The function g is the “inside” function and f is the “outside” function. {254} 29. 2.3 visits per year 18. a b 1 3 c. (3300)2 2 y2 (2189)2 23. Evaluate f (x) 5 Œx 2 1œ for the given values of x. Definition of n! • Let n be a positive integer. y 5 2x 1 5 c. 9 4 103. t 5 119. A21 5 £ 21 2 35. The blood alcohol concentration rose by an average of 0.03% per hour during the second hour. Write a model of the form P(t) 5 P0e kt to represent the population P(t) for a time t years since 2000. We have A 32 B k11 5 32 A 32 B k . f (21) d. Write a linear profit function for producing and selling x cups of lemonade. Optimized, Structured Learning Using adaptive artificial intelligence, ALEKS identifies precisely what each student knows and doesn’t know, and prescribes an individualized learning plan tailored to their unique strengths and weaknesses: • • • • • • Targets critical knowledge gaps Open-response environment Motivates student learning Presents only topics students are ready to learn Enhances learning with interactive resources Provides a structured learning path “I evaluated many different options, and ALEKS provided, by far, the best cycle of assessment and learning that allows for individualized instructional paths . The graph of a linear function is a slanted line. The ball is equally likely to fall in any one of the 38 slots. The vertex is (1, 8). (Source: U.S. Census Bureau, www.census.gov) If three people were selected at random from this population, what is the probability that all three would not have coverage? There are no restrictions on the letters or digits?) 23 7 b. floor(x) is the greatest integer less than or equal to x. 5ex11 2 100 5 0 5. Likewise, the y-coordinate of the midpoint is the average of the y-coordinates from the endpoints. finite 5. Slope-intercept form The slope is the coefficient on x. h(x) 5 2x2 16. Expanding Your Skills 93. R.1. (5v 1 2)2 R.2. A8a2 2 9b3 B 2 2 1 R.4. a m 1 2b 5 R.5. (4a 2 3b)3 R.3. A4x 1 115B 2 Concept Connections 1. A face card or a red card. • The company experiences a profit if more than 80 cups of lemonade are produced and sold. 212x 2 49 y12 7 2 7 a8 1 1 2 9. 78. y 5 f(x) 25 24 23 22 21 21 22 Number of attendees, y b. Interpret the meaning of the y-intercept in context. (See Examples 6–8) 10 7 2 k21 51. 5C5 11C3 45. y 5 1.2x 1 0.78 b. 111–113 Section 1.1 Practice Exercises, pp. For a recent year, approximately 36,000 people were killed in the United States in motor vehicle accidents. Therefore, the values of x must be chosen so that when substituted into the equation, they produce a real number for y. y 5 x2 1 6x 1 1 2 18. $20.80 f. 8 9 10 11 ,2 ,2 ,2 , p 11 22 33 44 50. 46 # x1 # 96 vehicles per hour; 67 # x2 # 117 vehicles per hour 23. y 5 23 37. 25a 1 10ab 1 b 6 d. This will help you to identify common mistakes and understand their behavior pattern, such as when they study and how frequently. log3 (80 1 1) 5 log3 81 5 4 ✓ a. Graph y 5 23f (2x). 5 83. 3 3 61. Skill Practice 5 Find the number of terms of the finite arithmetic sequence 16, 11, 6, 1, … , 2239. There are two scenarios for the salesperson’s income. In Example 2, we consider g(x) 5 (x 1 3)2. Given the sequence a1, a2, a3, … , each term after the first is obtained by multiplying the preceding term by r. f (w) 5 a. (2`, 22) 14. Another method is to use the vertex formula. The horizontal line is called the x-axis and the vertical line is called the y-axis. Real part: 3; Imaginary part: 27 b. We begin in Example 1, by using a figure called a tree diagram to organize different outcomes of a sequence of events. b30 5 252 32,686 75. {27, 3} b. 85. 5 4 3 2 Skill Practice 7 Graph the function. Maximum: 23 1 h. Therefore, the equation is a D E hyperbola with center a2 , 2 b. g)(x) and state the domain in interval notation. f (g(8)) 48. 2 166 ft3 19. P1 is true because 2 is a factor of (5)1 2 3 5 2. b 5 4 or b 5 24 Section 3.2 Practice Exercises, pp. a8 5 33 33. 10 6. x bM x Then 5 N 5 bM2N . In Example 4, y 5 2 34 x 1 1 can be written using function notation as f (x) 5 2 34 x 1 1. y 5 13 6 x 2 13 2 and y 5 2 13 6 x 1 e. $97,920 $2088 75 a. 25, 21, 3, 7, 11 Because the common difference is 4, each term after the first must be 4 more than its predecessor. (2`, 22] ´ [0, 3] c. 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 h(x) 5 4 3 2 y 5 g(x) 1 1 25 24 23 22 21 21 22 g(x) 5 4 3 2 5 4 3 2 y 5 h(x) 1 x 25 24 23 22 21 21 22 23 24 25 24 25 1 2 3 4 5 x Section 2.3 Functions and Relations 189 Solution: a. N b. Center: (0, 0) b. Approximate the value of log5 417 to 4 decimal places. 224: © Caroline Celano; p. The constant term gives the y-intercept. Observe the game being played by other players. x-intercept: (24, 0); 39. • 1200 new questions were added to the TestGen testbank. A student decides to finance a used car over a 5-yr (60-month) period. Determine Relative Minima and Maxima of a Function The intervals over which a function changes from increasing to decreasing behavior or vice versa tell us where to look for relative maximum values and relative minimum values of a function. (9, 0) c. 0 1 59. equation in the variables x and y can be written in the form Ax 1 By 5 C, where A and B are not 2. g(x) 5 21x 2 1 1 3 1 67. f (x) 5 x2 1 4x 36. x4 2 4x3y 1 6x2y2 2 4xy3 1 y4 a. m(a) 5 0 4 1 a 0 Domain: (2`, `) 4 5 The expression x2 $ 0 for all real numbers x. 41 2 840i n n! and a b5 r! ? The recursive formula for an arithmetic sequence is a1, an 5 an21 1 d for n $ 2. bn 5 1n 2 1 2n 13. 66151 f 3 5 25. Graph y 5 2 f a xb. Chapter R reviews skills and concepts required for success in college algebra. Since h(2x) ? (3y2 2 z)5 23. h(0) d. Perform Operations on In Section 2.5, we learned that a profit function can be constructed from the difference of a revenue function and a cost function according to the following rule. If the system represents two intersecting lines, then the lines intersect in exactly one point. g(x) 6 5 4 y 5 g(x) 3 2 1 26 25 24 23 22 21 21 22 23 24 25 26 1 2 3 4 5 6 x 254 Chapter 2 Functions and Relations Solution: Avoiding Mistakes Be sure to note that the value of a relative minimum or relative maximum is the y value of a function, not the x value. x2 1 y2 5 3 12. 21.2 1 0i 53. The proof of Property 2 follows from the distributive property of real numbers. 2 good batteries and 1 dead battery can be selected. n(d) 5 c. x 1 2 1xy 1 y d. Write a function that represents the cost C(x) (in euros) for x croissants. 2y2 1 26y 1 31 65. 5 4 3 2 1 21 21 22 1 2 3 4 5 6 7 8 9 x 23 24 25 1 a. The least-squares regression line, yˆ 5 mx 1 b, is the unique line that minimizes the sum of the squared vertical deviations from the observed data points to the line (Figure 2-24). g(0) d. See also Applications Index absolute value inequalities in, 151–152 compound interest in, 418–420 ellipse in, 642–644 exponential equations in, 460–461 exponential functions in, 421 hyperbolas in, 660–661 linear equations in, 84–85, 213–216, 276 linear functions in, 216–219 linear inequalities in, 151 linear programming in, 549–552 logarithmic equations in, 461 logarithmic functions in, 436–437 matrices in, 594–595 mixture, 96 parabolas in, 674–675 piecewise-defined functions in, 250–251 polynomial inequalities in, 376–377 proportion, 99 Pythagorean theorem in, 127 quadratic equations in, 126–129, 159 quadratic functions in, 286, 291–294 quadratic models in, 127–129 rational functions in, 360–361 sequences in, 702–703, 718–720 series in, 707–708, 718 simple interest, 94–95 systems of inequalities in, 543 systems of linear equations, 498–500, 512, 580–581 systems of nonlinear equations in, 531–532 uniform motion, 97, 134–135 variation in, 385–387 work, 98 Approximation of common and natural logarithms, 431 of rational and irrational numbers, 3 Area, of rectangle, 42 Argument, of logarithmic expressions, 428 Arithmetic sequences in applications, 702–703 common difference of, 701, 702 explanation of, 701, 765 finite, 705 nth partial sum of, 705–706 nth term of, 702–705 Arithmetic series, 707–708, 765 Associative property of addition, 10 of matrix addition, 588 of multiplication, 10 Asymptotes explanation of, 230 horizontal, 349–352, 393 slant, 352–353 vertical, 346–348, 393 Augmented matrix elementary row operations and, 565–566 explanation of, 564 in row-echelon or reduced-echelon form, 566–569 writing and interpreting, 564 Average rate of change, 203–204, 276 Axis of symmetry explanation of, 286 of parabola, 667, 671 B Base explanation of, 8 of exponential functions, 415, 418 of logarithmic expressions, 428 Base e, 418, 470–471, 696 Binomial coefficients, 732–734, 766 Binomial expansion explanation of, 732–733 finding specific term in, 735–736 Binomials. If two events A and B are not mutually exclusive, then P(A ´ B) can be computed by the formula P(A ´ B) 5 . These exercises cover concepts in the current chapter as well as all preceding chapters. [25, 22] d. x 5 23 The solutions to this equation must have an x-coordinate of 23. Systolic Blood Pressure by Age 180 (51, 130) (21, 118) 140 100 60 20 0 10 20 30 40 50 Age (yr) 60 70 80 a. f (x) 5 x 2 2 f (4) 5 (4) 2 2 5 2 f (1) 5 (1) 2 2 5 21 EXAMPLE 5 f (4) 5 2 can be interpreted as (4, 2). Write a linear function that represents the total property tax T(x) for a home with a taxable value of x dollars. Write a formula for the sequence {an} representing the number of cells after the nth cell division. (a 1 y 2 5)(a 2 y 1 5) 5xy(3x 1 8)(2x 1 3) 55. {(21, 0, 4)} R.1. b. y 5 2.99x 1 1 c. a , x , b 9. 15 yr e. 1 5 24 5! 5 5 ? Given a function defined by y 5 f (x), the statement f (2) 5 4 is equivalent to what ordered pair? 21 b. (2`, 0] h. If the sequence is geometric, find the common ratio r. {24} b. (0, 0), (0, 90), (80, 90), y (120, 60), (120, 0) 120 e. x11 3x 2 2 A C D Gx 1 H B Ex 1 F 23. Suppose that y 5 P(t) represents the population of a city at time t. 0 15 98. The range is the set of y values. an 5 12A212 B n 114. If the inequality is strict—that is, posed with , or .—then the bounding line or curve should be dashed. • Julie Miller created video content (lecture videos, exercise videos, graphing calculator videos, and Excel videos) to give students access to classroomlike instruction by the author. (See Example 2) 25. Vertex: (0, 0); p 5 2; Focus: (2, 0); Focal diameter: 8 b. minor 7. Recall: (a 1 b)2 5 a2 1 2ab 1 b2 5 3x2 1 6xh 1 3h2 1 2x 1 2h Answers 5. 9 2x 2 1 5 x 1 5 26 5 2x 23 5 x The solution set is {23}. Isner and Mahut would meet in the first round at Wimbledon in any given year. A function may be evaluated at different values of x by using substitution. y 5 3x 2 7 2 3i (multiplicity 1); 23i (multiplicity 1); 1 (multiplicity 2) a. Test 1. x 5 y 2) 5 40 b. x 19. Zeros: 3, 23, 1, 21 (each with multiplicity 1) c. y2 2 x 1 1 5 0 43. 1 3 7 21 b. a b 2a b 2 2 1 2x 5 [(e 1 2 1 e22x) 2 (e2x 2 2 1 e22x)] 4 1 5 (4) 5 1 4 ex(eh 2 1) 79. A 15, 2 12B and A415, 2712B 18. Up left and down right. Graph g(x) 5 1x for x $ 0. Let K be the event that a king is drawn: {K Let S be the event that a spade is drawn: ,K ,K ,K }. Selle Assessment Content Project Manager: Eric Dosmann Buyer: Jennifer Pickel Design: David W. a (2 2 5n) n51 30. Section 2.3 Functions and Relations 183 The general form of an equation of a circle is (x 2 h)2 1 (y 2 k)2 5 r2. If 0 r 0 $ 1, then the sum (does/does not) exist. 0 13. x-intercept: (0, 0); y-intercept: (0, 0) y 1 25 24 23 22 21 21 22 7 6 5 4 3 2 1 1 2 3 4 5 2 3 4 5 x 61. 49a 2p7 3k3 2 b2 27z15 x9y6 1 x16 63. 524–526 R.1. (4y 2 3)(3y2 2 4) R.2. (8u 1 5)2 20a 3x 1 2 R.3. R.4. 5x2 2 1 1 2 R.5. {26} (4a 1 3)(a 2 3) 5x 2 x 1 4 1. 10 sec after launch c. That is, the height is unique at any given time. [3, `) b. {(2, 24)} 2. [0, 2) ´ (4, 6] 117. g(2) 5 2(2) 1 1 55 Substitute 2 for x. Undefined f. a b 5 2! ? Given f 5 {(3, 21), (1, 5), (22, 4), (0, 4)}, a. 770 Chapter 8 Sequences, Series, Induction, and Probability 89. Given k1x2 5 Solution: 1k + m2 1x2 5 k1m1x2 2 a Evaluate k at m(x). f (x) 5 3x6 1 2x2 1 0 x 0 34. Range: {y 0 y . 9 16 13 5 Focal length: 3; Focal diameter: 12 29. Donnelley All credits appearing on page or at the end of the book are considered to be an extension of the copyright page. Explain why a person with AB1 blood can receive blood from anyone. No 11. [24, 5] 115. a 2 db 2 3 x 28. (h + g + f)(x) 5 2 (2x 1 1)2 87. Downward c. TIP The decomposition of functions is not unique. x3 1 4x2 2 5x 2 2 1 2 3x3 2 6x2 1 2x 2 4 x 15 5x 2 2 3x2 1 1 1 2 19. If a relation has two y-intercepts, then it would fail the vertical line test and the relation would not define y as a function of x. (2, 3) 73. 22 58. This is because for any real number x, the value of y is the unique number that is 2 less than x. Vertical asymptote: x 5 7; Slant asymptote: y 5 2x 1 11 1 1 13. In Example 7, notice that there are 3! 5 6 times as many permutations as combinations. Objective 1: Test for Symmetry For Exercises 7–18, determine whether the graph of the equation is symmetric with respect to the x-axis, y-axis, origin, or none of these. (See Examples 1–2) 3. Determine the equation of the least-squares regression line. Thus, 2x 2 6 5 24 2x 5 2 x 5 1 must be excluded. The intersection of their domains is [1, `). As the story goes, Gauss returned the correct sum of 5050 within minutes by taking the product of 50(101). Section 8.3 Geometric Sequences and Series 721 Objective 1: Identify Specific and General Terms of a Geometric Sequence For Exercises 9–18, determine whether the sequence is geometric. Sum does not exist 32,760 71. Evaluate f (21), f (1), and f (2). 2a2, a5, 2a8, a11, p 51. For two independent events A and B, P(A and B) 5 . 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 11. x 5 4 3 2 1 25 24 23 22 21 21 22 y 22. 10, 230, 90, 2270, … 100 a (4i 2 2) 5 2200 1 4 a i i51 i51 17. Then for each branch of custard, there are 2 branches representing the type of syrup. y 5 73. £ 0 0 0 1 0 0 2 0 † 67 § 1 12 19. y 5 4 3 60 119. a 5 5, b 5 3, c 5 0 3 6 137 f 57. 0 (multiplicity 2), 21 (multiplicity 2), and 6i 110 (each multiplicity 1) 81. 5985; There are 5985 ways to select 4 distinct items in no specific order from a group of 21 items. Is (x 1 3) a factor of f (x)? x(x 1 1) x 2t 1 1 5y4 a12 4 2 2 13 1 99. y 5 x2 23 3 22 y 5 √x 3 2 1 24 25 f (x) 5 0 x 0 g(x) 5 2 0 x 0 h(x) 5 12 0 x 0 6 3 2 4 1 double 4 23 22 21 21 22 x y 8 7 6 5 21 1 2 1 2 0 0 0 0 1 1 2 1 2 2 2 4 1 3 3 6 3 2 h(x) 5 1 1 2 g(x) 5 2|x| y f(x) 5 |x| 5 4 3 2 25 24 23 22 21 21 22 1 2 h(x) 5 1 1 2 3 4 5 |x| x 23 24 25 multiply by 12 g(x) 5 3x2 4 3 2 25 24 23 22 21 21 22 2 1 0x0 2 3 4 5 x 1 3 x2 For a given value of x, the value of g(x) is twice the value of f(x). y 5 x 1 3 b. y 5 (2x 1 4.5)3 1 2.1 55. 5 4 3 2 (f 1 g)(1) (fg)(0) (g 2 f)(23) (f + g)(3) (g + f)(4) f (g(1)) y 5 f(x) 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x y 5 g(x) 24 25 Solution: a. A system of linear equations contains only linear equations, whereas a nonlinear system has one or more equations that are nonlinear. Connect Math® Hosted by ALEKS Connect Math Hosted by ALEKS Corp. 10 h. 2 x(x 1 h) 4 1x 1 h 2 4 1x b. Instructors can then use this information to make more informed decisions on what topics to cover in more detail with the class. y 8 7 6 8 7 6 5 4 3 2 5 4 3 2 5 4 3 2 1 0 c. Skill Practice 6 Given the equation y 5 x2 2 4, a. 1 25 24 23 22 21 21 22 5 4 3 2 y 5 f(x) x 107. For i 5 121, find the first eight terms of the sequence defined by an 5 in. ceil(2.8) b. 3 good batteries can be selected. 210m4n6 31. hexagon (6 sides) 72. 3.5 3 100 a. 201 b. 750 Chapter 8 Sequences, Series, Induction, and Probability Write About It 85. a1 1 (n 2 1)d; an21 1 d 5. {(x, 23x 1 6) 0 x is any real number} 62y or e a , yb ` y is any real number f ; 3 The equations are dependent. (2`, 0) ´ a , 2b 5 120 1 15x 67. Write a linear revenue function representing the revenue R(x) for selling x dozen cookies. 98 39. Is n(2x) 5 2n(x)? (f + g)(5) 109. Y1 5 2x 1 8 1 Y2 5 2 2 x 1 3 3 2 1 27 26 25 24 23 22 21 21 1 2 3 x 22 23 For Exercises 13–16, graph the equation. a b5 (n 2 r)! ? Endpoints of a diameter (7, 5) and (1, 23) 14. A21 5 £ 3 2 R.2. 21 1. There are several ways that we can determine if three points, A, B, and C are collinear. 2 51 5. m 5 f (b) 2 f (a) b2a y52 1 2 3 4 45. • Note the added restriction that x2 2 4 ? Also, the selected points must fairly represent the shape of the graph. Given 3x 5 24y 1 8, b. Then subtract the terms corresponding to n 5 1 and n 5 2.) For Exercises 73–80, write the repeating decimal as a fraction. 15, 0.3, 0.33, 20.9, 212, 114 , 6, π6 a$5 17. 23.9c2d 2 16.5cd 19. R(x) 5 2.00x The price per cup of lemonade is $2.00. Explain the difference between the graph of an 5 n2 and f (x) 5 x2. y 33. 11, y ? Is the point (2, 27) on the circle defined by (x 1 6)2 1 (y 1 1)2 5 100? Then estimate the location of the fire. a (21)k a b 5 c (21)3 a b d 1 c (21)4 a b d 1 c (21)5 a b d 1 c (21)6 a b d k 3 4 5 6 k53 1 1 1 1 52 1 2 1 3 4 5 6 7 52 60 6 c. 5 2k2 2 2a 5 2(k2 2 a), which is an even integer. 285: NASA; p. 6x 1 3h 2 4 b. Foci: A0, 2 12 B, A0, 22 12 B g. Shift the graph to the right 2 units. Answers 3. 61, 62, 64 9. (See Example 1) b. The formula Fn 5 2 2 15 15 gives the nth term of the Fibonacci sequence. (23, 5), (23, 21) c. 3 1 6 1 12 1 … 1 768 3. No 29. EXAMPLE 2 Evaluating Functions for Given Values of x 1 , determine the function Given m(x) 5 4x, n(x) 5 0 x 2 3 0 , and p(x) 5 x 1 1 values if possible. (See Example 11) 91. g(x) 5 e x 1 2 for x , 21 2x 1 2 for x $ 21 64. One homeowner buys a house for $140,000 and finds that the value of the property increases by 3% per year thereafter. There are 26 letters of the alphabet from which to choose. 9.2 m T 2 Tf 1 1 t 5 2 lna b or Cln T0 2 ln AT 2 Tf B D k T0 k a. Determine the interval(s) over which f is increasing. [210, 10, 1] by [2150, 10, 10] For Exercises 89–92, graph the equation with a graphing utility on the given viewing window. (Highlighted in orange tint.) c. Julie Miller donna gerken Dedications   o my parents Kent and Joanne Miller who have always taught me the value of education. 1 2 3 4 131. For example, {gold, silver, bronze} represents the set of medals awarded to the top three finishers in an Olympic event. Compute the sum of the first 60 positive integers that are exactly divisible by 4. 425: © Brand X Pictures/ Superstock RF; p. 1 1 x12 (x 1 2)2 (x 1 2)3 47. $81,007.17 PC A1 1 nr B nt 2 1D b. f 21(x) 5 21x 1 3 y f. The width is approximately 5.4 yd and the length is approximately 7.4 yd. 0 Section 2.4 Linear Equations in Two Variables and Linear Functions 201 Linear Equations and Slopes of Lines Ax 1 By 5 C (A ? The CD has rap music. c(c 2 3)(c2 1 3c 1 9) 2 3 4 2 3 (2a 2 5b)(4a 1 10a b 1 25b6) 10x(3x 1 7)(x 1 2)(x 2 2) 51. These additions provide STEM students an opportunity to connect current topics to what they’ll learn in calculus. {14} b. 510 ? Determine f(3). The number of permutations of n elements taken r at a time is denoted by nPr and is computed by u or nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1). f (23) 5 (23)2 1 2(23) 5 3. Write an equation that represents the set of points that are 9 units from (24, 16). f (x) 5 b. Suppose that an individual is paid $0.01 on day 1 and every day thereafter, the payment is doubled. 2x 1 8 , 2 x 1 3 2 a. The Daytona 500 auto race has 40 cars that initially start the race. f (0.5) Write a piecewise-defined function to model the cost C(x) to mail a letter first class if the letter is x ounces. Vertex: (26, 3); p 5 5; Focus: (26, 8); Focal diameter: 20 b. (multiplicity 2), 1 6 i (each multiplicity 1) 2 79. a 5(3)n21 n51 ` 5 43. For example: 2 y5 x25 3 y5x14 y 5 2x (or y 5 2x 1 0) y56 (or y 5 0x 1 6) 2 3 m51 m52 m50 m5 y-intercept: (0, 25) y-intercept: (0, 4) y-intercept: (0, 0) y-intercept: (0, 6) If the slope and y-intercept of a line are known, we can graph the line. f (20.5) 75. a1 5 4 and a4 5 108. 2i 13 a. Write the set of ordered pairs that defines the relation given in Table 2-1. Use the graphs of f and g to find the function values for the given values of x. The pitch of a roof is defined as Rafter C 7 ft A B Span 24 ft 2.5% Grade For Exercises 25–36, determine the slope of the line passing through the given points. The point (1, 1) on the graph of f (x) 5 x3 corresponds to (1, 3) on the graph of h(x) 5 x3 1 2. 22x 5 3y 59. Az2 1 6B Az 1 16B Az 2 16B 2 Ax 2 15B 107. an 5 a1 1 (n 2 1)d an 5 2 1 (n 2 1)(2) an 5 2n a50 5 2(50) a50 5 100 n (a1 1 an) 2 50 (2 1 100) S50 5 2 S50 5 2550 Sn 5 General expression for the nth term Substitute a1 5 2 and d 5 2. g(x) 5 0 x 0 2 3 b. The sum of all terms in the sequence is an infinite series and is given by ` p a ai 5 a1 1 a2 1 a3 1 i 51 Any letter such as i, j, k, and n may be used for the index of summation. Find all values of y such that the distance between (4, y) and (22, 6) is 10 units. Center: a2 , 0b; Radius: 111 3 b. Solve for b. 744 n! . Neither 33. R 55. View student progress in a course area or at the individual topic level, including which topics students are struggling with the most. 2.85 G-forces 91. Write a linear cost function to produce x cups of lemonade. ¢ 2a 2a 5 log c b2 2 (b2 2 4ac) 5 log a 4ac 4a2 d b 4a2 c 5 log a b 5 log c 2 log a a 105. For example, consider the points (1, 5) and (4, 9). p(x) 5 5 3 4 d. e f 2 5 25 Skill Practice 9 a. 733–734 n n n n n b abn21 1 a bbn (a 1 b)n 5 a ban 1 a ban21b 1 a ban22b2 1 p 1 a 0 1 2 n21 n n n 5 a a ban2rbr r50 r n n n n The values a b, a b, a b, … , a b are called the binomial coefficients of the expansion of (a 1 b)n. Yes 21. 116,280 746 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Number of Combinations, nCr Most graphing utilities can evaluate the number of combinations of n elements taken r at a time. x2 1 y2 2 10x 2 22y 1 155 5 0 51. (q + n)(x) 116. x2 1 y2 1 10x 2 6y 1 25 5 0 Solution: x2 1 y2 1 10x 2 6y 1 25 5 0 (x 1 10x) 1 (y2 2 6y) 5 225 y 2 7 6 5 4 3 2 1 29 28 27 26 25 24 23 22 21 21 22 23 Figure 2-13 Answers 2 2 2. For Exercises 41–46, two terms of an arithmetic sequence are given. 192 Chapter 2 Functions and Relations Objective 1: Determine Whether a Relation Is a Function For Exercises 9–12, a. 736 Finding the kth term of a binomial expansion: n Let n and k be positive integers with k # n 1 1. a (23) i51 716 13. Write an expression for the distance between t and 5 on the number line. {1, 9} 51. x 5 12 35. Evaluate (f + f)(21). Center: (4, 22) e. TIP In Example 4(c), h(x) has a mixture of terms of the form xodd and xeven. Find the frequency for C one octave below middle C. 4n 27. 52 6 2x 2 8 52 3 x 24 2 2 Factor out 21 from the denominator. The graph defines the set of ordered pairs: {(23, 24), (21, 3), (0, 1), (2, 4), (4, 4)} Domain: {23, 21, 0, 2, 4} Range: {24, 1, 3, 4} The domain is the set of x values. The legs are 6 ft and 8 ft, and the hypotenuse is 10 ft. A2111, 2313B and A111, 2513B 35. f(x) 5 4 f(x) 5 3 2 1 23 22 21 21 22 23 2 3 4 5 6 7 m(x) 5 1 2 (x 1 4) 55. x2 1 y2 2 4x 1 6y 2 12 5 0 b. The value 1 is called the limit of i51 summation. Two Variables Determine the Slope of a Line Apply the Slope-Intercept Form of a Line Compute Average Rate of Change Solve Equations and Inequalities Graphically 60,000 bachelor’s degree y 5 1261x 1 33,296 40,000 y 5 642x 1 22,128 20,000 high school degree 0 0 5 10 15 20 Number of Years Since 1990 25 Figure 2-15 The graph in Figure 2-15 is called a scatter plot. Evaluate 15C6 12C2 and interpret its meaning. 90 dB c. Refer to the graph of the sequence {bn}. At age 28, an employee begins investing $100 each pay period (twice per month) in an ordinary annuity. (22t 1 v2)10; eighth term 29. T (170) 5 27 means that a mammal that inhales 170 mL of air per breath during normal respiration is approximately 27 kg (this is approximately 60 lb—the size of a Labrador retriever). Because there are infinitely many positive integers, there are actually infinitely many statements to prove and we cannot approach them on a case-by-case basis. R; (2`, `) 55. 21 7. In Example 4, we start by selecting several values of x and using the equation to calculate the corresponding values of y. 1 2. 12.0 # x # 15.2 g/dL 71. Thank you for overseeing the enormous job of managing digital content and ensuring consistency of the author voice. y 5 34.9(2.134) b. Sometimes, however, all passengers show up and there are more ticketed passengers than seats. a4 2 b4 c. [0, `) b. 97. For example: (2c 1 3)2 5 4c2 1 12c 1 9 In each case, factor out x to the smallest exponent to which it appears in both terms. 7 6 5 4 81. Passes through (8, 6) and is parallel to the x-axis. y 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 27. t 2 5 5. k(22) b. 236 Horizontal translation (shift) Horizontal and vertical stretch and shrink Reflections across the x- and y-axes Vertical translation (shift) SECTION 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions Consider the graph of an equation in x and y. The number of such committees is the number of combinations of n 5 15 students taken r 5 3 at a time. (2`, `) {} 18. 4 3 1024 87. not the same Replace y by 2y. [Hint: The nth term of the sequence is the difference between the sum of the first n terms and the first (n 2 1) terms.] SECTION 8.3 OBJECTIVES 1. This is equivalent to saying that b is greater than a (written symbolically as b . The cofactor is the product of the minor and the factor (21)i1j. Use i as the index of summation. From the slope formula, we have Formula 2. The sum Sn of the first n terms of a geometric sequence with first term a1 and common ratio r is given by the formula . y 5 26.3 25. 2x 1 3y 5 7 3 1 5 4x 5 26y 1 2 3 y52 x17 2x 5 y 1 1 y52 x15 2 4 4 35. 7. (2`, 26)) 26 31. e , 32 f 97. Suppose that $25,000,000 is put into savings, and that $75,000,000 is spent. 9 12 The viewing window is part of the Cartesian plane shown in the display screen of a calculator. R(x) 5 60x c. [24, 7.8] 113. 3 5 75 c. log2(x2t) 4 3 m x x11 57. Use the results from Exercise 107 to determine the slope and y-intercept for the graphs of the lines. log 8 1 log c 1 log d 11. This is between approximately 7.7 ft and 8.9 ft. F 2 1 F b. How many 3-digit numbers can a player choose? h (x) 5 x 1 5 5 2 2x 3 x 2 2 21 45. P(t) 5 19e0.01735t; P(t) 5 22.9e0.00343t b. $2200 b. (22, 1) y 72. a (2i2 2 i) i51 i51 50 50 93. 72. i51 n n n 3. 2 2 2 5 1; This is an equation of a hyperbola in the yz-plane b c z2 x2 with transverse axis on the y-axis. x2 1 y2 2 22x 1 6y 1 129 5 0 44. Center: (4, 23); Radius: 2 y 7 6 5 4 45. Let Pn be the statement 3n , 2n for n $ 4. Note: For any point (x, y) on the graph of y 5 f (x), the point 1 ax , y2 is on the graph of y 5 f (ax). Determine the total number of seats in the theater. Lemon juice is more acidic. For a certain district, a random sample of registered voters results in the distribution by political party given in the graph. $17,066 b. Graph f 77. The multiple-choice questions each have four possible answers of which only one is correct. a b 0 5 b. To graph y 5 f A 12 xB, divide each x value on the graph of y 5 f(x) by 12 . g(f (3)) 51. 1533 a1(1 2 rn) a1(1 2 0) a1 approaches 5 . Find the probability that all three children will be boys. c d 0 bd 0 14 97. (5, 10), (5, 210) f. 6.1 g. Write a function representing the total cost T(a) for a dollars spent in merchandise. f 21(x) 5 8 y 71. f (x) 5 x3 1 5 42. (2`, 5) ´ (5, `) 103. (23, 2) ´ (4, `) 4 63. 5 4 3 2 22 21 21 22 1 2 3 4 5 6 7 8 x 23 24 24 25 21. y 95. Shift downward 2 units. f (a) 49. 1, 22 (multiplicity 2) 4, 22, and 222 (1, 0) and (22, 0) 12. He borrowed $10,000 from his parents, $8000 from the credit union, and $2000 from the bank. If replacing y by 2y in the equation results in an equivalent equation, then the graph is symmetric to the x-axis. 2 (3x)2/3(x2 1 1)4/3 Chapter R Review Exercises, pp. Write the first five terms of a geometric sequence with a1 5 120, and r 5 23 . 20 15 10 (8, 7) 5 22522021521025 25 210 5 10 15 20 25 x 215 220 225 59. P1 is true because 6 5 1[2(1) 1 4]. x2 5 y2 1 1 b. • The graph of y 5 f (x) 1 k is the graph of y 5 f (x) shifted k units upward. H(t) 5 4.86 1 6.35 ln t b. Write a function representing the cost C(x) (in $) for x tubes of paint. For example: Probabilities 2. y 5 0.4x 1 109.6 y 5 0.4(55) 1 109.6 y 5 131.6 Substitute 55 for x. m 5 23. {1, 32} 3 115 2 3 111 2 216 3 2 1 1 1 2 1 10. • The point (4, 2) on the graph of f corresponds to (4 1 3, 2 2 2) 5 (7, 0) on the graph of p. g(x) 5 2 x 2 3 4 5 b. 1V + r21d2 5 πd3 is the 2 6 volume of the sphere as a function of its diameter. Apply the distance formula. Combining Functions and Determining Domain Given g(x) 5 2x, h(x) 5 x2 2 4x, and k(x) 5 1x 2 1, a. y 5 0 y 35. {ln 11}; x < 2.3979 e 3 ln 7 1 6 ln 2 R.1. {0} R.4. 1. Assume that any player can play any other player in the first round (that is, disregard the fact that seeded players do not play one another in the first round). To find the x-intercept(s), substitute 0 for y and solve for x. a2`, b 2 1 1 22. (See Example 5) b. What is the probability that the jury will consist only of men? 140–144 R.1. (x 2 3)(3x 1 4)(3x 2 4) R.2. a ? See Figure 2-13. A chocolate chip cookie is selected. Minimum: 0 h. Then solve the resulting system of nonlinear equations. 255–261 5 y 5 4 3 2 x 8) R.2. Interval notation: (2`, 8) 69. paper) — ISBN 0–07–783634–0 (alk. The ball lands on a black slot. (u2 1 2v4)15; tenth term 34. {(21, 4), (2, 3), (3, 4), (24, 5)} No two ordered pairs have the same x value but different y values. 20 yr 63. 16.7 sec c. Suppose that four people are to be randomly selected from a group of 8 women and 5 men. 80. x-intercept: (4, 0); y-intercepts: (0, 24), (0, 210) 1. y 5 f a xb 3 1 40. AI2 5 c R.3. d 278 15 1 0 27(1) 1 15(0) dc d5c 8 5.1 8 0 1 5.1(1) 1 8(0) 5 c b. Therefore, (y2 2 y1) can be represented by Dy and (x2 2 x1) can be represented by Dx. Slope Formula x2 x1 Change in x The slope of a line passing through the distinct points (x1, y1) and (x2, y2) is change in y (rise) Figure 2-17 m5 ¢y y 2 2 y1 5 provided that x2 2 x1 ? 2850 59. The difference quotient: . O1 b. (3x2 2 5y)3 Solution: The expression (3x2 2 5y)3 5 [3x2 1 (25y)]3 is in the form (a 1 b)3 with a 5 3x2 and b 5 25y. 202 Chapter 2 Functions and Relations y c. Passes through (21, 0) and m 5 . 1000 b. polynomial 3. Maximum: 0 h. y 101. A new drug and alcohol rehabilitation program performs outreach for members of the community. The set of all ordered pairs that are solutions to a linear equation in three variables forms a plane in space. 16C2 5 120 55. Notice that the slope of the secant line between x 5 0 and x 5 1 (shown in red) is greater than the slope of the secant line between x 5 1 and x 5 2 (shown in green). (h + f)(22) 55. f (5) c. w2y3 5 37. d 2 2 a. E22 6 i 12F 59. The intensity at 20 m should be 14 the intensity at 10 m. 8 u 5 u 87. (2`, 2) 73. 11i 7. Solve Applications Involving Quadratic Functions Quadratic functions can be used in a variety of applications in which a variable is optimized. (2`, 1) ´ (1, `) h. The next 60 sec is represented by the constant function y 5 45. 5 4 3 2 1 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x y c. C(x) 5 0.40x 1 120 b. 558–560 1. R.1. f 1x2 5 x21 x12 4 R.3. h1x2 5 13 2 x R.5. Given k1x2 5 x2 2 2x 1 3, find k1x 1 32. A baseball player with a batting average of 0.291 has a probability of 0.291 of getting a hit for a given time at bat. Plot Points on a Rectangular Coordinate System 2. y 5 f (2x) 4 3 2 y 5 f(x) 1 29 28 27 26 25 24 23 22 21 21 22 1 x 23 24 25 4. The x-intercepts are the real solutions to the equation f (x) 5 0. The number of combinations of n elements taken r at a time is denoted by nCr and is computed by . A21 5 £ 7 1 26. a2`, 2 4 4 35. P(x) 5 0 (the company breaks even) b. E A 12, 13, 216 B F Infinitely many solutions; The equations are dependent. • Exclude values of x that make the radicand negative within an even-indexed root. Domain: (2`, `); Range: (2, `) c. Passes through (2, 26) and is parallel to the line defined by 2x 2 y 5 4. (g + f)(10) Answers 5. 1 25a2b6 a. {2, 10, 18, 26, ...} 54. Suppose that n represents the number of distinct elements in a group from which r elements will be chosen in a particular order. 228 1. Neither 45. 5x 0 x $ 92 6 99. Prove a Statement Using Mathematical Induction 1. The closed dot from the red segment of the graph “overrides” the open dot from the blue segment. a1 5 3 and an 5 an21 1 10 for n $ 2 a. EXAMPLE 6 Using Summation Notation Write the terms for each series and evaluate the sum. Therefore, the function is neither even nor odd. Then the regions defined by the individual constraints are graphed. Determine the domain of f. $14,600 and $0 d. (k 1 2)! by the inductive hypothesis. (2`, 0) ´ (0, 3] 65. Given k(x) 5 28x5 2 6x3, find k(2x). f (3) 5 2; f (4) 5 6 b. (22, 0), (1, 0), and (3, 0) 4. Height of Girls vs. The graph of y 5 f(x 1 h) is a shift in the negative x direction. Description of Event: Set Representing the Event: Flip a coin and the outcome is “head” {head} Roll a six-sided die and an even number comes up {2, 4, 6} The number of elements in an event E is often denoted by n(E). , n2 Terms in the denominator are powers of 5: 51, 52, 53, 54, . The terms of the sequence defined by a1 5 x and an 5 aan21 1 b for n . g(x) 5 2 c. 4n 2 1 is divisible by 3. These alternative notations are often used in computer programming. e 2 , 2 f 2 4 2 2 {0, 4} 17. f (x) 5 x2 1 b. h(2x) 5 24x3 1 2x b. A set of ordered pairs (x, y) is called a __________ in x and y. Assume that 3 1 7 1 p 1 (4k 2 1) 5 k(2k 1 1) (Inductive hypothesis). p(1) 1 5 4(1) ? Expand (ex 2 e2x)4. Expanding Your Skills 61. 10 1000 100,000 34. [Hint: Write the expression as (1 1 0.01)4.] 47. f 21(x) 5 x3 1 2 5. In how many different ways can a customer fill out the survey? 3y z 2 2xz 51. 3 63. [0, 7] 111. ex1h b. Find the average rate of change in speed between waves that are between 4 m and 9 m in length. {2}; The value 142 does not check. Find the 20th term. However, the first equation represents an ellipse centered at (0, 0), whereas the second equation represents an ellipse centered at (1, 27). { } 2 {(22z 1 16, 3z 2 5, z) 0 z is any real number} 27. Neither 1 1 65. In a “Pick-4” game, a player wins a prize for matching a 4-digit number from 0000 to 9999 with the number randomly selected during the drawing. 1! 37. Apply the point-slope formula with x1 5 24, y1 5 1, and m 5 214 . 218 1 (223) 1 (228) 1 … 1 (2183) Objective 3: Apply Arithmetic Sequences and Series 65. vertices 5. g(x) 5 2122x 1 5 62. 10 e. P 5 a2t 27. R(x) . is an exciting, new assignment and assessment ehomework platform. The ball lands on a number that is a multiple of 6 (do not include 0 and 00). Once he reaches $40,000 in total sales, he earns an additional 5% commission on the amount in sales over $40,000. 5 4 3 2 h(x) 5 Î2x 1 23 c. 5 2. y 90. 1 51 4. 3.5 L should be replaced. 4 1 9 1 14 1 p 1 (5n 2 1) 5 (5n 1 3) 2 … 8. 1x 1 h 1 1 t 2 51. f (x) 5 e for x # 1 for x . a b 2 6 d. Rows 1 and 2 are interchanged between matrix A and matrix B. {x 0 x , 28} e. y TIP x In Example 5, we choose several convenient values of x such as 21, 0, 3, and 8 so that the radicand will be a perfect square. (c 2 2a 2 11)(c 1 2a 1 11) 7w2 1 2w 1 4 2 2 2 4 31. 2y 5 4 Solution: Avoiding Mistake The graph of a linear equation is a line. 5 2(2k) 5 2k11 Therefore, 3(k 1 1) , 2k11 as desired. a n b(3) b. Never decreasing h. g(21) c. Under the STAT menu, select CALC and then the LinReg(ax 1 b) option. growth; decay 22 b. No 4. The ball will hit the ground at the point A128 13, 2128B or approximately (221.7, 2128). In how receive many ways can four different people among the 20 be selected to prizes of $50 each? 5 4 3 2 1 22 21 21 22 23 1 2 3 4 5 6 7 8 x p(x) 5 √x¯¯¯¯¯¯¯ 2322 24 • The point (0, 0) on the graph of f corresponds to (0 1 3, 0 2 2) 5 (3, 22) on the graph of p. 0 2 2 15 0 or 0 15 2 2 0 b. Expenses for a company for year 1 are $24,000. k(x) 5 2 0x 0 42. After one half-life, the amount of substance has been halved. Write a linear profit function that represents the profit P(x) for producing and selling x items. 5 5 < 0.00879 b. zero; undefined 1 25 24 23 22 21 21 22 y5 57. 2x 5 6 36. The expansion of (a 1 b)n is given by n n n n n (a 1 b)n 5 a ban 1 a ban21b 1 a ban22b2 1 p 1 a babn21 1 a bbn 0 1 2 n21 n n n 5 a a ban2rbr r50 r Answers b. Vertices: (6, 7), (214, 7) Foci: A24 1 1181, 7B, A24 2 1181, 7B y 5 109 x 1 535 and y 5 2109 x 1 175 y 28 24 20 16 12 8 F F 4 216.1 24.05 16.1 22422021621228 24 24 C(24, 7)28 12.05 4 8 12 16 212 25 210 Section 7.2 Practice Exercises, pp. Not a real number 17. 2 real solutions 101. A B 2 21. Write the equation in slope-intercept form and determine the slope and y-intercept 3x 2 5y 5 215. 5 42. 126. E615F 99. The interval(s) over which g is decreasing. 228xy 22xy 91. y 5 Objective 2: Identify Even and Odd Functions 19. f (x) 5 21x 1 3 2 1 66. That is, n(S) 5 8C2 5 28 The probability that both positions will be filled by women is P(E) 5 n(E) 10 5 5C2 5 5 5 < 0.3571 n(S) C 28 14 8 2 Skill Practice 4 Suppose that a committee of three people is to be formed from a group of 8 men and 6 women. (g 2 f)(1) c. Therefore, the product 2.00x gives the amount of revenue for x cups of lemonade sold. 83.5 ft c. (25, 21] 1 9 7. For Exercises 63–64, e a. 712 Chapter 8 Sequences, Series, Induction, and Probability Expanding Your Skills 86. Center: A 12, 0B; Vertices: A 12, 5B, A 12, 25B; 16 25 Endpoints of minor axis: A272, 0B, A 92, 0B ; Foci: A 12, 3B, A 12, 23B (y 2 1)2 (x 2 3)2 1 51 11. For example, consider the equation 2x 2 1 5 x 1 5. Down to the left, up to the right; As x S 2`, f (x) S 2`, and as x S `, f (x) S `. 1 2 3 4 x 26 25 24 23 22 21 22 24 m(x) 5 3x 1 2 1 2 3 4 x b. Show that 2 1 4 1 … 1 2k 1 2(k 1 1) 5 (k 1 1)[(k 1 1) 1 1] 5 (k 1 1)(k 1 2). (x 1 7)2 1 (y 2 5)2 5 4 b. A R.3. y 5 x-intercept: (0, 0); y-intercept (0, 0) x-intercept: (26, 0); y-intercept: (0, 3) x-intercepts: (23, 0), (3, 0); y-intercept: (0, 9) x-intercepts: (3, 0), (7, 0); y-intercept: (0, 3) x-intercept: (21, 0); y-intercepts: (0, 21), (0, 1) x-intercept: (0, 0); y-intercept: (0, 0) x-intercept: None; y-intercept: None d(A, C) 5 2 126 mi and d(B, C) 5 2 117 mi a. Ascending order: Descending order: S5 5 1 1 4 1 7 1 10 1 13 S5 5 13 1 10 1 7 1 4 1 1 2S5 5 14 1 14 1 14 1 14 1 14 2S5 5 5(14) 2S5 5(14) 5 2 2 S5 5 35 ✓ Answer 6. This is slope-intercept form. a2122, b 7. Normal BP Elevated BP Total Smokers 42 28 70 Nonsmokers 80 10 90 Total 122 38 160 94. (m + n)(x) 68. Determine Theoretical Probabilities 1. Excluding x 5 4, the domain of hk is [1, 4) ´ (4, `). 2 35 n 101. h For Exercises 102–103, identify the location and value of any relative maxima or minima of the function. Major axis: in. If no letter may be repeated, then the number of letters from which to choose must be decreased by one when the second letter is selected. a1 5 64 3 9 27 79 49. • If c 5 0, then the graph will be a single point, (h, k). {0.05} 14. i c. 26p 1 2p 1 p 1 2p 2 5 19. 5 250 250 52 13 4 12 3 32 8 39 3 16 5 53. Domain: (23, `); Range: [1, `) 91. After having driven x miles, the distance remaining r(x) (in mi) is given by r(x) 5 250 2 x. y5x16 y 5 22x 1 6 y50 105. index; summation; lower; limit 5, 11, 21, 35 9. {(0, 2, 24)} 55. {(8, 4), (3, 21), (5, 4)} b. The first term is a1 5 8, and the 60th term is a60 5 185. No b. 6 2 y or 6A 2 yB 4 1y2 3y1y3 43. Examples • The examples in the textbook are stepped-out in detail with thorough annotations at the right explaining each step. The graph of the sequence from Example 3 is shown in Figure 8-4. The variable cost per item is the rate at which cost increases for each additional unit produced. 2 55. By 2012, the population reached 360,800. If two points in a set of ordered pairs are aligned vertically in a graph, then they have the same x-coordinate but different y-coordinates. y 5 21028 26 24 22 22 y 91. 7k 2 5 5 7 g(21) 5 21 TIP The name of a function can be represented by any letter or symbol. 89. AB 5 f 10 5 41. y # (x 2 2)2 1 1 3 2 23 31. 2 3 1 b. x-intercept: (22, 0); y-intercept: None 2 3 4 5 x 24 25 23 y 5 |x 1 1| 1 23 22 5 4 3 2 1 1 1 2 ; ax 1 b 49 7 5 4 3 2 6 5 4 3 2 x y R.2. n R.3. 5 12 R.4. x2 2 4x 1 4 1. The nth term is 2113. Count Permutations We now look at a situation in which n items are to be arranged in order. Answers will vary. 365, $12,213.89 e. The notes step through the material with a series of questions and exercises that can be used in conjunction with lecture. Domain: (2`, `); 12 9 33 6 Range: a2`, d 3 2 x 27 26 25 24 23 22 21 1 2 3 2 23 26 29 212 7 49 7 2 49 b. One method is to determine if the sum of the lengths of the line segments AB and BC equals the length of AC. 7 5 0 4x 2 2 0 1 5 16. [4, 9] 90. Each multiple-choice question has four possible choices (for example: a, b, c, or d). 1 1 4 1 16 1 p 1 4n21 5 (4n 2 1) 3 56. The first expression simplifies to 6, and the second expression simplifies to 1. 1 Fk 1 Fk11 5 (F1 1 F21 … Horizontal asymptote: y 5 0 d. Suppose that a1, a2, a3, … is an arithmetic sequence with common difference d. (Source: Stanford School of Medicine,) Refer to the table for Exercises 75–82. Over what interval(s) does the height decrease? The customer is female. Therefore, every other term is obtained by multiplying by r 2. y y 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 2. 25 x 24 25 25 24 23 22 21 21 22 y51 1 23 5 y 5 4 3 2 23 5 4 3 2 11. Round to the nearest tenth of a percent. P1 is true because for n 5 1, the sum is 5 1 1 2(1) 1 1 5 3 . Equation; e 2 6. h(x) 5 e 22x for x , 0 1x for x $ 0 63. 15 41. The two N’s can be arranged in 2! different ways. If an individual is randomly selected from the population, find the probability that the individual will have the Rh factor. Section 2.1 The Rectangular Coordinate System and Graphing Utilities Applying the Pythagorean theorem, we have y Q(x2, y2) d P(x1, y1) d 2 5 (3)2 1 (4)2 d 5 2(3)2 1 (4)2 5 125 5 5 |y2 2 y1| Since d is a distance, reject the negative square root. d 5 2(x2 2 x1)2 1 (y2 2 y1)2 1. However, it is acceptable for a function to have two or more x values paired with the same y value, as shown in Example 2(b). bn a 8 7 6 5 4 3 2 6 5 4 3 2 1 21 21 22 23 24 1 22 21 21 22 a. Some mathematics enthusiasts have named the date March 14 (π < 3.14) as World Pi Day. Answers 2. What does a 2 116. Use slope-intercept form to write an equation of the line that passes through the given point and has the given slope. x 5 quadratic 3. Row 1 of matrix B is 2 times row 1 of matrix A. Determine the t-intercept and y-intercept and interpret their meanings in context. 3 67. ln c d 2 1x 2yz 67. r (x) 5 1x 2 3 1 1 74. Prove a Statement Using the Extended Principle of Mathematical Induction Mathematical induction can be extended to prove statements that might hold true only for integers greater than or equal to some positive integer j. Write an equation for the directrix. Undefined 23. 0 3a 1 10 2 2 # 9 17. Evaluate s10 and interpret its meaning in the context of this problem. Then the probability of event E, denoted by P(E), is given by n(E) P(E) 5 n(S) p. 1210 55. 129–132 R.1. 260 ft2 R.2. 56 ft3 R.3. 155 m R.4. 121.5 km2 1 3. 2 2 log(c 1 10) 51. 0 for x . Hit ENTER and the approximate coordinates of the relative maximum point are shown (0.45, 0.63). (2`, 25) ´ (25, 24) ´ 124, `2 2 b. Informally, this means that f(a) is the greatest function value relative to other points on the function nearby. The window settings shown here are [0, 80, 10] by [0, 200, 20]. down 5. £ 0 4 5 29 22 6 2 27 † 23 § 23 10 3 23 12 6 ` d 6 6 1 29. y 5 2 b. 131. Round to 1 decimal place if necessary. t (x) 5 2 x21 y y 53. (n 2 m)(x) 117. Gives Your Students the ALEKS Advantage Are your students prepared for your course? The function h first evaluates the expression 2x2 2 5, and then takes the absolute value. One of the goals of this text is to identify families of equations and the characteristics of their graphs. In how many ways can four students be selected to act out a scene from a play involving 4 different parts? Sets and the Real Number Line 3 TECHNOLOGY CONNECTIONS Approximating Rational and Irrational Numbers The number 2116 is a rational number, and the number π is an irrational number. 23 11 13 25. {x 0 x # 6 or x . Write an expression S2(x) that x represents the area of the semicircle. By the inductive hypothesis, [1 1 4 1 p 1 4k21] 1 4(k11)21 5 13 (4k 2 1) 1 4k 5 134k 2 13 1 4k 5 43 ? 3 1 n 1)(2n 1 1) 5 2n 1 1 . By the inductive hypothesis, [1 1 5 1 p 1 5k21] 1 5(k11)21 5 14(5k 2 1) 1 5k 5 145k 2 14 1 5k 5 54 ? Solution: r5 an 5 an 5 15 12 9 6 3 0 23 26 29 212 215 an 5 15 ⎛2 35 ⎞ ⎝ 1 2 3 4 n21 a5 5 ⎠ 5 6 7 8 9 10 n a5 5 a2 29 3 5 52 a1 15 5 n21 a1r 3 n21 15a2 b 5 3 521 15a2 b 5 243 125 Divide a2 by a1 to obtain the common ratio 235 . The studio charges $60 for each private lesson, but has a variable cost for each lesson of $35 to pay the instructor. f (x) 5 • 892.50 1 0.15(x 2 8925) 4991.25 1 0.25(x 2 36,250) or y 1 1 26 25 24 23 22 21 21 22 2 0x 0 for x , 2 22 for x $ 2 113. True 89. An exponential growth model has unbounded growth, whereas a logistic growth model imposes a limiting value on the dependent variable. 4.4% b. 3 4 5 6 2 2 1 2 1 1 4 9 16 25 Solution: a. (x 1 2) 1 (y 2 1) 5 5 3. 7 7 48. s1 5 s2 2 ¢s 2 1 3 5 77. Find the probability that a dart thrown at the target will land in the shaded region. q16 u13 ; q fi 6, q fi 22 R.2. 2 ; u fi 0, u fi 3 q12 2u 3 ; m fi p, x fi 23 2 x13 q(x) 3. Custard Flavors Syrups Toppings Vanilla (V) Hot fudge (H) Nuts (N) Chocolate (C) Butterscotch (B) Granola (G) Mint chip (M) Peanut butter (P) Solution: e Ho Butters Va nil la We can depict the 4 flavors of custard by the left-most branches in Figure 8-10. If A is zero and B is not zero, then the equation can be written in the form y 5 k and the graph is a horizontal line. (26C6) (30C6) ? t(x) 5 x11 x 2 4x 2 12 105. Answer 9. See Least common denominator (LCD) Leading coefficient explanation of, 38 factoring trinomials with, 50 Leading term, 38, 302, 303 Leading term test, 302 Least common denominator (LCD), 62, 65 Least-squares regression line, 220–221, 276 Leonardo of Pisa (Fibonacci), 692 Like terms, 11, 12, 39 Linear algebra, 497 Linear cost functions, 217–218 Linear equations. 10 log2 x 2 log2 y 2 log2 z 31. x2 1 y2 1 2x 1 5 5 0 TECHNOLOGY CONNECTIONS Setting a Square Viewing Window and Graphing a Circle A graphing calculator expects an equation with the y variable isolated. New functions can also be formed from the sum, product, and quotient of two functions. xk . a20 5 75,000 1 (20 2 1)(4000) a20 5 151,000 n Sn 5 (a1 1 an) 2 20 S20 5 (75,000 1 151,000) 2 S20 5 2,260,000 Substitute a1 5 75,000 and d 5 4000. An employee invests $400 per month in an ordinary annuity. ln 3 f ; x < 0.5600 3 ln 4 2 2 ln 3 ln1 2.989 ln 400 2 ln 2.989 400 2 e f or e f ; t < 2.4483 22 2 5ln 86; x < 2.0794 71. The triangular front has a base of 6 ft and a height of 4 ft. 10 210 Figure 2-10 EXAMPLE 7 distance between tick marks x-axis distance between tick marks y-axis Graphing Equations Using a Graphing Utility Use a graphing utility to graph y 5 0 x 0 2 15 and y 5 2x2 1 12 on the viewing window defined by [220, 20, 2] by [215, 15, 3]. 53. Explain how to determine the break-even point. f (4). a1 5 29 43. y 5 25x 1 258 b. 0.27 6 1 7 5 b. (n + m)(x) 69. We sketch this function only for x values on the interval 21 # x , 2. (x 2 2)2 5 8(y 2 3) or (y 2 3)2 5 (x 2 2) 69. 2k; k) 211 11. y 5 4 3 2 x,6 1 2 3 4 5 6 7 8 5 6 7 25 24 23 22 21 21 22 23 24 25 y x2 1 1 2 y2 ,4 1 25 24 23 22 21 21 22 23 3 4 5 x 1 2 3 4 5 x b. the truth of 2. y 5 4 3 2 24 25 24 25 27. 0 (multiplicity 3), 2 (multiplicity 2), 21 (multiplicity 4) 4. 237 e. 13 11 1 1 27. 0 y 5 0 1 0 2 15 0 1 y 5 0 2 0 2 15 1 2 y 5 0 3 0 2 15 2 y Ordered pair (23, 2) (23, 2) (22, 1) 5 y 2 |x| 5 21 4 3 (3, 2) 2 (21, 0) (22, 1) (0, 21) 25 24 23 22 21 21 (21, 0) 22 (1, 0) (2, 1) (3, 2) Skill Practice 4 Graph the equation by plotting points. The value a b 5 1 is the 6 n coefficient of the last term of the expansion. a (21)j j51 3 n22 15. f (x) 5 2x3 1 4 50. y 5 1400x2 2 1200x on [25, 5, 1] by [21000, 2000, 500] 92. (22, 4) 7 6 5 4 1 c. 2 3 m(x) 1 1 x2 23 25 24 23 22 21 21 22 23 24 24 25 28 27 26 25 24 23 22 21 21 22 1 2 x 7 57. Using the roster method, the set of the even numbers between 0 and 10 is represented by {2, 4, 6, 8}. R.3. a2`, R.2. (2`, `) f 21(x) 5 x13 2 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x f(x) 5 2x 2 3 23 Section 4.2 Practice Exercises, pp. For Exercises 65–66, use the Using techniques from calculus, we can show that (1 1 x)n 5 1 1 nx 1 first four terms of this infinite series to approximate the given expression. That is, we can decompose a composite function into two or more simpler functions. Julie earned a bachelor of science in applied mathematics from Union College in Schenectady, New York, and a master of science in mathematics from the University of Florida. A point P is assigned an ordered triple P(x, y, z) relative to a fixed origin where the three axes meet. 3y 5 5 33. 2i 3x { }; The values 3 and 210 do not check. Show that Pk11 is true; that is, show that F1 1 F2 1 ... 2.0 3 1010 Domain: (2`, 0]; Range: (2`, 1] b. Pam can row to a point 166 ft down the beach or to a point 300 ft 3 down the beach to be home in 5 min. leading 5. Recall that 0! 5 1. A232, 132 B, A232, 212 B d. (See Examples 3–4) y 15. A department store marks up the price of a power drill by 32% of the price from the manufacturer. In a carnival game, players win a prize if they can toss a ring around the neck of a bowling pin. Evaluate Finite Geometric Series The nth partial sum Sn of the first n terms of a geometric sequence is a finite geometric series. y 6 5 4 3 2 1 25 24 23 22 21 21 g(x) 5 2x 1 1 1 2 3 4 5 x 22 23 24 Skill Practice 5 Evaluate the function defined by h(x) 5 4x 2 3 for the given values of x. Write 1.975 as a fraction. y 5 2g(x) y 5 f(x) 2 37. 2y 5 25x 1 2 12. {(210, 3)} 19. f(2) 5 5 b. Apply Vertical and Horizontal Shrinking and Stretching 4. (23, 0) d. To find the total income over 20 yr, we need to know a1 and a20. To Jason Wetherington and Mary Beth Headlee, thank you so much for your work on SmartBook and for the additional pairs of eyes on our manuscript. The width is 26.5 in. Two adjacent angles form a right angle. (4, 2) and (0, 26) 76. Y1 5 (first piece)/(first condition) Y2 5 (second piece)/(second condition) .. If so, identify the common ratio. If so, identify the common difference. That is, 5x4 1 4x3 5 x3(5x 1 4) and 5x24 1 4x23 5 x24(5 1 4x) Ax 1 15B Ax 2 15B 103. Evaluate a (21)i11 if n is odd. 22a7b3 4 8 25. k 5 5 2 t a. f (20.09) 77. If B is zero and A is not zero, then the equation can be written in the form x 5 k, and the graph is a vertical line. (2`, 0] c. 6 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 x 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 x S 1618 3 64 d 32 3 4 5 6 x 214 1 8 29. y y 7 6 5 7 6 5 4 3 2 4 3 2 1 1 26 2524 23 22 21 21 x y 7 6 5 1 2 3 4 x 22 23 69. Doctors in a certain city report 24 confirmed cases of the flu to the health department. The statement that Pk is true is called the inductive We must show that Pk11 is true. 3! Skill Practice 4 a. 1 Fn 5 Fn+2 2 1 for positive integers n $ 3. ix Efficient. {2} 17. Assume that 5 1 8 1 p 1 (3k 1 2) 5 (3k 1 7) (Inductive 2 hypothesis). 23 c. Suppose that y 5 C(t) represents the average cost of a gallon of milk in the United States t years since 1980. Find (d + r)(t) and interpret the meaning in the context of this problem. The intersection of the constraints defines the feasible region. Lakeisha wants to put down new tile in her home. EXAMPLE 3 Using Mathematical Induction Use mathematical induction to prove that 4 is a factor of 9n 2 1. 4 4 4 4 4 (a 1 b)4 5 a ba4 1 a ba3b 1 a ba2b2 1 a bab3 1 a bb4 0 1 2 3 4 4 4 4 4 4 (2x 1 3)4 5 a b(2x)4 1 a b(2x)3(3) 1 a b(2x)2(3)2 1 a b(2x)(3)3 1 a b(3)4 0 1 2 3 4 5 1(16x4) 1 4(8x3)(3) 1 6(4x2)(9) 1 4(2x)(27) 1 1(81) 5 16x4 1 96x3 1 216x2 1 216x 1 81 Skill Practice 3 Expand by using the binomial theorem. Section 3.1 EXAMPLE 1 287 Quadratic Functions and Applications Analyzing and Graphing a Quadratic Function Given f (x) 5 22(x 2 1)2 1 8, a. n 20. x 5 0, x 5 2 b. The horizontal asymptote is y 5 0 and means that the temperature will approach 08C as time increases without bound. a (5k 1 3) k51 i51 54. y 5 4 3 2 23 y 67. 7 6 5 4 3 2 1 1 2 3 4 1 2 22 23 5 4 3 2 x c. 5 1 1 23 24 25 x 24 85. Given a function defined by y 5 f(x), explain how to determine the x- and y-intercepts. (21, 5) 65. 452: © Comstock Images/Jupiter Images RF; p. In how many ways can a judge award blue, red, and yellow ribbons to 3 films at a film festival if there are 10 films entered? f(t) 5 1 t25 3 b. Rita needs to score between 77 and 100, inclusive. Y 47. If the Rh antigen is present, the blood is said to be Rh positive (Rh1); otherwise, the blood is Rh negative (Rh2). 4CD D 2C C ay2 1 12 9 6 3 28 26 24 22 23 26 29 212 1. 10 5 6,760,000 b. Ellipse: Center: (0, 2); Vertices: (5, 2), (25, 2); Endpoints of minor axis: (0, 5), (0, 21); Foci: (4, 2), (24, 2); Eccentricity: 45 3. 63 5 216 75. (See Example 5) 35. y 5 x2 EXAMPLE 2 b. (2`, 4) ´ (4,`) b. SECTION 2.7 d. Write a linear revenue function representing the revenue R(x) for holding x private lessons for the month. 0 x 0 5 2 0 x 0 . With a1 5 5, r 5 2, and n 5 11, we have Sn 5 a1(1 2 r n) 5(1 2 211) 5 5 10,235 12r 122 Skill Practice 7 Find the sum of the finite geometric series. The equations are equivalent, meaning that they all have the same solution set. p)(0) p c. {1} 13. 4 F 2 4 6 8 33. b; x ? The graph of y 5 f (x 2 c) is the graph of y 5 f (x) shifted (up/down/left/right) c units. 2 (9x)2 or A 1 9xB 2 43. 9 F 5 10 8 7 6 5 4 3 2 C(0, 4) 10 210 F 216.1 16.1 1 25 24 23 22 21 21 33. 23(x 1 2) 1 1 # 2x 1 5 c. 1 gal of 80% antifreeze should be used. 14. [220, 20, 2] by [240, 40, 10] b. R.1. 9! R.2. 0! R.3. 7! 5! R.4. 10! 4! 6! Concept Connections 1. 2A 2C k k b. 2115 1 i 155 35. 2 , 2 , 2 , 2 , p 3 6 9 12 53. 211 2 7i 67. 50 50 91. 23 m5 Move to the right 4 units. 7! b. log 2 1 log x 1 8 log(x2 1 3) 2 log(4 2 3x) 2 1 1 41. See also Systems of linear equations; Systems of linear equations in three variables; Systems of linear equations in two variables in applications, 84–85, 213–216, 276 graphs of, 197–202 method to solve, 83–84 as rational equations, 86–88 Linear equations in one variable in applications, 84–85 explanation of, 82, 113, 158 method to solve, 83–84 Linear equations in three variables, 506, 577. 1 59. 1 g. {(2, 1), (2, 21), (22, 1), (22, 21)} 17. y The parent function for g(x) 5 0 x 0 2 3 is f (x) 5 0 x 0. Write the range. 4, 10. If two events A and B are mutually exclusive, then P(A > B) 5 . {(1.028, 15.772)} 0.1 24 30 4 20.1 210 10 210 51. (Hint: The population of China is approximately 1.5 billion.) 81. f 21(x) 5 21x 1 9 6 y 5 f(x) 5 1 47. How much will the annuity be worth by the time the employee reaches age 62? f(0) 5 (0)2 2 4 5 24 The y-intercept is (0, 24). 1 5 P(E) 5 1 2 P(E) 5 1 2 5 The probability of rolling a sum other than 7 is 56. (2x3 2 y)5 22. Is m(2x) 5 m(x)? Skill Practice 12 Refer to the functions f and g pictured in Example 12. • The graph of the equation is symmetric with respect to the origin if substituting 2x for x and 2y for y in the equation results in an equivalent equation. 0 2 1/2 11 2 x 2 2cd 5 x2y6 5 1 99. 20 5 1 b. t21x2 5 x13 Domain: 12`, 232 ´ 123, 22 ´ 12, 32 ´ 13, `2 29. 1 3 x(x 1 4) x(3x 1 y) c. 2, x ? { } 6. A 5 c 22 3 3 0 0 d b. { } 23. The maximum profit is $114,000. However, if i is used for the index of summation, do not confuse it with the imaginary number i 5 121. (0.9959)10 < 0.9597 95. log2 9 107. Graph Equations Using a Graphing Utility Answers 6. That is, R(x) 5 C(x), or equivalently P(x) 5 0. a (4i 1 3) i51 3. 1 1 b. (22, 8), (1, 2), and (4, 23) 78. 6 The parent function for h(x) 5 x3 1 2 is f (x) 5 x3. 5(22z 1 16) 1 7(3z 2 5) 2 11z 5 45 ✓ 3(22z 1 16) 1 5(3z 2 5) 2 9z 5 23 ✓ (22z 1 16) 1 (3z 2 5) 2 z 5 11 53. For the given figure, a. Therefore, an equation written in slope-intercept form defines y as a function of x. Arithmetic Sequences and Series 1. For example, in the graph in Figure 2-18 shows the blood alcohol concentration (BAC) for an individual over a period of 9 hr. 7, 14, 28, 56, 112 21. Increasing on (3.750, `); Decreasing on (2`, 3.750) 10 210 10 210 135. Neither even nor odd 27. Write a formula for the nth term of a sequence that represents the resale value of the device n years after purchase. 0 103. an 5 1n a. The sum of two squares will equal zero only if each individual term is zero. (See Example 5) a. y2 x2 b. For example, row 1 represents the cost for plan A for months 1, 2, and 3, respectively. 5 4 3 2 93. 1,000,000 times more intense a. 1s 2 t2 1x2 Objective 2: Evaluate a Difference Quotient For Exercises 33–36, a function is given. (x 2 4)2 2 4 y 5 22x 1 6 and y 5 2x 2 10. Yes. 25 24 23 22 21 21 22 23 2 24 25 1 x 1 23 5 4 3 2 c. A sum of 7 will occur if the dice land on one of the following 6 outcomes. a2`, 2 d ´ c , `b 2 2 3 23 2 159 23 1 159 , b 29. (See Example 6) a. same x values {(3, 1), (2, 5), (24, 2), (21, 0), (3, 24)} When x 5 3, there are two different y values: y 5 1 and y 5 24. C 5 159n 1 0.11(159n) or C 5 176.49n b. 0 C 0 45. Based on the sample of data, the estimated systolic blood pressure for a 55-year-old is 132 mmHg. Skill Practice 7 Suppose that y represents the average consumer spending on television services per year (in dollars), and that x represents the number of years since 2004. p. A linear revenue function models revenue R(x) for selling x items. List all the permutations of three elements from the set. pages cm Includes index. Printed in the United States of America. 47 1. (14, `) c. (y 1 1)2 (x 2 5)2 2 5 0; The graph is a pair of intersecting lines: 4 9 y 5 32x 2 172 and y 5 232x 1 132 . We have that P(H) 5 0.279. p in interval notation. How many groups of 5 numbers are possible? Its converse is the statement "if q, then p." The converse of a statement is not necessarily true. Therefore, Y1 5 Y2 for x 5 2. 732 Chapter 8 Sequences, Series, Induction, and Probability Mixed Exercises For Exercises 33–36, use mathematical induction to prove the given statement for all positive integers n and real numbers x and y. How much money is initially infused into the local economy during the festival for admission, art, drinks, and food. Each year thereafter, he would receive a raise of $2400. Evaluate a Difference Quotient 3. For example, use the menu nPr function found in the under PRB. 5 4 3 2 21 21 22 8 7 6 y 5 |x| 2 2 2 1 73. Expanding Your Skills For Exercises 95–100, use transformations on the basic functions presented in Table 2-2 to write a rule y 5 f(x) that would produce the given graph. 2 51 b. z(x) 5 x Zx 1 1Z 2 4 106. 25 24 23 22 21 21 22 x b. The equation y 5 x 2 2 may be written in function notation as Answers 4. Substituting 0 for y, we have: 0 5 (x 1 3)2 x 5 23 y 6 5 4 3 2 1 25 24 23 22 21 21 22 y 5 (x 1 3)2 f(x) 5 x2 1 26 25 24 23 22 21 21 22 1 2 3 4 x 23 The x-intercept is (23, 0). Given f (x) 5 2x3 1 4, determine the average rate of change of the function on the given intervals. an 5 4a b 4 25 125 , ... 4 16 A graph of several terms of the geometric sequence from Example 3 is shown in Figure 8-5. (2`, `) 79. f(t) 5 80t b. {1, 24} 91. 1 26. h(x) 5 5 x14 4 94. Write a linear function to model the cost for parking P(t) for t hours. T21(2988) 5 120 means that if a homeowner is charged $2998 in property taxes, then the taxable value of the home is $10,000. In such a case, a z-axis is taken perpendicular to both the x- and y-axes. m 5 4 0.068 75. In Exercises 13–16, 2. SECTION 2.6 231 Transformations of Graphs y b. {21}: The value 12 does not check. 1 x 1 1 y 8 7 6 22 21 21 22 1 2 3 4 5 6 7 8 x 13 22 21 21 22 1 2 3 4 5 6 7 8 x 22 21 b. 6 c. 2 3 5. Precise Exercises, pp. 11 b. m 2 n 7. Avoiding Mistakes boxes that fend off common mistakes. Write a rule for a linear function y 5 g(x), given that g(0) 5 7 and g(22) 5 4. 2(x 1 1) as desired. e 3, f4 5 3 f (x) 5 x3 2 x2 1 14x 1 24 5 3 f (x) 5 x4 2 x3 1 x2 or f (x) 5 2x4 2 5x3 1 3x2 2 x2 2 44 77. Determine the sum for the equation (x 1 15)2 1 (y 2 3)2 5 225. Domain: (2`, `); Range: [24, `) 27 25 23 21 27 26 25 24 23 22 21 21 22 1 2 3 4 5 x 17 26. Center: (0, 0) 19. 10 8 6 4 10 8 F 6 4 2 FF F21028 26 24 22 22 24 26 2 4 6 8 10 x 26 4 6 8 10 28 F 210 5 4 3 5 4 3 2 1 2 3 4 5 25 24 23 22 21 24 5 25 (25, 23); m 5 2 3 1 3 70. Write a formula for the nth term of the geometric sequence. Thus, 16 P(A` `S) 5 52 5 134 Answers 6. 5 120 15 120 30 87 29 83 5 47 6000 41 160 40 c. {(5 2 2, y) y 0 y is any real number} c. g(x) 5 x4 1 x3 1 x 20. A heart, club, or spade. 7 1 R.2. y 5 2 x 2 8 8 y 4 5 3 2 23x 1 4x y5 12 5 4 3 2 . R.3. 122, `2 R.4. 3 10, `2 1. Suppose that each person spends an average of $300. In Example 4, we find specific terms of an arithmetic sequence given information about the sequence. To our colleague and friend Kimberly Adams, we're so grateful for your creativity in preparing the chapter openers and the group activities. Write terms with a common denominator. See page SA-47. 90. (x 1 4)(x 1 4)(x 2 1) 1 x 2 1 x 2 1 F2n21 5 F2n for all n. EXAMPLE 3 Writing the Nth Term of a Geometric Sequence 9 27 Write a formula for the nth term of the geometric sequence. f (x) 5 2 x 1 3 3 3 3 3 m5 81. s 5 216t2 1 16t b. 4 27. There is no need to test whether f is an odd function because a function cannot be both even and odd unless all points are on the x-axis. log4 (7 ? f (x) 5 x and g(x) 5 24 a. 14 1 h 1 2 2 2 Algebra for Calculus, pp. Skill Practice 3 Use translations to graph the function defined by q(x) 5 1x 1 2 2 5. a (21)n21(2n) k53 k51 20 8 65. The solution set consists of the ordered pair representing that point. • A function defined by f (x) 5 b is a constant function. Do the average monthly electric bills follow an arithmetic progression? How much money is initially infused into the local economy through this event? c. Vertical asymptote: x 5 0 c. b(x) 5 (x 1 1)3 e. y 5 0 Q. 33. Determine the maximum number of turning points of the graph of the function. (p(3) (m 1 p)(0) (p 1 m)(0) p(m(24)) (p 1 m) 1 25 24 23 22 21 22 23 4 5 y 5 p(x) 5 x2 2 x 3 1.1 31.0 Section 2.5 Practice Exercises, pp. 27 21 1 0 24 6 0 1 70. Write a linear model to relate the sales with the number of months of employment. y-intercept and interpret its meaning in context. 183: © Erik Isakson/Getty RF. p. Explain why if a is odd, 5 xm14 113. Use the sum of the squares of the odd integers from 1 to 101. Both n 5 1 and n 5 2 with a 1 b n 4 for dollars n principal invested at an interest rate r compounded n times per year for t years for the following compounding options. f(x) 5 3x f(x) 5 24x2 2 3x 1 44. Write A as a function of C. (0, 1) 1 b. False 105. Evaluate (h 1 f)(1). Graph the data in a scatter plot using the number of calories as the independent variable x and the amount of cholesterol as the dependent variable y. t2 1x2 s 28. f) (2) f d. The value 0 B 0 5 2 0 A 0. 1 2 log(a 1 b) 35. 2 39. A0, 22 DB e. 23 19. 307: NASA; p. Then write the linear equation using function notation, where y 5 f(x). In Exercise 103 from Section 8.3, we learned that if a fair coin is flipped n times, the number of head/tail arrangements follows a geometric sequence. 5C2 57. (x 1 3)(x 1 5) 1. Undefined 3 3 (r 2 p)(x) 5 2x2 2 6x; (2`, `) 21. (2`, 0] y 5 f(x) 8 6 4 2 21028 26 24 22 24 26 28 2 4 6 8 5 1. Use the data points (2, 308) and (6, 408) to write a linear equation relating y to x. 2 1 b 2 3 53. Therefore, the intersection of their domains is [1, `). 132. Find the total income for an employee who works at the job for 30 yr. 2076 e. successinmath.com xiii Our Commitment to Market Development and Accuracy Acknowledgments: Paramount to the development of College Algebra was the invaluable feedback provided by the instructors from around the country who reviewed the manuscript or attended a market development event over the course of the several years the text was in development. 39 6 ft/sec e. 100. (See Examples 1–2) 1 71. 741 n! n! 1! n!? x 1 y n! x y n!? 1 1 1 y. Find (T + C)(x). Neither even nor odd y f. Therefore, events A and S are not mutually exclusive, meaning that they overlap. 51 44. Passes through a , b and the slope is undefined. The second hose can fill the pool in 2 hr. P(all boys) 5 P(boy on 1st) ? 2x 2 2 67. {22, 4, 6, 7, 8} f. (x 1 3)2 1 (y 1 4)2 5 1 2 30. T 5 4 E Bk 3 105. x 5 2 1 6 10. a 5 i51 417 12. origin 5. If the annuity earns 7%, a. 22 1 10i 2 1 i 3 12 121 1 i 133 59. A function is continuous if its graph can be drawn without lifting the pencil from the paper. Domain: (2`, `); Range: [219, `) 12 2 Section 3.1 Practice Exercises, pp. {x 0 21 # x, } y 0 c. 5 4 3 2 5 4 3 2 For Exercises 31–34, write the domain in interval notation. Evaluate 13P5 and 13C5. 3x 5 5 b. a 5 22m2 1 n2 5 0.2 Compound inequality b. Answers 9 a. (n 2 1)! (n 2 1)! (n 1 1)! (n 1 1)! 5 (n 1 1)(n)! Skill Practice 3 Evaluate. The sum to an infinite geometric series exists if 0 r 0 , 1. Determine the degree of each term (that is, the degree of each term) is n. f(x) 5 2x 5 1 2 2 x 2 3 b. 18 6 4 12 9 6 2 3 21028 26 24 22 24 26 28 2 4 6 8 10 x 2152 1229 26 23 23 26 3 6 9 12 15 x 26 29 212 215 29. In the end, scientists combine a series of simple curves to approximate weather patterns that cover thousands of square miles. Evaluate 20C3 and interpret its meaning. Let M 5 log b x and N 5 log b y, then implies that M 5 x and N 5 y. Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 119 x 5 0 12 x 687 1. 1 6 x 2 f(x) 5 6 r 5 6 . • f (b) is a relative minimum of f if there exists an open interval containing b such that f (b) # f (x) for all x in the interval. g(x) 5 12x 2 4 1 73. 282–283 y 79. The fourth roots of 1 are 1, 21, i, and 2i. 5 y 2x2 2 4x 1 5x 16 4 53. {(5, 28)} 47. 148 Given a right triangle with a leg of length 7 km and hypotenuse of length 25 km, find the length of the unknown leg. (n 2 1)! n! 694 Chapter 8 Sequences, Series, Induction, and Probability In Example 4, we find a specific term of a sequence in which the expression for the nth term contains factorial notation. Determine if the relation defines y as a function of x. 1) Vertical shrink (if 0 , a , 1) Replace (x, y) by (x, ay). 18, 6, 2, , , a2 a6 1 5 5 , a1 18 3 a3 2 1 5 5 , a2 6 3 a4 2 1 5 5 , a3 2 3 S(8000) 5 1380; The salesperson will make $1380 if $8000 in merchandise is sold for the week. 23,) d. (3x 1 5)1 12 v21v28 23, y 48. 31. m 5 0.125 means that the amount of cholesterol increases at an average rate of 0.125 mg per calorie of hamburger. g(1) 5 2(1) 1 1 5 3 Substitute 1 for x. (5, 0) and (11, 0) f. Job 1 for 5 yr: $352,000; Job 2 for 5 yr: $350,000 b. A graph is concave down on a given interval if it "bends" downward. f (1) d. y 5 x 1 3.01 Section 2.5 SECTION 2.5 Applications of Linear Equations and Modeling 213 Applications of Linear Equations and Modeling OBJECTIVES 1. x 5 (x 5 2)/2(x 1 2). Since the two events can occur in sequence in 2. 1 2 1 24 25 12e. a. 1 2yb 2 For Exercises 65–67, find the indicated term of the binomial expansion. 5 lb x 1z t 15. What is the degree of each term in the expansion? Find the indicated term. Test for origin symmetry. 3 4x 2 5y # 20 2 c. g(f (4)) 101. Compute the sum of all integers between 50 and 100 that are exactly divisible by 3. y 5 x6 1 b. S5 5 45 9. y 5 23 b. 11.6 yr 17. e , 22 f 11. Shift 4.5 units to the left. y 5 6 3 3 50 yd. a (j 4 2 2j2) j51 SECTION 8.4 22. g(x) 5 0 x 0 2. (2`, 22) ´ [0, `) 103. 571–574 1 1 25 24 23 22 21 21 22 y 36. P(20) 5 376; P(30) 5 414 e. Suppose that two cards are drawn from a standard deck with replacement. 0.01 or 0 22 2 f 0 . e , 10 f 2 f 11. Assume that a number can start with a zero or zeros such as 0001. 5 101. (j 17 6 23. A(22, 25) 9 7 8a , 9 2 23 (23.6, 2 1) D5 (22, 0) 2 E(3.4, 0) F(0, 130 Objective 2: Use the Distance and Midpoint Formulas For Exercises 11–18, a. Type Probability O1 0.374 2 0.066 1 0.357 2 0.063 B 1 0.085 B 2 0.015 O A A AB 1 0.034 AB 2 0.006 75. 121 9? 39. (0, 24) g. 6. (718 c. A` B 5 8 b. (5) 63. For Exercises 22–25, graph the equation. 91. f(x) 5 5 2 1 19 29. This gives us 5 p 5 x 2 7 33. { 7 } (0, 1) 5 1 (2, 1) 2 2 21. TIP On many graphing calculators, the factorial function is denoted by n! and is found under the MATH menu followed by NUM. Probability of Total 56 46. • The sequence can be defined recursively as a1, 3 5 an21r for n $. 22 14 12 2 0.75 Theoretically, the total amount spent is $800 million. 29.68t 2 4.84h 1 88 b. q(x) 5 216 1 x2 40. {(22, 28, 2)} 16. The point (23, 5), for example, is placed 3 units in the negative x direction (to the left) and 5 units in the positive y direction (upward). That is, test whether g(2x) 5 2g(x). Let (x, y) be any other point on the line. A > C 5 {x 0 x , 2} e. Determine the horizontal or slant asymptote if either exist. f (x 1 h) 5 5x Substitute x. a. Undefined 3 49. (2`, 23] ´ [6, `) 59. In Figure 2-18, the average rate of change of f between two points on the graph is the slope of the secant line through the points. (x 5) 1x 2 4, 4, {(24, 3)} 7. 9 2x or 9A 1 x8 Z 7 7 c. The radius is approximately 24 yd. Verify that the points A(0, 0), B(x, 0), and C(0, x) make up the vertices of an isosceles right triangle (an isosceles triangle has two sides of equal length). a7 5 2 41. {23, 21] ´ [1, 5) 39. Not arithmetic 2. Find (A1 2 A2)(x) and interpret its meaning. (See Example 8) 56. m 1 4 . Plot the graph of the function. d. Then f (x) is greater. (x 1 2)(x 2 2) 5. The farmer should plant 900 acres of corn and 300 acres of soybeans. e f 2 71. {11, 3} 3 3 45. 8y 2 2 1y 2 1 5 79. A car can comfortably hold a family of five. No. 33. If two cards are drawn at random with replacement from a standard deck, what is the probability that both are kings? x 1 4y 1 3z 5 8 y 1 2z 5 12 z56 23. No. 25. Evaluate d(2) and interpret the meaning. 210x 2 5h 2 4 ; Domain: 123, 32 ` 13, `2 b. Skill Practice 4 Given f (x) 5 4x 2 2, a. Write an expression for the apparent nth term an for the sequence. 2, 1.5, 1.4167, 1.4142 113. y-axis, x-axis, and origin 5 4 3 2 y 5 f(x) 5 23 4 5 x 25 24 23 22 21 21 22 y 5 f(x) 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 21 22 23 24 25 The function is symmetric with respect to the origin. This is called the binomial theorem. {(1, 2), (1, 22), (21, 2), (21, 22)} 22x 2 h 1 2 2 For the sum S 5 1, 21. For i 5 121, find the first eight terms of the sequence defined by an 5 1 2 in. If the leading coefficient is negative, the graph will be down to the far left and down to the far right. Linear b. It also analyzed reviews to verify trustworthiness. c. 3 2 (14) 1 0(1) 3 0(24) 0(4) 1 1(3) 1 0(24) 1 0(4) 1 0(3) 1 (24) 2(1 4 4 3) 1 3 x 2 23 3 1 2 1 2 4 7 21 24 23 22 21 21 22 11 3 2 1 2 21 1 1 b 8. Linear b. It also analyzed reviews to verify trustworthiness. c. 3 2 1 3 6 3 3 2 1 1 2 b y 1 5 2 1 9 8 y 1 00 sum 101 sum 101 2 3 4 n 2 1 2 0 2 1 d 5 22 ? 11 2 3 2 0 2 1 2 2 s 4 2 0 c 50. b 1 3 8 4 y 1 8 n 9 5 5 1 y 2 1 2 2 3 6 2 2 n 2 6 8 c 5 1 2 n x 2 1 0 5 8 9 1 2 n 2 5 0 2 y 0 2 5 4 1 x 2 3 y 2 0 1 9 1 0 1 , 2 b 2 5. 12 9 3 8. Example 8, we evaluate an expression containing summation notation. 5 6 1 3 5 1 4 1 3 f 15. If both sides of an inequality are multiplied or divided by a negative real number, then the direction of the inequality sign must be reversed. On a graph, these two points are aligned vertically. QP 5 c 1 47. y 5 4 1 3 2 24 25 25 y 5 4 1 51. (2`, `) y 6 5 4 3 2 1 y 5 f(x) 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 21 22 23 24 25 The function is symmetric with respect to the origin. This is called the binomial theorem. a3, ... , y 5 22x 2 1 22 x 1 y 2 3 x 5 4 e. For Exercises 69–72, determine the number of diagonals for the given polygon. For now, we present the point-plotting method to graph the solution set of an equation. The code must represent a 3-digit number. y 5 4 3 2 f(x) 524x 1 5 1 Substitute m 5 4 and b 5 5 into the equation y 5 mx 1 b. Therefore the slope-intercept form is y 5 24x 1 5. 15 1 Summation Notation Consider an infinite sequence {an} 5 a1, a2, a3, a4, . . . , an, ... 75% of the money is respent in the state and then respent over and over again, each time at a rate of 75%. In how many ways can a student answer the questions on the test? E2: A black sock is selected. Smartbook® is the first and only adaptive reading experience available for the higher education market. 2 ai 5 i51 n 1 2(n 1 1)(2n 1 1) 6 ai5 i51 n 4 . (See Example 6) 65. The graphs match closely on the interval (0, 2). x 7 7 17. A function that is symmetric with respect to the origin is called an odd function. One solution Infinitely many solutions; The equations are dependent. (k3 2 1)10; middle term 36. 5 9. 52 Skill Practice 8 Use the graph to solve the equations and inequalities. a b 1 4 d. (x 2 4)2 1 (y 2 1)2 5 16 y c. Passes through (25, 1) and m 5 0. 2A 2C 3C 5 c 1 2 x y 5 k(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 24 b. $44,000 33. Therefore, the domain is the set of all real numbers, x. cn 5 ln e 15. 4 2 81. n57 27. 2x 1 8 5 2x 1 2x 3 2 5. Solve for y. Determine the vertical asymptote(s). 0 n 737 738 Chapter 8 Sequences, Series, Induction, and Probability 59. N 5 23.112.2832 t b. The distance formula can be used to derive an equation of the circle. The event that the numbers on the dice do not present a sum of 7 is the complement of event E. P(E) 5 0 760 Chapter 8 Sequences, Series, Induction, and Probability For Exercises 17–24, consider an experiment where a single 10-sided die is rolled with the outcomes {1, 2, 3, 4, 5, 6, 7, 8, 9, 10. 5 mph 200 y 5 21.22x 1 1273 10 0 850 210 10 210 73. Let Pn be the statement 3 1 7 1 11 1 p 1 (4n 2 1) 5 n(2n 1 1). on [0, 1] c. 66 111. {(2, 1)} 1 A21 5 1 2 f 92. A, B, A 75. 65 67 x. 697 698 Chapter 8 Sequences, Series, Induction, and Probability n 5. The general number is 68. 2 23 20 8 18 ? 20 x 1 k! k51 Four (2) Stretch function completing the square 9. 137 Stretching and shrinking. For Exercises 28–29, find the indicated term of the binomial expansion. An experiment is a test with an uncertain outcome. x 2 3 c. The complement of E, denoted by E, is the set of outcomes in the sample space but not in event E. 25 1 5 4 24 25 210 25 (3 2 i 5 2 i 5 i3 4 22 a 3 3 y 23 22 21 22 2 1 0 1 2 24 25 1 25 k(x) 5 y 5 x 1 x 1 2 3 4 7. PROBLEM RECOGNITION EXERCISES Comparing Graphs of Equations In Section 2.6, we will learn additional techniques to graph functions by recognizing characteristics of the functions. A jack or a diamond. {25, 22} b. If the money is respent in the local community over and over again at a rate of 65%, determine the total amount spent. At x 5 2, the function has a relative minimum of 0. 683–685 5. Graph E 2. 2x e4x 1 2e2x 1 1 75. 3x2 10. 165: © Image Source/Getty RF; p. Therefore, P(E) 5 12 , or 0.5, or 50%. 9 3 43. 4.162 75. E A1, 13 B, A1, 13 B, A1, 213 B, A21, 213 B F The numbers are 5 and 7. {77} 1 1 3. 4833 25. 1 5 4.1 4 1 3 5 1 . . . (230.5) 52. What will the resale value be 5 yr after purchase? Given f (? f 766 Chapter 8 Sequences, Series, Induction, and Probability SECTION 8.5 The Binomial Theorem Binomial theorem. Let n be a positive integer. k 5 23. $9568 and $3135 53. No. 15. Compute the sum of all integers between 60 and 150 that are exactly divisible by 8. y 5 x 2 5 y 5 24x 5 7 8 x 24 25 26 79. Objective 1: Apply the Point-Slope Formula For Exercises 5–20, use the point-slope formula to write an equation of the line having the given conditions. An employee identification code for a hospital consists of 2 letters from the set {A, B, C, D} followed by 4 digits. The interval(s) over which f is decreasing. 244 25 Skill Practice 8 Determine the domain and range for the functions shown. x . Suppose that a phone card has 400 min. Geometric Sequence A geometric sequence {an} is a sequence of the form a1, a1r, a1r2, a1r3, a1r4, p • The value a1 is the first term, and r is called the common ratio of the sequence. For Exercises 91–98, find two functions f and g such that h(x) 5 (f + g)(x). y4 5 2 1 x2 17. [0, `) i. 7 and 3 2 2 1 1 21. Chapter 3 Review Exercises, pp. Even function Odd function Neither even nor odd Even function Neither even nor odd Skill Practice 4 Determine if the function is even, odd, or neither. A detailed summary is located at www.mhhe.com/millercollegealgebra. t $ 0. 5. ((1, 24, 3)) 1 1 1 the two jobs over 20 yr? Objective 2: Determine the Slopes of Parallel and Perpendicular Lines For Exercises 23–28, the slope of a line is given. This is stated formally in the following definition. {x 0 x , 28 or x $ 21} f. 23.1407 1 1 2 3 4 5 x k(x) 5 2 { 31 } 2 1 } 24 25 26 27 b. $10,737,418.23 a. 99–104 R.1. x 2 254 R.4. 1 What is the probability that it lands heads up twice in a row? Domain: (2`, `); Range: (2`, 0] 1 2 x 26 27 28 1 11 b. If we solve the equation for x we get the inverse relation. 3x 5 b 6 2r 2 2 y 2 (k)2 50. 13–18 1. There is 1 spade that is an ace in the deck. P1 is true, and 2. if this condition continues. P1 is true. Because 4 5 ? F1v2 5 560a b 7 v2 2 4 x 2 x 4 x 22 1 2 x 3 x 5 c . FK) 1 Fk11 5 (Fk12 2 1) 1 Fk11 by the inductive hypothesis. f (3) x g. In this case, exclude x 5 0 and x 5 4. 90 9 150 15 93. Vertex: (26, 22); Focus: (28, 22); Focal diameter: 8 49. y 5 22 and y 5 4 1 2 64 63. (2c2 2 d5)9; Term containing d25. c(x) 5 1 x11 x23 26. A21 5 c 2 5 2151 1 5 2 d 15 21. 100 rabbits after 1 yr, 1667 rabbits after 5 yr, and 1818 after 10 yr. { }; The value 3 does not check. Solution: By definition (f 1 g)(x) 5 f (x) 1 g(x). (2`, `) 9x 1. y 5 0 x 2 5 0 2 2 54. 21 15. 1 5 12r 4 1 2 A23 B 15 The sum is . Assume that all distances on the map are represented in nautical miles. 2 5 32 c. This represents the amount of time (in yr) required to completely pay of a loan of A dollars at interest rate r, by paying P dollars per month. x $ 3 c. (0, 29) e. 49 c. a (2i 1 3) 5 [2(1) 1 3] 1 [2(2) 1 3] 1 [2(3) 1 3] 1 [2(4) 1 3] 1 [2(5) 1 3] i51 5 5 5 6 6 1 1 1 1 b. Thus, the solutions are 4 and 21. 18. 2 5 x 2 1 2 1 1 Suppose that a 1 1 mCtt 23 x 2 3 2 1 1 y 5 25 Concept Connections 1. In the figure, T'T 2 outcomes x outcomes If the coin is flipped 1 time, there are two possible outcomes, H or T. Isolate the absolute value. Therefore, the sequence a1, a3, a5, . . . is geometric with common ratio r 2. April 1 44. Determine the probability of 1 birth to be x? 27? How many arrangements of 1's and 0's can be made for y 5 27? 6 b. f(x) 5 23x 2 1 2x2 y 5 x 5 R.3. y 5 1 x2 5 R.3. y 5 1 Concept Connections 1. 2 1 19. The graph of a constant function is a horizontal line. First Die Each individual die has 6 equally likely outcomes. (23, 2) b. The sequence is not geometric because the ratio between a4 and a3 is different than the ratio of other pairs of consecutive terms. a78 5 2783 11. 6! 6 ? (g 2 h)(x) 5 g(x) 2 h(x) 5 2x 2 (x2 2 4x) 5 2x2 2 2x 1 6x The domain is (2`, `). Profit is defined as the difference of revenue and cost. 4.2 mi 3 x11 3 x11 2 b 1 5 4a b 215 x 1121 5 x 5 B 4 4 4x3 2 1 1 1 x43 5 x 3 x 2 6 9 5 x 1 3 8 43 5 3 3 52 x 5x B 4 B 4 y 3 2 1 23 22 21 21 24 25 26 1 2 3 4 5 6 x 2 2 8 y. The inductive hypothesis, [5 1 8 1 p 1 (3k 1 2)] 1 [3(k 1 1) 1 2] k 3k2 1 13k 1 10 5 (3k 1 7) 1 3k 1 15 x 13 2 (3k 1 2) 1 k 1 1)(3k 1 10) as desired. If replacing both x by 2x and y by 2y results in an equivalent equation, then the graph is symmetric to the origin. The data represent the number of hamburger with y calories. Graph Equations by Plotting Points The relationship between two variables can often be expressed as a graph of ordered pairs. Suppose that a county fair has an estimated 50,000 people attend over a 2-week period. h(1) e. • Section 2.7 for investigating increasing, decreasing, and constant behavior of a function now presents open intervals. 3 30. (1, 2) b. Is n(2x) 5 n(x)? 5 4 3 2 x y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 23 24 25 24 . 21x 2 2 2 1 , 2 2 4 3 4 2 4 b 1 1 1 1 x 2 x 2 x 2 x y 5 f(x) 24 2 4 3 4 2 6 6 . i 1 3 2 x 1 1 y 1 4 3 2 1 y 7 4 1 3 2 7 5 5 x 1 4 x 2 y 3 8 4 1 4 x 1 2 x 5 4 2 2 3 1 2 1 4 x 2 1 2 b 3 y x 3 2 2 2 2 1 3 3 4 x 4 4 y 2 1 4 x 3 x 4 0 1 (1, 1) y 3 4 x 1 y 4 1 4 x 2 1 0 2 2 3 2 2 2 2 1 1 3 (2, 3) x 2 3 0 1 2 0 x 0 1 0 1 4 2 1 1 2 1 2 4 1 4 3 4 4 6 8. g(x) 5 4x32 x 2 Replace x by 2x to determine if f (2x) 5 f (x). Is this function even, odd, or neither? Yes 69. 1) 5! 5! 5 5 20 (5 2 2)! 3! (3 ? 117. The range of a one-to-one function is the same as the domain of its inverse. 6.9 b. Given a square with sides of length s, diagonal of length d, perimeter P, and area A. c. a(n)(23.1) c. 0.000 000 8 36. 24P5 5 5,100,480 53. x f (x) 5 x2 g(x) 5 1 2 23 9 11 25 22 4 6 0 21 1 0 3 23 12 y 0 5 x2 2 4 0 0 2 0 4 1 21 1 0 3 23 12 y 0 5 x2 2 4 0 0 2 0 4 6 0 3 9 11 5 For each ordered pair (x, y) on the graph of y 5 f (x), the corresponding point • (x, y 1 k) is on the graph of y 5 f(x) 1 k. Find a. log5 x 1 3 6 1 43. 21 1 log7 m 1 2 log7 n 2 log7 29. an 5 102.6 (n 2 1)(5.4) c. Example: ceil(3.1) 5 4. C 5 15. a5 5 n(n 1 1) 2n 1 1 3 1 1 315 n11 n 2 1 5 24,192 49. sum is within 100 (13). 10 b. 675–680 R.1. 5 22 R.2. y 5 3 R.3. x 5 2 1 2. A geometric sequence is recognized by dividing any term after the first by its predecessor. n(x) 5 103. (n 2 1)! n! n! 5 . (See Example 6) 6! 3! 2! 3 A6 ? . In how many ways can 4 students from a group of 15 students be selected to serve on a committee? 4 x 5 24 25 3 24 Move up 3 units. That is, show that A 32 B 7 . i is the index of summation. Passes through (3.4, 2.6) and m 5 1.2. 10. ,4 ,5 ,6 ,7 ,8 , a. (3, 5) 111. (0, 17) 2 2 9 13 y e. C 5 7x b. Passes through (20.004, 0.009) and is parallel to the line defined by y 5 f(24) 99. Events A and K are mutually exclusive. xm28 117. y 5 32x 1 2; m 5 32 ; y-intercept: (0, 2) y b. (1, 3), (3, 1), and (0, 2) 20 40. Factoring: x2 5 x2 2 5 x2 2 22x 1 4x for the values of x given. The distance from the center of a circle to any point on the circle is called the . (T + C)(x) 5 1.5794x 2 1.06 represents the total cost to buy x songs for a first-time visitor to the website. Caroline adopted a puppy named Dodger from an animal shelter in Chicago. Write A as a function of P. {w 0 w # 3}; (2`, 3]; 3 1. h(x) 5 x 2 5 10. Evaluate the functions for the given values of x. CHAPTER 6 3 4 5 x R.1. {16} R.2. 100 A B A x C R.3. 1 R.4. 1 2 2 2 2 3 7x x 11 1. (See Example 11) b. f (x) 5 23x 114. The length is approximately 2.91 m. However, a different pattern exists. A cable company advertises short wait times for customer service calls. E5 1 5 F or E54y 8 12 5 8 3. {6}; The value 1 does not check. x n 5a1 1 (n 2 1)d The sequence is arithmetic because the difference between each term and its predecessor is the same constant. The graph of a linear function is a line. The total resistance is constant with the statement that the total resistance is always less than the resistance in any individual branch of the circuit. 0.08c b 2 0.06c2b2 1 0.01cb3 1 11 21. x 5 23, x 5 21, x 5 14 d. 16 terms 3 x 44. In how many ways can a platoon leader select 4 soldiers among 15 soldiers to determine the most time-efficient route. v2 5 Chapter 1 Test, pp. (25, 2) 3. Any real number. 8 2 4(1 2 x) 2 7 2 2x , 0 c. f (4) b. Center: (24, 23); Radius: 111 22. Find the first eight Lucas numbers. n For Exercises 17–20, the nth term of a sequence is given. ` d. 280: © Graeme Knox-k-island photography/Getty Images RF; p. y 5 53. (6, `) a. P(boy on 3rd) 1 1 1 1 5 ? V5 lwh 1. 7 24 25 x y 5 2f(x) 25 24 23 22 21 21 22 23 y 5 f(x) 1 2 3 4 5 6 7 x 23 24 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 23 22 21 21 22 1 2 3 4 5 x 23 24 25 21 22 23 y 5 2 f(x) 1 2 3 4 5 4 81. There are numerous variables that come into play. 1 17. (a, f (a)) and (b, f (b)) 51. 1 5 b. 36 b. floor(5.5) 4]. Approximate 12 by substituting 2 for x and finding the first four terms of the sequence. The maximum value is 23. (2`, 1), 1604 1 24(2p) 3 (pa) 3. 8 SA-30 Student Answer Appendix f. 2 3 x 2(x)x 1 1 22 23 23 24 25 1 23 4 b. Parallel 9. Write an equation of the line that passes through the points (2, 23) and (6, 21). (See Examples 9–10) 47. Skill Practice 11 Write the equation in standard form (x 2 h)2 1 (y 2 k)2 5 r2 and identify the center and radius. For Exercises 7–14, write the first five terms of the sequence. 1 2 2 22 d. x 6 1 1 1 15 yr 1 2 x 2 4 2 5 1 x 2 2 x 3 x 5 Bn = 1 b. 13. See (1 2 x)4 2 2 0.2 2 x 2 23.4 1 5 (0 2 x 2 8 2 1 0 2 2 4 3 4 25) 2 5 7x 1 1 0 2 x(x 1 2) 2 1 1 Objective 4: Compute Average Rate of Change For Exercises 79–80, find the slope of the secant line pictured in red. Doubling the radius results in (2)2 times the surface area of the sphere. (0.1 1 0.3m)4 3 c 27. Use the model in part (a) to approximate the time required for Dodger to reach 90% of his full-grown weight of 70 lb. Even 5. How many terms must be taken to get the nth partial 1 of the actual sum? 6744.25 157. What is the slope of a line defined by x 5 2? Explain why. (4, 1) 35. Evaluate the expressions. Shift the graph to the left 2 units. 4x 2 2 , 23x 1 5 c. 52 1 22 2 2 (x 2 1) (y 2 2) 1). h(x) 5 (x 2 2) 2 4 a. (x 2 1)2 b. In how many ways can 3 students be chosen? 4 5 5 4 23 24 5 25 24 25 b. 2 1 22 23 25 24 23 22 21 21 22 23 24 25 21 22 23 24 25 f (x) 5 (x 1 2)2 5 5 x d. 1 25 24 23 22 21 21 22 23 x 24 25 26 27 28 29 210 ...

5 11 x23 Mixed Exercises For Exercises 99–102, the graphs of two functions are shown. The cost and revenue functions C and R are shown for producing and selling x items. 4 2 R.1. (2`, 21) ´ (21, `) R.4. R.6. 1. 7 1 1 a. 222 Chapter 2 Functions and Relations SECTION 2.5 Practice Exercises Prerequisite Review R.1. R.2. R.3. R.4. R.5. Use slope-intercept form to write an equation of the line that passes through (3, 27) with slope 25. (21, 28) y 1 25 24 23 22 21 21 22 23 24 25 26 27 28 29 1 2 3 4 5 x h(x) 5 2(x 1 1)2 2 8 1 x 15. Create Models Using Linear Regression y (x4, y4) (x2, y2) d1 d2 d4 y^ 5 mx 1 b d3 (x3, y3) (x1, y1) x Figure 2-24 In Example 7, we used two given data points to determine a linear model for systolic blood pressure versus age. For Exercises 41–43, determine the slope of the line passing through the given points. This can be generated by the factor (21)i 1 1. Parabola b. Directrix: y 5 252 ; Axis of symmetry: x 5 0 c. (See Example 12) 99. 5120 5 1024 5 210 5 10 5 n5 5(2)n21 2n21 2n21 n21 11 Divide both sides by 5. (30, 252) and (222, 239) 31. Foci: A6, 2 12 B, A6, 22 12 B y e. {25, 1} 2 b. Through her friendly and engaging writing style, students are able to understand the material easily. • If b2 2 4ac . x 2 1 y . The graph of g(x) 5 12x 18. (a 2 c)(a 1 2c 1 1) (y 2 4)(y 1 3) x2 2 7x 1 2 79. Compute f (c) either by direct substitution or by using the remainder theorem. e 41. Given g(x) 5 1x 2 3, find (g + g)(x) and write the domain in interval notation. Determine the y-intercept of the graph of f. The slope and y-intercept are easily determined by inspection of the equation. 235 ft b. x 5 9. v21x2 5 103. r2! ? 781 c 23. (See Example 3) s1x2 5 x22 x2 2 9 t1x2 5 x23 22x 27. No vertical line intersects the graph in more than one point. 2b 15ab 2 16. A test consists of 3 multiple-choice questions, each with four possible responses, and 7 true/false questions. x 5 6, y 5 3, z 5 8 31. The set of ________ values is called the range of the relation. y 1 2 3 4 5 25 24 23 22 21 21 22 3 4 5 1 2 3 4 5 x y 1 1 x 2 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 26. 100 252 Chapter 2 Functions and Relations Intervals of Increasing, Decreasing, and Constant Behavior Suppose that I is an interval contained within the domain of a function f. Skill Practice 2 Graph the function defined by g(x) 5 0 x 1 2 0. e4x 2 4e2x 1 6 2 2x 1 4x e e x3 1 3x2y 1 3xy2 1 y3 2 3x2z 2 6xyz 2 3y2z 1 3xz2 1 3yz2 2 z3 1.04060401 47. 163–164 2y(y 2 3x) 24 2 x c. $17 b. EXAMPLE 8 Finding a Least-Squares Regression Line The data given in the table represent the age and systolic blood pressure for a sample of 12 randomly selected healthy adults. m 5 2 ; y-intercept: (0, 2) 2 y c. 2x or A 1xB b. (2n 1 1)! (2n)! For Exercises 45–48, the nth term of a sequence is given. Yes 1. (22, `) b. 3, 15 9 21 , , ,… 4 2 4 For Exercises 15–18, a. In a geometric sequence, the ratio between a term and its predecessor is a fixed constant. (4a 1 1) 2 1 36a 1 9 2 1 36a 1 8 4(9a 1 2) From the inductive hypothesis, replace 9k by 4a 1 1. Skill Practice 7 Find the sum of the first 50 terms of the sequence. Just as an athlete must first learn the basics of a sport and build endurance and speed, a student studying mathematics must focus on necessary basic skills to prepare for the challenge ahead. Given f (x) 5 , the domain is restricted so that x ? Circle; (x 1 1)2 1 (y 1 6)2 5 16 17. Vertex: (4, 21); p 5 23; Focus: (1, 21); Focal diameter: 12 b. x1 5 36.58F, x2 5 37.58F, x3 5 40.58F, x4 5 41.58F 0 0§ 1 1(1) 1 23(0) 1 4(0) 1(0) 1 23(1) 1 4(0) 1(0) 2 3(0) 1 4(1) 5 £ 9(1) 1 5(0) 1 3(0) 9(0) 1 5(1) 1 3(0) 9(0) 1 5(0) 1 3(1) § 11(1) 2 6(0) 2 4(0) 11(0) 2 6(1) 2 4(0) 11(0) 2 6(0) 2 4(1) 1 5 £ 9 11 23 5 26 1 b. an 5 0.16n 1 0.36 3n 27 6. 630–631 5 1 4 23 1 4 † 22 § 2 6 3 3. a (21)i11 i51 2651 14. x 5 0 y 0 Objective 2: Apply Function Notation 33. Choose x $ 21 so that the radicand is nonnegative. (2`, 22) ´ [0, `) 5. If one student is selected at random, find the probability of the following events. a b 4 Objective 2: Apply the Binomial Theorem For Exercises 15–28, expand the binomial by using the binomial theorem. Solution: To find the eighth term of (a 1 b)10, we require the exponent on b to be 7 (one less than the term number). k(x) 5 2 c. {22} 3 2 6 5 4 3 23 2 24 25 y 22 21 21 1 23 1 1 23 25 24 23 22 21 21 22 a. 2A 2C 16.1 210 Problem Recognition Exercises, pp. The graph will have a "hole" at x 5 22 rather than a vertical asymptote. Both the numerator and denominator of the rational expression are positive for all real numbers x. Skill Practice 8 The California lottery game "Fantasy 5" offers a grand prize to a player who selects the correct group of 5 numbers (in any order) from the numbers 1 to 39. A(57.8) 5 2.5 means that after 57.8 yr, the amount of 90Sr remaining is 2.5 µg. m 5 2 1 2 25. {24} d. (x 1 y)3 2 (x 2 y)3 For Exercises 49–52, simplify the difference quotient: 49. sum and is denoted by Sn. 6. y 5 0 1 23 22 21 21 22 1 2 3 4 5 6 7 x 23 24 25 41. a22 5 217 21. The point (1, 23) is a closed dot to show that it is part of the rule f (x) 5 23. x 5 0 g. Arithmetic b. The second rule f (x) 5 x2 is one of the basic functions learned in Section 2.6. It is a parabola with vertex at the origin. Odd 19. This uses a description of the elements of the set. 12 yr c. Notice that R and C intersect at (80, 160). Given an arithmetic sequence with first term a1 and common difference d, the nth term is represented by the formula or by the recursive formula an 5 for n $ 2. an 5 n 5 2 9. E64, 617F 3 e , 25 f 21. Recall that the Fibonacci sequence can be defined recursively as F1 5 1, F2 5 1, and Fn 5 Fn21 1 Fn22 for n $ 3. m 5 2 and the y-intercept is (0, 1). 4845 8. g(f (25)) c. Answer y 5 4 3 2 The function is symmetric with respect to the y-axis. (2`, `); { } y25 5. x2 c. 1 1 1 1 1 1 1 1 p 5 25 125 1 1 2 2 p 5 25 55. b214 5 22487 a1 5 44; d 5 8 c400 5 104 47. x 2 x1 y 2 y1 5 m(x 2 x1) This is called the point slope formula for a line. 0.69 5 A0e23k b. 5 22 5 5 x2 2 x1 7 1 2 122 2 2 25 24 23 22 21 21 22 m 5 22 1 2 3 4 5 x 23 24 25 26 A line with a negative slope "falls" downward from left to right. 1.783 26. 13 c. The business will make a profit if it produces and sells 254 dozen or more cookies. Event E is very likely to happen. To show that a statement is not true, all we need is one case in which the statement is false. g(22) Section 2.7 2 for 23 # x 1 for 22 # x 49. S(x) 5 0.11x 1 500, for x $ 0 b. 1 1 1 b. Determine the total amount spent. 10 2 6) 5 log4 64 5 3 ✓ 1 1 105. subtracts, x 2 6 1 y y 23 57. The truth of Pk implies the truth of Pk11. 185 Given a function defined by y 5 f (x), p. False 53. inverse 2b d a 0 d 1 1 0 9. With LearnSmart technology, questions are designed to foster critical thinking and conceptual learning. 8, 14, 20, 26, … , 320 36. Consider a right circular cone with given height h. {21} 73. Write the equation using function notation where y 5 f(x). [2, 4] d. 21.7037 c. Each true/false question has two possible choices (true or false). f 21(x) 5 x11 4 b. 5 4 3 2 y 5 f(x) f (x) 5 Œx œ where Œx œ is the greatest integer less than or equal to x. x a. Z d. i51 n (a1 1 an) to verify the fifth 2 partial sum of the arithmetic sequence from part (a). x 5 8 h. If a statement is false, explain why. The quadrants are labeled counterclockwise as I, II, III, and IV (Figure 2-1). Transformations give us tools to graph families of functions that are built from basic "parent" functions. Using function notation, this is equivalent to finding f(0). The domain of f is all real numbers. Therefore, we might restrict the domain to the set of integers greater than or equal to 2. x 5 21, x 5 3 d. Equation; e 2 f 4 b. The line in Figure 2-16 Section 2.4 199 Linear Equations in Two Variables and Linear Functions has a slope of $1261. 119. A 5 c 1 20. 3x2y2 2 1 x(5x 2 6) 12x 2 3 4x(2x 2 5) 8. m 5 21.2 mph/mb means that for an increase of 1 mb in pressure, the wind speed decreases by 1.2 mph. 0 y 1 1 0 5 x c. No Problem Recognition Exercises, p. $30,740 $29,150 b. A course in early civilization has 6 freshmen, 8 sophomores, and 16 juniors. f (x) 5 2 x 2 4x 1 4 x 2 3x 2 10 111. 6! 1 ? The result should be a system of two linear equations in two variables. 2 y d. x 5 22 and x 5 2 d. (7C2) 5 18,900 85. (See Example 6) 41. 22(22x 1 3)2(4x2 2 5)(28x2 2 24x 2 15) 25. (3, 4) d 5 2(x2 2 x1)2 1 (y2 2 y1)2 1 24 23 22 21 21 Circles 1 2 3 4 5 6 r 5 2[1 2 (21)]2 1 (2 2 0)2 5 2(2)2 1 (2)2 5 28 x An equation of the circle is: (x 2 h)2 1 (y 2 k)2 5 r2. For Exercises 85–90, determine the average rate of change of the function on the given interval. 0.066 b. Substitute a1 5 15 and r 5 235 to get the nth term for this sequence. 11. 25 ? (2, 0) and (22, 0) b. 600 3 3 c. Variable costs include labor, material, and shipping. 22.0842 f. 6 1 10 1 14 1 … 1 (4n 1 2) 5 n(2n 1 4) 24. (2, 0), (4, 0) e. 751 Let E be an event relative to sample space S. EXAMPLE 8 Solving Equations and Inequalities Graphically Solve the equations and inequalities graphically. Let Pn be the statement 1 1 5 1 p 1 5n21 5 14(5n 2 1). 2 1 8 1 14 1 … 1 (6n 2 4) 5 n(3n 2 1) n 5. (f + g)(x) 267 1 x 1 4, write a rule for each function and write b. Identify the y-intercept. Decreasing c. 2730 243x5 2405x4y2 1 270x3y4 2 90x2y6 115xy8 2 y10 1 8C2 ? See Addition method Ellipse in applications, 642–644 eccentricity of, 643–644, 682 explanation of, 634–635, 682 focus of, 634 graphs of, 637–640 reflexive property of, 642–643 standard form of equation of, 635–638, 640–642, 682 Ellipsoid, 650 Empirical probability explanation of, 754, 766 method to compute, 757 Empty sets, 2, 85 End behavior, of polynomial functions, 300–303 Endpoints, 4 Equality of matrices, 587 properties of, 83 Equations. a1 5 80 and r 5 245 23. 2123 218 d 54 7 9 213 § 48. Find the difference quotient, 3. Suppose that a line passes through the point (2, 25) and (24, 7). The coefficients of the terms in the expansion can be found n triangle or by using a b. • The sequence can be defined recursively as a1, an 5 an21 1 d for n $ 2. 462–466 5 2 5 6 261 R.2. e 2 , 2 f R.3. e f 3 5 2 { }; The value 2 does not check. y y 5 4 3 2 1 25 24 23 22 21 21 22 y 5 4 3 2 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 1 2 3 4 5 x A relation can also be defined by a figure showing a "mapping" between x and y, or by an equation in x and y. 1 2 3 4 5 6 7 8 y 9 25 24 23 22 21 21 5 4 1 2 3 4 5 3 2 1 x 22 23 24 26 25 24 23 22 21 21 1 2 3 4 x 22 23 25 y 25. i51 Objective 1: Write Terms of a Sequence from the nth Term For Exercises 7–14, the nth term of a sequence is given. (T + C)(x) 5 1.5794x 2 1.06 (T + C)(10) 5 1.5794(10) 2 1.06 5 14.734 The total cost for a first-time visitor to buy 10 songs is $14.73. a.2b. 2 real solutions 9. 0 1050 850 900 950 1000 c. 2 19. n(a) 5 0.0011a2 2 0.027a 1 2.46 b. y 5 4 15. 0) y5k (k is a constant) x5k (k is a constant) Horizontal line Vertical line Zero slope Undefined slope Slanted line Positive slope Negative slope 3. True 65. n 5 94 f. The 5-yr survival rate for stage I breast cancer is 88%. r (x) 5 12x 2 32 3 3 8 22. $700 9. How many terms are in the binomial expansion? complex (or compound) 9. To find the y-intercept(s), substitute 0 for x and solve for y. A junior is selected. Domain: R or in interval notation: (2`, `). Top semiellipse b. y¿ 5 2 25y 5 75. Never increasing f. {25, 23, 1, 3} 85. e 3 6 119 f 2 4. 60 19. R.2. Solve for x. Ex 0 x # 176 F; A2`, 19. w(x) 5 Zx 1 1Z 1 4 b. {3} c. Between 22 and 21 b. What is meant by a viewing window on a graphing device? A function that is symmetric with respect to the y-axis is called an even function. Given a number a 3 10n, log (a 3 10n) is between n and n 1 1, inclusive. 0.52, 0.68, 0.84, 1.00, … 5. 3 1 11 1 19 1 27 1 … 1 363 25. Which of the values can represent the probability of an event? The number of participants for a 4-week period is given in the table. h(x) 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 x 23 23 24 25 24 25 In some cases, a function may have restrictions on the domain. Find the number of terms in the geometric sequence. Suppose that 12 students (5 freshmen and 7 sophomores) are being considered for two different scholarships. The distance Joe rides d(t) (in mi) is given by d(t) 5 18t, where t is the time in hours that he rides. If a student forgets to study and must guess on each question, in how many ways can the student answer the questions on the test? 227 Undefined (not a real number) 59. e f 2 3 2 { }; The value 1 does not check. 12, $12,209.97 d. Aliyah invested $2760 in the stock returning 11% and $3000 in the stock returning 5%. h(t) 5 5 102. The first job offers $64,000 for the first year. y x x Barometric Pressure (mb) (x) Wind Speed (mph) (y) 1007 35 1003 45 1000 50 994 65 983 80 968 100 950 110 930 145 905 160 Number of Days (x) Weight (lb) (y) 0 11.0 5 12.8 12 14.3 18 16.1 24 17.2 31 19.2 40 22.0 45 23.4 52 24.7 60 27.5 Age (yr) (x) Height (in.) (y) 2 35.00 3 38.50 4 41.75 5 44.00 6 46.00 7 48.00 8 50.50 9 53.00 10 56.00 Section 2.5 74. 10x 1 22 53. (h, k) 5. 6 3 2 1 25 24 23 22 21 21 1 2 3 4 5 x y 5 x2 2 2x 22 23 11. Summarize Transformations of Graphs Table 2-2 Basic Functions and Their Graphs 1. r! 59. In Example 6(a), the value of g(6) is found first. 18, 22, 27, 33, … 8. c14 5 7.5, c101 5 29.25; Find c400. y2 x2 405,500 km 77. 2 12 117. 24. a 5 2c2 2 b2 107. Evaluate: h(2x) Evaluate: 2h(x) 2 h(2x) 5 2(2x) 1 (2x) 2h(x) 5 2(2x2 1 x) not the same 5 2x2 2 x 5 22x2 2 x Since h(2x) ? By completing the square, f (x) can be expressed in vertex form as f (x) 5 a(x 2 h)2 1 k. g(x) 5 e 23.1x 2 4 for x , 22 2x3 1 4x 2 1 for x $ 22 2.5x 1 8 for x , 22 131. When referring to individual elements of a set, the symbol [means "is an element of," and the symbol " means "is not an element of." For example, 5 [{1, 3, 5, 7} is read as "5 is an element of the set of elements 1, 3, 5, and 7." 6 " {1, 3, 5, 7} is read as "6 is not an element of the set of elements 1, 3, 5, and 7." A set can be defined in several ways. Identify the y-intercept in terms of the coefficients B and C. (4P4) ? 2x 2 2 # 2x 2 5 c. k(3) 39. 27} 31. Note: C 12(10)D 2 5 25, C 12(26)D 2 5 9 Factor. 6 5 180 77. Vertices: (0, 50), (10, 20), (20, 0) y y 60 50 Chapter 5 Review Exercises, pp. E3: A brown sock is selected. ` c. (x 1 1)2 1 (y 1 5)2 5 25 y x 26. An experiment. The midpoint of a line segment is the point equidistant from the endpoints (Figure 2-5). 6 5 336. There are two scholarships available. [x 2 (2 1 5i)][x 2 (2 2 5i)]Ax 2 17B Ax 1 17B 35. In the event that the linear trend continues, use the model from part (a) to predict the number of attendees in week 24. x 5 23, x 5 21, x 5 1 10 d. 2 111 1 1 1 1 2. The amount owed y 5 A(t) (in $) is given by A(t) 5 14,820 2 247t, where t is the number of months after purchase and 0 # t # 60. (22, 1] 55. (See Example 9) 73. Use the formula Sn 5 4 4 4 1 2 1 p using summation 3 5 7 notation with n as the index of summation. By the inductive hypothesis, [1 1 2 1 22 1 p 1 2k21] 1 2(k11)21 5 (2k 2 1) 1 2k 5 2 ? 2 is a factor of 5n 2 3. 2 3 4 5 x y 5 g(x) 24 25 1 8 3 21 6 30 9 40 12 46 15 56 18 68 c. Suppose that a function L gives the low H1L b(x) represent? Graph m(x) 5 x 2 2 for x # 22. The calculator asks for a right bound. i. 26115.5 264 63. Lines that intersect at a right angle are perpendicular lines. {25} 11. 2 3 3 8 1 1 1 b. 7 m2 99. Show that 1 1 5 1 p 1 5k21 1 5(k11)21 5 14(5k11 2 1). y will be 14 its original value. {(0, 1, 3)} 51. Alternatively, this can be stated as the point where profit equals zero: P(x) 5 0. 3 b. 690 A sequence in which consecutive terms alternate in sign is an alternating sequence. e e4, 4 f ; x < 54.5982, x < 0.0183 e 109. Find the y-intercept(s). (2`, 22) ´ (3, `) 61. If the interest rate is 5.2%, find the value of the annuity after 25 yr. (24, 1) ´ (1, `) d. y 7 6 5 4 3 2 4 3 2 1 26 2524 23 22 21 21 1 1 2 3 4 x 26 2524 23 22 21 21 22 23 c. 3 4 of its height. 4x 2x 2 5y 5 13 23x 1 2y 5 23 2 2z 5 24 6y 1 5z 5 8 7x 2 3y 5 13 c. M ¨ N b. Year (x 5 0 represents 1990) c. 368 1. x2 1 y2 2 10x 1 4y 2 20 5 0 45. 45 12 2 24 13 2 18 77. p(x) 5 24 0x 1 2 0 2 1 78. x 5 23 g. 21 21 22 23 6 C(24, 2) 4 2 41. 23 y 5 f(x) 2 24 25 The graph of y 5 f A 12 xB is shown in red. (Source: U.S. Census Bureau, www.census.gov) 3. 125% e. f [g(24)] d. 132 35. The inequality 5n . A map of a state park is 5 drawn so that the origin is 4 placed at the visitor center. Each year thereafter, she would receive a $3200 raise. This correlates to between 50% and 85% of the individual's maximum heart rate (Source: American Heart Association, www.americanheart.org). 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 x 10 Section 2.3 y 91. If a matrix has an inverse, it must be a square matrix. (Highlighted in red tint.) b. (1.4)3y2 [Hint: (1.4)3y2 5 (1 1 0.4)3y2] SECTION 8.6 4 66. d1r2 5 2r b. x2 5 5 1 y2 16. 4 3 2 1 37. 1600 ft 13. C(x) 5 21.95x b. Evaluate the expression in part (b) for h 5 0. A tropical depression moved through at the beginning of the 15th day and produced rain at an average rate of 2.5 in./day for 5 days. Sum, Difference, Product, and Quotient of Functions Given functions f and g, the functions f 1 g, f 2 g, f ? ln 1x 1 3 25. 2 9 128 The sum does not exist. The vibration of sound is measured in cycles per second, also called hertz (Hz). For example, male honey bees hatch from eggs that have not been fertilized, so each male honey bee has only 1 parent, a female. Given g(x) 5 5x 2 1, a. 50C4 5 230,300 b. (25, 22) ´ (2, `) x y 5 f 21(x) 24 25 4. However, we would be 100% certain of drawing a red, blue, or green marble from the box and the probability would be 1. y 5 4 3 2 23 5 4 3 2 y 5 f(x) 1 1 2 3 4 5 y 5 2f(x) x 25 24 23 22 21 21 22 24 25 1 2 3 4 5 x 23 24 25 (x, 2y) y Skill Practice 6 The graph of y 5 f (x) is given. 24. (2`, `) 35. (f + g)(3) f. What does ¢d ¢t represent? a2 , 0b and (1, 27) 2 (x1, y1) and (x2, y2) m5 2 1 Label the points. (5, 23, 2) and (4, 6, 21) 84. 5 23 g(22) 5 23 b. If five cards are dealt from a standard deck of 52 cards, find the probability that a. Increasing c. Write the answer in slope-intercept form. Let Pn be the statement a i2 5 i51 n(n 1 1)(2n 1 1) . 41. (See Example 10) a. The numerator is 1 more than the term number: (i 1 1) The denominator is the square of the term number: i2 The odd-numbered terms are positive. 20. EXAMPLE 8 Determining Domain and Range Determine the domain and range for the functions shown. Skill Practice 10 a. Determine Empirical Probabilities 3. a1 5 5; an 5 1 an21 31. e 23 6 2i, 2 , 1, 24 f 4 f (x) 5 5x3 2 4x2 1 180x 2 144 f (x) 5 25x4 1 10x3 1 60x2 2 200x 1 160 f (x) 5 18x3 1 39x2 1 8x 2 16 f (x) 5 x6 2 14x5 1 65x4 f(x) 5 x4 2 12x3 1 62x2 2 300x 1 925 Positive: 3 or 1; Negative: 3 or 1 51. No. There is no guarantee that the linear trend continues outside the interval of the observed data points. After making a down payment of $2000, the remaining cost of the car including tax and interest is $14,820. Minimum value: 48 (12, 36) 35 30 25 20 15 10 5 (48, 0) (0, 0) 0 5 10 15 20 25 30 35 40 45 50 x 37. 24.27 Cumulative Review Exercises 29. 1 x13 2x 1 5 x12 (x 1 2)2 3 1 8 23 4x 2 2 26. (317, 119) From the distance formula, d(A, B) 5 0 x 0 , d(A, C) 5 0 x 0 , and d(B, C) 5 0 x 0. P1 is true because (xy)1 5 xy 5 x1y1. 16, 3π 2 f. See also Regression Multiplication associative property of, 10 commutative property of, 10 of complex numbers, 108–109 of conjugates, 40, 41, 109 distributive property of, over addition, 11, 12 identity element of, 10 identity property of, 10 inverse property of, 11 matrix, 590–593, 602–603 of polynomials, 39–40 of radicals, 32, 42–43, 74 of rational expressions, 61, 74 scalar, 588–589 Multiplication property, of radicals, 105 Multiplicative inverse of real numbers, 11 of square matrix, 602–603, 626 Multiplicities, of zeros, 303–306, 339–340 Multiplier effect, 718 Mutually exclusive events, 755, 767 N Natural exponential functions, 418 Natural logarithmic functions, 430–431, 483 Natural logarithms approximation of, 431 explanation of, 430–431 to express solution to exponential equation, 454 Natural numbers, 2, 73 Negative exponents factoring expressions containing, 55–56 simplifying expressions with, 18–20 Negative factors, 48 Nested radical property, 30 Newton, Isaac, 81 Nonlinear inequalities graphs of, 369, 539–540 procedure to solve, 369 Nonlinear systems of equations. R(x) 5 80x c. 0, B ? 4π 2 11 4(x 2 2y2)(x2 1 2xy2 1 4y4) 10. an 5 5(20.8)n c. c 223 6 9 d 62 c. If replacing x by 2x in the equation results in an equivalent equation, then the graph is symmetric to the y-axis. (24, 21) h. Domain: (2`, `); 11 Range: c , `b 4 7 6 5 4 3 2 1 25 24 23 22 21 21 22 c. m 1 3 43. 102. Graphing calculator examples are placed in self-contained boxes and may be skipped by instructors who choose not to implement the calculator. J 5 M 2 3. {(Tom Hanks, 5), (Jack Nicholson, 12), (Sean Penn, 5), (Dustin Hoffman, 7)} b. y 1 3 7 6 5 4 3 1 1 1 24 25 b. floor(22) f. Based on the given data, does the water level follow an arithmetic progression? 1) Vertical shrink (if 0 , a , 1) • Horizontal stretch/shrink y 5 f (ax) Horizontal shrink (if a . A 1 c d 0 0 0 0 1 0 22 3 3 0 d. a 5 6 115. 6 5 4 5 4 3 2 3 2 1 1 25 24 23 22 21 21 1 2 3 4 5 x 22 23 24 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 3 1 5 1 19. Determine the area enclosed by the equations. ISBN 978–0–07–783634–4 (alk. 2 real solutions 1Aπ A or r 5 103. {23} 9. (f + g)(x) 5 f (g(x)) 5 2(g(x)) 2 6 1 5 2a b26 x14 2 5 26 x14 Function g has the restriction that x ? 8 e. 2n is true for all integers, n $ 4. Find the value(s) of x for which f (x) 5 23. 220 # x1 # 270 vehicles per hour; x2 5 150 vehicles per hour 130 # x2 # 180 vehicles per hour a. y 5 2g(x) y y 51. y 1 31. See Figure 2-40. Yes; If f (a) 5 f (b), then a3 2 1 5 b3 2 1, which implies that a 5 b. If one row (or column) of a matrix is a multiple of another row (or column), then the matrix does not have an inverse. an 5 16n 1 18 c. w3 1 12w2 1 48w 1 64 49. 1 3 which equals 1. The screen is 44 in. x-axis, y-axis, and origin 17. The lengths of the legs of the triangle are 0 x2 2 x1 0 and 0 y2 2 y1 0. Foci: A6 12, 21B, A26 12, 21B y e. 10 8 24 25 22 4 5 6 4 5 210 n c. The Earth's orbit 13 5 2 is more circular, and the orbit for Halley's Comet is very elongated. Center: (2, 0); Vertices: (21, 0), (5, 0); 3 2 Foci: (23, 0), (7, 0); 1 C F F Asymptotes: x 23 22 21 1 2 3 4 5 6 7 21 y 5 43x 2 83 and y 5 243x 1 83 ; 22 5 23 Eccentricity: 3 24 25 y 6 4 2 28 26 24 22 22 24 26 28 210 2 4 x 6 8 10 12 212 214 2 2 4 6 8 x 12. a a b n52 3 63. by 33 in. R.2. 5x R.3. 8x 2 29 $8.25 $82.50 6x 1 30 R.5. 5 1 hr 10 hr d $900 3. Specifically, the element in row 1, column 3 should be 0. 2x4 2 4x3 1 8x2 2 15x 1 25 1 x12 23. No Skill Practice 2 Determine if the relation defines y as a function of x. 22 121 19. Principle of Mathematical Induction Let Pn be a statement involving the positive integer n, and let k be an arbitrary positive integer. (h + h)(24) 61. Round to the nearest day. Determine Binomial Coefficients 1. (4, 1) c. A cell tower is a site where antennas, transmitters, and receivers are placed to create a cellular network. The Parent 2 Y gene is dominant, and therefore a plant with genes YY will have yellow peas, a plant with genes Yy or yY will have yellow peas, and a plant with genes yy will have green peas. Predict the water level on day 30 if this trend continues. P(B) For example, Let A represent the event that a coin lands heads up on the first toss. x 5 22, x 5 2 e. Sn 5 5. Center: (0, 0); Radius: 3.2 13. The length of a latus rectum is a a 2b2 . a , 2 b 2 2 3 13. EXAMPLE 4 Finding the Probability of an Event by Using Counting Techniques Suppose that 5 women and 3 men apply for 2 job openings. No y-intercept e. 80 150 P(x) 5 1.50x 2 120 100 50 (80, 0) 0 40 80 120 160 250 Profit 5 0 2100 for x 5 80 2150 Number of Lemonades Produced and Sold Profit ($) Cost/Revenue ($) Revenue , Cost Revenue . No 71. 0 2 3 4 5 x 81. P 5 $100, n 5 24, r 5 5.5%, t 5 28 yr Section 8.3 87. The viewing window with these parameters is denoted [210, 10, 1] by [210, 10, 1]. e ax, b ` x is any real number} 4 4y 1 3 , yb ` y is any real number f ; or e a 10 The equations are dependent. Now suppose that an individual student may not receive both scholarships. Foci: A24, 2 1 115 B, A24, 2 2 115 B y e. Write a function that represents the total cost T(a) for a dollars spent in merchandise and shipping. y 5 1x 2 10 29. an 5 2n; 1 # n # 12 j50 19. Domain: (2`, `); Range: (0, `) Range: (0, `) f(x) 5 !x 1 1 1 x 25 24 23 22 21 21 22 1 2 3 4 5 21 21 f (x) 5 x2 2 1; x $ 0 22 25 g. The player wins by choosing numbers that match those randomly selected in a drawing. The line through the points represents all ordered pairs defined by this function. x2 5 2 ft y b. (x2 1 9)(x 2 3)(x 1 3) (x 1 2) 30. 20,000 Monthly Income vs. (1, 23) c. 0 2x 2 11 0 1 1 # 12 3 20. x 1 y # 60,000 y e. A 5 bh 2 5. The function is one-to-one. We are now ready to generalize. p(x) 5 0 x 2 1 0 2 2 2 1 68. EXAMPLE 6 Counting Permutations in an Application If 8 horses enter a race, in how many ways can the horses finish first, second, and third? Debbie travels several times a year for her job. Since the vertex of the parabola is below the x-axis and the parabola opens downward, the parabola cannot cross or touch the x-axis. [210, 10, 1] by [210, 150, 10] d. No 65. Up to the left and down to the right; As x S 2`, f (x) S `, and as x S `, f (x) S 2`. x 5 y 2 1 58. a1 5 4 and an 5 an21 2 2 for n $ 2 a. Relative minimum of 27.825 at x 5 3.750 b. x 5 36, y 5 12 c. f (x) 5 x 9 , g(x) 5 2 x21 x 2 16 1 , find (f + f)(x) and write the x22 domain in interval notation. g(x) f f (x) a b(x) 5 provided that g(x) fi 0 g g(x) The difference quotient represents the average rate of change of a function f between two points (x, f (x)) and (x 1 h, f (x 1 h)). Is k(2x) 5 2k(x)? The range is [21, `). 240, 20, 210, 5, … For Exercises 37–39, find the indicated term of a geometric sequence from the given information. However, with the second job, José would have to pay $100 per month out of his paycheck for health insurance. {x 0 x , 21} e. n p 1 can a cai 5 ca1 1 ca2 1 ca3 1 i51 5 c(a1 1 a2 1 a3 1 p 1 an) Expand the terms in the series. Median Yearly Income by Level of Education 80,000 Median Income ($) 2. 2 2 2 5 1; This is an a c equation of a hyperbola in the xz-plane with transverse axis on the x-axis. To graph the circle, first locate the center and draw a small open dot. many ways can four different people among the 20 be selected to prizes of $50, $25, $10, and $5? If one student is selected at random from the group, find the probability that a. f is increasing on the interval (2, 3). At x 5 22, the function has a relative maximum of 4. Preparation for algebra is comparable to an athlete preparing for a sporting event. 6575 95. y 5 3x2 2 6x 1 1 B A B C A 1 25. SECTION 2.5 Applications of Linear Equations and Modeling p. {23, 3} 97. (See Example 6 and Figure 8-12) Find the probability that the card drawn is 49. e f 3 135 5 89. f(x) 5 1.2x 1 0.78 a. (p2 2 w4)6 24. Given a ai, the variable i is called the of . EXAMPLE 2 Finding the Probability of an Event An American roulette wheel has 38 slots, numbered 1 through 36, 0, and 00. 9, 22, 213, 224, … 13. p 5 24 b. 2 51 16 9 289 64 27. Determine f(21). Graph Linear Equations in The median incomes for individuals for all levels of education have shown an increasing trend since 1990. y-axis 93. P4 is true because 3(4) 5 12 and 24 5 16. 9, 8.4, 7.8, 7.2, … , 239 39. (1, 22) b. X 5 c 52 5 b. Write the solution set in interval notation. 25 24 23 22 21 21 22 23 5 4 3 2 1 2 23 22 21 21 22 x y 5 4 y 5 f(2x) 3 2 25 24 23 22 21 21 22 3 1 23 y 2 5 4 3 y 5 2f(x 2 1) 1 2 2 3 2 1 3 25 1 y 5 4 2 24 21 22 21 24 25 1 23 23 22 y 3 2 1 51. Suppose that d represents the distance between two points (x1, y1) and (x2, y2). y 5 3.01x 1 1 114. (4, `) g. g 5 2 P2V2 T 19 2 3 15 19 1 3 15 119. As we proceed through the text, we will develop tools to graph equations efficiently. 2 47. n Skill Practice 4 Use mathematical induction to prove that a b . The expression n! (read as "n factorial") is defined as n! 5 (n)(n 2 1)(n 2 2) ??? 26 x 1 e. Notice that each term after the first is 2 times the preceding term. 288π in.3 b. y is also tripled. 437–441 R.1. R.5. 1. The number of white marbles is 0. Each term has x raised to an odd power. Focus: (0, 6.3); Place the receiver 6.3 in. {62i, 4 6 i} 1 2 4 9. Find the Probability of the Union of Two Events 4. y 5 1x 1 4 b. {0, 12} c. 5 x 242 Chapter 2 Functions and Relations Write About It 91. 6.7 Section R.2 Practice Exercises, pp. 5P5 11P3 37. And SmartBook delivers. x2 5 230.4y for 21.2 # x # 1.2 b. v(x) 5 2(x 1 2)2 1 1 64. (f 1 g) (2) 23 for x , 22 98. Center: (25, 1); Radius: 3 17. (25p2 1 4)(5p 1 2)(5p 2 2) 2 (y 1 4)(y 2 4y 1 16) 45. (n 2 1)! (n 1 1)! 42. 59. {2}; The value 232 does not check. Given a line with slope m and y-intercept (0, b), the slope-intercept form of the line is given by y 5 mx 1 b. Composition of Functions The composition of f and g, denoted f + g is defined by (f + g)(x) 5 f (g(x)). The graph is not continuous. If so, find the common difference. x is between 3 and 4. g(0) 5 1 d. 63. 1 3 1 83. an 5 2(21.2)n d. (21, 1) g. The expression a3 1 3a2b 1 3ab2 1 b3 is called the expansion of (a 1 b)3. See also Binomials; Factors/ factoring; Monomials; Trinomials addition of, 39 complex, 321–322 degree of, 38 depressed, 330 division of, 316–320, 392 explanation of, 38 factor theorem and, 322–324 geometry applications and, 42 Subject Index on graphing utility, 310, 340 multiplication of, 39–40 prime, 55 quadratic, 344 reduced, 330 remainder theorem and, 320–322 special case products of, 40–42 subtraction of, 39 zeros of, 321–324, 329–340, 392 Population growth model, 469–470 Power functions, 301–302 Power property of logarithms, 444, 445 Powers, 8 Prime polynomials, 55 Principal square root, 8 Principle of mathematical induction, 726, 765 Probability empirical, 754, 757 of event, 751–754 explanation of, 750 review of, 766–767 of sequential independent events, 758–759, 767 theoretical, 750–751, 767 of union of two events, 755–757 Problem-solving strategies, 94 Product property of logarithms, 445 of radicals, 30–32 Products inner, 591 special case, 40–41, 43, 74, 109 Projectile motion, 286, 291 Proof by contradiction, 730 Proper rational expressions, 523 Property of equivalent fractions, 62 Proportions, 99 Pythagorean theorem, 127, 167 Q Quadrants, 166 Quadratic equations. x 1 2 55. x 5 21 13. The first 20 sec is represented by a linear function with a positive slope, y 5 2.25x. Replace x by 2x. 5 4 3 2 1 2 3 4 5 x 25 24 23 22 21 21 22 1 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 6 7 5 x 4. Use the model to forecast the average height of 11-yr-old girls. £ 4 21 b. If a motorist approaches the intersection twice during the day, find the probability that the light will be red both times. Write a linear function to model the sales person's weekly salary S(x) for x dollars in sales. The speed of the car s(t) (in mph) at a time t (in sec) after the car begins motion can be modeled by: 5 2 t for 0 # t # 12 12 for 12 , t # 72 60 s(t) 5 3 (92 2 t)2 for 72 , t # 92 20 1.5t for 0 # t # 20 30 for 20 , t # 40 t 2 19 Determine the speed of the sled after 10 sec, 20 sec, 30 sec, and 40 sec. y 5 4 3 2 5 4 3 2 5 4 3 2 1 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x y 39. The x-coordinate of the midpoint is the average of the x-coordinates from the endpoints. Point of Interest Solution: Among his many contributions to mathematics, René Descartes discovered analytic geometry, which uses algebraic equations to describe geometric shapes. Suppose that a lottery game has the player select 5 distinct numbers from 1 to 30, inclusive. EXAMPLE 3 Identifying Even and Odd Functions By inspection determine if the function is even, odd, or neither. As the plane climbs toward the top of the parabolic path, occupants experience a force of nearly 2 Gs (twice their body weight). As x S 2`, f(x) S 2`, and as x S `, f(x) S `. TIP In part 2 of Example 4, we manipulate the expression (k 1 1)! on the left side to show that it is greater than the expression on the right side for k $ 4. {(23, 21, 0)} 1 {(0, 2, 24)} 47. 22, x ? E 5 J 2 150 9. A polynomial consists of a finite number of terms in which the coefficient of each term is a real number, and the variable factor x is raised to an exponent that is a whole number. 5 21. EXAMPLE 1 Writing an Equation of a Circle in Standard Form a. (5n 1 m 1 6)(5n 2 m 2 6) 89. 506: © Digital Vision/Getty RF; p. y 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 8. (0, 55) g. At x 5 22, the function has a relative maximum of 3. 7.9 m a. The graph of the first 10 terms of the sequence is shown in Figure 8-7. a (j 1 1)(j 2 1) j51 n n 71. f(4) is not defined. The survey consists of 14 questions. y 5 log2(x 1 3) 25. What is the benefit of writing an equation of a line in slope-intercept form? x2 2 6x 2 1 d. Number of Oscar Nominations y Actor x Elevation at Airport (ft) y City x 5 Albany 285 12 Denver 5883 Sean Penn 5 Miami 11 Dustin Hoffman 7 San Francisco 11 Tom Hanks Jack Nicholson y 11. For example: • AB means that Alberto gets $1000 and Beth gets $500, whereas • BA means that Beth gets $1000 and Alberto gets $500. (0, ln 2) e. 755 The probability of A or B: Given events A and B in a same sample space, P(A or B) is given by P(A ´ B) 5 P(A) 1 P(B) 2 P(A > B). Our heartfelt gratitude goes to the production manager Peggy Selle for steering the ship and keeping us all on task. { } 22. a2`, 2 b ´ a2 , `b 3 3 3 y b. Passes through (0, 26) and (11, 0). 5 4 3 2 b. Find the difference quotient (do not simplify). 3. (The domain is [1, 4) ´ (4, `). 88 people 21 22 24 26 28 b. Dividend: f(x); Divisor: d(x); Quotient: q(x); 3. Round to the nearest 100 people. What will the resale value be 4 yr after purchase? n! 5. The numbers are 7 and 23. (1.9, 90) 150 4 0 3 0 c. Write a set of ordered pairs (x, y) that defines the relation. 168 Chapter 2 Functions and Relations EXAMPLE 2 Determining if Three Points Form the Vertices of a Right Triangle Determine if the points M(22, 23), P(4, 1), and Q(21, 7) form the vertices of a right triangle. a1 5 24 and r 5 20. 6 12 12 4 4 d. e < 0.78 902 143.52 2 2 y x 1 51 d. P1 is true because a 1 5 1. (21, 8) and (4, 22) 25 24 23 22 21 21 22 2. An equation is in quadratic form if, after a suitable substitution, the equation can be written in the form au2 1 bu 1 c 5 0, where u is a variable expression. 2i 01 3 2 a. 2264.9364 c. On a calculator or spreadsheet, the equation y^ 5 mx 1 b may be denoted as y 5 ax 1 b or as y 5 b0 1 b1x. 759–764 R.1. R.2. 1. {(5, 22), (25, 2)} 14. 401: © Justin Lewis/Getty RF; p. a , ha 2a 2a b. {(22, 5, 3)} 10. Answer 1. 2 3 2 y 5 3x 2 1 59. 232 Chapter 2 Functions and Relations EXAMPLE 3 Translating a Function Horizontally and Vertically Use translations to graph the function defined by p(x) 5 1x 2 3 2 2. scientific 5. No 87. a1 2 b5 ? A 5 {x 0 4 . f (x 1 4) 5 25 24 23 22 21 21 22 23 24 25 24 25 1 2 3 4 x22 x25 x 5 32. By how much do the results of part (d) differ from the result of Exercise 63(d)? The value of x is the month number and x 5 1 represents January. P(t) 5 320,000e0.01t b. A map of a wilderness area is drawn with the origin placed at the parking area. Skill Practice 3 Use mathematical induction to prove that 2 is a factor of 5n 1 1. above the vertex. 2 135. Therefore, the sum is cn. 25A 1 2B 21 3 D5 c 25 8 6 d 7 1 4 0 d 6 42. (223, 184) c. 7.2 3 10220 11 7 1.24 3 10 93. From an equation in x and y, explain how to determine whether the graph of the equation is symmetric with respect to the x-axis, y-axis, or origin. Write the solution sets to the inequalities in interval notation. The distance between two distinct points (x1, y1) and (x2, y2) is given by the formula . y 5 0 y 33. The slope of a line passing through the distinct points (x1, y1) and (x2, y2) is given by m 5 ¢y y2 2 y1 5 . (f + h)(21) 53. a b 5 6! ? Section 8.3 Geometric Sequences and Series 719 Suppose that an individual invests P dollars at the end of each year for 4 yr at interest rate r. Evaluate Infinite Geometric Series n For a positive integer n, the series a ai 5 a1 1 a2 1 a3 1 p 1 an is called a finite i51 1 32 … 1 16 1 8 1 2 1 4 Figure 8-8 ` series because there are a finite number of terms. Determine f (0). H T 2 outcomes H HH T H HT TH H T T TT 4 outcomes 80. Over what interval(s) does the depth decrease? y 5 3x 2 1; f(x) 5 3x 2 1 or f(x2) 2 f(x1) x2 2 x1 x2 x1 ¢y y 2 2 y1 5 x2 2 x1 ¢x Determine the average rate of change of blood alcohol level Answer Secant line 0.06 (2, 0.09) (1, 0.06) 0.04 0.02 (8, 0.02) (0, 0) 1 2 3 4 5 Time (hr) 6 7 8 9 x 204 Chapter 2 Functions and Relations Solution: a. (2`, 1) ´ (4, 7] 83. (See Examples 7–8) 63. Write a function that represents the distance d(t) (in miles) that the car travels in t hours. The truck was driven 144 mi in the city and 110 mi on the highway. Such a relation is called a function. 2, indicating that 4 is indeed a factor of 8. For what value of x is f(x) 5 3? Given a polygon of n $ 3 sides, the sum of the interior angles within the polygon is given by sn 5 180(n 2 2). (9, 25, 23) and (2, 0, 1) y2 – y1 2 2 P(x, y, z) y x Section 2.2 Circles 177 Objective 5: Graph Equations Using a Graphing Utility (Technology Connections) 87. Horizontal asymptote: y 5 2 f. 22} or in interval notation: (22, `). ` 1 i21 a. c1 5 5; cn 5 22cn21 1 1 3 4 5 6 7 1 1 1 1 2 4 8 16 32 14. However, the money invested at the end of the fourth year will not earn any interest. a , 0b 3 d. f(x 1 h) 5 3(x 1 h)2 1 2(x 1 h) 5 3(x2 1 2xh 1 h2) 1 2x 1 2h h(23) 5 215 h(21) 5 27 c. 5, 11, 29, 83, 245 Perhaps the most famous sequence is the Fibonacci sequence, named after the twelfth-century Italian mathematician Leonardo of Pisa (known as Fibonacci). We have Y1 5 2x 2 1 and Y2 5 x 1 5. 62i, 4 6 i b. Write an expression for the nth term of the sequence representing the kitten's weight, n weeks after birth. By contrast, the graph of g is the graph of y 5 0 x 0 with a horizontal shift to the right 3 units and a vertical shift downward 2 units. Given h(x) 5 4x 2 2x, find h(2x). The greatest profit is realized 20 (0, 0) (120, 0) when 80 kitchen tables and x 0 20 40 60 80 100 120 140 90 dining room tables are Kitchen Tables produced. P(200) 5 2137; In the year 2210 the U.S population will be approximately 2.137 billion. differ by d units. Write the answer in slope-intercept form (if possible) and in standard form (Ax 1 By 5 C) with no fractional coefficients. (2`, `) 3 c. h(0.05) 51. Next, assume that Pk is true and show that Pk11 is true. h(x) 5 2 2 2x 2 (1, 3) 2 1 25 24 23 22 21 21 b. Pn represents the statements, P1, P2, P3, and so on. 1 1 5 1 25 1 p 1 5n21 5 14(5n 2 1) 25. 2 1 81 Student Answer Appendix 2x 1 1 10. Find a20. Center: (24, 1); Vertices: (214, 1), (6, 1); Endpoints of minor axis: (24, 7), (24, 25); Foci: (212, 1), (4, 1); Eccentricity: 45 i51 91. Partial fraction decomposition is a procedure in which a rational expression is written as a sum of two or more simpler rational expressions. E1: A blue sock is selected. logistic 70 0 0 b. Determine the number of ways that 5 students can be selected from the class of 24 to play 5 different roles in a short play. She recorded Dodger's weight during the first two months. It costs the farmer $84,800 to run the tractor for 800 hr during the first year. Center: (0, 0); Radius: 2 15 15. Vertex: (3, 4); Focus: (5, 4); Endpoints of latus rectum: (5, 0), (5, 8) Directrix: x 5 1; Axis of symmetry: y 5 4 6 y 24. (See Examples 1–2) 9. a1 5 , d 5 2 3 b. Between 4 and 5; 4.6705 5 2 b. 10 units2 A C A C a. 5000 y 5 4 3 6 p(x) 5 x 2 2 9 2 1 x 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 0 0 1000 c. The function has a relative maximum of 4.5 ft at a time 12 days after recording began. A linear equation in the variables x and y is an equation that can be written in the form: Ax 1 By 5 C This is called the standard form of an equation of a line. The graph shows the cumulative number y of flu cases among passengers on a 25-day cruise, t days after the cruise began. a2`, 2 b ´ a2 , `b 1 3 b. (2z 1 7)(3z 1 2) yz(7y 1 2z)(y 2 6z) 31. 21028 26 24 22 22 21028 26 24 22 22 2 4 6 8 10 x 2 4 6 8 10 x 24 26 24 28 26 28 210 212 (x 2 8)2 1 (y 1 11)2 5 25 35. Maximum: 15,000 5 0 (20, 0) 3 6 9 12 15 18 21 24 27 30 x b. R 79. Column matrix 15. What is the probability that a given outcome is bar-bar-bar? Create Linear Functions to Model Data 4. For example, the element 5500 in the first row tells us that 5500 cal would be burned by a 120-lb individual who biked 6 hr, ran 3 hr, and walked 5 hr in a given week. Such a sequence of fixed payments made (or received) by an individual over a fixed period of time is called an annuity. 243(left): Mike Mcken/Getty RF; p. Is f (2x) 5 f (x)? 123. f (x) 5 x2 2 14x 1 113 Direct substitution; 22 85. The expression 3i 1 5 is linear in the variable i. {22}; The value 7 does not check. e 5 73. Reflect y 5 f (x) across the x-axis. The first is called an arithmetic sequence. Powered by the intelligent and adaptive LearnSmart engine, SmartBook facilitates the reading process by identifying what content a student knows and doesn't know. Undefined n n n SA-1 SA-2 Student Answer Appendix 29. 3.1 2 2.2(t 1 1) . (The match stretched over a 3-day period with Isner winning 70-68 in the fifth set.) In 2011, after a random draw, the two men met again in the first round of Wimbledon. 107. 45c3 x22 2x 39. e f ; n < 2.8466 e 0.2 2 5 ln 3 f ; x < 21.6286 e 2 ln 5 2 6 ln 3 ln 2 2 4 ln 7 f ; x < 20.7093 31. y 93. The value of the series is the sixth partial sum of the sequence of terms. R.3. { } R.6. 5 4 3 2 1 ln A AP B ln A 2 ln P t 5 e(922S)yk 2 1 38. ceil(22) Write About It 115. 120% g. 3 10. E A 12, 1B F 27. EXAMPLE 4 Graphing an Equation by Plotting Points Graph the equation by plotting points. Test for symmetry with respect to the x-axis. Slant asymptote: y 5 5x 1 4 4 6 g(x) 5 4 2 c. Discriminant is 57; two x-intercepts 69. 1200 deer 42. Apply the distributive property. 4 months 85. The sum of the numbers showing on the dice is 8. The animations are diverse in scope and give students an interactive approach to conceptual learning. If x is the cost of the meal, then the total bill C(x) with an 18% gratuity and a 6% sales tax is given by: C(x) 5 x 1 0.06x 1 0.18x. {(0, 4), (22, 0), (2, 0)} 91. (2a 1 5)(4x 1 9) (3x2 2 10)(4x 2 3) 21. The number of combinations of n elements taken r at a time is given by nCr 5 p. 2 a. a 7a b 3 i51 27 21. C(225) 5 279; If the cost of the food is $225, then the total bill including tax and tip is $279. This type of plan is meant as a long-term investment, and withdrawals are typically taken after age 59½ without penalty. a (21)i11 i51 12. • The second rule f (x) 5 23 is a horizontal line for x $ 1. If the probability of an event is 0.0042, is the event likely to occur or not likely to occur? If a couple has 4 children, how many boy/girl sequences are possible for the four births? Event E is somewhat likely to happen. Assume that h 5 6 in. y-axis b. 6(3x 1 1)3(x2 1 2)2(5x2 1 x 1 4) 16. {(5, 21)} 3. x-intercepts: (5, 0) and (25, 0); y-intercept: (0, 25) 24 25 c. These exercises provide students with an opportunity to synthesize multiple concepts and decide which problem-solving technique to apply to a given problem. 691 A recursive formula defines the nth term of a sequence as a function of one or more terms preceding it. ≥ 6 6 6 ¥ 4 3 6 0 0 2 1 6 6 6 x 2 45 § 53 c. 250,000 742 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Counting Permutations a. Likewise, the number of letters must be decreased by one again when the third letter is selected. A . Substitute x1 5 2, y1 5 23, and m 5 24. 15,000 cases d. 28, 22, 2 , 2 , … 2 8 29. Graph the line by using the slope and y-intercept. y 5 f. a , `b 12. With increased demands on faculty time, this has been a popular feature that helps faculty write their lectures and develop their presentation of material. By the intermediate value theorem, because f (3) 5 2 and f (4) 5 6, then f must take on every value between 2 and 6 on the interval [3, 4]. n Let Pn be the statement 5 1 8 1 p 1 (3n 1 2) 5 (3n 1 7). Informally, this means that we can draw the function without lifting our pencil from the page. Write the nth term vn of the sequence representing the velocity in the downward direction after n seconds. Assume that a i 5 i51 k11 Show that a i2 5 i51 1(1 1 1)[2(1) 1 1] . 13P5 5 154,440 and 13C5 5 1287 A permutation of n items taken r at a time is an arrangement of r items taken from a group of n items in a specific order. 0 x 2 7 0 . The extended principle of mathematical induction has us test the truth of a statement for the first allowable value of n. The shell will explode 6.75 sec after launch. x A point (x, y) on the graph of y 5 f (x) corresponds to the point Q , yR on the graph a of y 5 f (ax). 5 a ax 1 b 2 b2 b 2 1c 2a 4a Factor the trinomial. Section 8.1 Sequences and Series 699 Objective 3: Use Factorial Notation For Exercises 33–44, evaluate the expression. a (21)k(6k) 116. Apply Arithmetic Sequences and Series In Example 9, we use an arithmetic sequence and series in an application. A hospital depreciates a $9000 Coulter Counter at a rate of 75% per year after purchase. {10} c. {28, 3} 11. 16.94 cm 16 y2 x2 1 51 a. The range is [22, `). (2, 5); m 5 0 72. If 0 , x , 1, then xn , xn21. 2 4 (6x 1 1)2 c. Term number: n 5 1 2 The numerator is 1 more than the term number: n11 The denominator is 2 more than the term number: n12 3 4 1 4 9 16 ,2 , ,2 , p 5 25 125 625 an 5 (21)n11 ? a 3 2b 35. {22, 0, 4, 8, 12} d. y 5 f(x) 1 25 24 23 22 21 21 22 n 113. S1(x) 5 x2 1 4x 8 1 c. u 5. 0.552x3 1 4.13x2 2 1.84x 2 10.2 , 0 b. 3 Show that 34 1 163 1 p 1 4k 1 4k31 5 1 5 1 2 A 14 B k11. In this case, 500 acres of corn and 700 acres of soybeans should be planted. 3 1 3 1? 0. (2`, `) 37. 0 0 10 20 30 40 Time (sec) 50 60 70 t a. Answers 11. The animated content illustrates difficult concepts by leveraging the use of on-screen movement where static images in the text may fall short. Explain why the graph of h(x) 5 312x can be interpreted as a horizontal stretch of the graph of f (x) 5 1x or as a vertical shrink of the graph of f (x) 5 1x. 27. $46,204.09 b. 0.8 74. Profit is equal to revenue minus cost. P1 is true because x1 . 3 5 4 3 20. 25 45. This means that if the polynomial has nonreal zeros, there would be an even number of them. Interest compounded monthly Concept Connections 1. (x 1 3)2 1 (y 2 5)2 5 0 18. The person has normal cholesterol or is 61 or older. m(x) 5 5x 1 1 c. evaluate f a 2a The y-coordinate of the vertex is given by Vertex Formula to Find the Vertex of a Parabola For f (x) 5 ax2 1 bx 1 c (a fi 0), the vertex is given by a EXAMPLE 3 2b 2b , fa bb. The graph of f is shown in Figure 3-3. f (x) 5 2 1x 1 3 24 for x , 22 9. x 5 4 23. Write a formula for the nth term of a sequence that gives the payment (in $) on day n. 90 SA-50 Student Answer Appendix 51. 5 4 3 2 5 4 3 2 1 1 2 3 4 5 x 25 24 23 22 21 21 22 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 24 25 57. Student Answer Appendix Center: (0, 4) e. 24 months 33. f (23) b. 389: © Ingram Publishing RF; p. 1 give successively better an21 2 approximations of 1x for x . 2 135 79. E1: The ball lands on an odd number. A 13x2 1 y3 B 9; fourth term 38. y¿ 5 6. 24 25 D 5 1 b. No 232 d 2 0.08 0.00 20.07 20.06 73. EXAMPLE 5 Writing the nth Term of a Geometric Sequence Given the terms a2 5 80 and a5 5 40.96 of a geometric sequence, find r, a1, and an. Now we want to find the distance between two points in a coordinate plane. The game "Florida Lotto" for example, pays a grand prize to players who choose six distinct numbers from 1 to 53 (in any order) that match the same group of six numbers in the drawing. Suppose that {an} is a sequence representing the sales person's total yearly income based on the number of units sold n. , , , , p 3 4 5 6 1 4 9 16 b. The base is 10 ft and the height is 8 ft. Determine f(2). a (2i 1 7) 59. For Exercises 55256, the fixed and variable costs to produce an item are given along with the price at which an item is sold. All real numbers 57. cn 5 (3n)! ; find c3 5n 48. The alternation in signs can be represented in the nth term by a factor of 21 raised to a variable power that alternates between an even and odd integer. 22 23 25 24 23 22 21 21 22 1 2 3 4 5 3 4 5 x 1 5 6 7 8 91. A ´ B 5 B 17. f (x) 5 22x4 1 5 0 x 0 TIP In Example 4(a), we suspect that f is an even function because each term is of the form xeven or 0 x 0 . Halina Adamska, Broward College–Central Mary Beth Angeline, West Virginia University Colleen Beaudoin, University of Tampa Rachel Black, Central New Mexico Community College Tony Bower, Saint Phillips College Bowen Brawner, Tarleton State University Denise Brown, Collin College Wyatt Bryant, Tarleton State University Christine Bush, Palm Beach State College Michelle Carmel, Broward College–North Lydia Casas, Saint Phillips College Carlos Corona, San Antonio College Deric Davenport, Pikes Peak Community College Alan Dinwiddie, Front Range Commmunity College–Fort Collins Marion Foster, Houston Community College Charles Gabi, Houston Community College Jason Geary, Harper College Steve Gonzales, Northwest Vista College Jeffrey Guild, Broward-Central Campus Craig Hardesty, Hillsborough Community College–Southshore Lori Hodges, University of New Orleans Carolyn Horseman, Polk College Kimber Kaushik, Houston Community College Lynette Kenyon, Collin College–Plano Daniel Kernler, Elgin 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University of North Carolina Linda Ho, El Camino College Lori Hodges, University of New Orleans Heidi Howard, Florida State College Sharon Jackson, Brookhaven College Erin Joseph, Central New Mexico Community College Chandra Karnati, University of North Georgia Susan Keith, Georgia Perimeter College Lynette Kenyon, Collin College Plano Raja Khoury, Collin College–Plano Minsu Kim, University of North Georgia Daniel Kopsas, Ozarks Technical Community College Ramesh Krishnan, South Plains College Bohdan Kunciw, Salisbury University Weiling Landers, Windward Community College Sungwook Lee, University of Southern Mississippi Xuhui Li, California State University–Long Beach Domingo Litong, Houston Community College Rene Lumampao, Austin Community College–Rio Grande Edmund MacPherson, Tyler Junior College Anna Madrid-Larranaga, Central New Mexico Community College Jason Malozzi, Lehigh Carbon Community College Cynthia Martinez, Temple College Shawna Masters, Collin College–Plano Ramon Mata-Toledo, James Madison University Janet Mayeux, SE Louisiana University Roderick McBane, Houston Community College Cynthia McGinnis, Northwest Florida State College Christine McKenna, University of Nevada Las Vegas Mary Merchant, Cedar Valley College Chris Mizell, Northwest Florida State College Monica Montalvo, Collin College–Plano Malika T. 1! 2! 3! n! b. For Exercises 75–86, write the sum using summation notation. c 5 249 2 a2 2 b2 32. If one card is drawn at random from a standard deck, what is the probability that it is a red card or a 5? Graph F 12. x 5 y2 29. a 1 16 e. Vertices: (0, 9), (0, 29) Foci: A0, 1106 B, A0, 21106 B y 5 95x and y 5 295x 19. f. 16 yr 105. 1024 In an arithmetic sequence, the difference between a term and its predecessor is a fixed constant. Multiply each element in the matrix by the scalar. [29, `) h. rational 7. 12! 3 ? from each end. 1 2 3 4 5 6 7 8 9 0 DOW/DOW 1 0 9 8 7 6 ISBN 978–0–07–783634–4 MHID 0–07–783634–0 ISBN 978–1–259–57046–9 (Annotated Instructor's Edition) MHID 1–259–57046–0 Senior Vice President, Products & Markets: Kurt L. 8 ? AB BA AC CA AD DA AE EA BC CB BD DB BE EB CD DC CE EC DE ED To find the number of combinations, we divide the number of permutations (in this case 20) by 2! because there are 2! ways in which two letters can be arranged in order. (See Examples 2–3) 37. 1 3 3 3 3 The values of a b, a b, a b, and a b match the entries in the 0 1 2 3 fourth row of Pascal's triangle. Skill Practice 3 Write an equation of the line passing through the point (23, 2) and parallel to the line defined by x 1 3y 5 6. 0.4 AU b. P1 is true because 2 is a factor of 51 1 1 5 6. h(x) 5 Solution: Answers y 3. Prove a Statement Using In this section, we present a technique of mathematical proof that enables us to prove the validity of a statement that is true over the set of positive integers. Is the operation of function composition commutative? • The company experiences a loss if fewer than 80 cups of lemonade are produced and sold. Determine the location and value of any relative minima. 3 0 6 22 The graph of a horizontal line will have no x-intercept unless the line is the x-axis itself. Liza is a basketball coach and must select 5 players out of 12 players to start a game. The student answered "Yes" or had "No Opinion." b. In how many different ways can a student fill out the answers to the quiz? While on vacation, Jim does not read email. (g + f)(24) 100. 22 101. Assume that 1 1 4 1 p 1 4k21 5 13 (4k 2 1) (Inductive hypothesis). g(23) d. t 5 2 r 12 lna1 1 b 12 3 4 y 26 25 24 23 22 21 21 0.758t lna1 2 2 3 2 20 0 1 15. 4 2(x2 1 2) (2t 1 5) (x 1 4) (x2 1 4)1/2 2(x 2 1)(x 1 1) 6(2x 2 1) 1 20. The x-increment is entered as ¢Tbl (read "delta table"). T(a) 5 1.055a 1 4.99 c. The common difference is d 5 20.8 in. The sum of the numbers on the dice is not 12. Replace (x, y) by (2x, y). r (x) 5 2 12x 1 1 70. 46 16x4 y6 57. The range is (2`, 8]. x 1 2 b. H1L a b(x) represents the average of the high and low temperatures 2 for day x. (See Examples 3–4) 37. y 5 12.2 2 x For Exercises 31–44, graph the equations by plotting points. a 12 3 12 e5 69. 615, , 22, and 24 (each with multiplicity 1) 2 1 73. Substitute a1 5 1 and an 5 n. Easy to Use. Q(t) 5 300e20.0063t b. 3 5 6. Invoke the linear regression feature on a calculator, graphing utility, or spreadsheet. SECTION 8.5 58. Solution: x 1 4y 5 3 4y 5 2x 1 3 1 3 y52 x1 4 4 y 2 y1 5 m(x 2 x1) 1 y 2 1 5 2 [x 2 (24)] 4 1 y 2 1 5 2 (x 1 4) 4 1 y2152 x21 4 The slope of the given line can be found from its slope-intercept form. x1 5 60 vehicles per hour; b. n n n n a banb0 1 a ban21b1 1 a ban22b2 1 a ban23b3 0 1 2 3 These values match the exponent on b. x 5 2 and x 5 22 11. Write a function that represents the total cost T(a) for a dollars spent on tickets. The difference between any term after the first and its predecessor in an arithmetic sequence is called the and is denoted by d. (x 1 4) 1 (y 1 3) 5 11 y b. Furthermore, the vendor knows that the lemons, sugar, and cups collectively cost $0.50 for each cup of lemonade produced. The remote control can "talk to" the overhead door unit if the 10 corresponding switches in the unit are in the same up/down sequence. She takes 2 pairs of slacks, 6 blouses, and 4 scarves, all of different colors. In this case, the manufacturer should produce 1200 grill A units and 0 grill B units. 3 1 1 1 1 15. y 25 24 23 22 21 21 22 1 2 3 4 5 x 1 24 23 22 21 21 22 25 26 27 28 33. geometric; ratio 3. 701 The nth term of an arithmetic sequence: p. 1 1 1 1 Show that a1 2 b a1 2 b p a1 2 b c1 2 d 2 3 k11 (k 1 1) 1 1 1 1 5 . Maximum: 7 4 8 6 h. Find the Value of an Annuity Geometric Sequences and Series 1. Write an equation of the circle that is tangent to both axes with radius 111 and center in Quadrant III. m(x) 5 12x 1 5 For Exercises 79–84, use the graph of y 5 f (x) to graph y the given function. x14 Write About It 118. To solve 6x 2 2(x 1 2) 2 5 # 0 determine the values of x for which Y1 # 0 (where the function is on or below the x-axis). Identify Subsets of the Set of A hybrid vehicle gets 48 mpg in city driving and 52 mpg on the highway. Event E is as likely to happen as not to happen. Then identify the center and radius. P(E) 5 0.994 12. t(x) 5 1 x22 23. 13. an 5 5(0.8)n a. • If c , 0, then the solution set is the empty set { }. g(2) 37. Average rate of change: m 5 EXAMPLE 6 x m5 f(x2) 2 f(x1) x2 2 x1 Computing Average Rate of Change Blood Alcohol Concentration vs. z(x) 5 249 1 x2 41. All x for which f(x) 5 1. (2.7, `) 40. Then hit the GRAPH key. How much will the sales person earn in a year for selling 42 new units? A ginger cookie is selected. Write a linear cost function that represents the cost C(x) to produce x items. A 17, 2315B and A217, 15B . 3 2 32 x 4. 2270 65. Neither 39. All of you are amazing. This is equivalent to saying that 3 is a factor of 4n 2 1. (2`, 0) ´ a , 1b 25. Notice that each y value on f 1 g is the sum of the y values from the individual functions f and g. Apply the Binomial Theorem 3. Updates to College Algebra: • Two new sections, "Algebra for Calculus" and "Equations and Inequalities for Calculus", were added to Chapter R and Chapter 1. First enter Y1 5 2x 2 3 and Y2 5 x 2 1. Show that Pk11 is true; that is, show that 2 is a factor of 7k11 2 5. { } 19 29 , f 3 3 3 53. Check the result by graphing the line with the data points to verify that the line passes through or near the data points. X 5 c 1 5 238 d 273 8 5 13 d 210 51. Consider a right circular cone with 3 fixed height h 5 6 in. 4 115. A relative maximum of a function is the greatest function value relative to other points on the function nearby. 3 x 64. 225 19. Round to the nearest milligram. 4 4 95. Between 3 and 4 b. In this context, it represents the change from one value of x to the next. 2 The midpoint between the points is given by M 5 a 2 p. 3x 5 2y 2 4 54. Singular matrix 4 5§ 0 21 11 8 25 d ; This matrix represents the reflection of the 2 triangle across the y-axis. 0 for all real numbers x. There are 4 dead batteries among the 20. SA-48 Student Answer Appendix n 19. 212 Chapter 2 Functions and Relations Expanding Your Skills 103. (y 2 3)2 x2 1 5 0; The graph is a single point: (0, 3). The sum of the numbers on the dice is 4. Graph h 75. 23258 31. $289,993 103. exponential 41. y 5 4 3 2 y 5 4 3 2 1 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 25 24 23 22 21 21 22 23 23 24 25 24 25 24 25 b. True 103. a i51 (i 1 1)! 7i 4 i3 b. f (24) 5 (24)2 1 2(24) 5 8 Evaluate f (5) first. 1 2 y 32. w1z x1y 2 1 3 2 3 3 2 2a 1 1ab 1 2b 129. (27, 7) 27. Using the Vertical Line Test Consider a relation defined by a set of points (x, y) graphed on a rectangular coordinate system. t(0.4) e. R.2. y 5 0 75. f (x) 5 x3 2 4x 1 2 For Exercises 63–70, refer to the function f 5 {(2, 3), (9, 7), (3, 4), (21, 6)}. Minimum degree 6 b. y 5 2 y 10. Our goal is to offer every student an opportunity for success in college algebra by bringing together a seamless integration of print and digital content delivery. 6 5 4 3 h(x) 5 √x 1 3 y 5 √x 2 1 22 21 21 22 Using similar logic as in Example 2, we can show that the graph of h(x) 5 (x 2 3)2 is the graph of f(x) 5 x2 translated to the right 3 units. 2 4x2 b. 1 real solution 55. Assume that 2 1 4 1 … 1 2k 5 k(k 1 1) (inductive hypothesis). 0.984 33. No 13. Write a linear revenue function for selling x cups of lemonade. f(22) 5 1 b. 5k 2 14 5 14(5 ? e 0, 625 f 16 fq 103. 16m2n(5m2n7 2 3m3n2 2 1) 81. 127. y 5 x 1 5 5 75. • The minimum braking distance of a car depends on the speed of the car. The length is 9 ft. latus; rectum 9. Vertical asymptotes: x 5 , x 5 2 ; Horizontal asymptote: y 5 0 2 2 5 14. Show that Pk11 is true; that is, show that 3 is a factor of 4k11 2 1. EXAMPLE 6 Reflecting the Graph of a Function Across the x- and y-Axes The graph of y 5 f (x) is given. y 5 x 2 4 Functions and Relations 31. (5a 1 7b)(3c 2 2) 83. These are the points where a graph intersects the x- and y-axes. The graphs are the same. 5p3, 25p5, 5p7, 25p9, … 35. m 5 21 6 Perpendicular 31. 28 5 256 25. One runner runs 6 m/sec and the other runs 4 m/sec. 3.2839; 73.2839 < 596 ln 7 65. This is because the two N's are indistinguishable. Real Numbers (R) Rational Numbers Integers Whole Numbers Irrational Numbers Natural Numbers Figure R-1 The relationships among the subsets of real numbers defined in Table R-1 are shown in Figure R-1. (See Example 2) 15. Passes through (22, 3) and is perpendicular to the line defined by 5y 5 2x. π 2 3 b. See also Counting principles Fundamental theorem of algebra application of, 332–335 explanation of, 333 Future value, 719–720, 765 I-4 Subject Index G Galois, Evariste, 344 Gauss, Carl Friedrich, 333, 568, 707 Gaussian elimination, 567–570, 625 Gauss-Jordan elimination, 568–570, 625 GCF. 114. 1 1?2 1?2?3 1?2?3?4 , , , , p 3 9 27 81 4. 3 2 1 11. 6 5 26 Student Answer Appendix 101. Skill Practice 5 Given the terms a2 5 54 and a5 5 182.25 of a geometric sequence, find r, a1, and an. 0 and a1 . Vertices: (0, 10), (0, 210) e. Use the points (1, 8) and (9, 40) to write a linear function that defines the number of attendees as a function of week number. A ¨ S: Overlap of A and S A 5 {A ,A S 5 {A ,2 ,A ,3 ,A ,4 } ,5 ,6 ,7 ,8 ,9 , 10 ,J ,Q ,K } Figure 8-13 Notice that events A and S share the comment element of the ace of spades, A . 57. x15 6. 159, π [H f. (2, `) d. Use a graphing utility to graph the function. x 1 1 $ 2x 2 2 1 8. Arithmetic; d 5 2 3 5 Geometric; r 5 21 4. x2 1 y2 5 36 72. 5 160 16 160 16 132 33 28 7 4 4 1 99. k 5 4.2 7 2 28. 702 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 1 Identifying an Arithmetic Sequence and the Common Difference Determine whether the sequence is arithmetic. (; 2 76 1 3 (39. 1 1 2 1 22 1 23 1 … 1 2n21 5 2n 2 1 3 3 3 3 1 n 1 1 1p1 n512a b 4 16 64 4 4 … 13. 3, 9, 36, 180, … 32. Skill Practice 11 g(x) 6 5 4 y 5 g(x) Relative maximum g(2) 5 1 3 2 1 26 25 24 23 22 21 21 22 1 2 23 Relative minimum g(21) 525 4 5 6 f(x) a. 752: © Brand X Pictures RF; p. 1 1 15 < 1.62 b. 5 4 3 2 1 230 240 250 260 20. Instructor Notes to assist with lecture preparation. w 5 c 6 2c2 1 4kr 2k 2v0 6 2v02 1 2as 2CR 6 2C2R2 2 4CL 117. Reflect across the y-axis. Identify Specific and General Terms of a Geometric Sequence The sequence 2, 4, 8, 16, 32, … is not an arithmetic sequence because the difference between consecutive terms is not the same constant. (2`, 22.01) ª (21.99, `) 1. x 5 3 and x 5 23 59. 3 2 127. Evaluate C(225) and interpret the meaning in the context of this problem. {(2.017, 20.015)} 99. 5 4 3 2 TIP T IP Avoiding Mistakes 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 Answers Note that the function cannot have a closed dot at both (21, 1) and (21, 2) because it would not pass the vertical line test. Notice that the midpoint of the diameter is the center of the circle. Write an equation representing line L. , 3k 1 3k , 2k 1 2k by the inductive hypothesis. Then showing that any falling domino in the sequence will cause the next domino to fall is the idea behind part 2 in mathematical induction. (2`, `) 1 3 a. • f is the name of the function, • x is an input variable from the domain, • f(x) is the function value (or y value) corresponding to x. Reflect the graph across the x-axis. 2x2 1 2y2 2 32x 1 12y 1 90 5 0 49. Use the formula for the nth term of a geometric sequence. a1 5 102, d 5 4 b. 98. c 3 d 25 21 27 23 27. {(2, 1), (5, 4)} 45,000 b. Each dimension was decreased by 1 in. e , 5 f 3 73. (2`, 23) ´ (4, `) (2`, 23] ´ [4, `) d. In how many ways can such a committee be formed? x0 for x . $750,000 b. T(t) 5 78 1 272e20.046t b. [21, `) a. 34 5 5184 56C12 a. Use the model from part (a) to approximate the average for a student who misses 6 classes. That is, the exponent on a is n minus the exponent on b. a c 5 cn Adding a constant c a total of n times equals cn. 1 F 25 24 23 22 21 21 22 35. 3 10 b. 21 a. The order of selection is important. To find a50, substitute 50 for n. If a person is selected at random from the population, find the probability that the individual has the A antigen. Domain: (2`, `); Range: (23, `) c. x 5 20, y 5 0 c. That is, AB or BA represents the same group of two elements.) 49. It may have three or fewer turning points. a 5 4, v0 5 18, and s0 5 10 55. 4k11 5 4 ? Find the sum of the first 1000 positive integers. This is generalized as the fundamental principle of counting. 0.03x 1 0.04y 5 0.12 57. Domain: (2`, `); Range: [3, `) 1 2 3 4 5 x 28 210 y 10 8 6 4 2 25 24 23 22 21 22 24 1 2 3 4 5 x 26 28 210 5 4 3 2 1 25 24 23 22 21 21 1 2 3 4 39. P(x) . In how many ways can the professor choose 3 questions from 10 questions? Such solutions are called Pythagorean triples, such as a 5 5, b 5 12, and c 5 13. 2 x 2 2 2 4 a 1 5b b. • The function has a relative minimum of f (b). The legs are 4 ft and 7 ft. Domain: [0, 4); Range: [0, `) 1 23 22 21 21 22 6 7 x is not; is 3. 16 1 16 d. At the time of the purchase, the exchange rate was $1 5 €0.80. 1 4 93. y 5 12x1 1 4x2 1 4000 d. s 5 216t2 1 75t 1 4 b. Assume that 2 is a factor of 5k 1 1. sum 101 Sum of the first 100 positive integers: 50 pairs, each summing to 101. The lines are not exactly the same. This is motion followed by an object influenced by an initial force and by the force of gravity. y 5 x2 2 2x y 8. (See Example 9) 109. m(x) 5 1 x23 c. TIP In Example 2, the slope-intercept form of a line can also be used to find an equation of the line. 9.3 mCi c. This technique is called mathematical induction. There may be multiple representations. The maximum amount that can be removed from each end would be half of 24 in. (3a 1 1) 2 1 Replace 4k by 3a 1 1. {(Dara Torres, 12), (Carl Lewis, 10), (Bonnie Blair, 6), (Michael Phelps, 16)} b. {22} 93. n(x) 5 216 2 (x 2 3)2 38. • Then show that the truth of the statement for an integer greater than or equal to j implies the truth of the statement for the integer that follows. f (x) 5 2 1 1 x13 y b. They can be easily skipped for those who do not encourage the use of calculators. The graph defines y as a function of x if no vertical line intersects the graph in more than one point. If the system of equations reduces to a contradiction such as 0 5 1, then the system has no solution and is said to be inconsistent. q21(x) 5 (x 2 1)5 1 4 5 4 3 2 25 24 23 22 21 21 22 9 8 1 24 25 61. Yes d. In how many ways can she arrange the musical selections? Determine the vertex of the parabola by using the vertex formula. 24 Therefore, the new x-intercept (and also the vertex of the parabola) is (23, 0). 2835x4y6 30. The person has elevated blood pressure. (23, 21) y 5 f(x) 24 25 1 2 3 4 5 x Section 2.7 253 Analyzing Graphs of Functions and Piecewise-Defined Functions 5. 1660 at (4, 9) 21. 197 p. 1 24 25 24 25 26 h(x) 5 2x3 26 25 24 23 43. Write f(x) 5 ax2 1 bx 1 c (a fi 0) in Vertex Form 4 3 2 1 27 26 25 24 23 22 21 21 Vertex 22 h. 720–724 5 R.1. 2 4 R.2. {4} 1 1 R.3. g(0) 5 1, g(1) 5 , g(2) 5 , g(21) 5 4, g(22) 5 16 4 16 1 R.4. h(0) 5 1, h(1) 5 16, h(21) 5 16 R.5. a. None of these 25. Consider the following sum: Mathematical Induction 2. (2`, 24) ´ (21, `) d. y 5 0 x 2 2 0 93. The card is an ace or a king. 693 By definition, 0! 5 1. y 5 3x 1 12 y 13. Undefined The domain of g is (2`, `). k(x) 5 x16 x22 b. a c 5 cn i51 n n 2. Between months 4 and 6: 2683 cases/month; Between months 10 and 12: 2110/month c. 1 2 3 4 5 x (1, 22) 24 25 f. 0 (multiplicity 3) and 5 6 3i (each multiplicity 1) 83. ¢t 48. According to the Centers for Disease Control, the probability that a live birth will be of twins in the United States is 0.016. { } 35. an 5 2 51. g(x) 5 2 1 x26 B3 56. 0 x 2 70 2 12. 3y 5 24x 1 6 13. 5 63. For example, enter the function defined by Y1 5 x3 2 4x2 1 3x. However, we will work on the right side of the equation only. • The company breaks even if exactly 80 cups of lemonade are produced and sold. Hyperbola; Center: (2, 22); Vertices: (6, 22), (22, 22); Foci: (7, 22), (23, 22); Asymptotes: y 5 34x 2 72 and y 5 234x 2 12 ; Eccentricity: 54 2. Such shifts are called translations. 457 pixels b. 64 64 x 64x2 5q2 5p3 1 b. (See Example 8) 72. The company will make money. If the interest rate is 5%, find the value of the annuity after 18 yr. 3940 2918 55. The solution set is (2`, 23). Therefore, no further restrictions need to be imposed. A sequence is a function sequence is a sequence in which consecutive terms alternate in sign. Time 0.10 f(x) (2.5, 0.095) BAC (%) 0.08 (2, 0.09) 0.06 (1, 0.06) 0.04 0.02 (0, 0) (8, 0.02) 1 3 2 4 5 Time (hr) 6 7 8 x 9 Figure 2-18 A line drawn through two points on a curve is called a secant line. The length of a latus rectum is 2y 5 a 2 2 y x 83. The student answered "No" or was female. y 5 f (3x) 38. 5 1 2 Call this statement P1. 536: © Image Source/Getty RF; p. P(boy on 2nd) ? 40,320 b. Find the sum of his yearly salaries over a 20-yr period. f (x) 5 x 1 1 for x $ 2 y c. (2, 28); m 5 25 71. 36 ft c. 5 4 3 2 1 (0, 1) 25 24 23 22 21 21 22 1 2 3 4 5 23 x Then begin at the y-intercept, and use the slope to find a second point on the line. a1 12r Future value of an ordinary annuity: Suppose that P dollars is invested at the end of each compounding period n times per year at interest rate r. Milk has 300 mg per cup and spinach has 240 mg per cup. 27 28 b. e 2 3 f ; x < 20.5331 e2 f 3 ln 5 ln 2 7 ln 2 2 3 ln 3 f ; c < 1.0346 30. The graphs have the shape of y 5 x2 but show a vertical shrink or stretch. True 5. (5 2 2i)4 56. That is, m(a) 5 m(b) 5 23, but a fi b. 365: © Denkou Images/Getty RF; p. Here we will give the basic premise and use a graphing utility to perform the calculations. y y 5 f(x) 1 1 2 3 4 5 x 6 25 24 23 22 21 21 22 23 23 24 25 24 25 82. Skill Practice 2 Write an equation of the line passing through the points (2, 25) and (7, 23). h(21) c. (g + h)(x) 5 1x 2 5 2 3 3 27. f (x) 5 and g(x) 5 x 1 4 99. y 5 4 3 2 1 3 2100 2x4 2 5x3 2 17x2 1 41x 2 21 3. m(2x) 5 4x2 2 2x 2 3 b. From the table, the probability that a 20-yr-old will live to age 21 is 0.9991. Determine the slope of the line containing the points (3, 22) and (5, 22). See Figure 2-4. 2x 5 25y 208 Chapter 2 Functions and Relations Objective 2: Determine the Slope of a Line 21. Use the regression line to predict the amount of cholesterol in a hamburger with 650 calories. e 15. f (x) 5 x 1 3 3 3 3 a. f(x) 5 x 2 10x 1 9 b. No solution; The system is inconsistent. For Exercises 59–66, use the data in the table categorizing cholesterol levels by the ages of the individuals in a study. 88. TIP Coefficients of a Binomial Expansion Let n and r be nonnegative integers with n $ r. x 25 24 23 22 21 21 22 Chapter 7 Test, pp. f (x) 5 2 109. To find the y-intercept, substitute 0 for x and solve the equation for y. Yes, because (f + g)(x) 5 (g + f)(x) 5 x 7. End-of-Chapter Materials The textbook has the following end-of-chapter materials for students to review before test time: • • • • Brief summary with references to key concepts. True b. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 x 25 24 23 22 21 21 22 23 23 24 25 24 25 2 3 4 5 b. R; (2`, `) 67. 178 an 5 22n 1 8 vn11 2 vn 5 [v0 1 a(n 1 1)] 2 (v0 1 an) 5 v0 1 an 1 a 2 v0 2 an 5 a The difference between two consecutive terms is the constant a. 14,097 1530 54. a b 5 TECHNOLOGY CONNECTIONS Evaluating Binomial Coefficients To evaluate binomial coefficients on a graphing utility, use the nCr function found menu under PRB. 9 12. f (2) 25 24 23 22 21 21 22 b. Therefore, we want a factor of –1 raised to an even exponent on odd-numbered terms and an odd exponent for evennumbered terms: (21)n11 Skill Practice 5 Find the nth term an of a sequence whose first four terms are given. (1, 25) and m 5 2 3 4 63. The domain of (f + g)(x) is the set of real numbers x in the domain of g such that g(x) is in the domain of f. Then Pn is true for all positive integers n if p. In how many ways can 7 different books be arranged on a bookshelf? x2 5 640 b. 0 12 2 2 0 or 0 2 2 12 0 b. an11 r5 an • The nth term of the sequence is given by an 5 a1r n21. 3 129. After the ball falls from its initial height of 4 ft, the vertical distance traveled for every bounce thereafter is doubled (the ball travels up and down). If she anticipates working for the company for

10 yr, find the total amount she would earn from each job. In Examples 6 and 7, we graph piecewise-defined functions. This is the interval where the blue line is below the red line. 2 d. (Source: Internal Revenue Service, www.irs.gov) If your taxable income is over— but not over— The tax is of the amount over— $0 $8925 $0 1 10% $0 $8925 $36,250 $892.50 1 15% $8925 $36,250 $87,850 $4991.25 1 25% $36,250 Write a piecewise-defined function that expresses an individual's federal income tax f (x) (in $) as a function of the individual's taxable income x (in $). {32} 43. 1 5 5040 Evaluating Expressions with Factorial Notation Evaluate. 350 300 250 200 150 100 50 0 R(x) 5 2.00x (80, 160) C(x) 5 0.50x 1 120 Revenue 5 Cost for x 5 80 0 40 80 120 160 Number of Lemonades Produced and Sold Figure 2-22 Profit , 0 for 0 # x , 80 Profit . Skill Practice 7 Refer to the data given in Example 7. 20 1 30 16 2 20 12 75. Determine the vertex of the graph of the parabola. (37.1, 224.7) and (31.1, 232.7) 17. Explain how the fundamental principle of counting or the permutation rule can be used to determine the number of first-, second-, and third-place arrangements. For example, the following three series are all equivalent. 121. • The y-intercept is given by f (0). In a business meeting, every person at the meeting shakes every other person's hand exactly one time. (1, `) 28 27 2625 24 23 22 21 21 22 23 c. 3 a. Approximate the population in the year 2015 assuming that this trend continued. 1 1?2 1 n 5 2 1?2 1 n 5 3 1?2 1 n 5 4 1?2 n 5 1 TIP The proof of the statement 1 1 1 1 1p1 1?2 2?3 n(n 1 1) 5 n 5 n11 is given in Example 2. c d 18 45 64 b. R.2. {x 0 x , 8} R.3. {x 0 22.4 # x , 5.8} 9 R.4. e x ` x $ 2 f 2 Concept Connections 1. How many triangles can be made if the vertices are from three of the six points on the circle? Apply Function Notation A function may be defined by an equation with two variables. f (a 1 4) 52. e 2 f 41 41 3 2 1. To find the probability of the event (A or B), denoted P(A or B), find the probability of the union of A and B. Write an equation of the line passing through the point (22, 6) and perpendicular to the line defined by x 1 3y 5 4. f (0.09) 78. Find all x for which f (x) 5 24. 3 3 2 1 1 2 3 4 5 27 26 25 24 23 22 21 21 22 x 1 x 23 24 25 26 27 102. The sequence is not arithmetic because the difference between a2 and a1 is different than the difference between a3 and a2. 1 22.7x 2 4.1 for x # 21 130. (0, 0), (4, 0) b. {13} d. The minimum value is 27. e 0, , 26 f 2 1 4 9. (23, 3) 119. 256 b. w6 2 3xA6 2 x B 3y 2 1 33. y2 2 1 5 x Solution: y2 2 1 5 x y2 5 x 1 1 y 5 6 1x 1 1 Solve for y in terms of x. (9, 0, 4) c. 197 53. { } 51. Rocco borrowed $1500 at r 3% and $3500 at 2.5%. Explain how you would evaluate 1206! 1204! on a calculator. {(22, 3)} 14. The sum of the numbers showing on the dice is not 8. Substitute a for x. 5b w; w 99. 0 ng/mL 12x 2 x 3t 1 32 13x 1 6 cm 91. (y3 1 2z2)14; tenth term 35. Given x 5 0 y 0 2 4, 8. Then the number of distinguishable permutations of the n elements of the set is n! r1! ? Linear; {24} b. The number of such permutations is given by 6! 5 720 There are 720 ways in which 6 people can be arranged in line. Ellipse; (x 1 1)2 1 y2 51 16 15. Answer 1 24 25 x must be 23. y 6 5 4 y , 2x2 1 b. For example, the points (1, 22) and (0, 25) are on the left branch of the parabola. Objective 4: Find the Probability of Sequential Independent Events 67. 9 5 1,404,000 Skill Practice 2 A code for an alarm system is made up of two letters, followed by four digits. Use transformations on one of the parent functions from Table 2-2 on page 229 to model these data. A21 5 c 2 5§ 1 2 21 3d 252 2 28. 4v2 2 4v 1 1 2 w2 73. 1 32 Section 8.7 759 Introduction to Probability Solution: Let H represent the event that Albert Pujols gets a hit on a given time at bat. a b(23) g y 5 4 3 2 y 5 4 3 2 102. Find the total income for an employee who works at the job for 20 yr. See also Complex numbers explanation of, 104 method to simplify, 104–105 powers of, 107 Imaginary part, of complex numbers, 106 Improper rational expressions, 522–523 Inconsistent systems of linear equations explanation of, 493, 575, 625 on graphing utility, 575 identification of, 575 in three variables, 509, 575 in two variables, 493, 556, 575 use of dependent equations to solve, 576–581 Independent events, 758–759, 767 Indeterminate, 10 Index, 28 Index of summation, 695, 707 Inductive hypothesis, 727, 765 Inequalities. a 2a b 4 k51 j51 5 5 5 5 1 53. The center is (4, 6) and the circle is tangent to the y-axis. Use the model from part (a) to estimate the average consumer spending on television services for the year 2007. (22, 4), (5, 0), and (25, 1) 22. Determine the number of ways that the letters in the word MICROSCOPIC can be arranged. h(x) 5 6 x k(x) 5 24 25 8 7 y 12 5x r(x) 5 x 2 2 x 2 6 21028 26 24 22 21 22 23 h(x) 1 x 23 77. y 5 34x 1 174 and y 5 234x 2 14 F 1 2 3 4 5 e. Graph i 57. The command LinReg(ax 1 b) prompts the user to enter the list names (L1 and L 2) containing the x and y data values. by using r Section 8.5 The Binomial Theorem 5. {3} 101. EXAMPLE 2 Translating a Graph Horizontally Graph the function defined by g(x) 5 (x 1 3)2. Prove that a (ai 1 bi) 5 a ai 1 a bi. 60 mph 37. The speed of the sled s(t) (in ft/sec) at a time t (in sec) after movement begins can be approximated by: s(t) 5 • 257 Analyzing Graphs of Functions and Piecewise-Defined Functions , , , , x#1 x#2 x#3 x#4 b. Skill Practice 6 Repeat Example 6 in the case where the vendor can cut the cost to $0.40 per cup of lemonade, and sell lemonades for $1.50 per cup. 770–772 1. To put this in perspective, the following events are more likely to happen than winning the grand prize in "Florida Lotto." Principle of Counting 2. Undefined (not a real number) x24 24. Using the formula for vn given in Exercise 29, a. The graph of y 5 3f (x) is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). For example, the graph of f (x) 5 x10 1 1 has no x-intercepts. 72–73 0 y 2 L 0 , ε or 0 L 2 y 0 , ε 0 x 2 c 0 , δ or 0 c 2 x 0 , δ a. c 1 5 c 21 c. The final exam grades for a sample of students in a Freshmen English class at a large university result in the following grade distribution. E23 6 i 131F 1 3 114 5 197 e 4, 2 f 47. 1 38 b. Identify the center and radius of the circle. (228, 218] 2 12 9 6 1 2 4 6 8 10 k(x) 5 x 25 24 23 22 21 21 22 2 x x2 2 x 2 12 1 2 3 4 5 x 23 24 25 53. The center is (22, 24) and the circle is tangent to the x-axis. The distance d(t) (in ft) that the car travels t seconds after the brakes are applied is given by d(t) 5 24.84t2 1 88t, where 0 # t # 9.09. 1 for x . One solution 5. Verify that the points A(0, 0), B(x, 0), and C a x, 2 2 make up the vertices of an equilateral triangle. y 5 2f (x) 54. The purpose of writing an equation of a circle in standard form is to identify the radius and center. The range is (2`, 23]. Each plant has two genes, one from the female (seed) and one from the male (pollen). For example, consider the different arrangements of the letters in the word FIVE. y $ 22 63. It would take Joan approximately 5.5 hr working alone, and it would take Henry approximately 6.5 hr. z1y2 5 2y 2 4 3 m(x) 5 1 x, n(x) 5 x 1 1, h(x) 5 4x, k(x) 5 x2 Chapter 2 Review Exercises, pp. E1: The ball lands on the number 7. y 5 x 32. d 5 an11 2 an • The nth term of the sequence is given by an 5 a1 1 (n 2 1)d. f (x) 5 22x2 1 6x 2 3 59. Chapter review exercises. For what value of x is f (x) 5 7? Functions and Relations y 96. Write a piecewise-defined function to model the salesperson's total monthly salary S(x) (in $) as a function of the amount in sales x. an 5 13 n14 2 For Exercises 11–28, evaluate the sum if possible. f(x) 5 1x 1 15 b. 988,000 49. (x 2 5)2 1 (y 1 5)2 5 25 y b. 5 2 t 4. A 1 c 1 3 0 21 23 24 24 24 24 c. x 5 22 61. Note: This means that there are n! ways to arrange n distinguishable items in various orders. Choose the row or column with the greatest number of zero elements. 9! 5! ? 7! 34. H HH 103. a 4a b 2 10 70. ceil(4) 114. across the y-axis. Graph n(x) 5 2x 1 1 for x . Find a7. Show that 2 1 6 1 p 1 (4k 2 2) 1 [4(k 1 1) 2 2] 5 2(k 1 1)2. Yes No No Opinion Total Male 92 7 4 103 Female 36 102 24 162 128 109 28 265 Total If one student is selected at random from the group, find the probability that a. Write Terms of a Sequence Defined Recursively The sequences in Example 1 were defined as a function of the nth term. 5 160 40 52 13 52 52 169 Chapter 8 Test, pp. Analyzing Graphs of Functions and Piecewise-Defined Functions OBJECTIVES 1. 6 By the inductive hypothesis, k11 k i51 i51 2 2 2 2 a i 5 a a i b 1 (k 1 1) 5 2k3 1 9k 1 13k 1 6 as desired. Major axis: 12 ft; Minor axis: 10 ft b. R.1. 2 17 R.5. 1. { } 91. 2 3 4 5 x 23 22 21 21 22 3 4 5 4 5 6 7 x 5 4 3 2 1 1 2 y 50. y 5 2 2 3 x 91. 15 hr 23. x11 3m4 47. 1 1 6 1 36 1 216 1 … ` 2 j21 65. successinmath.com xii Quality Content For Today's Online Learners Why SmartBook? Evaluate C(4) and interpret the meaning in the context of this problem. 3 ? a q b(x) For Exercises 27–32, refer to functions s, t, and v. 3 d. J 5 C 2 1 b. Q(x , y , z) 2 83. (8, 12) and (18, 20) b. a n 10 10 ban2(k21)bk21 5 a b(2x)102(821)(y4)821 5 a b(2x)3(y4)7 5 960x3y28 k21 821 7 The eighth term of the expansion is 960x3y28. If Albert Pujols had a batting average of 0.279 for a recent season, determine the probability that he would get a hit on four consecutive times at bat. The shaded region would contain points on the circle (solid curve) and points outside the circle. Now find the sum of the first 50 terms. y 5 2f (x 2 3) 1 1 20 408 84. CN1 5 £ $40 § ; The matrix CN1 represents the additional cost for $2.40 24 text messages and 100 extra minutes for each of the cell phone plans. Round to the nearest tenth of a year. A freshman is selected. AB, AC, BC (Note: The order within the individual combinations does not matter. 6 a 2 b 2 1x 2 12 x 21 ? Decreasing 125. f (x) 5 45. An equation of the form x 5 k where k is a constant represents the graph of a line. True Problem Recognition Exercises, p. What does ¢P ¢t represent? f)(0) 105. (2`, 2) c. k 5 2.4 75. Linear programming is a technique that enables us to maximize or minimize a function under specific constraints. Median Yearly Income by Level of Education Median Income ($) 80,000 1 yr 1 yr 60,000 y 5 1261x 1 33,296 $1261 $1261 40,000 y 5 642x 1 22,128 20,000 0 0 5 10 15 20 Number of Years Since 1990 25 Figure 2-16 y (x2, y2) Change in y y2 y1 x (x1, y1) Consider any two distinct points (x1, y1) and (x2, y2) on a line (Figure 2-17). 218x7 1 7.2x3 2 4.1; Leading coefficient 218; Degree 7 1 13. Find all values of x such that the distance between (x, 21) and (4, 2) is 5 units. 18 8. [213, 25] c. 212,639 1. 54.5982 b. How many possible routes are there? Vertices: (9, 21), (29, 21) c. The sum of the numbers on the dice is not 4. {16} 5 A { }; The value 24 does not check. {x 0 x . 1 e. Graph y 5 2f(x 2 1) 1 2. x2 1 (x 1 2)2 5 (2x 2 2)2 b. See page 755. 11 111. Therefore, x1 . f(25) 47. If the applicants are equally qualified, find the probability that both positions are filled by women. 16 2y7 x32 49. SmartBook breaks down the learning experience into four stages: Preview, Read, Practice, and Recharge. (g + h + f)(x) Section 2.8 273 Algebra of Functions and Function Composition 87. In Example 9 we encounter a situation in which more than one technique of counting must be used. EXAMPLE 3 Answers 1. Will we approach some finite amount of pie? 22 a. The nth term of the sequence of terms can be written as an 5 5(2)n21. (2x)1/2(x 1 1)3/2 (16 2 x2) 216 2 x2 5(x 1 4) 4(x 1 5)3/4 (x 2 1)(x 1 1) 28. 753 Empirical probability is computed based on observed outcomes of the relative frequency of an event to the number of times an experiment is performed. Identify x- and y-Intercepts 5. Vertex: A 14, 3B; p 5 274 ; Focus: A232, 3B; Focal diameter: 7 b. For Exercises R.2–R.4, graph the set and express the set in interval notation. • The Classroom Activities using Wolfram Alpha promote active learning in the classroom by using a powerful online resource. n 6. Simplify the expression from part (a) for t , 5. (y 1 2)2 (x 2 2)2 2 51 10. R.2. 20 16 R.3. 7 13 4 R.4. p2 2 3 3 12 R.6. 3 15 1 12 2 21 3. 1 39. Each term of the geometric sequence a1, a2, a3, … can be written in the form a1r n21. f (x) 5 (x 2 2)2 2 3 97. T1 5 117. x2 1 (x 1 1)2; 2x2 1 2x 1 1 63. No Yes; If f (a) 5 f (b), then 4a 2 7 5 4b 2 7, which implies that a 5 b. 5 x 117. 2x 2 2 . g)(x) 5 ; Domain: (2`, 3) ´ (3, `) x23 g 1 ; Domain: (2`, 3) ´ (3, 4) ´ (4, `) 25. a 1 b 63. CN 5 c d ; This represents the total number of calories burned 8040 by two individuals with different weights after biking 6 hr, running 3 hr, and walking 5 hr. To further illustrate the rationale for the order of steps taken in Example 8, begin with the parent function y 5 1x. A traffic light at an intersection has a 120-sec cycle. 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 89. x 1 4 c. For a recent year, the Centers for Disease Control reported that the probability that a 50-yr-old will live to age 51 is 0.9959. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 y 93. Test for x-axis symmetry. (See Example 9) 58. x2 5 60y for 24.1 # x # 4.1 b. To solve for a1, substitute r 5 0.8 into the equation a1 5 80 . 5 4 3 2 p 112. Therefore, a minimum of two points is needed to graph the line. Find a1. 4 3 2 1 C(0, 21) 2 4 6 8 10 x 24 23 22 21 21 22 F F F C(3, 2) 1 2 3 4 5 6 x 23 24 25 (y 2 6)2 (x 1 2)2 1 51 5 3 Center: (22, 6); Vertices: A22 2 15, 6B; A22 1 15, 6B Endpoints of minor axis: A22, 6 1 13 B, A22, 6 2 13 B Foci: A22 2 12, 6B, A22 1 12, 6B (y 2 1)2 (x 2 5)2 1 51 6 9 Center: (5, 1) Vertices: (5, 4), (5, 22) Endpoints of minor axis: A5 1 16, 1B, A5 2 16, 1B Foci: A5, 1 1 13 B, A5, 1 2 13 B (y 1 7)2 51 x2 1 4 Center: (0, 27) Vertices: (0, 25), (0, 29) Endpoints of minor axis: (21, 27), (1, 27) Foci: A0, 27 1 13 B, A0, 27 2 13 B Ax 2 52 B 2 (y 1 4)2 1 51 25 9 5 Center: A 2, 24B Vertices: A 152, 24B , A252, 24B Endpoints of minor axis: A 52, 21B, A 52, 27B Foci: A 132, 24B , A232, 24B y2 (x 2 1)2 1 51 1 1 4 9 2 y x 1 51 16 7 (y (x 2 2)2 47. Hamburger Calories Cholesterol (mg) 220 35 420 50 460 50 480 60 560 70 590 105 610 65 680 80 720 90 Animal Gestation Period (days) Longevity (yr) Rabbit 33 7.0 Squirrel 44 8.5 Fox 57 9.0 Cat 60 11.0 Dog 62 11.0 Lion 109 10.0 Pig 115 10.0 Goat 148 12.0 Horse 337 23.0 Elephant 620 35.0 226 Chapter 2 Functions and Relations Objective 4: Create Models Using Linear Regression For Exercises 67–70, use the scatter plot to determine if a linear regression model appears to be appropriate. [22, 4)) 22 4 b. For example, a 25-year-old with a maximum heart rate of 195 beats per minute should strive for a target heart rate zone of between 98 and 166 beats per minute. x 2 y 3 3 11. 12x 1 6y 5 6 b. {(1600, 40)} b. y 5 4 3 2 y 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 67. 5 4 3 2 1 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 y 108. 2i 43. 3}. 5 25 10 210 5 25 10 210 3. The initial swing (one way) of a pendulum makes an arc of 2 ft. y $ 0 3 4 y 5 4 3 2 25 24 23 22 21 21 22 d. substitution; addition 5. 17. Therefore, h is neither even nor odd. y 5 0 x 0 1 2x 1 7 15. 4 3 2 1 1. x2 1 y2 5 28 3 2 3 2 81 15. Not applicable c. f (2) 5 5 because the function contains the point (2, 5). That is, R(x) , C(x), or equivalently P(x) , 0. S 5 b. f (x) 5 x2 b. h(0) 5 23 h(1) 5 1 e. Tests for Symmetry Consider an equation in the variables x and y. 36, 18, 9, 92 , 94 25. Explain why this is not a sufficient proof that the expression is prime for all positive integers n. In a drama class, 5 students are to be selected from 24 students to perform a synchronized dance. In this case, the order in which the students are selected matters. y x13 5 b. Vertices: (0, 0), (0, 40), (8, 40), (36, 12), (36, 0) 19. f is decreasing on the interval (24, 21) ´ (3, `). 1 51 b. L 5 2 80 2 2x 80 2 2x 160 2 4x or y 5 b. $289,503.57 53. • f is increasing on I if f (x1) , f (x2) for all x1 , x2 on I. 5 4 3 2 1 89. The midpoint of the line segment with endpoints (x1, y1) and (x2, y2) is given by the formula 5. 30 45. k)(x) 5 g(x) ? Minimum: 28 h. 10, e 7. For Exercises 23–25, use mathematical induction to prove the given statement for all positive integers n. (2`, 22) ´ (22, `) b. x-intercept: (26, 0); y-intercept: None 1 y57 4 3 2 24 25 2y 5 25x 1 2 x 8 7 6 5 x 24 25 1 1 2 3 4 23 4 3 2 y 1 25 24 23 22 21 21 22 R.5. 22 5. Skill Practice 10 Suppose that after a tax rebate an individual spends $210. Center: (0, 0); Radius: 4.2 25. x2 1 4 5 0 2 x 2 2x 1 5 5 0 115. Stretch horizontally by a factor of 4. Objective 1: Determine Theoretical Probabilities 9. {9} 121. Evaluate (T + C)(10) and interpret the meaning in context. 40P3 or 40 ? The center is (25, 3), and the radius is 19 5 3. (c 2 d)8; fourth term 32. Find (T + C)(6) and interpret its meaning in the context of this problem. 27 26 25 24 23 22 21 22 24 9 b. (3 ? • The deck consists of 52 cards. Evaluate W(20) and interpret the meaning in the context of this problem. {0} d. Two key features are the x- and y-intercepts of a graph. h(3) Evaluating a Function Evaluate the function defined by f (x) 5 3x2 1 2x for the given values of x. • The graph of the equation is symmetric to the x-axis if substituting 2y for y results in an equivalent equation. 689: © Image Source/Getty RF; p. (2`, 1) ´ (3, `) 119. {e, e4}; x < 2.7183, x < 54.5982 119. 2 5 (1)(1 1 1)(1 1 2) . The range. f (x) 5 e 22 for x , 1 3 for x $ 1 1 for x , 0 109. Notice that the slope-intercept form of a line y 5 mx 1 b has the y variable isolated and defines y in terms of x. E21, 13, 213F 2 c. (5x2 2 y3)(25x4 1 5x2y3 1 y6) 1 x13 9 18. This excludes p. Determine the maximum height. y 8 32 y1652 x1 5 5 (21, 2) 3 2 1 23 22 21 21 22 8 32 y52 x1 26 5 5 1 2 23 8 2 y 5 2 x 1 (slope-intercept form) 5 5 5 6 8 7 y525x1 24 25 26 27 8 32 30 y52 x1 2 5 5 5 3 4 x 2 5 (4, 26) To check, we see that the graph of the line passes through (4, 26) and (21, 2) as expected. f (21). Linear; {1} 77. 3 110 7. e 11. 7 87. or 0.036 49. a0, 2 1 2 x 5 63. a0, 2 b 5 e. g(x) 5 y c. In how many ways can such a team be formed? (See Examples 5–6) 1 g(x) 5 h(x) 5 5 k(x) 5 1x 1 1 f (x) 5 x2 1 3x 1 x 35. a2t2v1 a1t1 (2 23 26 1 95. First, the equation is not necessarily unique. The center is (22, 21) and another point on the circle is (6, 5). {2} b. Simplify. EXAMPLE 1 Writing an Equation of a Line Given a Point on the Line and the Slope Use the point-slope formula to find an equation of the line passing through the point (2, 23) and having slope 24. How many identification codes are possible if letters and digits may not be repeated? Undefined 5 x SA-16 49. The person has normal blood pressure or is a smoker. gA 12 B e. Let h be a positive real number and let Q be the point (x 1 h, f (x 1 h)). Thank you for making us shine. (2`, `) 26. Programmers also make use of the "ceiling" function, which returns the smallest integer not less than x. To find a9 substitute n 5 9. 3c # 9 19. 25, 6, 27, 8, … Answers 2 15 5. m 5 28 m 5 25 93. (3n 1 1)! 2. 491: © Michael Hitoshi/Getty RF; p. Graph Linear Equations in Two Variables 1. Find 2m(x). 8; 16; 32 b. False; log5 a bfi AThe left side is 23 and 125 log5125 the right side is 13.B 93. 22 23 24 25 22 23 8 10 5 25 24 23 22 21 21 1 4 6 24 x 21 2 x 1 1 26 n(x) 5 x 28 210 109.94 1 20x C(x) 5 109.94 1 20x b. (0, 0) e. True 83. Increasing 2 a. 5 c. The associative property of addition indicates that the manner in which quantities are grouped under addition does not affect the sum. Weight vs. Determine the slope of a line perpendicular to the given line, if possible. 2,400,000 35. (2, `) c. The x-intercepts of a quadratic function defined by f(x) 5 ax2 1 bx 1 c are the real solutions to the equation f(x) 5 0. (h 1 k)(21) b. Use the graph to find the solution set to the inequality 6x 2 2(x 1 2) 2 5 # 0. 170 • To find a y-intercept (0, b) of the graph of an equation, substitute 0 for x and solve for y. y 5 2 x 1 2 17 17 2 7. 1 Fk 5 Fk12 2 1. {(1, 1)} {(0, 9), (23, 0), (3, 0)} 31. Explain why g(x) 5 2x 1 1 1 shifting the graph of f (x) 5 one unit to the left and x reflecting across the y-axis, or by shifting the graph of f one unit to the right and reflecting across the x-axis. (See Example 5) 49. The solution set is { }. Then set the increment by which to increase x, in this case 1. The x- and y-axes are called asymptotes of f and will be studied in detail in Section 3.5. 2. 1.86 3 1016 89. Graph the line. (2`, 2] ´ (3, `) 57. t $ 0 c. 409–414 1 d 4 2 (n + p)(x) 5 x2 2 3x 1 1 R.5. (p + n)(x) 5 x 2 x 2 2 (p + p)(x) 5 x4 2 6x3 1 6x2 1 9x {(2, 1), (3, 2), (4, 3)} 3. (Hint: Consider using the basic functions learned in Section 2.6 and transformations of their graphs.) y 105. Solution: The parent function for p1x2 5 1x 2 3 2 2 is f (x) 5 1x. p 5 6 b. The numbers are 8 and 6 or 28 4 and 26. The x-coordinate of the point of intersection is the solution to the equation 2x 2 1 5 x 1 5. Round to the nearest year. Vertices: A 52, 0B, A252, 0B d. [1, 37] 15. f(a) 5 3a2 1 2a b. 4 units2 105. 46,750 n 93. Constant. Find the 6th term of a geometric sequence with a1 5 23 and r 5 2. Figure 2-22 shows the graphs of the revenue and cost functions from Example 6. (3P3) 5 1728 Section 8.7 Practice Exercises, pp. Write A as a function of s. {2} {24} 59. Explain why a 213 b is undefined. e 21, , 24 f 2 67. x 5 21 2 29 2 (y 2 2)2 x 5 21 1 29 2 (y 2 2)2 y 5 2 2 29 2 (x 1 1)2 y 5 2 1 29 2 (x 1 1)2 68. 47! There are 22,957,480 different groups of 6 numbers taken from 53 numbers. A linear profit function models the profit for producing and selling x items. a1 5 128; r 5 2 49. The numerator of each term on the left side of the equation is nonnegative. 1 1 2 4 32 1 1 p 1 3 9 243 58. 2 2 1 r(x) 5 ! x 2 3 1 1 1 1 y 75. g(0) 5 0 2 4 5 24. 8u 1 2u v 2 15v 31. 4 x 5 y2 2 4 3 2 24 23 22 21 21 22 x 5 y2 2 4 2x 5 y2 2 4 x 5 2y2 1 4 x x 2x 2x x 5 5 5 5 y2 2 4 (2y)2 2 4 y2 2 4 2y2 1 4 Test for symmetry with respect to the origin. {(3, 2), (5, 22)} {(22, 0), (0, 4), (2, 0)} 35. 212 27. x 5 1; 24 57. Shift y 5 x5 to the right 3 units. {(5, 26)} 7. an 5 2 3n (n 1 1)! n 2 an 5 (21) (n) 55. Show that Pn is true for n 5 1. Apply the midpoint formula. Multiply row 1 by 3 and replace the original row 1 with the result. Center: (0, 2.5); Radius: 2.5 3 3 9 13. {(0, 5)} 27. Then the price is decreased to $6.99 per shirt thereafter. Given f (x) 5 41x, a. e f ; The value 2 does not check. g(0) 5 2(0) 1 1 51 Substitute 0 for x. A0, 13B e. True a. 184 sec after launch f. If one number is selected, in how many ways can we obtain 9. SECTION 8.2 OBJECTIVES 1. A ball rolling down an inclined plane rolls 4 in. Write the first four terms of the geometric sequence with a1 5 4 and r 5 32 . 2 2 2 a b a b2 2 2 7. 82. Find a b(x) and write the domain of in interval notation. i51 n Answer 2. This is called the mortality rate. South Florida humorist Dave Barry often wrote about his dog, Zippy. Gaynelle can travel one of 3 roads from her home to school. positive 149. 5 4 3 2 h(x) 5 x3 1 2 The graph of h (shown in blue) is the graph of f shifted upward 2 units. 0 AB 0 5 2130; 0 A 0 5 10 and 0 B 0 5 213. If two DVDs are selected from the box without replacement, determine the probability that both are comedies. f (x) 5 x2 Function f squares the result. The graphs of the following functions are related to y 5 f (x) as follows. 3, 12, 48, 240, … a. Use this data to inform your teaching, group students based on similar knowledge levels, and shape a meaningful learning experience for your students. V 5 khr 17. k(x) 5 5 1x 1 15 2 2 108. 122. 2.3 b. ⎛ 5 ⎞ 2 ,0 ⎝ 2 ⎠ 27 (1, 27) 28 Skill Practice 2 Find the slope of the line passing through the given points. How far will the ball roll in the 10th second? 164 1. 0.54 81. Move the constant term to the right. Compose and Decompose Functions The next operation on functions we present is called the composition of functions. She spent 4 nights in Washington, 2 nights in Atlanta, and 8 nights in Dallas. P1 is true because a i2 5 (1)2 5 i51 k 2 2. 2400a 1 800b 1 c 5 36,000 2000a 1 500b 1 c 5 30,000 3000a 1 1000b 1 c 5 44,000 c. k)(x) and write the domain of g ? 2x 1 4 5 2x 1 1 b. 7 6 117 7 1 117 b. What is the probability that the couple will have at least one girl? (xy)n 5 xnyn 34. Evaluate P(189) and interpret the meaning in the context of this problem. Determine the Slope of a Line One of the important characteristics of a nonvertical line is that for every 1 unit of change in the horizontal variable, the vertical change is a constant m called the slope of the line. Answer 8. For example the point (0, 0) on the graph of f (x) 5 0 x 0 corresponds to (0, 23) on the graph of g(x) 5 0 x 0 2 3. 371,800 c. The money deposited at the end of the first year will have 3 yr in which to earn interest. 1200 in. What is the probability of randomly selecting a jury of 6 women and 6 men? Round to the nearest dollar. (53 2 6)! 6! ? m 5 26 28. 78.32 ft/sec c. Assume that Pk is true; that is, assume that k2 2 k is even. (0, `) c. 1 i 35. Then, P(E) 5 n(E) 3 1 5 5 n(S) 6 2 The value of a probability can be written as a fraction, as a decimal, or as a percent. This makes the slope undefined because the ratio representing the slope has a divisor of zero. 708–712 R.1. f (2) 5 5 R.3. {(1, 22)} 1. f(x) y 5 f(x) (x2, f(x2)) (x1, f(x1)) m 5 If f is defined on the interval [x1, x2], then the average rate of change of f on the interval [x1, x2] is the slope of the secant line containing (x1, f (x1)) and (x2, f (x2)). 9 The solution set is e f . (1, `) b. Show that 6 1 10 1 p 1 (4k 1 2) 1 [4(k 1 1) 1 2] 5 (k 1 1)[2(k 1 1) 1 4] 5 (k 1 1)(2k 1 6). This gives the slope of the road as the change in elevation per 100 horizontal feet. Arithmetic; d 5 3. The maximum value is 8. • The test score that a student earns is related to the number of hours of study. Length: 3 12 ft; Width: 2 12 ft b. (See Example 1) a. See also Completing the square of binomial, 40, 41 difference of, 52–53 Square matrix explanation of, 586 multiplicative inverse of, 602–603 Square root functions, 229 Square root property, 114–115, 120, 158 Square roots explanation of, 27 principal, 8 of real numbers, 9 Square system, 578 Standard form of complex numbers, 106 of equation of circle, 177–179, 275, 634 of equation of ellipse, 636–638, 682 of equation of hyperbola, 652–653, 657–658, 682 of equation of line, 197 of equation of parabola, 667–668, 673–674 Step functions, 249–250 Stifel, Richard, 39 Stirling, James, 738 Stirling's formula, 738 Stretch/shrink horizontal, 233–234, 236 vertical, 232–233, 236 Subscript notation, 38 Subsets, 2 Substitution method to factor trinomials, 55 to solve systems of linear equations, 493–494 to solve systems of nonlinear equations in two variables, 528–529 Subtraction of complex numbers, 107–108 of matrices, 587–588, 626 of polynomials, 39 of radicals, 33 of rational expressions, 62–64 Summation notation, 695–697 Summation properties, 697, 764 Sum of cubes, factored form of, 53 Symbols. 3i Real part: 3; Imaginary part: 27 25. 3 5 a. recursive 5. y 5 20.7 1 9.72 ln x t 0 k(x) 5 23x 1 1 c. 27.2502 11 57. c 1c b. 10 5 15. (4, 25) b. rational a. www.mhhe.com About the Authors Julie Miller is from Daytona State College where she has taught developmental and upper-level mathematics courses for 20 years. 2 Solution: We need to find two functions f and g such that h(x) 5 (f + g)(x) 5 f (g(x)). 3 7 21 5 (5)2 2 A 15B 2 5 25 2 5 5 20 6 3 4 2x2 2 y2 w2n 2 52 123. 21 1 4 1 9 1 … 1 49 62. Expanding Your Skills Stirling's formula (named after Scottish mathematician, James Stirling: 1692–1770) is used to approximate large values of n!. A sled accelerates down a hill and then slows down after it reaches a flat portion of ground. EXAMPLE 8 Evaluating a Finite Arithmetic Series 60 Find the sum. 22x2 1 3x 2 9 1 2 x 1x23 b. E3: The ball does not land on a red slot. b2x2 1 a2y2 5 a2b2 a2y2 b2x2 a2b2 1 2 25 2 2 2 2 ab ab ab y2 x2 1 251 a2 b 101. No restricted values x23 13. Interpret a Function Graphically In Example 10, we will review the key concepts studied in this section by identifying characteristics of a function based on its graph. Three points are collinear if they all fall on the same line. (23, 3) 24. (n 2 r)! (n 2 r)! ? 10 c. Based on the data given, does the weight of the kitten follow an arithmetic progression? f(x) 5 2x 2 5 x 14 d. Domain: (2`, `); Range: (2`, 23) c. (t3 2 v5)6 25. a ban2(k21)bk21 k21 a. Not a real number 77. 4k 2 1) 5 13(4k11 2 1) as desired. 22 1 43. {(2, 23)} { }; The system is inconsistent. Never decreasing f. 23 6 2i, 2 , 1, 24 c. (24, 1) 22 23 1 171 13. 739 A permutation is an ordered arrangement of distinct items. Minimum: 24 h. y 5 3f (x) 36. Use this information and the table with Exercises 75–78 for Exercises 79–82. The distance between the points is 5 units. Evaluate r(50) and interpret the meaning. (26, 2), (3, 1), and (1, 22) Objective 3: Graph Equations by Plotting Points For Exercises 23–24, determine if the given points are solutions to the equation. Section 1.7 Practice Exercises, pp. See also Polynomials explanation of, 38 method to factor, 49, 52–53 square of, 40, 41 Binomial theorem, 734–735, 766 Branches, of hyperbola, 651 C Calculators. Center: (0, 0) 15. Find a8. In the Illinois state lottery game "Little Lotto," a player wins the grand prize by choosing the same group of five numbers from 1 through 39 as is chosen by the computer. positive integers n $ 3. The CD has jazz music. 12, `2 c. 5e3 2 26; x < 18.0855 {4}; The value 23 does not check. 762 Chapter 8 Sequences, Series, Induction, and Probability 55. Likewise, as x approaches ` and 2`, the graph approaches the x-axis without touching the x-axis. $468,750,000 83. 2268c3 d30 SECTION 8.5 Practice Exercises Prerequisite Review For Exercises R.1–R.5, multiply and simplify. Online Exercises were carefully selected and developed to provide a seamless transition from textbook to technology. x 5 1 g. y 7 6 5 4 5 4 3 2 3 2 1 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x y 5 v(x) 25 24 23 22 21 21 67. In this case, the x values represent the number of years since 1990, and the y values represent the median income in dollars. P(A) 5 4 1A 4 16 d d 12 f. Even and Odd Functions • A function f is an even function if f (2x) 5 f (x) for all x in the domain of f. 23.9069 < 15 81. 3 Focus: (0, 21); Focal diameter: 4 2 1 b. Find all x for which f (x) 5 21. 16 b. 8 7 115. (See Example 2) f (x) 5 22x g(x) 5 0 x 1 4 0 h(x) 5 9. Assume that 1 1 2 1 22 1 p 1 2k21 5 2k 2 1 (Inductive hypothesis). an 5 2n 1 1; The sequence is {3, 5, 7, … , (2n 1 1), …}. There are 30 seeds in a package. Graph Piecewise-Defined (x, y) (2x, y) Functions 4. 1 is not a function. EXAMPLE 1 Finding the Probability of an Event Suppose that a box contains two red, three blue, and five green marbles. 665 5 8 59. P(0) 5 78 means that on January 1, 1900, the U.S. population was approximately 78 million. That is, if domino 1 falls, and any falling domino makes the next domino in line fall, then all the dominos will fall. Two events in a sample space are if they do not share any common elements. Graph iv Problem Recognition Exercises, p. Find the area of the triangle. Show that the sequence log a1, log a2, log a3, … is arithmetic and find the common difference d. 5zy7 2 2z2x 17. (f 1 g)(4) 104. 723 Geometric Sequences and Series 88. Explain what the difference quotient represents. Downward 11 d. Performing these two transformations in the reverse order, would not result in the function we want. (See Examples 6–7) b. Therefore, p(x) ? If an instructor presents all of the highlighted exercises, then each objective of that section of text will be covered. For example, use the menu nCr function found in the under PRB. Consider a relation that defines a time y during the course of a year when the temperature T in Fort Collins, Colorado, is 708. y y (x 2 4)2 1 (y 2 4)2 5 4 y 5 x2 1 1 x x No x-intercept No x- or y-intercept 5. y y5x12 5 4 3 2 (2, 4) (0, 2) 1 25 24 23 22 21 21 22 1 2 3 4 5 y5x12 25012✓ 22 5 24 1 2 ✓ 45212✓ Solution (0, 2) (24,22) (2, 4) x 23 (24, 22) 24 25 Figure 2-6 The set of all solutions to an equation is called the solution set of the equation. k(21) c. transverse y 5 ba x; y 5 2ba x 29. p)(x) 5 (x 1 3) 1x 1 1; Domain: [21, `) p 1x 1 1 c. Answers 6. y 10 8 6 4 25 24 23 22 21 22 24 26 37. Center: (0, 1) {(1, 2), (1, 22), (21, 2), (21, 22)} 31. 11 c. 2 m5 111. (2`, 14) The line will be slanted if both A and B are nonzero. Compare the result to part (a). k(x) 5 20 x 0 1 2 2 80. The number of ways that n distinguishable items can be arranged in various orders is . We can make this process generic by labeling the points P(x1, y1) and Q(x2, y2). The width should be between 2 115 ft and 4 15 ft. a 22a b 4 n51 ` 1 n 24. 28 5 22(x 2 1)2 2 4 5 (x 2 1) 6 14 5 x 2 1 1 6 25x x 5 3 or x 5 21 The x-intercepts are (3, 0) and (21, 0). f(x) 5 x2 y 5 4 3 2 24 25 Figure 2-27 3 4 5 x Section 2.6 235 Transformations of Graphs Reflections Across the x- and y-Axes Consider a function defined by y 5 f (x). No 7. While on vacation in France, Sadie bought a box of almond croissants. 22 b. S(x) 5 20.4x 1 109.6 The value S(x) represents the estimated systolic blood pressure for an adult of age x years. (21.5, `) 10 210 Cholesterol (mg) 10 210 111. 23 83. Given {A, B, C}, a. 638 ft a. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 23 24 25 1 2 y5 3 4 1 2 x2 2 5 x 25 24 23 22 21 21 22 91. y 5 1x but is reflected across the x-axis. 2 5 29. x 5 0 y 0 2 3 44. Calories b. (T + C)(4) 5 104.058; The total cost to purchase 4 boxes of stationery is $104.06. B A line segment connecting any two nonadjacent vertices of a polygon is called a diagonal of the polygon. $8000 b. p(x) 4 5 x 212 220 225 216 220 230 235 240 224 228 232 73. Estimate the times and values of any relative maxima or minima on the interval (0, 70). To compute the probability of an event, we first need to define several key terms. x 5 y2 2 4 Graph is symmetric 2 x 5 (2y) 2 4 with respect to the Replace y by 2y. Substitute x 5 2 and y 5 23 from the given point (2, 23). 31 4 a. y 5 2x 2 6 b. 1 x2 2 for x # 22 2 c. 0.72 81. We have 1 1x 2 2 2 5 1 (m + p)(x) 5 1x 2 2 2 5 5 Answers 7. 708 Chapter 8 Sequences, Series, Induction, and Probability Solution: a. a b 5 For Exercises 11–14, evaluate the expression. Explain how you can use slope to determine if two nonvertical lines are parallel or perpendicular. KEY CONCEPTS Reference SECTION 2.1 The Rectangular Coordinate System and Graphing Utilities The distance between two points (x1, y1) and (x2, y2) in a rectangular coordinate system is given by p. n 2 2 possible nonreal zeros 101. ˇ Student Answer Appendix 63. 49 5 a1 1 14d Multiply by 21 249 5 85 5 a1 1 26d 285 5 236 5 203 5 2a1 2 14d 2a1 1 26d 2a1 1 12d d 49 5 a1 1 14d 49 5 a1 1 14(3) 07 5 a1 With d 5 3 and a1 5 7, we have an nth term of an 5 7 1 (n 2 1)3. 52 6 5i6 d. and d. [0, `) c. 2,000,000 c. 585 (computer): © Jeffrey Coolidge/Photodisc/Getty RF; p. { } 3 97. s 5 216t2 1 60t 1 2 b. f (21) a. (23, 23, 1) b. Therefore, the graph of y 5 (f 1 g)(x) is the graph of f with a vertical shift (shown in blue). 22 1 1 49. Domain: (2`, `); 3 2 13 1 Range: c 2 , `b x 28 27 26 25 24 23 22 21 1 2 4 21 22 23 24 25 25. y 5 4 3 2 1 21221028 26 24 22 22 5 4 1 75. 2 3 3 b. Use the Distance and Midpoint Formulas 3. Graph the data in a scatter plot using the number of days for gestation as the independent variable x and the longevity as the dependent variable y. y . x-intercept: None; y-intercept: (0, 2) y 28 27 26 25 24 23 22 21 21 22 3 4 23 5 4 3 2 23 x 5 26 2 59. a A4 2 14kB k51 k51 61. Section 2.8 Algebra of Functions and Function Composition c. 485–487 1. m 5 45. Vertex: A23, 32 B; Focus: A2132, 32 B ; Directrix: x 5 12 37. 2 (1.3)3 Principles of Counting OBJECTIVES 1. $17,091 c. f (x) 5 x 1 4 81. 24 yr c. 178 lb 29. f(x) 5 2x17 x 13 7 6 5 4 3 2 1 27 26 25 24 23 22 21 21 22 23 1 2 3 x 105. (2)(1) • Zero factorial is defined as 0! 5 1. • A Group Activity is available for each chapter of the book to promote classroom discussion and collaboration. 141 c. b 13. 11, 14, 17, 20, 23, … , 122 26. There are no real numbers x and 4 9 y that would make the sum of two squares equal to 21. Then 5k 1 1 5 2a for some positive integer a. y 5 2 y 39. 109. Therefore, a third-degree polynomial has at most 2 turning points. [x 2 (4 1 i)][x 2 (4 2 i)](3x 2 4) a. 6 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 x 1 25 24 23 22 21 21 22 23 2 3 4 5 1 2 3 4 5 x 23 24 25 24 y 89. (x 1 8)(x 2 8) b. e f ; The value does not check. k 5 Ae2Ey(RT) 11. 6 59. Even 35. The common ratio is r 5 13 . 13 21. By the inductive hypothesis, [6 1 10 1 p 1 (4k 1 2)] 1 [4(k 1 1) 1 2] 5 k(2k 1 4) 1 (4k 1 6) 5 2k2 1 8k 1 6 5 (k 1 1)(2k 1 6) as desired. (n 2 2)! n! 43. Based on these results, what is the probability of selecting a student at random taking Freshmen English and getting a student who received a. Investigate this statement by evaluating the sum for n 5 10 and n 5 50. 0.00000261 b. AB 5 c d 20 44 22 37 51 23. A face card (jack, queen, or king). V(x) 5 240x2 1 240x b. y12 32x3z6 16. h (f 1 g)(x) 5 0 x 0 1 3; Graph d (f 1 g)(x) 5 x2 2 4; Graph a 11 4 213 11. The relation contains the ordered pairs (1, 2) and (1, 3). 5 43. x2 2 x 1 ¢x Given a line with slope m and y-intercept (0, b), the slope-intercept form of the line is given by y 5 mx 1 b. h(27) 41. $150,000,000 b. Skill Practice 1 Use mathematical induction to prove Pn: 2 1 4 1 6 1 8 1 p 1 2n 5 n(n 1 1). { } b. If 23 # If 22 # If 21 # If 0 # x If 1 # x If 2 # x … x , 22, then x , 21, then x , 0, then , 1, then Œx œ , 2, then Œx œ , 3, then Œx œ Œx œ 5 23 Œx œ 5 22 Œx œ 5 21 50 51 52 y f(x) 5 vxb 5 4 3 2 1 25 24 23 22 21 21 22 1 2 3 4 5 23 24 25 Skill Practice 8 Evaluate f (x) 5 Œx œ for the given values of x. As a result, there are 10 combinations of 5 people taken 2 at a time. a 4(2)i 62. Show that 10a1, 10a2, 10a3, 10a4, p is a geometric sequence and find the common ratio r. Geometric; $2,059,993 c. How much money is infused into the local economy during Bike Week? 3k11. g(22) 5 2(22) 1 1 Substitute 22 for x. The given statement log5 (25) 1 log5 (225) is not defined because the arguments to the logarithmic expressions are not positive real numbers. As x S 2`, f(x) S 2`, and as x S `, f(x) S 2`. No 22 b. c21(x) 5 B 4 x 2x 1 4 3 21 21 51. The motorist will save money beginning on the 16th working day. 387: Courtesy of NOAA; p. Yes; d 5 k52 5 4 25. For positive integers n and k (k # n 1 1), the kth term of (a 1 b)n is given by a baubu. A graph of an equation is symmetric with respect to -axis if replacing y by 2y results in an equivalent equation. On a graphing calculator hit the STAT button and select EDIT to enter the x and y data into two lists (shown here as L1 and L2). Let K be the event that a king is drawn: {K ,K ,K ,K }. Find all points on the line y 5 x that are 6 units from (2, 4). 3x2 2 2x 2 9 1 1. { } a. 64 4 40. 1 64 B Apply the formula for the nth partial sum with n 5 6. 325–329 y 28 210 27 20 250 26 25 26 103. 101 The points M, P, and Q do not form the vertices of a right triangle. 40 ft by 80 ft b. 5 6 22x2 1 8 Simplify the denominator. 127 127 127 45. {4}; The value 26 does not check. • If 0 , a , 1, then the graph of y 5 f (ax) is the graph of y 5 f (x) stretched horizontally by a factor of 1a . an11 2 an 5 log a1r n 2 log a1r n21 5 (log a1 1 log r n) 2 (log a1 1 log rn21) 5 (log a1 1 n log r) 2 [log a1 1 (n 2 1) log r] 5 log r The common difference is log r. Does this relation define y as a function of t? A second job offers $54,000 the first year with a raise of $2000 each year thereafter. or 100 ft. f 21(x) 5 2 x 2 20 7 x21 67. 1 x15 3 2 5 3 9 8 x4 b. Determine the slope of a line parallel to the given line, if possible. The following related statement is also true: If a2 1 b2 5 c2, then a triangle with sides of lengths a, b, and c is a right triangle. 70. y y 5 4 3 2 y 5 23f(2x) 1 2 3 4 1 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 1 x y 5 f(2x) 2 2 2 89. SECTION 8.4 For Exercises 53–56, use mathematical induction to prove the given statement for all positive integers n. 1410 a. Find the total earnings for job A over 20 yr. • Each suit consists of 13 cards labeled: Ace (A), 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack (J), Queen (Q), and King (K). Determine the maximum or minimum value of f. If the sequence is geometric, determine r. 2 is a factor of 7n 2 3. Write r as a function of d. Expression; 4x 1 36 (x 2 3)(x 1 7) 3. 685–686 1. e 615, f 2 1 67. With decades of scientific research behind its creation, ALEKS offers the most advanced adaptive learning technology that is proven to increase student success in math. 561–562 1. (27, 24) and (2, 5) 14. Greatest integer less than or equal to 0.4 is 0. The vertical distance between the points is @ 9 2 5 @ 5 4. See Rectangular coordinate system Counterexample, 732 Counting principles applying multiple, 746 combinations and, 744–746, 766 fundamental principle of counting and, 738–740, 743, 766 permutations and, 741–744, 766 Cramer's rule determining applicability of, 620 explanation of, 617–618, 627 patterns presented in, 618 for system of equations with three variables, 620 for system of n linear equations in n variables, 619 for system of two linear equations in two variables, 618–619 Cross point, 305 Cube functions, 229 Cube root functions, 229 Cubes factoring sum or difference of, 53 volume of, 42 Cubic equations, 344 Curie, Marie, 421 D Decay functions, exponential, 416 Decimal notation, 23 Decimals, repeating, 717–718 Decomposition of functions, 269 partial fraction, 517–524 Degenerate cases, 179–180 Degenerate conic section, 681 Degree, of polynomial, 38 Denominator least common, 62 rationalizing the, 31–32, 66–67, 74 Dependent equations explanation of, 493, 576, 625 in systems of linear equations in three variables, 509, 577–579 in systems of linear equations in two variables, 493, 498, 556, 575–577 Depressed polynomials, 330 Descartes, René, 166, 178 Descartes' rule of signs application of, 335–337 explanation of, 336 Determinants Cramer's rule and, 617–620, 627 explanation of, 612 on graphing utility, 616 method of diagonals to evaluate, 616 of n 3 n matrix, 612–617, 627 review of, 626–627 used to determine with matrix is invertible, 616–617 of 2 3 2 matrix, 612, 626 of 3 3 3 matrix, 614–616, 627 Difference of cubes, 53 of squares, 52–53 Difference quotient evaluation of, 264–265 explanation of, 264, 277 Directrix, of parabola, 667–669 Direct variation applications involving, 385–386 explanation of, 383, 393 Discriminant, 120–121, 158, 290 Distance absolute value to represent, 8 method to find, 167–168, 275 perpendicular, 667 Distance formula, 98, 166–168, 177, 635 Distributive property of multiplication over addition, 11–12 Dividend, 317 Division of complex numbers, 110 long, 316–318, 352, 356 of polynomials, 316–320, 392 of rational expressions, 61–62, 74 synthetic, 318–320 with zero, 10 Division algorithm, 317 Division property, of radicals, 105 Divisor, 317 Domain of functions, 188–190, 263–264, 267–268, 275 of logarithmic functions, 435–436 of polynomial functions, 301 of rational functions, 345 of relations, 183, 275 Doppler effect, 366 E Eccentricity of ellipse, 643–644, 682 of hyperbola, 658–659, 682 Elementary row operations, 565–566, 625 Elements, 2, 3 Elimination method. Yes 53. The slopes are 5 and 21. x-intercept: (2, 0); y-intercept: (0, 24) 77. $66,438 c. 239; Yes 25. 8 7 6 5 4 3 2 7 6 5 4 3 2 f(x) 5 ex 2 4 1 22 21 21 y 9 8 1 2 3 4 5 6 7 8 x b. Reciprocal function: f (x) 5 y x 2 24 25 24 25 24 25 22 21 0 1 2 1 x y 5 4 3 2 21 21 22 5 23 y 0 1 2 3 4 3 4 3 6. A 5 ≥ 0 22 26 5§ 25 9 37. The slope of a vertical line is ________. (3, 0) d. a b 3 4 e. x3m14 y2n15 Section R.3 Practice Exercises, pp. The x- and y-axes divide the coordinate plane into four regions called . 4 243 81 91. A graph is concave up on a given interval if it "bends" upward. Right semiellipse d. 0 x 2 4 0 5 6 or equivalently 0 4 – x 0 5 6 b. Therefore, by the fundamental principle of counting, the number of ways the pair of dice can fall is 6 ? g(x) 5 1x 1 1 71. Not possible 24 d 236 b. 2: © McGraw-Hill Education/Mark Dierker, photographer; p. Write the equation of the circle in standard form. , 2 , ,2 , p 5 25 125 625 Solution: a. Compute Average Rate of Change The graphs of many functions are not linear. The numbers are 12 and 10. f (x) 5 x3 2 2 43. If a player chooses one group of six numbers, then the probability (likelihood) of winning the 1 . 34 5 x 1 1 b. e. 7 ? (0, 1) 12. 182 Chapter 2 Functions and Relations Objective 2: Write the General Form of an Equation of a Circle 37. Undefined 2. The graph in Exercise 62 shows the weight of Dodger, a puppy recently adopted from an animal shelter. 1 4 9 16 n2 1 1 1 1p1 2 3 4 5 n11 78. A function is constant on an interval in its domain if its graph is horizontal over the interval. That is, Y1 5 Y2 when x 5 23. The exact distance is 4 110 units. 12 740 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 2 Applying the Fundamental Principle of Counting A computer password must have three letters, followed by two digits. Event E is very unlikely to happen. x $ 0 d. 4! Skill Practice 5 Determine the number of ways that 2 students from a group of 4 students can be selected to hold the positions of president and vice president of student government. m(x) 5 41 x 30. We can also reverse this process. 692 For a positive integer n, the quantity n! ("n factorial") is defined as n! 5 (n)(n 2 1)(n 2 2) … (2)(1) p. 1 1 15 n 1 2 15 n b 1a b gives b. 28 f. Graph y 5 2f(x 1 1) 2 2. 1?2 2?3 k(k 1 1) k11 Assume that Pk is true. x 1 2 for x # 0 c. 10. 3.4 3 1028 W/m2 corresponds to 45.3 dB which indicates a moderate hearing impairment. 283–284 1. y 0 0x0 x 5 5 5 5 0x0 2 1 0x0 2 1 1 1 or x 5 21 To find the x-intercept(s), substitute 0 for y and solve for x. Notice that in Example 2(c), the function p n is not defined for x 5 21 or for x 5 3. The average water level in a retention pond is 6.8 ft. k k c. Apply the Point-Slope Formula 1. an 5 3000n 1 57,000 b. Graph y 5 2f(x 2 2) 2 3. $34,665.06 a. • f is an odd function if f (2x) 5 2f (x) for all x in the domain of f. Center: (2, 0); Vertices: (2, 4), (2, 24); 3 F 2 Endpoints of minor axis: (21, 0), (5, 0); 1 C x Foci: A2, 17B, A2, 217B; 23 22 21 1 2 3 4 5 6 7 21 22 17 F 23 Eccentricity: 24 4 25 y 10. b2 1 b 2 c a bd 5 2 2 a 4a b b2 b2 5 a ax2 1 x 1 2 b 1 a a2 2 b 1 c a 4a 4a Remove the term 2 b2 from within 4a2 parentheses along with a factor of a. At x 5 2, the function has a relative minimum of 24. {(5, 21), (8, 27)} 79. y 113. a1 5 7 and r 5 2 21. Consider the geometric series: Sn 5 a1 1 a1r 1 a1r2 1 a1r3 1 p 1 a1rn21 Suppose that we subtract rSn from Sn. 1 p 1 a1rn21 1 p 1 a1rn Sn 2 rSn 5 (a1 2 a1r) 1 (a1r 2 a1r2) 1 (a1r2 2 a1r3) 1 p 1 (a1rn21 2 a1rn) Sn 2 rSn 5 a1 2 a1rn The terms in red form a sum of zero. 924h24 4 1 13,608 p12q5 41. Given a sequence a1, a2, a3, … , an, the arithmetic mean a is given by a 5 1 n a ai. The students at Prairiewood Elementary plan to make a pyramid out of plastic cups. A disc jockey has 7 songs that he must play in a halfhour period. m 5 26 b. f A 18 B 5 23 93. The point (2, 1) is the highest point in a small interval surrounding x 5 2. Horizontal stretch/shrink y 5 f (a ? 27, , 2 , , … 2 4 8 5 5 5 12. x 1 y 5 6.76 y b. One such model is called the least-squares regression line. Therefore, the intersection of A and K is the empty set, A ¨ K 5 {}, and we say that events A and K are mutually exclusive (do not overlap). Let N be the event that the student answered "No." Let F be the event that the student is female. f 21(x) 5 x3 + 7 8. In how many ways can the letters in the word MISSISSIPPI be arranged? 558: © Royalty-Free/ Corbis; p. (2`, 4.1]; {x 0 x # 4.1} [26, 0); {x 0 26 # x , 0} ; (2`, 6] 6 37. 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 26 27 28 m(x) 5 2ex 2 3 8 h(x) 5 e x 1 2 1 2 3 4 5 x b. • Over 600 algorithmic homework exercises were added to Connect Math Hosted by ALEKS to ensure 90% textbook coverage. Source: Internal Revenue Service, www.irs.gov 165 166 Chapter 2 Functions and Relations SECTION 2.1 OBJECTIVES The Rectangular Coordinate System and Graphing Utilities Websites, newspapers, sporting events, and the workplace all utilize graphs and tables to present data. If P(E) 5 0.73, what is the probability of P(E)? The bounding line would be 4 drawn as a dashed line. E11 6 i, 613F 35. a 5a2 b 5 5 2 1 2 1 1p 3 3 9 27 81 i51 The sum is an infinite geometric series with a1 5 5 and r 5 213 . y y 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 y 5 4 3 2 5 4 3 2 y 5 f(x) 1 1 2 3 4 5 x 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 23 24 25 24 25 24 25 EXAMPLE 4 y 5 f(x) 1 2 3 4 5 x Identifying Even and Odd Functions Determine if the function is even, odd, or neither. 239 a. {(2, 21, 0, 4)} 63. Rewrite the series as an equivalent series with the new index of summation. columns; rows 7. Determine the maximum height of the object. 5 2 13. On a computer, 1 bit is a single binary digit and has two possible outcomes: either 1 or 0. He would then tell me what the peaks and features in the graph meant in the context of his experiment. What value does the difference quotient seem to be approaching as h gets close to 0? 1320 744 Chapter 8 Sequences, Series, Induction, and Probability TECHNOLOGY CONNECTIONS Evaluating a Number of Permutations, nPr Most graphing utilities can evaluate the number of permutations of n elements taken r at a time. This observation leads to the vertical line test. 6 5 4 3 2 f(x) 5 |x| 1 25 24 23 22 21 21 22 23 24 1 2 3 4 5 g(x) 5 |x| 2 3 x The graph of g (shown in blue) is the graph of f shifted downward 3 units. 1 2 3 4 5 6 7 8 5 x 1 2 2 21028 26 24 22 22 24 26 2 4 6 8 10 f(x) 5 x 3x 1 6 x22 28 18. x2 1 2xh 1 h2 1 3x 1 3h 57. Solution: Let Pn denote the statement 1 1 3 1 5 1 7 1 p 1 (2n 2 1) 5 n2. Week number 1 2 3 4 Number of participants 34 50 66 82 a. 120, 80, , , 37. f (x) 5 1x b. The IRM includes Guided Lecture Notes, Classroom Activities using Wolfram Alpha, and Group Activities. Constant f(x) 5 4 3 2 1 25 24 23 22 21 21 22 23 Answers 10. 3 2. The base of the triangular portions is 5 ft and the height is 12 ft. x2 2 1 • m has the restriction that x2 2 1 ? 0 2 i 5 5 173 173 41 41 13 13 i 89. f (24.2) 74. See also Systems of linear equations in three variables Linear equations in two variables. Use the points (950, 110) and (1000, 50) to write a linear 100 (1000, 50) model for these data. For any x . g(x) 5 4x3 2 x c. • f (a) is a relative maximum of f if there exists an open interval containing a such that f (a) $ f (x) for all x in the interval. 2 1 11i 55. In how many ways can 5 students be selected from the 24? Find the average amount earned per year between the 5th year and the 10th year. TIP The equivalence property of exponential expressions indicates that iff bn 5 bm, then n 5 m. Instead, our system considers things like how recent a review is and if the reviewer bought the item on Amazon. No, eventually the number of cases would exceed the human 11,731 population. h(x) 5 2x2 1 x h(2x) 5 2(2x)2 1 (2x) h(2x) 5 2x2 2 x Determine whether the function is even. Parent 1 59. The only real solution to the equation x3 2 27 5 0 is x 5 3. r(x) 5 31. Change in population over change in time 85. The graph of f is the graph of y 5 1x shifted to the right 1 unit, stretched vertically by a factor of 2, and shifted upwards 3 units. 127 265 758 Chapter 8 Sequences, Series, Induction, and Probability 4. 1 2 3 4 5 The function is not symmetric with respect to either the y-axis or the origin. Typeface: 10.5/12 pt. (2`, 22) ´ (1, 4) 2 7 7 (25, 21] 25. a1 5 6, d 5 5 17. In a group of ten 50-yr-olds, what is the probability that all ten survive to the age of 51? a 1 3b 2 771 27. Thus, the graph is shifted upward 2 units. 40,400 c. (3n 2 1)! 2!(3n 1 1)! c. P(x) 5 R(x) 2 C(x) P(x) 5 2.00x 2 (0.50x 1 120) P(x) 5 1.50x 2 120 d. An "A." b. a (ai 6 bi) 5 a ai 6 a bi i51 i51 i51 765 Key Concepts Reference SECTION 8.2 Arithmetic Sequences and Series An arithmetic sequence is a sequence in which each term after the first differs from its predecessor by a common difference d. 1 2 3 4 5 6 7 8 9 x x 1 y2 5 2 4. Show that a (ai 2 a) 5 0. a 23a b 3 ` 1 n 23. 2 , 1 17. List all the permutations of two elements from the set. a2 1 2ab 1 b2 35. y 28 27 f(x) 5 2 x 3 2 1 ⎛1 ⎞ 3 2 1 75. The interval(s) over which f is increasing. Use a calculator to verify this statement for n 5 1, n 5 2, and n 5 3. The boundaries of the window are often denoted by [Xmin, Xmax, Xscl] by [Ymin, Ymax, Yscl]. The domain of h is (2`, `). No asymptotes f. 2 51 40 4 16 9 2 2 2 2 y y y2 x x 2 5 1 61. h(x) 5 e 5 4 3 2 25 24 23 22 21 21 22 e. Skill Practice 11 Suppose that an employee contributes $100 to an annuity at the end of each month for 25 yr. Slope intercept-form has the y variable isolated. Yes; The model gives a mean surface temperature of approximately 29.18C. g(x) 5 2x2 1 2 a. 726: © Image Source/Getty Images RF; p. Use Gaussian elimination or Gauss-Jordan elimination to solve the system of equations. (m 1 n)(x) 5 2 0 x 0 1 4 Figure 2-38 6 x (f 1 g)(4) 5 f(4) 1 g(4) 5315 58 Section 2.8 Algebra of Functions and Function Composition 263 In Example 2, we evaluate the difference, product, and quotient of functions for given values of x. at c 5 c sta1 sta3 b2 1 a2 d b4 1 a4 c 0 0 0 d 50 0 ta1 ta2 a1 a2 db 5 s ? y 8 1 1 22 21 21 22 1 2 3 4 5 6 7 8 x y 45. (g + f + h)(x) 85. Domain: (2`, `); 5 4 49 3 Range: a2`, d 2 8 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x SA-18 Student Answer Appendix 9 2 13 9 13 23. 23y 1 4x 5 6 5. ; Ex 0 x $ 235 F 45. P(x) 5 1.50x 2 120 5 1.50x 5 x5 0 0 120 80 The vendor will make $72. g(x) 5 2 1x 43. The data in the table give Dodger's weight y (in lb), x days after adoption. y 80. Whether f is even, odd, or neither. 6000 cases 1 1 205e20.67t 49. If an 5 256, what is n? x 1 7 for x , 22 f (x) 5 • x2 for 22 # x , 1 3 for x $ 1 5. 141. { }; The value 24 does not check. 10n 2 1 is divisible by 3. 2.1} 2.1 (2`, 4] {x 0 4 $ x} 4 5. 3 3 1 b. No 37. What is the total distance that the ball will travel in 10 sec? How much profit will be made for producing and selling 128 cups? Definition of a Function Given a relation in x and y, we say that y is a function of x if for each value of x in the domain, there is exactly one value of y in the range. Assume that each player can play any other player without regard to seeding. "Do you think that the college has adequate lighting on campus at night?" The table gives the results of the survey based on gender and response. No doubt, many instructors and students thank you as well. 26 5 35,152 b. In Example 5, we use the general formula for the nth term of an arithmetic sequence to find the number of terms in an arithmetic sequence. 3315 61. form) Skill Practice 1 Use the point-slope formula to find an equation of the line passing through the point (25, 2) and having slope 23. a7 5 1 1 and r 5 2 . x x2 x3 x4 1 1 1 (Hint: Note the pattern produced 1 2 6 24 by n! for n 5 1, n 5 2, and so on.) 86. 1 95. i 14 5 i2 136 5 21 ? Round the slope to 2 decimal places and the y-intercept to the nearest whole unit. m(x) 5 4 3!ß x 28 210 10 1 24 25 31. h(x) 5 f (g(x)) 5 (g(x))2 5 (x 2 3)2 EXAMPLE 11 Decomposing Two Functions Given h(x) 5 0 2x 2 5 0 , find two functions f and g such that h(x) 5 (f + g)(x). 114 cups 71. Yes f. logarithmic x 0 24 70 b. 0, 28, 19 2 d. For example, we can rename y as S(x). Because 0 r 0 5 0 0.75 0 , 1, we have S5 a1 200 5 5 800. (g + f)(x) Composing Functions and Determining Domain Given m(x) 5 x 21 5 and p(x) 5 1x 2 2, find (m + p)(x) and write the domain in interval notation. Therefore, n(E2) 5 2 and n(E2) 2 1 5 5 < 0.0526. A student studying to be a veterinarian's assistant keeps track of a kitten's weight each week for a 5-week period after birth. Using calculus, we can show that the series k n k21 (0.5) (21) approaches ln 1.5 as n approaches a k k51 infinity. p(x) 5 2x2 1 3x b. The volume of the cone as a function of its radius r is given 1 by V1r2 5 πr2h. By Descartes' rule of signs, there are no positive or negative real zeros. At x 5 1, there are two different y values. Answers may vary. a 13 b 3 12. linear 24 13. Identify the focus. Section 3.6 Practice Exercises, pp. Objective 1: Determine Binomial Coefficients 8. Solution: To find the x-intercept(s), solve the equation f (x) 5 0. (2`, 0) g. and day 30? solution 5. y 23 22 21 21 2 3 1 2(x 1 y) . i51 k 2. (n 1 1)! . Domain: (2`, `); Range: (2`, `) 93. {(22, 4)} 45. The value 8 is listed in the domain one time only. 7 Q ln a b Q0 ln Q0 2 ln Q or 3. No (4.2, 24) and (22.8, 3) (x1, y1) and (x2, y2) 4.2 1 (22.8) 24 1 3 M5a , b 2 2 1 5 a0.7, 2 b or (0.7, 20.5) 2 (22.8, 3) Label the points. A "C." Distribution of Grades Party Distribution F (5) Other 18 A (8) D (10) Independent 56 B (15) Democrat 206 C (21) Republican 220 Objective 3: Find the Probability of the Union of Two Events For Exercises 49–58, consider the sample space for a single card drawn from a standard deck. R.2. 64a4 2 144a2b3 1 81b6 1 2 4 16x2 1 8 115x 1 15 R.4. m 1 m14 25 5 3 2 2 3 64a 2 144a b 1 108ab 2 27b n binomial 3. Graph a Quadratic Function In Chapter 2, we defined a function of the form f(x) 5 mx 1 b (m fi 0) as a linear function. a a b j52 2 4 1 n 62. y 5 4 3 2 x2 1 y2 5 9 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x Section 2.7 245 Analyzing Graphs of Functions and Piecewise-Defined Functions Test for y-axis symmetry. Evaluate the difference quotient for x 5 1, and the following values of h: h 5 1, h 5 0.1, h 5 0.01, and h 5 0.001. a500 5 156.6 52. No 43. 22 2 3i 55. Suppose that one card is drawn from a standard deck of cards. (q + r)(x) 72. He invested $4000 in the large cap fund, $2000 in the real estate fund, and $2000 in the bond fund. { } y 5 4 3 2 10 9 8 1 25 24 23 22 21 21 22 7 6 5 4 3 2 1 2 3 4 5 x 23 24 25 3. Neither 4 81. Rafael received an inheritance of $18,000. All statements are true. The mathematics involved in finding maximum heart rate and an individual's target heart rate zone use a linear model relating age and resting heart rate. Listing the elements in a set within braces is called the roster method. P1 is true because a1 2 b 5 . an 5 2n2 1 3 9. {3} 107. k 5 0.117 y 9. 10C3 5 120 37. Use the nth term to find a20. log4 7 1 log4 y 1 log4 z 27. † 23 2 1 † 5 0 b. floor(20.1) e. impossible; certain 5. f (4) 248 Chapter 2 Functions and Relations TECHNOLOGY CONNECTIONS Graphing a Piecewise-Defined Function A graphing calculator can be used to graph a piecewise-defined function. {2}; The value 26 does not check. If a series does not converge, we say that the series diverges (the sum does not exist). y 5 23x 2 13 214 Chapter 2 Functions and Relations Solution: To apply the point-slope formula, we first need to know the slope of the line. Passes through (211, 13) and is parallel to the y-axis. 5465 43. This is the break-even point. 215 8 y 5 0.5x2 2 2 26 Skill Practice 7 Use a graphing utility to graph y 5 2x 1 2 and y 5 0.5x2 2 2 on the viewing window [26, 6, 1] by [24, 8, 1]. f(t) 29,000 Altitude (ft) y 5 f(t) t (min) 20 40 60 80 100 120 140 160 Figure 2-36 Notice that the plane's altitude increases up to the first 40 min of the flight. x2 1 y2 1 12x 2 14y 1 84 5 0 43. Is 2 1 i a zero of f (x)? (k 1 1)(2k) . How many different meals can be formed if a patient chooses one item from each category? A21 5 21 d. Fermat included a comment that he had "found a remarkable proof of this fact, but there is not enough space in the margin to write it." Proof of this theorem eluded mathematicians for over 350 yr until Andrew Wiles of Princeton University announced in June of 1993 that he had solved the problem. a 5 2 13 c. 21 51. Notice that a point (x, y) on the graph of f corresponds to the point (x, 2y) on the graph of g. Notice that one side is zero. Vertical asymptotes: x 5 3, x 5 23; Horizontal asymptote: y 5 0 30. for x , 1 x c. 15, 5, 515, 25, … 3 3 3 16. (n + d)(t) 5 represents 28 7 the number of gallons of gasoline used in t hours. 24 (odd multiplicity), 23 (odd multiplicity), 21 (even multiplicity), 2 (odd multiplicity), 72 (odd multiplicity) 51. y 5 12x 1 17 91. f (1.7) b. [0, 2] 2 4 42. 5 4 3 2 Horizontal Translations of Graphs g(x) 5 |x 1 2| • The graph of y 5 f (x 2 h) is the graph of y 5 f (x) shifted h units to the right. c 2 , d 2 2 5 22 13 2 43. This example also illustrates that function composition is not commutative. 2x2 1 2x 1 4 1 2 x 2 3x 1 1 b. m(x) 5 2 ` x 1 1 ` 3 1 75. At x 5 0, the function has a relative maximum of 2. h(x) 5 x3 1 2 Solution: a. Figure 8-12 Let A be the event that an ace is drawn: {A ,A ,A ,A }. 219 p. Determine Relative Minima and Maxima of a Function (x, y) (x, y) (2x, 2y) (x, 2y) Figure 2-28 Figure 2-29 Figure 2-30 The photo of the kingfisher (Figure 2-28) shows an image of the bird reflected in the water. Show that P7 is true. Passes through (23, 5) and m 5 22. Thus, a1, a3, a5, … { } d. Furthermore, the account owner adds $12,000 to the account each year after the first. The person is 61 or older or has elevated cholesterol. [2, 5] c. Evaluate (f 2 h)(6). Section 3.7 Practice Exercises, pp. (1, 22) 23 26 6 121 3 x < 20.47 x < 23.53 e. Vertical asymptotes: x 5 2, x 5 22, and x 5 21; Horizontal asymptote: y 5 0 47. The sum of the numbers showing on the dice is not 7. |x2 2 x1| x Figure 2-4 • The horizontal leg of the right triangle is 0 x2 2 x1 0 or equivalently 0 x1 2 x2 0 . True 65 a. 10 5 1,757,600 b. y 5 5 b. If we assume that all elements in a sample space are equally likely to occur, then we define the theoretical probability of an event as follows. The equations that represent the two lines are called linear equations in two variables. 5 4 3 2 1 24 23 22 21 21 22 23 24 25 1 2 3 4 5 6 r(x) 5 3! 2x 1 1 x Transformations involving a horizontal shrink, stretch, or reflection often introduce confusion when coupled with a horizontal shift. (2`, 3] b. The angles are 328 and 588. Skill Practice 9 A teaching position has a starting salary of $60,000 with a raise of $3000 every year thereafter. y 5 0x0 2 1 2 y 5 0 23 0 2 15 2 1 y 5 0 22 0 2 15 1 0 y 5 0 21 0 2 15 0 0 21 y 5 0 0 0 2 15 21 1 x2 y Solve for y in terms of x. 1117 2 Yes 21. 2.5217 d. Determine the probability that a 20-yr-old will survive to age 21. A visual representation of the data can be helpful in determining the type of equation or function that best models the data. 23 y 5 k(x)24 25 (m ? {(x, 4x 2 2) 0 x is any real number} y12 or e a , yb ` y is any real number f 4 47. Basketball player Lebron James makes approximately 76% of free throws. a 1 ar 1 ar2 1 p 1 ar12 81. Therefore, the graph of g is the graph of f reflected across the x-axis. 1 51 25 25 9 2 2 y (x 2 3) 53. 726 Chapter 8 Sequences, Series, Induction, and Probability We might consider evaluating the nth partial sum for several positive integers n to determine if a pattern exists. Do they learn at different paces? A2 1 i 13 B 2 4A2 1 i 13 B 1 7 5 0 ✓ b. x 2 108 85. What is the probability that a player will win the grand prize by playing 5 different tickets? A 1 (2A) 5 c a3 a4 2a3 2a4 a1 1 (2a1) a2 1 (2a2) d 5 5 c a3 1 (2a3) a4 1 (2a4) 5 1 5 1 5 5 1 5 1 5 87. h)(x) and write the domain in interval notation. 1 x 2 2 2 y y x x 2 51 43. 15.9% 105. e 6 if 87. x 5 2 c. 24–27 1. ,9 , 10 ,J S 5 {A ,2 ,3 Q ,K }. ln x 1 ln y 2 ln w 2 2 ln z 2 3 3 3 1 2 37. (q + n)(x) 70. y 5 1 ⎝ ⎠ 25 24 23 22 21 21 22 0 c. How many total cups will be required? Definition of Linear and Constant Functions Let m and b represent real numbers where m ? To prepare for the discussion in Section 2.6, use a graphing utility or plot points to graph the basic functions in Exercises 128. Determine f (22). (2, 9) 20 (16, 18) (25, 21) 15 10 (0, 6) 5 (0, 1) 0 1 2 3 Day Number 4 5 0 0 5 10 15 20 Day Number 25 30 Section 2.7 243 Analyzing Graphs of Functions and Piecewise-Defined Functions Technology Connections 103. 118. Suppose that the driver starts a trip with a full tank of gas and travels 450 mi on the highway at an average speed of 60 mph. 5 45. a (21)n21(2n) (Exercise 65) n 1 117. sequence is a sequence in which each term after the first is found by adding a fixed constant to 2. In this scenario, we want to select a set of 2 people from a set of 5 people without regard to order. When a motorist approaches the intersection, find the probability that the light will be red. a (j 2 3) 57. The value of P(x) is 0 for 80 lemonades produced and sold (Figure 2-23). permutation; r n! 7. (2`, 22] ´ (3, `) d. Ar b 12P 57. The sum of the first 50 positive even integers is 2550. 2x2 2 2xh 2 h2 2 5x 2 5h 1 2 22x 2 h 2 5 48 b. Given a geometric sequence whose nth term is an 5 25(1.6)n, are the terms of this sequence increasing or decreasing? 5y 1 1 5 11 16. d1 5 , d2 5 , d3 5 5, d4 5 5 5 5 b. Given a geometric sequence whose nth term is an 5 3(1.4)n, are the terms of this sequence increasing or decreasing? f (x) 5 (x 2 5)(x 2 i)(x 1 i) b. x2 5 2y 1 16 2 56. Determine the number of cookies (in dozens) that must be produced and sold for a monthly profit. (27, 3) c. Along these lines, we must express our utmost gratitude to digital authors Alina Coronel, Esmarie Kennedy, Tim Chappell, Stephen Toner, Michael Larkin, Lizette Foley, Meghan Clovis, and Lance Gooden for their diligence writing digital content. For what value of x is f(x) 5 4? a23 5 103 27. x2 5 60 29. For Exercises 27–28, consider an American roulette wheel. 32 87. How many passwords can be made if no digit or letter may be repeated? x 1 3 for x , 21 x2 for 21 # x , 2 Solution: The first rule f (x) 5 x 1 3 defines a line with slope 1 and y-intercept (0, 3). 2 1 2 log2 a 1 log2 (3 2 b) 2 log2 c 2 2 log2 (b 1 4) 2 45. (k + h)(4) f. Yes 3. These may not include x values at the leftmost and rightmost points on the circle. x b. 5.5% simple interest results in less interest. The base is approximately 17.7 ft and the height is approximately 9.7 ft. 4, 12, 20, 28, 36 23. Time h 80 Height (ft) 4 Depth (ft) 1 24 25 y 3 2 60 40 20 1 0 1 x 23 100. 6.1% b. {24} 19. In how many ways can the letters in the word SHUFFLE be arranged? 0), y 1 27 26 25 24 23 22 21 21 22 Vertex 23 (22, 23) 24 f(x) 5 2x2 2 4x 2 7 • If b2 2 4ac 5 0, the graph of y 5 f (x) has one x-intercept. 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1 1p p. m 5 2 4 1 40 23. Because it's more than just words on a page. Arithmetic; d 5 ln 2 Problem Recognition Exercises, p. Minimum: 3 h. Round to the nearest $100. e , 2 f 65. The plane flies at a constant altitude for the next 1 hr 20 min, so we say that f is constant on the interval (40, 120). 16C3 5 560 c. 79. d(r) 5 7.2r c. loga b 5 7 2 27. f (x) 5 2x3 1 1 101. • New "Prerequisite Review" exercises appear in every section. 1 1 41. (g + f)(5) Solution: TIP When composing functions, apply the order of operations. EXAMPLE 9 Solving Equations and Inequalities Graphically a. y y 5 4 3 2 1 In Example 3(c) there is only one y value assigned to x 5 1. The number of such six-number combinations is 22,957,480 (see Example 8). A24, 0B c. x(x 1 2) 5 120 b. 0, 28, 1.45, 19, 2 3 e. (p 1 q)11; ninth term 31. Insert four arithmetic means between 19 and 64. ft 16 8 6 4 21221028 26 24 22 22 F 24 26 2 F 4 3 2 1 11. 2 1x 1 3 a. No 186 Chapter 2 Functions and Relations EXAMPLE 4 Determining if a Relation Is a Function Determine if the relation defines y as a function of x. Determine f(25). 4x5/2(3x 2 1) 95. TIP The binomial theorem can be proved by using mathematical induction. Determine whether the sequence is arithmetic or geometric and find the value of the common difference or the common ratio. p 5 254 b. The customer will wait at least 90 sec but less than 120 sec. c2 2 d 6 43. 228 109. 26 ? 1 13 xb 67. 2 2 M 2 24 Skill Practice 2 Determine if the points X(26, 24), Y(2, 22), and Z(0, 5) form the vertices of a right triangle. (0, 50) 45 50 40 (20, 40) 35 40 15. 212 10. a b 6 734 Chapter 8 Sequences, Series, Induction, and Probability Solution: n n! For parts (a)–(d), apply a b 5 r r!(n 2 r)! 6 6! 6! 6! a. The rate of increase, $12.99 per additional family member, is the slope. Evaluate 21P4 and interpret its meaning. The studio needs more than 60 private lessons per month to make a profit. 4! 6 6! 5 5 5 15 c. Wiles's proof is extremely complex and was revised to correct a slight but critical flaw shortly after publication. (h ? h(x) 5 2x3 45. S2 5 48,000 1 2000x c. 230 ft b. a1 5 , d 5 3 2 b. a 6a b 3 8 49. R 99. 0.9981 age 40 in the United States, 8038 die before the age of 41 and 4,216,062 survive. Determine the x- and y-intercepts of f. Based on the graph, does a linear model seem appropriate? a , 0b 2 d. The Pythagorean theorem tells us that if a right triangle has legs of lengths a and b and hypotenuse of length c, then a2 1 b2 5 c2. 236 c. 23 24 y 2. c(x) 5 22ax 1 b 1 b. Write 0.7 as a fraction. 22, 3, 1, 4, 5, 9 2. n n n 95. This operation does not affect the solution set of the system. A6 2 i 13B 2 2 12 A6 2 i 13B 1 39 5 0 ✓ 10 8 6 4 b. (0, 3) 1 11 g. What is the probability of selecting 2 women and 2 men? The graph of y 5 f (2x) is shown in blue. 23x 1 1 . Symmetric to the y-axis, x-axis, and origin. a, d Domain: (2`, `); 17. Parent function y 5 1 1. Write the first four rows of Pascal's triangle. 107. Given an arithmetic sequence with a14 5 148 and a35 5 316, find a1 and d. (25, 22) c. x 2 x d. f 21 21 R.1. Domain (2`, 3), Range (2`, 0] R.2. a. P1 reads: 4 is a factor of 91 2 1 5 8. (22) 5 210(22) 5 20 a4 5 a3 ? Write a function that represents the distance traveled d(r) (in ft) for r revolutions of the wheel. 0 3x 25 0 5 0 2x 1 1 0 14. If the weight of the kitten continues to increase linearly for 3 months, predit the kitten's weight 12 weeks after birth. x 22 23 d. y 6 5 8 7 6 5 4 3 2 4 3 2 8 7 1 c. (x 1 2)2 1 (y 2 5)2 5 1 19. Let E represent the event that the numbers showing on the dice have a sum of 7. Nonlinear e. y 5 x3 36. Neither b. Describe the general shape of the graph of y 5 xn where n is an even integer greater than 1. xk21 ? Eighteen slots are red, 18 are black, and 2 are green. Find the average rate of change in temperature between months 9 and 11 (September and November). 11,000 b. 2(2 2 x2) 3x2 2 4xy 1 3y2 x(3x 2 14) 9. 23.1 is not an element of the set of whole numbers. The odd-numbered terms are positive, and the even-numbered terms are negative. Natural numbers, N Whole numbers, W Integers, Z Rational numbers, Q Irrational numbers, H Definition {1, 2, 3, …} {0, 1, 2, 3, …} {… , 23, 22, 21, 0, 1, 2, 3, …} e p ` p, q [Z and q fi 0 f q • Rational numbers can be expressed as a ratio of integers where the denominator is not zero. 2 51 25 49 16 5 2 2 (y 2 2) (x 2 1) 2 51 49 25 5 a. x 5 11.2 ft and y 5 7.5 cm 49. $333 a. 1 23 a. 212 3 3 89. (See Example 8) y y 88. A(s) 5 s2 2 P P2 c. 2x(x 1 10)2 9y 2 22x 33. Domain: {24, 22, 0, 2, 3, 5}; Range: {23, 0, 2, 1} 31. a b 2 80. P1 is true because (1)2 2 (1) 5 0, which is even. 1)(5!) 1 n! 1 n! 5 5 b. (0, 0, 0) is the only solution. To Nora Devlin, thank you for managing the solutions manual projects, lecture notes, and Internet Activities. 73 2 5 15 4 3 6 1 i 41. The base is 13 yd and the height is 8 yd. Write the function in vertex form: f (x) 5 a(x 2 h)2 1 k. The sides are 15 in., 18 in., and 22 in. y 46. In each case, the proof is concluded by showing that the truth of a statement for any other positive integer after the first allowable value of n follows directly from its predecessor. 5 4 3 2 1 M(0.7, 20.5) 25 24 23 22 21 21 22 1 2 3 4 23 24 25 (4.2, 24) 5 x Section 2.1 169 The Rectangular Coordinate System and Graphing Utilities Skill Practice 3 Find the midpoint of the line segment with endpoints (21.5, 29) and (28.7, 4). (2`, 2) 29. {5} 3 7 c. 2 13 5. TIP For an equation in standard form, the value of A, B, and C are usually taken to be integers where A, B, and C share no common factors. Then the value A (in $) of the annuity after t years is given by A5 EXAMPLE 11 PC A1 1 nr B nt 2 1D r n Finding the Value of an Annuity Suppose that an employee working for a state college puts aside $150 at the end of each month in a tax-sheltered annuity. We can construct a list of the possible outcomes. c 1 27. Yes 11. 2 c7d 2 cd 7 103. r for n $ 2. 2 1 6 1 10 1 … 1 (4n 2 2) 5 2n2 4. 678: NASA/GSFC RF; p. 1140; There are 1140 ways to select 3 distinct items in no specific order from a group of 20 items. 5 4 3 2 a. Vertical asymptote: x 5 22 f. Directrix: x 5 14 ; Axis of symmetry: y 5 0 c. Explain the difference between an arithmetic sequence and a geometric sequence. The maximum height is the value of h(t) at the vertex. (Source: NOAA: www.noaa.gov) 150 (950, 110) (See Example 7) a. What is the probability that an ace is selected, followed by a heart? Prove that F1 1 F2 1 F3 1 … 1 Fn 5 Fn12 2 1 for positive integers n. 23, , 2, 4 19. 2i 23. For n $ 1, the expression Furthermore, by definition, 0! 5 represents the product of the first n positive integers n(n 2 1)(n 2 2) … (2)(1). Solve the equation for y. $3456 b. 340–344 R.1. 81 1 0i R.2. 49 1 0i R.3. 222 1 0i 1. Center: (22, 5); Radius: 1 18. 23 (multiplicity 2) and (multiplicity 2) 2 1 75. same Since f (2x) 5 f (x), the function f is an even function. In how many ways can she select the 5 players if each player is equally qualified to play each position? Given a line L1 defined by L1: 2x 2 4y 5 3, determine if the equations given in parts (a)–(c) represent a line parallel to L1, perpendicular to L1, or neither parallel nor perpendicular to L1. 0.000 007 m 8 3 105 85. n. a25.1, 2 b 2 or 4. Then hit ENTER. 246 51. Given k (x) 5 23x 1 1 and m(x) 5 , x a. To solve 6x 2 2(x 1 2) 2 5 $ 0 determine the values of x for which Y1 $ 0 (where the function is on or above the x-axis). f (x) 5 x 1 9 2 2 67. Explain the difference between a permutation and a combination of n items taken r at a time. Write a piecewise-defined function that expresses the cost C(x) (in $) to buy x shirts. How many passwords can be made if there are no restrictions on the letters or digits? Between 26 and 25; 25.4949 e. Each stage provides personalized guidance and just-in-time remediation to ensure students stay focused and learn as efficiently as possible. A number less than 5 is rolled. Vertices: (0, 0), (20, 40), (60, 0) 15. Since a , 0, the parabola opens downward. 65 19. {16} 4. 4 1 7 1 10 1 13 1 16 1 19 1 22 1 25 1 28 1 31 1 34 1 37 50. x 2 5 23. Every term thereafter is defined by an 5 2an21 1 1 Value of the nth term is two times the value of the preceding term, plus 1. (2`, 25) ´ (5, `) a 1b 18. 399 1. (x 1 3)(x 2 3) b. 64 73. (See Example 4) 33. x-intercept: None; y-intercept: (0, 2) y-intercept: (0, 2) y 5 4 3 2 1 22x 1 4y 5 8 1 25 24 23 22 21 21 22 41. Evaluate a Finite Arithmetic Series 3. At a hospital specializing in treating heart disease, it was found that 222 out of 4624 patients undergoing open heart mitral valve surgery died during surgery or within 30 days after surgery. Letter from the Authors For many students, college algebra serves as a gateway course to the higher levels of mathematics needed for a variety of careers. EXAMPLE 4 Writing an Equation of a Line Perpendicular to Another Line Write an equation of the line passing through the point (2, 23) and perpendicular to the line defined by y 5 12x 2 4. Show that n2 2 n is even for all positive integers n. The user who knows the code turns the dial to the right to the first number in the code, then to the left to find the second number in the code, and then back to the right for the third number in the code. 8. 1 5 24 and 24 5 16. Then highlight Calculate and hit ENTER. Reference p. 28. P(x) 5 45.5x 2 2275 d. Since division by zero is undefined, the calculator does not graph the function on that interval, and the function is effectively "turned off." Enter the function from Example 5 as shown. 6 A252, 92 B, A 72, 92 B y 5 32 g. 23 9. Rational equation 9 6 241 v 2 7. 2` 69. Thus, the 500th term is given by a500 5 7 1 (500 2 1)3 5 1504. The mother and father in turn each have two parents and so on. (3 1 i)3 n n 57. Let (x, y) be an

arbitrary point on the circle. The factors impacting weather are not constant and change over time. An object is launched straight upward with an initial speed of 400 ft/sec from a height of 4 ft. y 9 8 7 6 5 1 2 3 x (22, 21) f. The solution to Example 4 can be checked by graphing both lines and verifying that they are perpendicular and that the line y 5 22x 1 1 passes through the point (2, 23). There is no maximum value because the y values of the function become arbitrarily large for large values of x. 55. 210 3. 4.2 3 100 L a. SmartBook is the first adaptive reading experience designed to change the way students learn. [23, 3] 95. The students in the sample are the students who had no opinion. They can graph many points quickly, and the more points that are plotted, the greater the likelihood that we see the key features of the graph. x 47. If this linear trend continues during Dodger's growth period, how long will it take Dodger to reach 90% of his expected full-grown weight of 70 lb? 105. 21 3 1 f. e 5 1 11. {a 0 a # 8.5}; (2`, 8.5]; 15. By the inductive hypothesis, k11 i51 k i51 i51 a 1 5 a a 1b 1 1 5 k 1 1 as desired. (This means that the probability that Iglesias will get a hit on a given time at bat is 0.306.) a. a 5 3 Section 1.2 Practice Exercises, pp. y 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 23 24 25 24 25 x 25 24 25 40. If the player moves at 120 pixels per second, will the player have enough time to pick up both prizes? 220 Chapter 2 Functions and Relations 4. 1, 5, 10, 16, 23, ... Solution: a. f (x) 5 2 , g(x) 5 22 2 x , g(x) 5 23 2 x x 1 2x x 1 2x x x 29 79. A car accelerates from 0 to 60 mph (88 ft/sec) in 8.8 sec. 2 97. Use the distance formula c 5 2(x2 2 x1)2 1 (y2 2 y1)2 1 (y2 2 y1)2 2 (x2 1 y 2) 5 0 y 11. Let r represent a positive real number. 5(3k2 1 7)(2k 2 1) 2 a. (900) 99. The axis of symmetry is the vertical line through the vertex: x 5 1. ln ay 47. For what value of x is f(x) 5 6? m 5 25 33,105,000 SECTION 8.2 Practice Exercises, pp. Answer R.1. Given f(x) 5 7x 2 9, evaluate f(2). i51 i51 50 i51 i51 50 For Exercises 91–94, use the system in a 5 2 42,925 and a 5 1 1275 and the properties of summation given on page 697 to i51 i51 evaluate the given expression. A0, 254 B 5 1 1 c. To eliminate this distortion, use a ZSquare option, located in the Zoom menu. CN3 5 c $40 $9.60 $0 § ; The matrix CN3 represents the $2.40 $5.60 $3 additional cost per month for each plan. 61, 62, 63, 66, 6 , 6 , 6 2 2 4 4 1 1 2 4 8 1 1 11 16, 1 2 7 5. (5x 1 3)5 17. (See Examples 3–4) 41. (23, 24) c. – Second edition. x-axis 11. (x 2 4)2 1 (y 2 6)2 5 2 25 57. Y2 for x . None of. 9w4 2 49z2 41. 1 2 ln 5 17. What is the probability that this individual's blood can be used for a transfusion for a person with type A1 blood? Use the binomial theorem to expand (a 1 b 2 2)3. 5 8 6 4 2 33. 104 15. 10,000 61. Find the solution set to each individual inequality in the system. Undefined 25 89. 2y 2 6 5 8 y x 61. h(x) 5 (x 2 4)2 120. 9c2d 12 2 3 4 5 x0 7 2 x 0 10 4 2 30 5. k11 as desired. The graph of the sequence an 5 n2 is a set of discrete points corresponding to n 5 1, 2, 3, ... , whereas the function f (x) 5 x2 is a continuous curve over the set of all real numbers. If a horizontal line intersects the graph of a function in more than one point, then the function has at least two ordered pairs with the same y-coordinate but different x-coordinates. Show that 8 1 4 1 p 1 (24k 1 1) 1 12] 5 22k 1 1k(k 1 1)(2k 1 2) 2 n 5 3 Write the first four terms of the arithmetic sequence whose nth partial sum is n2 1 3n. 22x 2 h 1 3 6. Determine the location and value of any relative maxima. 5 4 3 2 2x 2 1 for x , 21 f (x) 5 • 23 for 21 # x , 2 a. The money invested at the end of the second year will earn interest for 2 yr, and the money invested at the end of the third year will earn interest for 1 yr. 3.3 months d. (See Examples 1–3) 15. (2`, 22] "[22, `) 57. x 5 24 e. 6 f {232, 22} 73. Given f (x) 5 4x 2 3x, a. Pushing the first domino down is analogous to proving P1. 36 gal 137. a 27. Where will it pass through the x-axis? a4 2 2a2b2 1 b4 b2a b. 585 (screen): © Royalty-Free/Corbis; p. Approximately 82 mg 0 12 120 y 5 0.118x 1 4.97 0 0 750 8 7 77. E617, 62iF 13. (undefined) Skill Practice 2 Use the function defined in Example 2 to find a. on [0, 1] b. The value r! in the denominator "divides out" the repeated cases involving different arrangements of r elements within the same group. pp. 9 8 7 6 5 4 3 2 1 7 6 5 4 3 25 24 23 22 21 21 22 1 2 3 4 5 22 For Exercises 9–18, evaluate the functions for the given values of x. [H1] 5 1 0(2pH R.2. n 5 5A–29 Student Answer Appendix 39. 16 c. These are approximately 3.8 ft to the left and right of the center. P(S) 5 13 52 . Odd 43. Use a graphing utility to find the least-squares regression line. ≥ 5 53 37. China has the largest population of any country with approximately 1.5 billion people. Point of Interest Boxes that offer interesting and historical mathematical facts. 1a ? 2 2. 0.6718 b. e 5 6 1137 f 14 5 69. a 4a b 4 b. Identify the x-intercept(s). Therefore, the graph touches but does not cross the x-axis at 5. (2`, 27) ´ (7, `) 45. 14 12 A 10 (26, 10) 8 6 4 2 21028 26 24 22 22 C 2 (4, 8) B(6, 0) 2 4 6 8 10 x 24 26 y 64. y 5 f a ya b. 2 In this case, define {an} with domain n $ 0 to allow for the possibility of 0 units sold. If 4 batteries are drawn at random, what is the probability that all four will be defective? If the lines in the system are parallel, then the lines do not intersect and the system has no solution. 3 28 6 12 227 37. 1) Number of people to be selected (2). Skill Practice 7 Given f (x) 5 3x 1 4 and g(x) 5 x 2 11 , write a rule for each function and write the domain in interval notation. CD 46. See also Linear equations; Linear equations in one variable; Linear equations in three variables; Linear equations in two variables; Systems of linear equations in three variables; Systems of nonlinear Subject Index equations in two variables; specific types of equations absolute value, 135–136, 159 in applications, 84–85 of circle, 177–180, 275, 634 conditional, 85–86, 158 constraint, 292–293 contradictions as, 85, 92 cubic, 344 dependent, 493, 498, 509, 556, 575–581, 625 of ellipse, 636–638 equivalent, 82 exponential, 432–456, 484 fifth-degree, 34 graphical solutions to, 204–207 graphs of, 169–173, 276 identities as, 85, 91 inverse of, 406–409 literal, 88–90, 466–467 logarithmic, 457–462, 484 polynomial, 133, 159, 344 quadratic, 113–122, 158–159 in quadratic form, 139–140 radical, 137–138, 159 rational, 86–88, 134–135 solution set of, 82, 86, 169 solutions to, 82, 86, 169 steps to solve, 83–84 use of graphing utility to solve, 171–173 use of graphing utility to verify solutions to, 206 of vertical lines, 201 Equivalence property explanation of, 716 to solve exponential equations, 453 to solve logarithmic equations, 457 Equivalent equations, 82 Euler, Leonhard, 696 Even functions, 245–246 Events complementary, 753 explanation of, 750–751, 766–767 finding probability of, 751–754 independent, 758–759 mutually exclusive, 755, 767 union of two, 755–757 Experiment, 750 Exponential equations in applications, 460–461 explanation of, 453, 484 to solve, 453–456 in quadratic form, 456 Exponential expressions, equivalence property of, 429–430 Exponential form, solving logarithmic equations by using, 458–459 Exponential functions in applications, 421 base b, 415, 483 base e, 418 to compute compound interest, 418–420 clear, 416 explanation of, 414–415, 483, 494 graphs of, 415–418, 422 graphs of, 433–434 to graph exponential functions, 416 inverse of, 428 modeling with, 466–475, 484 natural, 418 Exponential growth/decay, 467–472 Exponential models, 474–475 Exponential notation, 8, 405 Exponents applying properties of, 20–21 explanation of, 8 integer, 22, 73 negative, 18–20, 55–56 rational, 27–29, 55–56, 74, 139 simplifying expressions with zero and negative, 18–20 Extended principle of mathematical induction, 729–730, 765 Extraneous solutions, 137 F Factorial notation, 693–694 Factors/factoring applications for, 47 binomials, 49, 52–53 expressions containing negative and rational exponents, 55–56 general strategy for, 53–55, 74 greatest common, 47–48, 74 by grouping, 49 negative, 48 perfect square trinomials, 51–52, 115–116 quadratic functions, 315–316, 318–319, 37 polynomials, 44–46 Factor theorem to factor polynomials, 322, 392 to factor polynomials, 323 to identify factors of polynomials, 323 Feasible region, 549 Fermat, Pierre de, 730 Fermat's last theorem, 730 Ferrari, Ludovico, 344 Fibonacci (Leonardo of Pisa), 692 Fibonacci sequence, 692–693 Fifth-degree equations, 344 Finite arithmetic sequences, 706 Finite series arithmetic, 707, 709 explanation of, 690, 694 geometric, 715–716 on graphing utility, 696 First-degree equations. It is important to note that the lower limit of summation need not be 1. z(x) 5 1 x2x 1 5 2 x 1 4 for 22# x , 2 2 for x $ 2 For Exercises 135–135, use a graphing utility to a. e f ; x , 0.1733 e 2 ln 3 ln 2 4x 2 (0) 32. Average rate of change 5 f(x2) 2 f(x1) f(1) 2 f(0) 0.06 2 0 5 5 x2 2 x1 1211 5 0.06 f(x2) 2 f(x1) f(2) 2 f(1) 0.09 2 0.06 5 5 x2 2 x1 1211 5 0.03 c. The slope is 4 and means that the number of attendees has increased by approximately 4 people per week. M ´ N Concept Connections 1. h(2) 38. Printer: R. Answer 6. 6. (2`, 3) 29. The exponent on b increases from 0 to n on sequential terms from left to right. For g , we further restrict the domain to exclude values of x for which g(x) 5 0. (29, 4) and (21, 26) 29. In addition to linear functions, we will learn to identify other categories of functions and the shapes of their graphs (Table 2-2). k! . Output f(g(x)) Figure 2-41 EXAMPLE 6 Composing Functions 2 Given f (x) 5 x 1 2x and g(x) 5 2 , 2 2, find a. 128 EXAMPLE 10 Investigating an Application of an Infinite Geometric Series—The Multiplier Effect Suppose that $200 million is spent annually by tourists in a certain state. a number that is a multiple of 10? p(x) 5 (2x3 3 46. y 5 20.9x 1 5.29 61. y 5 3x Yes; 3 1 31 19 27 d. c The transverse axis is vertical if the coefficient of the y2 term is positive. {24, 22, 1, 3}, c. 2201(6c8d25 69. A0, 115 B f. 500 nm 33. 2 3 4 5 (y 2 1)2 (x 1 3)2 a. For example, 5x Z x is an even number between 0 and 10 In our study of college algebra, we will often refer to several important subsets of real numbers (Table R-1). 19 105. Find the difference quotient to determine the average rate of speed on the following intervals for t. J 5 E 1 150 b. 0.5 5 0.5555 p 5 5 5 5 5 1 1 1 p 10 100 1000 10,000 Infinite geometric series with a1 5 25 and r 5 101 0.5 5 Answers 8. $40 c. There are 31 terms. hypothesis. 1 28 27 26 25 24 23 22 21 22 23 y 5 f(2x) 23 24 25 26 1 2 3 4 x (24, 22) becomes A 24 2 , 22B 5 (22, 22) 24. Each week thereafter, she increases the time on the treadmill by 5 min. 7 2 x(x 1 h) 67. Once the first digit is selected in the password, there are only nine remaining digits available for the second choice. 45. [22, 3) b. 3 3 1 43. 2x 1 4 $ 2x 1 1 92. y 5 0.118x 1 4.97 b. f 21(x) 5 log4 x 83. f(x) 5 4x 22 4 2 4 For Exercises 53–56, use the binomial theorem to find the value of the complex number raised to the given power. For a recent year, the federal income tax owed by a taxpayer (single—no dependents) was based on the individual's taxable income. f(x) 5 e 25 24 23 22 21 21 22 23 5 4 3 2 y 5 2x y 2 23 5 y 1 3x Such an arrangement is called a permutation. vertical shrink f(x) 5 |x| 1 1 10 5 25 24 23 22 21 22 23 19. (x 0 3 , x # 4}) 1 19 25. Write the final answer in slope-intercept form. Not possible 63. 8 3 a 5 ax3 5 x 51. (See Example 4) 3 27. The graph of y 5 f (x 2 h) is the graph of y 5 f (x) shifted h units horizontally. Figure 2-19 shows that the graphs Section 2.4 205 Linear Equations in Two Variables and Linear Functions of the two lines intersect at (23, 2). 1.0 3 1025 cm 73. 4 x 26. Fetch: Section (3, 2); Radius: 2 13 b. f (b) d. One such triangle is shown in the figure. (Highlighted in green tint.) f(x) 5 4 3 2 y 5 f(x) 1 25 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 f(x) 5 24 23 22 21 1 2 3 4 5 x 25 24 23 22 25 Skill Practice 10 Use interval notation to write the interval(s) over which f is a. Find f (x 1 h). Horizontal asymptote: y 5 0 f. If one sock is selected at random, find the probability of the event. a1 5 2 and r 5 3 223 22. No letter or digit may be used more than once? Show that 3(k 1 1) , 2k11. < 0.245 56C12 26C12 6 < 0.0000173 36. Y1 , Y2 to the left of x 5 2. 2 71. Given f (x) 5 x3 2 x2 1 x 15, x2 2 8x 1 16 B 5 3. Fish 3 2 3. Use f(x) 5 x3 2 x 3. d. Not applicable 1 4 47. If the population had 300,000,000 people at that time, estimate the probability of being killed in a motor vehicle crash. ({1, 3, 1}, (21, 23, 21)) c. Also C(x) 5 mx 1 b m is the variable cost per item. In many applications, we prefer to work with relations that assign one and only one y value for a given value of x. Similarly, the graphing calculator exercises are keyed for the exercise sets and may also be easily skipped. 5 d. If the player has to pick the correct 5 numbers in a specific order, what is the probability that the player will win? We have shown that P1 is true, and that if Pk is true, then Pk11 is true. Even d. Admission to the fair is $5.00. Solution: Let x represent the amount in sales. Callouts Throughout the text, popular tools are included to highlight important ideas. y 5 4 3 2 1 2 3 4 5 1 x 25 24 23 22 21 21 22 23 22 2. If the scholarships were for equal amounts (say for $500 each), then the order in which the 2 students are selected does not matter. The complement of E, denoted by E (or sometimes by ,E or E9) is the set of outcomes in the sample space but not in event E. (21, 0) and (3, 0) e. 3y 1 9 5 6y x 62. (2`, `) 11. 4c4d 2 20c2d2 1cd 1 25cd4 77. 2 16 2 41. x x13 b. 24y3 7. (0, 25) 33. That is, f (g(x)) . f (x) for x ≥ 0 . For x values in the domain of the relation. Domain: (2` , `); Range: (0, `) 1 2 3 4 77. For two nonvertical lines have the same slope but different y-intercepts, then the lines are (parallel/perpendicular). Find the 23rd term of the sequence 239 The regression line passes near or through the observed data points. This is a point slightly to the left of the relative maximum. Section R.4 Practice Exercises Prerequisite Review For Exercises R.1–R.4, factor completely. Marlee needs to score at least 96 on the final exam. (15.99, 16.01) 87. Center: (25, 22); Radius: 121 3, y 22 21 21 22 1 2 3 4 5 x 22 23 24 25 y 10 8 6 4 2 2 4 6 22 21 23 6 7 8 2 3 4 5 x k(x) 5 23x 24 25 26 x b. g(x) 5 x2 1 2 x 3x 2 28 c. See Notation/symbols Symmetry axis of, 286 test for, 243–245 Synthetic division to determine slant asymptote, 352 to divide polynomials, 319–320 explanation of, 318 Systems of inequalities applications, 543 on graphing utility, 537, 541 graphs of, 537, 542 methods to solve, 540–543 Systems of linear equations in two variables, on graphing utility, 537 Systems of linear equations Cramer's rule for, 619–620 explanation of, 492 Gaussian elimination to solve, 567–570, 625 on graphing utility, 496 homogeneous, 584 matrices to solve, 564–570, 625 solution set to, 492–493 Subject Index 509, 575 substitution method to solve, 493–494 use of inverse matrix to solve, 608, 626 with no solution, 493, 497 applications of, 496–497 Systems of linear equations in three variables applications of, 512 Cramer's rule for, 620 dependent equations to solve, 509, 577–579 determining number of solutions to, 510–511 explanation of, 506 inconsistent, 509, 575 methods to solve, 507–509 modeling with, 513 ordered triple as solution to, 506–507 Systems of linear equations in two variables addition method to solve, 494–497 applications of, 498–500 Cramer's rule to solve, 618–619 dependent equations in, 493, 498, 556 explanation of, 492 Gaussian elimination to solve, 575–577 explanation of, 492, 556 general solution to, 498 on graphing utility, 496 inconsistent, 493, 556, 575 Systems of nonlinear equations in two variables addition method to solve, 529–530 in applications, 531–532 explanation of, 527, 557 on graphing utility, 530, 531 substitution method to solve, 528–529 T Tartaglia, Niccolo, 344 Tax deferred, 720 Terms heading, 38 like, 11, 12, 39 Theoretical probability, 750–751, 766 Theory of relativity, 98 Third-degree polynomial functions, 387 Touch point, 305 Transformations explanation of, 265 Translations vertical, 236–238, 276 to graph exponential functions, 417 to graph logarithmic functions, 434–435 to graph rational functions, 353–356 nonrigid, 232 rigid, 232 Translations explanation of, 230 horizontal, 231–232, 236 vertical, 230–232, 236 Transverse axis, of hyperbola, 651, 652, 655 Tree diagrams, 738, 739 Trial-and-error method, to factor trinomials, 51 Trinomials. Not a real number 8. 36.8020 d. 5 4 3 2 1 25 24 23 22 21 47. Section 8.7 763 Introduction to Probability Mixed Exercises The blood of an individual is classified according to the presence of certain antigens, substances that cause the immune system to produce antibodies. (3, 6) and (24, 21) 15. 449–452 R.1. x9 R.2. y5 16z8 R.3. 6 R.4. n3 w 343k12 1 1 h(x) 5 19 2 x c. Focus groups and symposia were conducted with instructors from around the country to provide feedback to editors and the authors and ensure the direction of the text was meeting the needs of students and instructors. (2`, 25) ´ (1, `) 2 5 2 8. n 5 49 41. In how many different ways can he order the 7 songs? [2, `) Y 67. y 5 x 1 3 9 3 8 y52 x18 15. { }, Yes; values 2 and 18 do not e 6 , 22 f check. EXAMPLE 2 Write the standard form of an equation of the circle with endpoints of a diameter (21, 0) and (3, 4). Probability of a Sequence of Independent Events If events A and B are independent events, then the probability that both A and B will occur is P(A and B) 5 P(A) ? Round to 1 decimal place. Find the slope of the secant line pictured in red. Horizontal asymptote: y53 23 b. The company should make 8 trips with the small truck and 6 trips with the large truck. 8 115 1 22 81. Solution: We begin by labeling the students as A, B, C, D, and E. 5y y 22x x z 67. 4(x 1 3)2 5 y 5 45 83. {ln 5, ln 3} y 17. Even 19. [22, 0] "[3, `) 11. Use the binomial theorem to find (1.1)5. Therefore, replacing x by 2x will result in the opposite of the original term. !127 For Exercises 11–18, solve the equation or inequality. f (x) 5 46. y 5 2.3(1.12) 43. The call letters for a radio station must begin with either K or W. The surface area is 4 times as great. 0 1 8i 4 3 33. Determine Domain and Range of a Function Given a relation defining y as a function of x, the domain is the set of x values in the function, and the range is the set of y values in the function. 84. 2 for x # 21 22x for x , (g 2 f)(2) c. Solution: Each of the 10 marbles in the box is equally likely to be selected. Endpoints of minor axis: e. The ball lands on an even number (do not include 0 and 00). In each case, replacing x by 2x results in the opposite of the original term. 5 4 3 2 2. (25, 0) c. (x 2 2i)(x 1 2i)(x 1 1)2(x 4 2 i) k(0) d. 227 Applications of Linear Equations and Modeling Number of Years Since 1990 x() Enrollment (millions) (y) 0 10.8 4 11.2 8 11.1 12 12.8 16 13.2 20 14.4 24 14.8 76. 2 6 24 120 1 1 1 1 x11 x12 x13 x14 x15 For Exercises 87–88, rewrite each series as an equivalent series with the new index of summation. (23, 21] "[2, `) 69. 164: © Tetra Images/Getty RF; p. 4x 1 2h 1 3 b. (Source: www.census.gov) The function defined by f (x) 5 9.4x 1 35.7 represents the amount spent f (x) (in $) x years since 2006. 3 27 x4 1 x3 1 x2 1 54x 1 81 16 z 2 1024c10 2 1280c8t4 1 640c6t8 2 160c4t12 1 20c2t16 2 t20 29603 v14 29. a. 0b and (21, 0) d. 2 58. c a c 1 0 a R1 SR1 1 d 5 c c 1 b 1 ` d 0 2c ? a 4(3)n21 n51 n51 7 3 j21 52. a (2i 1 3) i51 k51 6.c. For what value(s) of x is f (x) 5 g(x)? 121 Create Linear Functions to Model Data In many day-to-day applications, two variables are related linearly. R1 1R2 SR2 5 a ?R2 SR2 a2 b c 5 c 2ba ?R2 1R1 SR1 5c 1 0 c b a 1 0 1 0 Therefore, A21 5 d2 b a2cb a 2ba 1 d ? c 1 2ad c `1 ` 1 a 2ac bc ad ad c 1 0 a c ad d 2 bc 0 c 0 1 d 0 1 c 5 c 1 0 0 d a 5. (0, 2) 95. Solution: f (x) 5 1 2 x © David Wasserman/Getty RF; p. a (x) 0 10 d. (23, 0] 57. Yes 2 6 y 23 22 21 21 22 1 2 3 4 5 x 23 24 25 ab 1 2 b 2 ` 2 ` ` 2 d 25 `7 1 f h(5)? 1 x23 10. 1 0 0 Solutions 1 0 1 d. Solution: Graphing utility are used to spot patterns in data and to plot data points for Exercises. Given f (x) 5 4x2 1 1, define functions m, n, and k such that f (x) 5 (m + n + h + k)(x). (See Example 9) 97. 8; BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG c. c, d, g, h 11. Now the students will be selected to a committee and assigned different roles (president, vice president, and treasurer). 118 # x1 # 168 vehicles per hour; 163 # x2 # 213 vehicles per hour 5500 31. However, a graphing utility can be used to approximate the location and value of relative maxima and minima. 2,562,560u12v36 39. 2110 2n 15 29 63. Minimum point: (8, 29) d. 1?2 2 n 1 1 1 1 1 12 left side of statement right side of statement 728 Chapter 8 Sequences, Series, Induction, and Probability 2. f(x) 5 x23 x24 b. Write the answer in slope-intercept form (if possible). h(x) 5 0 x 0 2 0 76. Examples Standard form Center Radius (x 2 4)2 1 (y 1 2)2 5 25 (x 2 4)2 1 (y 1 2)2(2 5 (5)2 (4, 22) 5 (0, 4)2 5 (x 2 5)2 1 (y 2 3)2 5 4 (0, 3) 17. 18 2 12 18.02 5 (x)2 1 A y 2 12 B 2 5 A 11.2B 2 (x 2 0)2 1 (y 2 0) 5 5 5 17B 2 2 2 x 1y 57 2 2 5 x 12 2 13 (0, 0) 17. In Example 1, we write an equation of a circle in standard form. f (x) 5 log5 1 1 0(x 1 h) 2 1 5 22(x1 2xh 1 h2) 2 4 h 2 2h2 1 4 x 2 2 h 2 22x 2 22h2 1 4 2 2(x 2 2 x 1 h) 1 h ; Suppose that a parent wanted to estimate the average price of a new car in 2020. 1. Use a graphing utility to find the equation of the regression line. f (2x) 5 4(2x)2 2 30 x 6 3x 5 23x 2 2 2` c 5 3x 3 2 5 2y 2 5 2 6. The variable x represents the number of years since 1990 and the y variable represents the number of students (in millions). a , 5b 5 3 3 a2` , 5) `5, `> e. P(s) 5 4s b. This is a point slightly to the left of the relative maximum. 67.5 ft 77. P(t) 5 4.3e0.01341t; P(t) 5 4.6e0.00618t; 4.3 million; 4.6 million b. Evaluate P(1.6) and interpret the meaning in the context of this problem. p(x) 5 x16 x2 2 1 x 1 9 99. TIP As an alternative to computing P(A) 1 P(S) 2 P(A ¨ S), count the number of elements in the event (A ´ S), being careful not to count the events common to A and S twice. Write a function that represents the cost C(x) (in $) for x boxes of stationery. Blood Alcohol Concentration vs. 4 good seeds can be selected. 1 is the lower limit of summation. If the employee invests $1000 per month in the annuity instead of $500 at 5% interest, find the value of the annuity after 18 yr. Consider the sequence defined by {an} 5 {8, 18, 32, 44, 20, 8 36, 28, 32, 38}. (f + g + h)(x) 8d. Plot the points. Use the model to predict the number of attendees in week 24 assuming that the linear trend continues. Therefore, 3(4) , 2(4). If(x . A number less than or equal to 10. (a) in the interval notation. { } 103. 2m(x) 5 24x2 2 2x 1 3 c. x 2 10 x 1 1 26 95. Problem Recognition Exercises, p. v2 1x2 v2 14. f 2 1 5 f 21(2 2 3) 5 f 21(1) 2 2 3 f. The solution in part (i) is even. Inconsistent 7, c 2 , 6 f 3 4 Compound inequality: x 1 1 . The function whose value is … y 2 3 1 3 3 4 b 2 42 y 63. a 1 3 9 6 2 2 72. 5 12(y 2 1) 2 65. 562i, 626 5 3 22 2 3. The card is a 2 or a red card. [2`, 0) ´ AZ B "33. cross 11. 2500 Section 8.2 Arithmetic Sequences and Series 707 Point of Interest An old story suggests that at the age of 7, Carl Friedrich Gauss (see page 333) amazed his teachers by quickly computing the sum of the first 100 positive integers. Therefore, we can replace k! by 2k and replace by 5 sign with . { } 7. 24C5 5 42,504 b. 69 min (1 hr 9 min) 79. 2 1 81 32 1 828 1 1 28 1 c. 64. 233.1787 c. x1 x3 5 370 x1 1 x2 5 400 e. f(x 1 h) 2 f(x) . Graph M 8. 210 10 210 1. Future Value of an Ordinary Annuity Suppose that P dollars is invested at the end of each compounding period n times per year at interest rate r. b. 5 6 12 k! 66. Ocean: 14.1 m; Tahoe: 8.7 m; Erie: 3.5 m 75. Donovan would need to sell more than $250,000 in merchandise. 5 5. The value 5 is a zero with even multiplicity. Gerkel, Donna. The function given by y 5 f (x) shows the value of $5000 invested at 5% interest compounded continuously, x years after the money was originally invested. 180 1 190 5 x1 1 x3 b. Therefore, every other term will have a negative coefficient. Jewelry 10. The set contains 21 points. 2, 3, 4, 5, 6, 5 {10A1 2 17}; p. 15.272.2541 4 2 e3 47. (c 0 c , 2}; (2` , 2) 17. 12x 2 9y 1 16 5 215 x1 y2 254 x 2 y 1 5x 3 2 24. Odd 31. Use vertical-intercept form 51. 23 c. Find p(x). x 1 2y 5 1 4.45 1 g(x) 1 8 28 x2 8 x9 2x 7 x 2 1 24 1 4 2 x ... 1 g(x) 5 4. (1, 1) log6 5 log 6 1. 47 22 2 1 1 x2 The events from parts (a) and (b) are not complementary events. 1.6569; 1.9524; 1.9950; 1.9995 c. 2x 1 3 1x 2 1 2x 1 3 2 1 x 1 2 x ? d 3, 4 5 3x a 3 (3x 5 d a 3 l 1 5 3 4 x 3 1 0 1 0 1 7 1 6 2 1 3 5 3 ... 3 (3) ... , 5) and (2`, 3) are 1 5 4 1 3 ... (5 2 3 2 1 ... 3 k 1 1) (2 1 3 1) (3 1 3) (3 1 3) k(k 1 1) ... EXAMPLE 6 Write a Series Using Summation Notation Write each sum using summation notation. Yes 113. f A 12xB is in the form f (ax) with a 5 12 . 2(4) 2b 5 52 2a 2(21) y-coordinate: f (2) 5 2(2)2 1 4(2) 2 5 5 21 The vertex is (2, 21). Objectives 2–3: Count Permutations and Combinations 25. 86. a 1 11a 1 28 53. Suppose that a person is randomly selected from the population. Once the plane goes over the vertex of the parabola, flyers free fall inside the plane. 1 log x2 5 log(x21)2 5 log 2x2 5 log 0 x 0 2 7. The points in the solution set represent a common plane in space. $0.40 per mile b. i51 n n 2. (a 2 b)(a2 1 ab 1 b2) 2 1 5. Sub. Assume that the trend continues, find the value of the vehicle after 10 years. (a) 250 {1 A52 15B A5 1 5B) a) w. C. Write an expression for the nth term of the sequence. b. An expression that represents the week number. a i51 1 (21)1 1 i ! 3 n2 75. The number of dots on the die is 6. 8 11,232,000 19. Chapter 5 Cumulative Review Exercises, pp. Test for Symmetry 2. (2`, `) b. {17} 23. Range: {92, 58, 98, 72, 86} Skill Practice 1 For the table shown, x a. No 57. b 65. 100. a. Center: (0, 0) a55 c. Section 2.2 y 6 5 4 3 2 179 The radius of the circle is the distance between either endpoint of the diameter and the center. Although it is impossible to add an infinite number of terms on a term-by-term basis, we might ask if the sum approaches a limiting value. No; The elements on the main diagonal are not 1 with zeros above and below. Write a recursive formula to define the sequence. Given f(x) 5 80. 75–78 1. In particular, notice that together the elements of the set of rational numbers and the set of irrational numbers make up the set of real numbers. 4(2 n 5 6 and F 5 2. Therefore, 4x1 (h , k) 1 3(k 1 2)! 5 (k 13)! as desired. 35. logb x 1 logb y 3. The graph of is the same as the graph of y 5 0 x 0 with a horizontal shift to the right 2 units and a vertical shift downward 3 units. 2.31% d. 21 4. Write a function to represent the cost C(x) (in $) for a first-time visitor to purchase x songs. g(x) 5 x2 2 4 c. A0) 5 ,800000.0621 k. The slope-intercept form of a line is particularly useful because we can identify the slope and y-intercept by inspection. EXAMPLE 1 Translating a Graph Vertically Use translations to graph the given functions. 45. 0.1520 13. Graph A represents Equation 2. Intuitively, mathematical induction is similar to the sequential effect of falling dominos. x2 1 y2 # 16 y . From school to work there are 4 different routes. {100, 1} 121. 5 h 5 24x 2 2h 1 4 266 Chapter 2 Functions and Relations Given f (x) 5 2x 2 2x 1 2, Skill Practice 5. True 97. {(0, 1), (2, 5)} E(3, 1), 25. Show that Pk11 is true, that is, show that 2 is a factor of 5k11 2 3. (See Example 8) 68. Jean has a list of 8 books that she knows she must read for a class in the upcoming fall semester of school. 1 40. The horizontal distance between the points is @ 4 2 5 3. Use the graph to find the solution set to the inequality 3x 2 (x 1 4) 2 1 $ 0. Reference SECTION 2.2 Circles The standard form of an equation of a circle with radius r and center (h, k) is (x 2 h)2 1 (y 2 k)2 5 r2. 23 b. 0(t) 69. True 95. e a , yb ` y is any real number f 23. Graph is 55. Take a logarithm of any base to each side of the equation. 1 21 x(2 x)21 2 x (x 2 1 x2 2 x x 1 2 3 x 4x 1 B C D x 1 2 5 2 2 3 x 4x 1 B C 1 D 2 3 2 8 2 2 3 x 4x 1 B C D x 2 3 2 5 25 E 1 2 11. 8 3 2 (2)(3) 13 a. 5 1 42x2 2 x 2 5 y 5 4.1 28 29. Some elements have been rated 6.33 mass of a mammal based on the amount of air inhaled per breath. x 1 k(x) 5 13x3 1 12x 36. 2x 2 4)2 1 (y 2 1)2 5 25 y b. The graph of y 5 f (x) is shown. Ten questions have 5 possible responses (strongly agree, agree, neutral, disagree, or strongly disagree). Write a function that represents the number of minutes remaining r(x) as a function of the number of minutes already used x. End of year 1 End of year 2 End of year 3 End of year 4 $P invested $P invested $P invested $P invested at the end of the 4th year P (interest compounded for 0 yr) P(1 1 r) (interest compounded for 1 yr) P(1 1 r)2 (interest compounded for 2 yr) P(1 1 r)3 (interest compounded for 3 yr) The total amount A, also called the future value of the annuity, is given by A 5 P 1 P(1 1 r) 1 P(1 1 r)2 1 P(1 1 r)3 TIP In this section we study ordinary annuities. 251cd 22c 59. (See Example 7) b. x(x) 5 (x 2 3) 3 90. 5 55. EXAMPLE 8 Counting Combinations in an Application In the game "Florida Lotto," a player must select a group of 6 numbers (without regard to order) from the numbers 1 to 53. Then write the equation using function notation. For Exercises 35–36, evaluate the function for the given value of x. 40, 49. See also Complex numbers; Integers; Real numbers imaginary, 104–105 irrational, 2, 3, 73, 418, 483 natural, 2, 73 rational, 2, 3, 73, 329 real, 2 sets of, 2, whole, 2, 73 O Objective functions, 547–548, 557 Odd functions, 245–246 One-to-one functions explanation of, 403, 482 identification of, 403–405, 407 Opposite, 11 Ordered pairs, 492–493 Ordered triples, 506–507, 556 Order of matrix, 585–586 Order of operations, 8–9 Origin, 166 P Parabola as algebraic form, 641–642 explanation of, 641 focus and directrix of, 667–669 on graphing utility, 672 graphs of, 286–288, 290, 669–672 (See also Quadratic functions) latus rectum of, 669, 670, 683 standard form of equation of, 667–668, 673–674 vertex of, 289–290, 667–672 Parallel lines, 214–215 Parameter, 498 Parentheses clearing, 12 mistakes involving, 64, 137, 453, 727 Partial fraction decomposition explanation of, 517–519, 557 method to check result of, 522 with rational expression containing irreducible quadratic factor, 522–523 with rational expression containing repeated quadratic factor, 524 with rational expression that has repeated linear factors in denominator, 522 with rational expression where denominator is product of distinct linear factors, 521–522 setting up for, 519–520 Pascal, Blaise, 733 Pascal's triangle, 733, 766 Perfect square trinomials explanation of, 51 factored form of, 51, 115–116 method to factor, 51–52 Perihelion, 644 Permutations in applications, 743 combinations vs., 744–745 determining number of, 741–743 explanation of, 741–742, 766 on graphing utility, 746 Perpendicular distance, 667 Perpendicular lines explanation of, 214 slope of, 215–218 pH scale, 423 Piecewise-defined functions in applications, 250–251 explanation of, 247 graphing utility, 248 graphs of, 276–277 interpretation of, 247 Pi (π), 3 Point-slope formula, 191 Point-slope form of equations, 213–214 Polynomial, 276 Polynomials, 120 degree of, 36 explanation of, 36, 39 division of, 317, 320 division of, 301 end behavior of, 302–303 explanation of, 299 finding zeros of, 301 fourth-degree, 386 graphs of, 301, 391 intermediate value theorem, 313–314 leading coefficients of, 299 multiplicities of zeros of, 301 real zeros of, 323 multiplication of, 31 order of operations of, 8–9 repeated roots of, 327 on graphing utility, 310 graphs of, 303, 307–310 intermediate value theorem and, 306–307 third-degree, 301 turning points of, 303–306, 391 Polynomial inequalities explanation of, 376–377 solution sets of, 369, 393 method to solve, 369–372 Polynomials. a 3 5 3 1 3 1 3 1 3 5 18 n51 6 terms Skill Practice 6 Evaluate the sum. y 5 lâx 210 1 25 24 23 22 21 22 35. 0 b. In any event, the coefficient of x is the slope of the line, and the constant gives us the y-intercept. 1 Explain why a line with an infinite number is a geometric or geometric. Determine the total number of ancestors that an individual has going back 12 generations. Interpret the meaning of the y-intercept in the context of this problem. x2n 2 4xx 2 21. 67. Equation: {29} b. 5 25 24 23 22 21 21 22 1 2 3 4 5 x 24 23 22 21. (x) h(x) 5 x23 x1 1 98. 6 4 2 2 1 25 20 21. (x 1 5)x1 1 2x2 1 9x 1 18 f (x) 5 2 ln 1 2x 2 16 x 8 18. Wrestlers competing in the same class are normally within +/- 2 units. (See Example 6) 18. Further, x 2 1 2 2 2x2 1 x 1 1 x 1 3 x 2 n 2 4x x 1 2 5 2 x 1 2 4 x 2 x 2 5 6 For Exercises 9–16, determine the center and radius of the circle. (x 2 4(xx 2 4x 1 16. 544–546 R.1. (x 2 4(x 2 4x 1 2 2. 5 b R.2. 5 {4} 23 24 25 26 1 2 3 4 5 x 2 22 23 24 4 3 2 1 4 5 x 2 2 2 1 3 2 x 2 2 4 5 x 13. A. Probability c. C(x) 5 5x 1 C(5) 5 41.99; C(30) 5 23.67; C(120) 5 20.92 The average cost per disk is approximately $20 per session. (x 1 5) 1 (y 2 1)2 1 5 9 b. Passes through (6, 8) and is parallel to the line defined by 3x 5 7y 1 5 , 0b 4 c. 116 75. 1000 0 0 69. The vertex is (h, k), which is (1, 8). Completing the square results in an equation of the form (x 2 h)2 1 (y 2 k)2 5 c, where c is a constant. Count Permutations 3. The word MICROSCOPIC has 11 letters. Y2 for x , 23 Y1 , Y2 for x . Perform Operations on Functions 1. 80 (5, 75) (9, 79) y 5 f(x) 60 (3, 64) 40 (11, 64) 20 x 0 0 2 4 6 8 10 12 Month (x 5 1 represents January) 84. 5 (k 1 1)(k 1 1) k1 k12 By the inductive hypothesis, 1 1 1 1 1 1 b d c1 1 c a1 a 1 a1 b a1 2 a 2 2 3 k11 (k 1 1) 1 1 5 1 1 k11 k 11 Alternatively, the number of first-, second-, and third-place ordered arrangements can be found by using the formula for the number of permutations of 8 horses taken 3 at a time. 8P3. 4a 2 B 5 c d 1 4A 6 1 2 C D 10. f (x) 5 x2 2 6x2 1 36 y 5 2 8x 5 x3. 8 x 5 25 37. (21, 6) (2, 0) (f + g)(0) c. Horizontal asymptote: y 5 3 1 2 3 4 5 x y 5 log5 x 1 1 (x22)2 x 5 log2(x 1 3) 8. log5 x (x) 5 2 x 1 2 9. 21 4 x 3 8 25 1 6 1 4 2 6 y1 5 a2 b1 5 x 1 2 f 21(x) 5 4 3 x 0 5 b. (21, 0) 9. 21 (x 2 6) 5 1 log x 29 50. f (k) 5 24 x 2 1 2 2 x2 4 4 x 25 24 23 22 21 22 b. (21, 22) 11. a 2 3 1 1 (x 2 1)(x 1 1) log(5) 5 2x 1 1 5 b. 1 1 1 2 4 1 6 3 1 4 x 12 1 3 4 5 0 8 11. x 2 8 b2 25 16 4. The graph is 61. f (x) 5 log(x 1 3) 28 17. 4 66. EXAMPLE 2 Writing Several Terms of a Geometric Sequence Write the first five terms of a geometric sequence with a1 5 3 and r 5 2. y 2 2x 1 7 5 0 x; y 2 14x 5 4. 2 2 5; y-intercept. (0, 3) 1 b. Show that (k)k11 5 (k11)k11. Singular matrix b. A 1 B 5 c 91. If a is b plus eight, and c is the square of a, write c as a function of b. 2x 2 x1y b. linear 3. Assume that 2 1 6 1 p 1 (4k 2 2) 5 2(k2 (Inductive hypothesis). The term 3 3 21 x 5 3x . y 5 1x 34. Find the 78th term of an arithmetic sequence with a1 5 64 and d 5 215. 2058F 2 b. 697 i51 n 1. Apply Reflections Across the x- and y-Axes 5. The graphs have the y-intercept (0, 5) and y 5 52 with a vertical shift. 741 • The number of permutations of n distinct elements is n!. (h 1 g)(72) 57. Find the probability that a student answers each question incorrectly. Graph g 73. Amount Spent on Video Games per Person by Year 140 Amount Owed on Vehicle after t Months 120 12,000 Amount Spent ($) 15,000 A(t) 5 14,820 2 247t 9,000 6,000 3,000 0 0 10 20 30 40 Number of Months, t 50 100 80 60 f(x) 5 9.4x 1 35.7 40 20 60 0 2 4 6 8 Year (x 5 0 represents year 2006) Objective 4: Determine Domain and Range of a Function For Exercises 87–96, determine the domain and range of the function. 2 65. Format made this claim, now called Fermat's last theorem, while annotating a copy of Diophantus' Arithmetika. The common difference the same for each term. (4x 2 2)2 52 6 2,5 (2) 29 r(x) 62. Determine the time at which the stone will hit the ground. 497 462 243x5 1 405x4 1 270x3 1 90x2 1 15x 1 1 343x3 1 441x2 1 189x 1 27 16x4 2 160x3 1 600x2 2 1000x 1 625 32x15 2 80x12y 1 80x9y2 2 40x6y3 1 10x3y4 2 y5 p12 2 6p10w4 1 15p8w8 2 20p6w12 1 15p4w16 2 6p2w20 1 w24 a10041 1 7 2 6 51. {x 0 x 2 1 g(x) 5 x3 x ... 0 ... 0 ... 20 x 0 0.0032k 1 0.0024k2 1 0.0008k3 1 0.0001k4 3 2 3 x3 2 c 2 c d 1 cd2 2 d3 29. 2.25x for 0 # x # 20 f (x) 5 • 45 for 20 , x, 80 21.5x 1 165 for 80 # x # 110 EXAMPLE 5 Interpreting a Piecewise-Defined Function y Evaluate the function for the given values of x. Graph Piecewise-Defined Functions Speed (mph) 0 # x # 20 20 , x , 80 # x # 110 Suppose that a car is stopped for a red light. 8! 35. O2 blood is absent all three antigens and will not introduce a new antigen to the recipient's blood. n(x) 5 2 ` 3 ` 2 1 74. No. If x represents the measure of the smallest angle, then the equation x 1 (x 1 2) 1 (x 1 4) 5 180 does not result in an odd integer value for x. (See Example 9) Weight (oz) Cost Over Price 1 oz $0.44 2 oz $0.61 3 oz $0.78 3.5 oz $0.95 76. 5 4 3 2 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 23 24 25 26 104. Inductive hypothesis We must show that 4 is a factor of 9k11 2 1. However, by the rational zeros theorem, the only possible rational zeros of f (x) are 61 and 65. 2n 3 2 for n y 5 x 1 y 10.50 Linear Equations and Modeling Select the STAT PLOT option and turn Plot1 to On. For the type of graph, select the scatter plot image. Write a linear function to model the monthly cost C(x) (in $) of a family plan for x additional family members added. £ $69,754 $28,400 § ; The first column gives the total revenue $66,438 $26,960 for Friday, Saturday, and Sunday, respectively. p(x) 5 24 2 x2 1 x 2 93. —Donna Gerken iii Table of Contents Index of Applications CHAPTER R xvii Review of Prerequisites 1 Section R.1 Sets and the Real Number Line 2 Section R.2 Integer Exponents and Scientific Notation 18 Section R.3 Rational Exponents and Radicals 27 Section R.4 Polynomials and Multiplication of Radicals 38 Problem Recognition Exercises: Simplifying Algebraic Expressions 47 Section R.5 Factoring 47 Section R.6 Rational Expressions and More Operations on Radicals 59 Algebra for Calculus 72 Key Concepts 73 Review Exercises 75 Test 78 CHAPTER 1 Equations and Inequalities 81 Section 1.1 Linear Equations and Rational Equations 82 Section 1.2 Applications and Modeling with Linear Equations 94 Section 1.3 Complex Numbers 104 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452 Section 4.6 Modeling with Exponential and Logarithmic Functions 466 Key Concepts 482 Review Exercises 485 Test 487 Cumulative Review Exercises 489 CHAPTER 5 Systems of Equations and Inequalities 491 Section 5.1 Systems of Linear Equations in Two Variables and Applications 492 Section 5.2 Systems of Linear Equations in Three Variables and Applications 506 Section 5.3 Partial Fraction Decomposition 517 Section 5.4 Systems of Nonlinear Equations in Two Variables 527 Section 5.5 Inequalities and Systems of Inequalities in Two Variables Problem Recognition Exercises: Equations and Inequalities in Two Variables 547 Section 5.6 Linear Programming 547 536 vi Table of Contents Key Concepts 556 Review Exercises 558 Test 560 Cumulative Review Exercises 561 CHAPTER 6 Matrices and Determinants and Applications 563 Section 6.1 Solving Systems of Linear Equations Using Matrices 564 Section 6.2 Inconsistent Systems and Dependent Equations 575 Section 6.3 Operations on Matrices 585 Section 6.4 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750 Key Concepts 764 Review Exercises 767 Test 770 Cumulative Review Exercises 771 Appendix A Additional Topics Appendix A-1 (Online only) Student Answer Appendix SA-1 Instructor Answer Appendix (AIE only) IA-1 Credits C-1 Index I-1 Key Features Clear, Precise Writing Because a diverse group of students take this course, Julie Miller has written this manuscript to use simple and accessible language. (2`, 5) ´ (5, `) 33. (x 1 4)2 5 232(y 2 7) 41. Frank needs to drive 250 mi from Daytona Beach to Miami. a (5i 1 4) 94. (2t4 2 3v)3 5. 527: © Jupiterimages/ Imagesource RF; p. Then x 2 b y by 2x and y by 2y. EXAMPLE 9 Using a Piecewise-Defined Function in an Application A salesperson makes a monthly salary of $3000 along with a 5% commission on sales over $20,000 for the month. Note: For any point (x, y) on the graph of y 5 f (x), the point (x, ay) is on the graph of y 5 af (x). from x1 5 0 to x2 5 5 1. y (x2) y2(x1 2 y) x 1 y y2 2 2 x 2 y 1 y2 2 y 2 x, y1) Now we have the coordinates that we want to find the midpoint of the line segment between the distinct points (x1, y1) and (x2, y2). a. 10 i51 j50 100 5 34 x1562 16. {7, 27} b. [2, `) a. 8 1 8 1 8 7. 536 deer c. It follows that P(E) 1 P(E) 5 1. 22 5 F 23 24 25 2x 12 B 2 y E One byte is 8 bits. In this case, the nursery should have 360 large trees and 144 small trees. y 5 2n21 1 8 7 6 5 1 2 3 2 4 5 x 24 23 22 21 21 22 23 24 25 x 1 1 2 x 4 23 24 25 26 ... n in 1 d. Jesse travels 6 km/hr in still water. 4x 2 17B 2 1 A y 2 17B 5 7 (21, 3)) 39. . 6 Use the graph of y 5 f(x) below. 9. 11. 2 b 5 c. cubes, (a 1 b)(a2 2 ab 1 b2) 23. y2 5 x 2 1 2 9 48. Approximately 63.7% of the new homes in the United States a 2 2 ab 1 b2 2 ab b2 2 2 ab b2 1 2 1 b 1 a x x 1 0 5 ... 5 5 10 5 1 0 1 0 2 0 5 0 1 0 2 0 1 0 ... 0 1 0 5 a 4 (10) ... x 5 1 0 .1 2 b 1 ... 4.59 2. (b) Use the model to predict the number of students ... 10 and 5 ... 2x 2 2x 1 5 x(x 2 2) 2 (x 2 3x 1 6) 2 2x 2 3x 2 1 6x 1 3x2 2 ... 29. Degree 4; leading coefficient negative e. The sidewalk moves at 1 ft/sec and Josie walks 4 ft/sec on nonmoving ground. y 10 1 1 1 1 2 3 4 5 x 25 24 23 22 21 21 22 23 d. 39. Write About It 105. 5(3x2 1 4x 1 1) 5 1 3(24) 1 5 Remove 24 from within parentheses, along with a factor of 3. False (27, `) {x 0 x . f 21(x) 5 10x Domain: (2` , `); Range: (0, `) Domain: (2` , `) Range: (0, `) b. None of these 15. y2 x2 1 5 1 64 289 81. y 5 12 f (x 1 2) 1 3 x 2 y Rates of change differ. 12 25 20 15 10 5 21 21 5 100 16 101 8 6 13. Calculate the amount after 30 years ... 40 is a 23 x 2 2 2 k 3 x 5 8 22. 2 ... 10 ... 60 ... 4 67, 8 ... 64 ... The graphs of f (x) 5 1x (in black) and g(x) 5 1x 1 2x (in blue) are shown in Figure 2-27. a2n 2 25 87. How many groups of 6 numbers are possible? (f + G)(x) 23.267x 1 10.99 d. The function defined by f(x) 5 x4 2 x2 1 2 for (2` , 2) could be called a quadratic function. Graph p(x) 5 x 2 4 1 2 for x # 0. 46. Yes: 11x 2 9. Nonvertical parallel lines have the same slope and different y-intercepts (Figure 2-40). x 2 2 0 # 5 105. In fact, sometimes the upper and lower limits of summation and the expression being summed is written in a more convenient form. Yes; The height of the opening is approximately x2 5 CHAPTER 8 x r 2 y 0 2 1 2 To do this, we use Pascal's triangle. f (0) d. R.1. x4 2 R.2. 215r4 2 60r3 R.3. w2 1 4w 1 4 R.4. v2 2 9v 1 18 For Exercises R.5–R.6, simplify. p(x) ? A 5 4π 12 square units b. y 5 mx 1 b 26 5 258 (4) 1 b 26 5 232 5 1 b 26 1 32 5 5 b 26 5 b 5 b Therefore, y 5 258 x 1 26 . P1 is true because 1 5 13 (41 2 1). P2 is true because 42 5 16 and (2 1 2)! 5 24. a 5a b 6 k21 k51 ´ 1 7 8 21. Find the 30th term. A palindrome is an arrangement of letters that reads the same way forwards and backwards. 82. Hence k 5 1 2 2 4 57. 87. (See Examples 1–2) 5. Write an equation with the following conditions. 3 4 5 27 2 6 1 4 1 2 (3) 2 2 21 2 1 2 1 26 ... 1 1 5 2 16 ... 7 12 ... f 22 2 0 0 5 2 1 22 5 1 2 2 ... 3 ... 2 ... 2 (x 2 3)2 1 1 ... If the horizon is 96 ... 3 c. Your talents are also applied ... We have 11 R... of z ... E ... Then 4x 2 3y 5 30 z ... x 2 ... 3 . The value in column ... 5 ... 2x ... There are 7 ... Show that ... 3 2 ... Interpret the ... 5 ... This ... A ... F 5 ... 0 5 ... 3 ... 7 ... a) x 2 4 ... The water level in a retention pond started at 5 ft (60 in.) and decreased at a rate of 2 in./day during a 14-day drought. a1 5 4 a2 5 1 1 1 1 ... 5 ... Section 2.5 Applications of Linear Equations and Modeling 223 For Exercises 37–44, write an equation of the line satisfying the given conditions. Distance (ft) 96. 2 7 2 21. (2`, 3] y 3 x 5 4 24 25 y 4 7 6 Y2 5 2x 2 2 Y1 5 x 1 1 5 x 3 2 (3, 4) 1 22 23 b. (2`, `) b. If an inequality is true, the function is divided by 1 on that interval and is "turned on." If an inequality is false, then the function is divided by 0. e. 2 f 67. 94: © Design Pics/Raven Regan RF; p. Objective 3: Apply the Slope-Intercept Form of a Line For Exercises 51–62, a. 37. (That is, the blue line is below the red line.) 2 2 3 2 2 In interval notation the solution set is (2`, 2). b. 9. 2 i51 8 32 128 1 1 1 1 p 3 9 27 Solution: 2 2x 5 y. A316, 215B and A 16, 15B For Exercises 37–42, determine the slope of the line. Write the solution set to the inequalities in interval notation. 25.4800: 2 < 4.68 3 10 87. Divide by 21 and reverse the inequality sign. y 5 0 x 5 Student Answer Appendix 17. Under this system, a person with AB1 blood has all three antigens, and group O2 is absent all three antigens. 2x2 1 y2 c. y 5 29 2 x2 y 5 2x 2 x y2 5 x2 5 29 2 y2 x 5 29 2 x2 y 2 9 y 2 x 1 2 x 1 y 5 2 3 2 2 3 4 5 6 7 x y 79. Center: (0, 0) Chapter R Review of Prerequisites Table R-2 Summary of Inequality Symbols and Their Meanings Inequality a,b Verbal Interpretation a is less than b a.b a is greater than b a#b a is less than or equal to b a$b a is greater than or equal to b a5b a is equal to b aZb a is not equal to b a < b a is approximately equal to b a B c. 0, 8, 29 Student 1 a. c1 c2 c3 c4 c5 c6 c7 c8 c9 76 38 36 d 10 29 p 18 21 6 x2 y 6 5 3 x 1 d. = If y 1 f(x) y 5 f(h + g)(8) 63. P7 is true because 7! 5 5040 and 37 5 2187. A2 5 c 27 8 18 16 36 d 10 22 26 22 230 § 225 28 2 n 15 2 22 25 5 19. (24, 22); m 5 73. 21 77. 3 # 22x 1 1 , 7 For Exercises 18–20, perform the indicated operations and simplify. 89 75. a. 1 5 n 18. 227 81. n 5 169; (p 2 13)2 e 6 2 2 35. 28. d. If the nth term of a sequence is (21)nn2, which terms are positive and which are negative? The fixed cost does not change relative to the number of items produced. Therefore, 2 and 24 are also eliminated from the list of possible rational zeros. 4 log (2x 2 3) 21. an 5 0.01(2)n21 (dollars) b. 12! b. The code must represent an even 3-digit number. e. 67. Find a formula for the nth term of the sequence. {(0, 0)} 2 1 0 3 4 5 6 7 8 9 10 Hours Studying Algebra 67. Explain how you will remember the midpoint formula to find the midpoint of the line segment between the points (x1 2 y1) and (x2, y2). x 2 7 5 1 2. Cost of admission per day to run tickets online for a dance show is $60 per ticket. Let A represent the event 5y2 1 15 d c. 2 4 2 2 ... 22. y 5 6x 1 7x 2 5 6 b. Let C(x) be the cost to buy tickets as follows ... (x) ... Cost and Revenue for a Custodial Company ... x (number of students) c. 10a6 ... 41 ... the number of stores in ... Which of these cells is the ... Therefore, x 5 ... 15 ... 2 2 ... For a model ... The company can not ... 3 ... = ... 7 ... 2 ... 2 ... The function s(x) ... 8 ... 5 ... 5 4 ... Four students make up a 15 ... Domain: 0 ... 2n 5 ... 2 9 ... 3 1 2 ... 2 2 ... 2n ... 24 ... 2 ... 1 ... 6 3 ... 7x 2 1 6x5/6 15. How far apart are the players? U63, 626 V 7 b. (2`, 24) ´ (24, `) e. Approximately 5012 times more intense. Ellipse b. Each equation represents a vertical major axis of length 30 units and a horizontal minor axis of length 20 units. 748 Chapter 8 Sequences, Series, Induction, and Probability 29. During a time of drought, the water level of a reservoir decreased at a rate of 3 in./day. EXAMPLE 3 Writing an Equation of a Circle in Standard Form Write the equation of the circle in standard form. 5 9. 750: © Ingram Publishing RF; p. Apply the distributive property. f(x) 5 (x 1 1)(x 2 3)(x 1 3)2 9(x 1 k) 5 (y 1 120) x 5 251 b. {21} 11. 35. 116 In Example 7, we practice composing functions and identifying the domain of the composite function. (x 1 3)2 (y 2 10 5 1 1 5) In Section 8.7, we present basic principles of counting and will learn to use these to compute probabilities. log6 x35 f(x). P(E) 5 5 1 5. d. Suppose that we want to find the sum of the first terms ... Therefore, we expect that the dealer clears for each model. Section 2.1 EXAMPLE 6 The Rectangular Coordinate System and Graphing Utilities 171 Finding x- and y-Intercepts Given the equation y 5 0 x 0 2 1, a. (24) 1 0 2 5 5 a n51 Solution: i51 i52 i53 i54 i55 a. Therefore, the sign ... 3 1 1 1 1 ... ... 100 2 3 n51 1 1 ... 5 ... 54 ... 5 2 ... 1 ... 7 ... 1 2 0 3 2 3 1 2 ... ... 2 ... The assumption that Pk is true is called the inductive hypothesis. m(x) 5 1x a. Therefore, we might suspect that the function is neither even nor odd. (6.0 3 1013)(9.0 3 108) 2.0 3 1026 For Exercises 7–10, simplify the expression. What is the probability that a person selected from the viewing audience was undecided? 12`, 22 4`, b 3 35. 308 135. 4x2 1 4y2 2 2 1 x a. 7 1 2 3 27: © StockTrek/Getty RF; p. e f 2 3 27. Output g(x) Input g(x) Apply function f to g(x). f (x) 5 Œx 3 a# 82. (b) 5 5 16. Therefore, 5 1 Sale and $6 for each pound. Mary is ... Find the ... Solution 2 ... 8 ... Linear Function ... 1 2 ... The average increase ... y 5 ... f 12 ... 1 1 ... The probability that a person ... 20x 1 10 ... In the ... To find the number of ... Answer each ... b. There are 5 ... 7 ... 2 27 ... 5 8 1 7 1 4 ... a. 5 ... 2 2 ... k. (21, 2) 5 1 2 4 (x 1 5) Center (h, k) 5 4 ... 5 2 ... 1 2 3 ... 0 1 ... 24 ... 2 ... 5 ... 2 23 ... 21 ... The average rate ... 3 ... Section 2.3 191 Functions and Relations Solution: a. Write the answer in slope-intercept form if possible. 2 k 2. The ages are 7 and 8 or 27 and 28. (See Example 4) 29. y 5 6 3 49. The number of arrangements of letters and digits is given by the product of the number of outcomes for each character. Hyperbola; Center: (24, 1); Vertices: (24, 13), (24, 211); Foci: (24, 14), (24, 212); Asymptotes: y 5 125x 1 535 and y 5 2125x 2 435; Compound; Extremities: 13 12 12. (0, 3) c. Neither 3 4 b. Section 3.5 Practice Exercises, pp. The value 5 is not defined within two of the expressions in the equation. 2 2 107. 2 a. ? The y variable can be any real number. Find the probability of each event. 9 39. Apply Arithmetic Sequences and Series (Exercise 66) b53 k53 k53 5.1 15 d ✓ 8 1 0 278 dc 0 1 5.1 278 5.1 15 d ✓ 0A27 B 1 (5.1) 15 d ✓ ... Determine the number of ... (24) ... 1 1 ... A. Since it ... 2 ... 2 ... 1 5 ... 8 ... 2 ... 4 ... The domain of f has no restrictions. Just as a coin toss ... 3 1 1 ... 3 5 ... Therefore, the ... 4 ... 15 ... 5 ... In how many ways can a group of 3 U.S. senators be selected from a group of 7 senators to fill the position of chair, vice-chair, and secretary for the Ethics Committee? Answers 4 Let Pn be the statement that A 32 B n . Row 2 of matrix B is the same as the sum of 1 row of A and row 2 of A. Show the solutions to the inequalities in interval notation. Find a36. He invests $6480 and then spends $11,520 of the money on college tuition, books, and living expenses for school. {(0) 5 13. 5 4 23 24 25 23 24 25 77. 40, 216 B, A0, 16 B f 1 x 10 25 24 23 22 21 21 22 1 2 3 4 x 26. Expanding the series, there are n terms and each term is c. 2 45. 5 114 3 m2 12 11 10 3 2 x 55. {(1, 22, x)} 37. Real part: 10; Imaginary part: 19 Real part: 214 ; Imaginary part: 0 29. 1 2 4 y 5 x 4 x 2 a. 5 5 seconds result: We will set x 5 0 b. The composition of f and g, denoted by f + g, is defined by (f + g)(x) 5 f (g(x)). 8 2 7 f (x) 5 1 x 3 ... 20 ... 5 ... 1 ... 3 ... Show that the ... 2 ... 23 2 x ... 21 ... 15 ... 4 x y ... 2 1 and a22 5 22665 number. Find the exact distance between the points. (215, 9) 61. Apply the quadratic formula. y $0 y c. Section 8.4 EXAMPLE 1 Proving a Statement Using Mathematical Induction 727 Using Mathematical induction to prove that 1 1 3 1 5 1 7 1 p 1 (2n 2 1) 5 n2. Each swing (one way) through the pendulum covers an arc of 90% of the length of the previous swing. y 5 2 7 5 2 3x2 60. The person has elevated cholesterol. r(x) 5 281 2 (x 1 2)2 39. A x2 , 22 15B ` (24, 4) ´ (24, 2`, B 121. Determine if the function is even, odd, or neither. 2 9, 2n. Translations (Shifts) 3. 1) 5 2 x (slope-intercept form) 4 1 4(y) 5 4x2 x6 1 4y 5 x 2 10 (standard form) y 5 (24) 1 4 5 x 1 4 1 1 2 b 1 c c c 1 ... (22, 1) x 5 4 2 ... 24 ... 24 2 x ... 2 3 ... Write the expression ... We ... and so ... 23 1 x ... (22) 5 ... 26 ... 7 ... 1 2 ... 22 ... 5 ... 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x 12 b. 4 3 2 1 p 1 ... 1 4 ... The graph of g(x) 5 ... 1 ... 3 ... The graph of g(x) 5 f ... 5 ... 1 1 ... 5 ... 1 4 ... 2 ... 1 1 5 ... 3 ... 2 ... from ... 1 2 ... the ... 5 ... 3 2 2 ... 2 1 5 ... 7 ... The graph of y 5 ... EXAMPLE 2 Determining if a Relation Is a Function Determine if the relation defines y as a function of x. For Exercises 65–68, graph the equations. 5 69. x # 61. If one card is selected from a standard deck of cards, what is the probability that the card is a diamond or an ace? a b 5 85. Passes through a2 , b and an the slope is undefined. 0 x 2 4 0 . P(0) 5 2,000,000; P(1) 5 2,000,000; P(12) 5 2,000,000 P(4) 5 1953 31. Ay 2 32 B 5 2140x 1 39 Chapter 7 Review Exercises, pp. There are 18 girls in ... Therefore, 2 ... x ... 5 ... The domain is ... The sum of ... 2 ... 3 ... 5 ... 5 ... 2 ... 5 ... 7 ... The function ... 4 ... 1 ... 2 ... 5 2 ... 1 5 4 ... 1 1 ... the ... number of ... 5 ... 2 ... 4 ... 1 ... 3 ... 5 ... 8 ... (h 1 k)(x) ... (24, 0) ... 23 ... A speed limit. If no such restriction is stated, then by default, the domain is all real numbers that when substituted into the function produce real numbers in the range. s(x) 5 5 12x 2 2 71. There are annuities in which money is invested at the end of each of the compounding periods. 2x2 1 11 115. • The graph of the equation is symmetric with respect to the y-axis if substituting 2x for x in the equation results in an equivalent equation. a b represents the number of ways we can choose a group of r items in any order from a group of n items. f (x) 5 x y 5 (x 2 ... ... a 1 1 ... x 2 ... Symmetry ... 2 1 2 ... The graph is symmetric with respect to the y-axis, the x-axis, and the origin. 10 10 210 210 10 210 SA-12 Student Answer Appendix 5. Solution: The first term is given: a1 5 4. The break-even point is the point where revenue equals cost. y 5 ... x ... (0) ... The graph of an equation is symmetric with respect to the x-axis if substituting 2y for y in the equation results in an equivalent equation. 15 1 L A RK or 15 1LRK cRK 113. For this case, 24 scoops of whey protein should be mixed with 36 scoops of soy protein. ceil(20.1) c. a , 0b, (23, 0), (1, 0) c. y 5 f (2x) 1 b. The function is written as f(x) 5 x 2 1. 697–701 7 6 5 4 3 2 1 2 ft at a point 3 ft from the edge. Suppose that {a1, a2, a3, ...} is an arithmetic sequence with common difference d. 250 Chapter 2 Functions and Relations EXAMPLE 8 Graphing the Greatest Integer Function Graph the function defined by f (x) 5 Œx œ . Piecing together the data requires a variety of techniques of mathematical analysis using powerful computers. 5 36 12 36 16 2 6 1 13 35. y 5 4 3 2 y 5 3 1 2 1 y 5 4 ... 7 ... 2 ... 4 ... 2 ... 5 ... 1 ... 1 ... (x) 5 ... 204 Reference The point-slope formula for a line is given by y 2 y1 5 m(x 2 x1) where m is the slope of the line and (x1, y1) is a point on the line. 2, 26, 18, 254, 162 b. n21 3. y-axis 9. Student Answer Appendix 40 120 0 0 3 6 9 Week 12 15 18 Student Answer Appendix b. Nonlinear c. Explain how cost and revenue are related. P(0) 5 2,000,000; P(12) 5 2,000,000 P(4) 5 1953 ... k 1 1 ... 5 ... Therefore, the vertex ... 4 ... The ... number of ... 3 ... 1 ... that ... The ... function ... 2 ... x ... 26 ... 4 ... 1 ... Objective 5: Summarize Transformations of Graphs For Exercises 55–62, a graph is given. ... has an x-coordinate of . Use the model to estimate the systolic blood pressure for a 55-year-old. What is the probability that all four will be good? (See Example 3) 33. 1 8 3 7 6 5 4 3 2 1 y 5 ... 25 24 23 22 21 21 22 23 ... 2 4 23 25 24 25 24 25 92. Identify Subsets of the Set of Real Numbers 1. y 5 4 c. 3x 1 12y 5 264. Domain: [21, `); Range: [21, 1 3) 47. 8. (h, k); (h, k) p); y 5 f(x 2 h) 1 k ... • • • • The exponent on a decreases from n to 0 on sequential terms from left to right. x2 1 y2 2 2y 2 5 0 3 9 Mixed Exercises 55. b 45. common, natural 5. x 28. False. 12 10 8 5 14. a2`, 2 2 b 2 2 2 7 7 ... 22 ... 4 3 2 ... f(x) 5 ... The rational ... 4 3 2 1 ... Show that 3k ... 2 ... 6 ... 1 ... The number of ... 5 ... The ... 2 ... 7 ... 1 2 ... 5 ... 3 ... 2 ... of the ... 2 ... 2 ... 2 ... 1 480 b. For x the data points (480, 60) and (720, 90) to write a linear function for the amount of cholesterol c(x) as a linear function of the number of calories x. Substitute n 5 50, a1 5 2, and a50 5 100. 39 yr c. Another method to define this set is by using set-builder notation. h(0) a. 2 Label the points. y 5 3x 1 4 5 5 x(25) 2 24x2 4 x 1 y 5 5 A52, 0B x 3 4 5 x 10. 2, 4 (0, 0) 35 2 5 2 x 3 3 4 5 x 4 5 x 1 5 ... 1 1 ... 7 ... 5 ... 2 ... 3 ... 2 ... 1 ... 3 ... 1 ... 7 ... 4 ... 6 ... 7 ... Because ... 1 ... 2 ... 5 ... By the inductive hypothesis, 5 we can replace the sum of the first k terms by k2. f (x) 5 f(2x) 5 2x ... Therefore, P ... Section 8.6 Principles of Counting 745 Solution: a. Not possible SA-38 Student Answer Appendix 11. Square root function: f (x) 5 1x b(x) 2 2y 2 x 25 29. 294 21251 13. 1x2 5 2 2 15 8 5 9. Fetch 2x 2 6y ... 2 ... 5 ... The ... 4 ... 1 ... 5 ... 2 ... 1 ... 7 ... The origin is the ... 5 ... Figure ... Write ... 2 ... The ... 1 ... 5 ... 2 ... 8 ... 4 ... 1 ... The ... 2 ... Systems of linear equations in two variables, on graphing utility, 495–496 Systems of nonlinear equations in two variables, 527–535 ... Student Answer Appendix ... 4 ... 2 ... 3 ... 3 ... 2 ... 1 ... inequality, 3–4 infinity, 4, 302 interval, 4–5, 145 inverse, 405 matrix, 586, 612 radical sign, 28 scientific, 22–24 set, 2, 5 set-builder, 2–4, 145 subscript, 38 summation, 695–697 nth partial sum of arithmetic sequences, 705–706 explanation of, 694, 764 of geometric sequences, 715–716, 765 Null sets. 0, b) (a, 0) Ordered pairs x Figure 2-7 TIP In some applications, we may refer to an x-intercept of a graph as an x-coordinate of a graph that makes with the x-axis. e. 22 f 43. Find a22. Therefore, there will be either 2 or 0 nonreal zeros, leaving room for either 1 or 3 real zeros. If the system ... 3 ... 5 ... Suppose that the students build the pyramid so that there are 12 rows, how many cups will be at the top? Test for symmetry with respect to the origin. (21, 2, 23)) Infinitely many solutions; The equations are dependent. 15 1 5 1 1 3 9 27 81 2 1 0 1 ... lines: 19. Using function notation, y 5 f(x), this is equivalent to finding the real solutions of the equation f (x) 5 0. In a rectangular coordinate system, the point where the x- and y-axes meet is called the 2. 2053 yr 25. Write a function that represents the cost C(x) (in $) for x boxes. 9P9 36. x 5 x 5 41t 62b b26 A 18 P5 89. (2n 1 1)! 8! c. 12 19. In one county, homeowners pay a flat tax of $172 plus a rate of 19 mil on the taxable value of a home. (n 1 d)(7) 15 means the 4 rates of ... 5 ... 1 ... the graph of y 5 f (x) horizontally compressed. Leading coefficient positive; degree odd c. c1d . P(E) 5 n(S) 6 c. [0, 730) c. Keep doing that, and I'll keep listening. The second ellipse with is 9. Passes through (5, `23 and the slope is 4) 51. 1x 12 2 21 f 12 ... Z x 1 2 ... These ... Therefore, the ... 8 ... 4 ... Therefore ... 6 ... 3 ... 2 ... 1 ... 2 ... 4 ... 5 ... 7 ... first n terms. {(0, 3), (5, 0)} 89. 2(8x2 1 9) 2 2x (x 1 1)x 1 24x2 1 9 x 5 y, then the dominator x 2 y will equal zero. x 5 2 p. f 21(1) 5 3 f 21(1) 5 ... 24 23 24 22 23 24 ... 25 ... 2 5 ... y 5 ... (x) ... 21 ... 21 ... x ... 1 ... Graph ... 1 ... 2 ... 3 ... 5 ... 4 ... 4 ... 1 ... 5 ... 2 ... There are 6 horses that are available for third place. 1 (k 1 1) (k 1 2) (k 1 1)(k 1 2) 5 k2 1 2k 1 1 k 1 1 k 1 2 Add the fractions. For A and C of the same sign, if k has the same sign as A, it also has the same sign as C and is nonzero. {(300, 2100)} 39. t2 5 2t a 2 t1 13. {(25, 216), (3, 0)} 45 23 38. 39,902 b. x22 3x 1 1 c. 1 3 2 x2 1 5 2ln x 4 10. 154 ft2 c. 2p3q 2 6p2q3 3 p 1 p 3 2 ... In how many ways can a class of 12 kindergarten children line up at the cafeteria? Let x represent a positive real number. f (x) 5 ... 4 ... 5 ... 2 ... 3 ... is, R(x) 5 C(x) and the company breaks even. f. d) e. (11) 55. Write About It 105. Solution: e 6 2 12 f 2 4 . (2`, 2k) 7. x2 (k) 5 C(x) 5 0.5x 1 120 The fixed cost is $120 because it does not change relative to the number of cups of lemonade produced. y 5 f(x) y 5 f(x) 1 24 23 22 21 21 22 1 2 3 4 5 x 23 24 25 a 2 b5 b 5 4 a2 24a 26. The slope is 1 and ... 3 ... 2 ... 5 ... to ... x ... 2 ... 4 ... 1 ... 7 ... of ... 3 ... 12 ... the ... 2 ... 21 ... n 5 ... 3 ... 0 ... 2 ... 1 ... 2 ... 2 ... 23 1 3 1 2 1 5 6 5 1 ... 2 ... 6 ... 3 ... 2 ... c. 2ln 3 ... f (x) 5 ... 0 ... 5 ... 2 ... 4 ... 3 ... 2 ... 1 ... 5 ... 1 ... 2 ... 3 ... 5 ... 2 ... 1 ... 2 ... 3 ... 4 ... Suppose that an employee invests $100 per month in an annuity at 6% interest, find the value after 40 yr. However, we often are able to approximate nonlinear functions on small intervals. The width is 17 yd and the length is 37 yd. g(2) Solution: a. 4k11 2 1 5 4 ? Evaluate (n + d)(7) and interpret its meaning in the context of this problem. Day number Water level (in.) 1 2 3 4 5 54.0 53.2 52.4 51.6 50.8 Section 8.2 703 Arithmetic Sequences and Series a. 1 2 3 4 5 6 7 x 25 24 23 22 21 h(x) 5 24 x2 2 4 1 2 3 4 5 6 7 x 25 24 23 22 21 21 22 y 5 3 2 1 x 1 2 3 4 5 x 25 24 23 22 21 1 22 23 24 25 1 2 3 4 5 x 25 24 23 22 21 22 1 2 2 h 48 49. 28 yr 27. Graph h(x) 5 1x for x $ 0 60. (y 2 4) 5 4p(x 2 h) 9. Suppose that the average rate of change of a continuous function between any two points to the left of x 5 a is negative, and the average rate of change of the function between any two points to the right of x 5 a is positive. Older models of garage door remote controls have a sequence of 10 switches that are individually set in the up or down position. V 5 lwh 5 (30 2 2x)(24 2 2x)x 5 4x3 2 108x2 1 720x The domain is restricted to 0 , x , 12 because the original sheet is 24 in. x 1 1 19 y 5 2x 1 30 11 2 5 ... a 5 ... 2 ... 1 ... 2 ... 5 ... 3 ... 2 ... 2 ... 1 ... 5 ... 4 ... 7 ... 1 ... 2 ... student has not met the prerequisites of such course and that there are no scheduling conflicts, count the number of ways in which the student can select these courses. Undefined 55. The variable cost is $0.50 per lemonade. Geometric b. The water level on day 30 will be 30.8 in. 2x 2 E22 6 12F 83. u(x) 5 2x 1 2)2 2 2x 1 3 27 2. The blood alcohol concentration rose by an average of 0.06% per hour during the first hour. The graph of y 5 f(x 1 h) is the graph of y 5 f(x) with a horizontal shift. Solution: This situation can be thought of as a sequence of two events in which we apply the fundamental principle of counting. When the ... 7x1 1 10x2 1 24 b. 1 R.2. Determine the slope and y-intercept of the line y 5 2x 1 8. 109. 477: © Julie Miller; p. y 5 2x y. Notice that the number of ancestors for a generation for a male honey bee follows the Fibonacci sequence (Figure 8-3). Objective 2: Evaluate a Finite Arithmetic Series For Exercises 49–50, find the sum. 1.036 77. An for positive integers n. 8 (5, 6) c. 7530 Arithmetic; d 5 (1, 5) 6. Use synthetic division to divide by a 5 2. Graph 1x 2 1 x 1 2 y. See Example 7) 109. g 21 Nonlinear; Identify that a sequence is defined to the same? 2, 4, 12,200,00 c. No 5 $30 a. The money ... (0) ... 1 ... 2 ... 4 ... 6 ... x 5 ... 2 2 ... 5 ... 1 2 ... 3 ... 2 ... 5 ... 21 ... 3 ... 4 ... 1 ... 2 ... 5 ... 4 ... 3 ... 5 ... 1 ... Shown in the figure shows which the ... 5 ... x 2 ... 3 ... 4 ... 2 ... 7 ... 1 ... 1 ... 2 ... 3 ... 4 ... 5 ... 6 ... 7 ... x ... 25 ... 24 ... 23 ... 22 ... 21 ... 21 ... 22 ... 23 ... 1 ... 2 ... 5 ... 4 ... 3 ... 2 ... 1 ... 26 x 6 8. 27 26 25 24 23 22 21 21 22 23 24 23 24 1 2 x (2, 21) For Exercises 73–74, an isosceles triangle is shown. 9 1 x 5 2 y5x 1 1 x 2 2 4 21 2 3 2 4 3 21 2 3 4 5 ... 7 ... 21 2 x 7 4. 10 ... 5 ... a 2 2 4 ... 5 a a 2 ... 2 8 ... 9 ... 20,105 ... 1 2 ... 5 4 3 ... 21000 93. Apply the Binomial Theorem 6 6 6 From Example 2, notice that a b 5 1, a b 5 6, and a b 5 15 are the coefficients 0 1 2 of the first three terms of the expansion of (a 1 b)6. The person's ... Amount ... 1 ... 2 ... 3 ... 4 ... 5 ... at ... there ... will make 6? 39 99. Find the x-intercept. This technique uses the premise that a statement's being false would imply a contradiction. Write a piecewise-defined function to represent the salesperson's monthly income I(x) (in $) for x dollars in sales. Between 0 and 1 b. 33. This image is symmetric with respect to the origin. Graphing utilities can help with both of these weaknesses. SECTION 8.3 For Exercises 32–34, determine whether the sequence is geometric. {(22, 21)} 23. one, to one. 5 Mixed Exercises 59. f(x) 5 20.4x3 2 1.1x2 1 2x 1 3 Section 3.5 Rational Functions and Relations SECTION 2.8 Algebra of Functions and Function Composition OBJECTIVES 1. 1. The inequality 0 x 2 3 0 # 0 will be true only for values of x for which 0 x 2 3 0 5 0 (since no absolute value will never be less than 0). The origin is not the center point of the graph's domain of the function. 21 2 21 2 1 4 x 2 1 3 5 1 6 7 8 x Figure 8-6 Figure 8-5 EXAMPLE 4 1 Finding a Specified Term of a Geometric Sequence Find the fifth term of a geometric sequence {an} given that a1 5 15 and a2 5 29. 76 b. 680 deer d. e f 3 23. The aquarium is 24 in. 748: © Royalty-Free/Corbis; p. Across all blood types, is a person more likely to have the Rh factor or less likely to have the Rh factor? Principal invested: ($150)(12)(34) 5 $61,200 The amount of interest is $199,548.50 2 $61,200 5 $138,348.50. a2, b and m 5 0 49. f(x) 5 0.5x3 1 2.1x2 2 3x 2 7 135. X 5 c 2 7 d 5 2 49. An employee invests $100 per month in an ordinary annuity. There are 2 green slots on the wheel. 7 21. Skill Practice 6 A judge at the County Fair must give blue, red, and white ribbons for first-, second-, and third-place entries in a poetry contest. Point-Slope Formula The point-slope formula for a line is given by y 2 y1 5 m(x 2 x1), where m is the slope of the line and (x1, y1) is a point on the line. R.2. r1x2 5 1x 1 3 R.4. p1x2 5 2x2 2 3x 1 1 c. The customer will wait less than 30 sec. At a hospital, the dinner menu consists of 4 choices of entrée, 3 choices of salad, 6 choices of beverage, and 4 choices of dessert. {63i, 62} {210} 81. An odd function is symmetric with respect to the . 2 243 3 4 Sum does not exist 65. 8x 2 5y 5 3 32. • If m1 and m2 represent the slopes of two nonvertical perpendicular lines, 1 or equivalently m1m2 5 21. relation; domain; y 3. Evaluate a12 and interpret its meaning in the context of this problem. {(1, 2, 3)} 7 0 21 63. Graph L 6. 4 For example, an 5 n21 is not defined for n 5 1. {x 0 x , 23 or x $ 22} f. (3x4 2 2)8; middle term 67. 9x3y 2 6.9xy3 97. a) because b lies to the right of a. {36} Radical equation b. y 2 0 x 0 5 21 Solution: y 2 0 x 0 5 21 y 5 0x 0 2 1 x 23 22 Answers 21 5 3. TIP Relative Minimum and Relative Maximum Values Note that relative maxima and minima are also called local maxima and minima. mn 5n 1 m 109. Write an absolute value expression that represents the distance between the points x and 7 on the number line. n 3. A bicycle wheel turns at a rate of 80 revolutions per minute (rpm). 21 79. (n 2 r)! SECTION 8.7 Introduction to Probability Reference Theoretical probability of an event: Let S represent a sample space with equally likely outcomes, and let E be a subset of S. How many up/down sequences are possible in an arrangement of 10 switches? form of an Objective 1: Write an Equation of a Circle in Standard Form 5. f (x) 5 20.6x2 1 2x 1 3 133. A license plate has 3 letters followed by 3 digits. Although the exact keystrokes on different calculators and graphing utilities may vary, we will use the following guidelines to find the least-squares regression line. The kth term of (a 1 b)n is a ban2(k21)bk21 k21 Reference SECTION 8.6 Principles of Counting Fundamental principle of counting: If one event can occur in m different ways and a second event can occur in n different ways, then the number of ways that the two events can occur in sequence is m ? n a15n 2. 5! 5 120 59. Write an expression an for the apparent nth term of the sequence. h(x) 5 2 3 4x d. 714 Chapter 8 Sequences, Series, Induction, and Probability In fact, a geometric sequence with r . Effective. Consider the standard form of a linear equation Ax 1 By 5 C in the case where B ? Therefore, the graph of g is the graph of f reflected across the y-axis. (2`, `) 103. (5)2 x 2 2 ? 236 12. an odd number? Table 8-4 Age (yr) Probability of 1-yr Survival 10 0.9999 20 0.9991 30 0.9990 40 0.9981 50 0.9959 60 0.9907 70 0.9791 80 0.9434 90 0.8543 Experiment: Sample Space: Flip a coin {head, tail} Roll a single 6-sided die {1, 2, 3, 4, 5, 6} An event is a subset of the sample space and is often denoted by E or some other capital letter. Predict the number of participants in week 10 if this trend continues. 6 R.2. e 22, 2 , 2 f 5 R.1. {29, 0, 2} 1 2 3 4 5 x a. Age 60 Height (in.) 63. A car has a 15-gal tank for gasoline and gets 30 mpg on a highway while driving 60 mph. y y 5 4 3 2 5 4 3 2 1 2 3 4 5 x 28 27 26 25 24 23 22 21 21 22 23 23 24 25 24 25 31. 123–125 SA-5 7. (4, `) 35. 58.96 ft/sec d. 2 3 x From Example 2, the discriminant of 3x2 1 12x 1 5 5 0 is (12)2 2 4(3)(5) 5 84 . Graph y 5 f (2x) 2 2. 2 in. { }; The value 2223 does not check. The slope of a horizontal line is ________. (2`, 26] ´ c , `b 2 101. F 5 1.06D 5 c d $30,210 $28,514 71. (2`, 23) ´ (23, `) h. log4(2x 1 7) 5 2 1 log4 x 18. 1 2 3 4 5 6 7 8 9 n Estimate the first four terms of the sequence. A senior is selected. The sequence a11, a12, a13, a14, p can be written as a11, a11r , a11r2, a11r3, p or 55. f (x) 5 1x 2 2 f (2) 5 12 2 2 f (2) 5 0 x 5 2 is on the interval x $ 2. 25 24 23 22 21 21 22 57. Greatest integer less than or equal to 1 is 1. y 5 1 b. 6 15 m 99. False 89. {(7, 22, 1)} 53. Find the average amount earned per year between the 20th year and the 25th year. R.5. t 4 1 1 t14 R.6. 9 3 1 a a(a 2 3) Concept Connections 1. If the second and third terms of a geometric sequence are 4 and 1, what is the first term? 20 15 10 5 4 3 2 5 23 22 21 25 210 1 2 3 4 5 6 7 x 0 0 5 99. x-intercepts: (0, 0) and (3, 0); y-intercept: (0, 0) y y 8. 7! 5 5040 73. $40,250.86 41. y 5 4 3 2 1 2 3 4 5 x y 5 4 x 5 |y| 1 1 3 2 1 1 25 24 23 22 21 21 22 23 1 2 3 4 5 x 25 24 23 22 21 21 22 1 2 3 4 5 24 25 25 24 23 22 21 21 22 1 1 25 24 23 22 21 21 1 2 3 4 5 x 28 27 26 25 24 23 22 21 21 22 2 1 2 3 4 5 x 23 24 25 45. (21, 5), (0, 3), and (5, 213) Write About It 79. (2, 0), (21, 0), and (24, 0) 6. An even function is symmetric with respect to the . 8 g. That is, the calculator may graph points close to (28, 3) and (22, 3) but not exactly at (28, 3) and (22, 3). Write the first five rows of Pascal's triangle. We must show that Pk11 is true. Find the sum of the first 20 terms. Never constant a. Explain how the average rate of change of a function f on the interval [x1, x2] is related to slope. Write a formula for the nth term of a sequence representing the number of outcomes if a fair coin is flipped n times. Determine the probability that both students chosen are freshmen. f(x) 5 3(x 2 1)2 2 2 3 6 16 c. For Exercises 33–46, determine if the function is even, odd, or neither. The total monthly cost of the plan with 4 additional family members beyond the primary account holder is $150.96. Given the sequence defined by an 5 n 2 2n, find the fifth partial sum. The product is 5 ? The second job offers $60,000 in the first year. {x 0 x $ 10} 29. Costa Rica: 2011; Norway: 2013 c. The data in Exercise 66 give the average gestation period x (in days) for selected animals and their corresponding average longevity y (in yr). 3 107. (4, 10) 13. 1 25 26 27 28 29 x 5 22 f. 8! 3! ? 6 6 Skill Practice 3 Suppose that two dice are rolled. The minimum value of f is k. £ 13.2 7 3 1 5 2 3 12 § 24 29. (2`, 4) b. 6 5 6 5 4 3 2 4 3 2 1 27 26 25 24 23 22 21 21 22 1 1 2 3 x 21 21 22 23 1 2 3 4 5 6 7 8 9 x 23 24 24 2 2 15. 2x3 1 x2 2 2x 2 10 d. Therefore, the sign of each term is dictated by the denominator. 11, 10.7, 10.4, 10.1, … , 23.4 38. 3, 13, 23, 33, 43 b. Writing the expression 5 bM2N in y y b x logarithmic form, we have logb a b 5 M 2 N, or equivalently, y x logb a b 5 logb x 2 logb y as desired. Therefore, the domain of f 21 must be [0, `). y 5 3.2x 51. (k 1 1)(3k) by the inductive hypothesis. 1.8 1 Greatest integer less than or equal to 1.8 is 1. {4} 37. Given an arithmetic sequence with a12 5 221 and a50 5 297, find a1 and d. {(z 1 3, 2z 1 5, z) 0 z is any real number} Chapter 6 Review Exercises, pp. Use mathematical induction to show that 4n , (n 1 2)! for integers n $ 2. 20,000 x Section 2.7 Analyzing Graphs of Functions and Piecewise-Defined Functions 251 Therefore, a piecewise-defined function for monthly income is I(x) 5 e 3000 3000 1 0.05(x 2 20,000) Alternatively, we can simplify to get 3000 for 0 I(x) 5 e 0.05x 1 2000 for x A graph of y 5 I(x) is shown in Figure 2-35. 2 1 2 5 1 1 251 y5b 12 2 2 B a b a b a a2 2 c2 b y5b y 5 2a2 2 c2 a B a2 Recall that c2 5 a2 2 b2, or equivalently b2 5 a2 2 c2 and b . 2x 2 2 5 2x 2 5 b. f (x) 5 (x 2 3)(3x 2 1)2 b. y 5 216 2 x2 y 5 2 216 2 x2 x 5 216 2 y2 x 5 2 216 2 y2 66. Then the rate of new cases dropped more rapidly between months 4 and 6 (perhaps as health department officials managed the outbreak). Therefore, the expression cannot be negative for any real number. set real, numbers 0 a 2 b 0 or 0 b 2 a 0 (a 1 b) 1 c; (ab)c a. 15 2 2 5 11. S(x) 5 5x 1 100 b. (See Example 4) 45. 1 16 c. 5 4 3 2 1 1 1 2 3 4 5 6 7 x 23 22 21 21 22 23 23 23 24 25 24 25 24 25 1 2 3 x Section 2.1 175 The Rectangular Coordinate System and Graphing Utilities For Exercises 51–62, find the x- and y-intercepts. Special thanks to the digital team, Rob Brieler and Victor Pareja, for keeping the digital train on the tracks. The customer paid cash or was female. The graph is a left semiellipse with center at the origin and major axis of length 8 units and minor axis of length 6 units. 12z 1 32 12z 95. (23, 0), (5, 0), A 2, 0B c. The sum does not exist. The dimensions are either 2 cm by 3 cm or 21 1 113 cm by 1 1 113 cm. This is done so that the seats for the few passengers that are no-shows will still have been sold. [ln(x 1 h) 2 ln x] 5 ln a b h h h x x 1 h 1yh b 5 lna x 103. 213; Yes 0; No 29. Then each group selected is called a of n elements taken at a time. 2x 1 8 $ 2 x 1 3 2 f (x 1 h) 2 f (x) c. The plane to Los Angeles travels 400 mph and the plane to New York City travels 460 mph. How many license plates can be made if no digit or letter may be repeated? Never decreasing c. 5 2 1; find b20 n 17. 725 2 3 2. 1 f (x) 5 2x2 1 3x g(x) 5 h(x) 5 1x 1 2 x 3. From Example 1, we see that a linear equation may represent the graph of a slanted line, a horizontal line, or a vertical line. Yes; r 5 19. A number less than 1 is rolled. Suppose that 61 people bought tickets for a flight that has 60 seats. y 5 x4 2 3 d. If the sequence is arithmetic, determine d. • The value of d is the difference of any term after the first and its predecessor. 1s 1 t21x2 5 2 x3 2 4x2 2 5x 1 23 1x 1 321x 2 321x 2 22 1x 2 22 1x 1 3 1x 2 321x 1 32 33. c 5 9 91. (y 1 1)2 (x 2 4)2 1 51 25 9 101 29 37 13 , d2 5 , d3 5 , d4 5 b. Skill Practice 9 Write the domain of each function in interval notation. 11.2 yr y 5 76.8 11. Domain: (2`, `); Range: (0, `) c. CHAPTER 8 KEY CONCEPTS Reference SECTION 8.1 Sequences and Series An infinite sequence is a function whose domain is the set of positive integers. f (23) c. Write a formula for the nth term of an arithmetic sequence that represents the distance dn (in inches) that the ball will roll in the nth second. (2`, 0) ´ (0, `) 63. Solution: 4 3 2 1 22 21 21 22 23 24 25 26 Writing an Equation of a Circle in Standard Form A sketch of this scenario is given in Figure 2-12. Polynomial equation SA-7 14. 3(2x 1 1) 24x5 18. 3 e. 23, x ? Area: 25 m2 Collinear 77. Radical equation b. Use the model in part (a) to approximate the wind speed of a hurricane with a barometric pressure of 900 mb. In how many ways can a jury of 6 women and 6 men be selected? m 5 and b 5 24 85. 58. Write a linear profit function representing the monthly profit P(x) for x maintenance calls. Write the domain of the relation. {3, 23} 1 105. m 5 2 4 5 4 4 3 3 e. 28 25. Therefore, we have the restriction f (x) ? 245 p. S1 5 45,000 1 2250x b. Center: (0, 22); Vertices: (0, 4), (0, 28); Foci: (0, 8), (0, 212); Asymptotes: y 5 34x 2 2 and y 5 234x 2 2; Eccentricity: 53 1 2 3 4 5 6 7 x y 8 F 6 4 2 21028 26 24 22 22 24 26 28 210 212 2 C F 4 6 8 10 x SA-45 Student Answer Appendix y b. Determine the slope of a line parallel to the given line. Vertical asymptotes: x 5 2 , x 5 5; Horizontal asymptote: y 5 2 3 3 y y 51. The ball will be at an 80-ft height 1.5 sec and 3.2 sec after being kicked. (p ? Determine if the given ordered pair is a solution to the equation 4 0 x 2 10 1 y 5 18. Round to 3 decimal places if necessary. 3 25. 5 4 12 3 q(x) 5 2 x 16 2 10 8 6 4 2 21028 26 24 22 22 24 26 28 210 7 6 5 1 29 212 215 218 Problem Recognition Exercises, p. g(x) 5 5x 1 1 and f 1x2 5 1 x 12. The set of x values in the relation is called the __________ of the relation. a 35. 27 26 25 24 23 22 21 21 23 x n(x) 5 x2 2 4x 1 q(x) 5 x25 111. Outcomes B BBB Solution: Each birth is independent of the birth that precedes it. Find the indicated function and write the domain in interval notation. Put another way, this means that approximately 99.91% of 20-yr-olds will live to age 21 (see Example 5). ; x ? f 21(x) 5 log2 (x 1 7) 89. Find an equation of the median of a triangle drawn from vertex A(6, 25) to the side formed by B(24, 1) and C(12, 3). Use the third rule in the function: f (x) 5 1x 2 2. The statement f (4) 5 1 corresponds to what ordered pair? Write the first five terms of an arithmetic sequence with first term 25 and common difference 4. R.2. 215r3(r 1 4) R.3. (w 1 2)2 2 t 2 15 3 R.6. (v 2 3)(v 2 6) R.5. t14 a23 induction; P1; Pk11 Let Pn be the statement 2 1 6 1 p 1 (4n 2 2) 5 2n2. 224x2 2 16x 1 8 15 2 4 109. No function defined by y 5 f (x) can have two y-intercepts because the graph would fail the vertical line test. (0, 0), A4 1 13, 0B, A4 2 13, 0B d. Suppose that a die is rolled followed by the flip of a coin. For Exercises 83–86, find the indicated functions. a p b(x) q 24. The data in the table give the average height y (in inches) for girls of age x (in yr). 2 e. a1 5 27, an 5 13an21 for n $ 2 For Exercises 25–30, write a formula for the nth term of the geometric sequence. Up left and up right. Over several weeks, management asks the driver to drive each possible route and record the time required to complete the route. Evaluate the functions at the given values of x if possible. 5P5 5 5! 5 120 65. 2 7, 2 49, 7, 72 7, … 4 8 16 17. For example: < 0.0009766 < 0.0000305 1 10 1 15 1 1 1 1 , , , , p,a b , p,a b , p 2 4 8 16 2 2 In fact, for 0 r 0 , 1, as n S `, rn S 0. Ex 0 x $ 256 F; C256, `B; 5 26 25. e 2 , f 5 5 10 133 f 9. A softball team has 9 players consisting of 3 women and 6 men. Determine the nth term of the arithmetic sequence whose nth partial sum is 2n2. 23x2 2 6xh 2 3h2 1 7 3 2 2 3 61. Not possible 27 37. Infinitely many solutions; {(2z, 3z, z) 0 z is any real number} 57. 8 d. p ? Show that 4k11 , [(k 1 1) 1 2]!, or equivalently, that 4k11 , (k 1 3)!. (3.7, 24.4) 17. 4 h. 5 36 9 52 52 52 64 8 76 19 (0.319)3 < 0.0325 44. (See Example 3) n n n(n 1 1) 2 17. h 34. For Exercises 83–86, determine the distance between the two given points in space. 3 47. 22.8 , y and y # 15 37. If the second and third terms of a geometric sequence are 15 and 75, what is the first term? It is defined by y 7. £ 4 0 26 0 3 51. 2119 1 120i 71. Write the domain in interval notation. £ 4 2 5 22 1 6 2 23 † 10 § 5 1 1 31. f (x) 5 x2 and g(x) 5 x 1 7 93. An ace or a 2. Chapter 4 Cumulative Review Exercises, p. Jim has 8 unread emails in his inbox before going on vacation. Parent function: y 5 0 x 0 1. 0 21. Substitute a1 5 2 and r 5 32 . Geometric; r 5 4 b. Either point can be labeled (x1, y1). f (x) 5 (x 1 1)2 Ax 2 13B Ax 1 13B 105. 23 y 7 6 5 4 3 2 1 Y1 5 2x 2 1 (23, 2) Y1 5 Y2 for x 5 23 27 26 25 24 23 22 21 21 Y2 5 x 1 5 1 2 3 x 22 23 Figure 2-19 The graphs Y1 5 2x 2 1 and Y2 5 x 1 5 can also be used to find the solution sets to the related inequalities. 2x3 1 15x2 1 37x 1 30 79. 3 b 2y 4 ; y ? 23x 1 4y 5 12 10. 1 x14 2x 2 3 x x22 w22 w13 5 4 23 1 4x 1 1 1 1 29. A number between 2 and 7, inclusive, is rolled. The integers are 10 and 12 or 210 and 212. If Zippy had an "accident" in the house, what is the probability that it would happen on the expensive rug? y 5 2x 2 4x 1 1 1 22. p 5 9 b. Then use the graph to find the solution set to the inequalities in parts (b) and (c). 5 4 c. Horizontal asymptote: y 5 2 2. Section 8.6 EXAMPLE 1 739 Principles of Counting Counting the Outcomes of a Sequence of Events Suppose that a frozen custard shop offers 4 flavors of custard, 2 types of syrup, and 2 toppings. This tells us that the terms of the series form an arithmetic progression. Center: (24, 2) 27. Not possible 33. h 81. False 2. Evaluate S(15) and interpret the meaning in the context of this problem. 6 5 336 3 factors There are 336 possible first-, second-, and third-place arrangements. TIP a. If a code for an alarm is a 4-digit sequence, determine the probability that someone guesses each digit correctly. {(24, 1)} 43. In the event that the linear trend continues beyond the last observed data point, use the model in part (a) to predict the number of students enrolled in public colleges for the year 2020. In the expression (6x)0, the exponent 0 applies to a base of (6x). Section 2.8 EXAMPLE 4 265 Algebra of Functions and Function Composition Finding a Difference Quotient Given f (x) 5 3x 2 5, a. In how many ways can 2 students from the 5 be selected to receive the scholarships? ` b. (n + r)(x) 74. kt ln 2 7 25. Point of Interest As mentioned in the section opener, the probability of winning the grand prize in "Florida Lotto" for a player who plays 1 combination 1 of 6 numbers is 22,957,480 . A ´ C 5 {x 0 x , 11} d. CHAPTER 2 Review Exercises SECTION 2.1 For Exercises 1–2, a. The cards are all hearts. 2 6 5 4 3 23 24 25 1 y 102. Given {W, X, Y, Z}, a. Assume that Pk is true. A salesperson makes a base salary of $2000 per month. 2i c. (a 2 b) 9. h(c) 5 24 1c 1 20 2 1 109. Expression; 6x2 2 13x 2 5 2. Fundamental Principle of Counting If one event can occur in m different ways and a second event can occur in n different ways, then the number of ways that the two events can occur in sequence is m ? Replace (x, y) by (x 2 h, y). {x 0 23 # x , 5} CHAPTER 1 Section 1.3 Practice Exercises, pp. 0, 8 f. e 21. Economists call this the multiplier effect. For example, in the last row of Figure 8-9, we have 1, 1 1 4 5 5, 4 1 6 5 10, 6 1 4 5 10, 4 1 1 5 5, and 1 EXAMPLE 1 Expand. 192 53. This is a finite geometric series with a1 5 P and common ratio of (1 1 r). 81; (x 1 9)2 49. y2 5 x y 5 6 1x Solve the equation for y. x2 1 y2 2 x 2 3 3 y2 50 2 4 2 5 5 54. Solution: TIP In Example 6, we can also find the value of d by dividing the difference of a27 and a15 by the number of terms between a27 and a15. n Pr 5 u 8. (f + g)(0) 5 f (g(0)) 5 f (24) 58 d. f (x) 5 0 x 0 and g(x) 5 24 2 7. Not possible 22. Throughout her career she has been actively involved with many projects at Miami Dade including those on computer learning, curriculum design, and the use of technology in the classroom. 81 Sn 5 4C1 2 A 12 B 6 D 4A1 2 a1(1 2 r n) 5 5 1 1 12r 122 2 5 63 8 1 i21 9a a 3b i51 7 Skill Practice 6 Find the sum. a1 5 8 and an 5 an21 2 3 for n $ 2. {t 0 t $ 23}; [23, `); Equations and Inequalities for Calculus, p. From Figure 8-13, events A and S are not mutually exclusive. y 5 0 x 0 8. 215a 1a 5y 4 3 3 83. Written in Vertex Form Write f(x) 5 ax2 1 bx 1 c (a fi 0) in Vertex Form Find the Vertex of a Parabola by Using the Vertex Formula Solve Applications Involving Quadratic Functions Create Quadratic Models Using Regression TIP A quadratic function is often used as a model for projectile motion. 8 63. (2`, 1) x 1 2 3 4 x 22 23 24 25 26 27 0 b. 1 15! 15 ? What are the advantages of writing an equation of a circle in standard form? For example: (0, 26), (1, 211), (22, 4) 4 71 37. Find the difference quotient, f (x 1 h) 2 f (x) . Fixed cost: $2275 Variable cost per item: $34.50 Price at which the item is sold: $80.00 56. José must choose between two job offers. dn 5 32n 2 16 b. 23 1. Would there be enough Social Security numbers for the population of China if the Chinese used the same system? y 5 4 3 2 5 4 3 2 1 25 24 23 22 21 21 22 1 1 2 3 4 5 x 25 24 23 22 21 21 22 (0, 75); The base cost to rent the car is $75. Section 8.4 Practice Exercises, pp. (2`, 4) ´ (4, `) h. Determine the vertical velocity 1 sec after release and 5 sec after release. 181–183 R.1. n 5 16; (c 2 4)2 5 4 3 2 25 24 23 22 21 21 22 1 2 3 4 5 x y 2 |x| 5 2 1 23 25 24 23 22 21 21 22 22 24 25 41. 5 2 21 2 x Vertical asymptote: x 5 0; Slant asymptote: y 5 2x Vertical asymptote: x 5 26; Slant asymptote: y 5 23x 1 22 Vertical asymptotes: x 5 15 and x 5 215; Slant asymptote: y5x15 45. (p + n)(x) 67. Apply Vertical and Horizontal Translations (Shifts) We will call the eight basic functions pictured in Table 2-2 "parent" functions. TL (The product LT is not possible.) b. Therefore, 3 7 A 2 B . Maximum value: 37,800 50 Section 6.1 Practice Exercises, pp. 9. 6 ? a , 3b 2 5. A recursive formula defines the nth term of a sequence as a function of one or more terms preceding it. computed from the fomula P(A ´ B) 5 8. a A3 2 12kB 60. g(x) 5 2 1x 1 3 85. A bookstore marks up the price of a book by 40% of the cost from the publisher. {4, 8} e. 5x 1 5h 1 9 b. < 58 in. f(a) b. f (x) 5 x 3 , g(x) 5 2 x14 x 21 82. The range of f. C 5 0.12k 1 14.89 b. y 51. If the scaling is the same on the x- and y-axes, the graph will appear elongated horizontally. 2 y(2x 1 y) x(2y 1 x) 9 5. 50. 9 2 6 122 5 d ´ c , `b 6. {x 0 x , 7} d. C 5 J 1 1 119. an 5 2n ; find a5 (n 1 2)! 46. Finally, the plane's altitude decreases for the last 40 min, so we say that f is decreasing on the interval (120, 160). The left side of the equation is graphed as Y1 5 2x 2 3. Write a rule for a linear function y 5 h(x), given that h(1) 5 6 and h(23) 5 2. q)(x) 22. (21, 22) c. Find (S1 2 S2)(x) and interpret its meaning. {(21, 21), (0, 0), (1, 1)} 57. 24x 5 5y 39. 2 13 R.2. a2 , `b 2 R.3. 12`, 212 ´ 36, `2 3 4 3 23. a , 0b and a , 0b d. (2`, 25] 3. V(t) 5 20.0406t 1 0.154t2 1 0.173t 2 0.0024 1 25 24 23 22 21 21 22 215 SA-19 1 2 3 4 5 x 1 230 240 250 260 270 69. 2; 4; 6; 8; 10 b. The same logic is used when selecting the digits. 23 R.3. There are no restricted values on the variable. (22) 5 20(22) 5 240 a5 5 a4 ? f 21(x) 5 c. The domain is [1, `). LDL is 144 mg/dL and the total cholesterol is 204 mg/dL. Without Emily, we'd still be on page 1. g)(21) 12. What is the total amount earned in 30 days? 3391 45 990 a. m(x) 5 24x5 1 2x3 1 x 37. (6 2 2)! 2! ? Concave up b. • The coauthor, Donna Gerken, ensures that each algorithm in the online homework has a stepped-out solution that matches the textbook's writing style. y 5 28. 0 2x 2 5 0 2 3 61. 0, 8, 2 , 2.1, 20.4, 23 7 π 5 , 8, 2 , 2.1, 20.4, 23 6 7 SA-4 Student Answer Appendix 1 b. sides of the statement are equal for n 5 1. b1 5 10; bn 5 2 1 bn21 32. Julie Miller Daytona State College Digital contributions from Donna Gerken Miami-Dade College Kendall COLLEGE ALGEBRA, SECOND EDITION Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. 5 52 13 52 13 52 13 52 4 14 98 49 168 21 112 5 61. Irrational numbers are real numbers that cannot be expressed as a ratio of integers. b 5 15 Vertices: A2 13, 0B, A22 13, 0B Endpoints of minor axis: A0, 15 B, A0, 215 B f. Between 23 and 22; 22.2924 a. Multiplying both sides of the equation (xy)k 5 xkyk by (xy) gives (xy)k(xy) 5 xkyk(xy). 120.75, 24.2752 33. 1506 11. (g 2 f)(23) 5 g(23) 2 f (23) (g 2 f)(23) is undefined. 1 1 x23 x15 (x 2 3)2 3 24 1 a. f (24). Graph A 7. These are called degenerate cases. g(35) 5 35 2 4 5 31 Skill Practice 6 Refer to functions f and g given in Example 6. The dancer will save money on the 17th dance during a 3-month 55 period. 21, 4, 29, 16, … 54. The order of the matrices must be the same, and the corresponding elements must be equal. 24428 23. ea 5 x 1 y 17. Increasing Graph b 93. Suppose that a fellow student showed that the expression n2 1 n 1 1 is prime for n 5 1, 2, and 3. a i2 5 i51 n(n 1 1)(2n 1 1) 6 23. 15, 19, 23, 27, … 11. y y 5 f(x) TIP The function in Example 7 has a gap at x 5 21, and therefore, we say that f is discontinuous at 21. 9 25 5 eccentricity 7 is more elongated. 211.2 2 4.6(c 2 3) 1 1.8c , 0.4(c 1 2) 112. 730 Chapter 8 Sequences, Series, Induction, and Probability EXAMPLE 4 Using the Extended Principle of Mathematical Induction Use mathematical induction to prove that n! . k < 0.052 d. 190 Chapter 2 Functions and Relations EXAMPLE 9 Determining the Domain of a Function Write the domain of each function in interval notation. These antigens are denoted by A, B, and Rh. If an individual's blood contains either the A or B antigen, these letters are listed in the blood type. (23, 22) c. Thus, the k k denominators and are both positive. 0 A 0 44. To find 2A, take the additive inverse of each individual element of A. a 4 j51 66. To expand (a 1 b)3, we can find the product (a 1 b)(a 1 b)2. Solution: (25, 1) and (7, 23) (x1, y1) and (x2, y2) Label the points. 22w 111. loga z5 x 1y 3 b CHAPTER 7 Section 7.1 Practice Exercises, pp. x 5 1 (2`, 8) 7 a2 , `b 6 (2`, `) (2`, 24) ´ (4, `) (2`, 11) (2`, 23) ´ (4, `) (2`, 4) ´ (4, `) b. 12 The number of new flu cases dropped slowly during the first two months. We show three such applications in Examples 4–6. The value x 5 0 is already excluded because it is not on the interval [1, `). 2c3y4(c 1 2) x4 y4 2(2x 1 1) 8x 1 5 85. Solution: To find the value of a9, we need to determine the common difference d. (5, 0) d. A sequence is a sequence in which each term after the first is the product of the preceding term and a fixed , r. x is between 2 and 3. Interchange rows 2 and 3. 2 7. Once the first horse finishes, there are 7 horses remaining that can come in second. 4 5 20. The total vertical distance traveled by the ball is given by 4 1 2 ? d 21. (n 2 m)(x) 5 x2 2 x 2 12; Domain: (2`, `) b. (h + g + f)(x) 86. k in interval notation. Passes through (6, 2) and (23, 1). 25 7. The notation E represents the Furthermore, P(E) 1 P(E) 5 event. Y1 5 2.38(1.5)x b. 4C3 5 4 b. [22, `) 3 2 y 15. 24 25 24 25 x 69. 1 1 1 1 15. 92. Interpret the results from parts (a) and (b). 3.9069 c. The original population is 40,000. 4x 1 2y 5 2 5 4 3 2 y51 1 25 24 23 22 21 21 22 23 23x 5 12 24 25 1 2 3 4 5 x 4x 1 2y 5 2 b. 2 (n 2 r)! 3 15. 5 8 6 94 81 6 15 5 1 i 81. Use the points (4, 11.2) and (14, 13.0) to write a linear model 5 for these data. 2! 3! This formula can be used to evaluate binomial expressions raised to noninteger exponents. 2 1 6 1 18 1 … 1 13,122 8 3 243 121 1 p 1 3 2 512 1 1 1 2 2 2 p 2 8 32 63. f (x 1 h) 5 3(x 1 h) 2 5 5 3x 1 3h 2 5 Substitute (x 1 h) for x. a 6 i51 i51 7 j51 i51 3 n53 3 50 64. 8 16. What is the probability that a player will win if the numbers do not have to be selected in any particular order? Such motion often produces motion sickness, thus earning the aircraft its name. . Find the sum of her yearly salaries over a 20-yr period. False c. (2x 2 5)(3x 1 12) 1 65 5 6x2 1 9x 1 5 ✓ 6 3x2 1 x 1 4 1 11. 21, 4, 29, 16 n11 odd-numbered terms, negative; even-numbered terms, positive odd-numbered terms, positive; even-numbered terms, negative 692 Chapter 8 Sequences, Series, Induction, and Probability Because a sequence is defined only for positive integers, its graph is a discrete set of points (the points are not connected). 633: Nick M Do/Getty RF; p. How many codes can be made if a. c 0 3 4 d 2 21 b. From the graph, the minimum or maximum value of the function is readily apparent. 1 2 x x15 2x (x 1 5)2 x 19 4 2x 2 1 3x 2x 2 7 x231 1 2 33. x 5 22 Increasing: (2`, 0) ´ (1, `); Decreasing: (0, 1); Never constant 0.1x 127. (See Example 3) 11. v1x2 5 20.1436x2 2 0.4413x 1 195.7 d. g. 25 12 17. 61, 62, 64, 68 c. 1g + f 21x2 5 1 ; 3x 1 3 Domain: (2`, 21 ) ´ (21, `) 8. Center: (3, 2) b. 214 In many-day-to-day applications, two variables are related linearly. a 3(2)n21 50. 553: © Julie Miller; p. p1x2 5 ax 1 b 2 b. B ´ C f. Interpret the meaning of the slope in context. 6 d. 5 4 3 2 c. (22, `) g. (2`, 0] d. {210, 2} 103. y 5 2 x 1 b. Find the y-intercept. What is the probability that a given offspring will have green peas? Identity; R 43. A 5 or a heart. (See Example 7) 89. Equation; e , 2 f 2 3 b. 0 mg/L 97. y 5 2.75x 1 29.5 b. 436: © kickers/Getty RF; p. 5 2(12) 1 (24) 5 1160 5 4110 < 12.65 2 2 d 5 2(x2 2 x1)2 1 (y2 2 y1)2 Simplify the radical. The graph in Exercise 64 shows the number of students y enrolled in public colleges for selected years x, where x is the number of years since 1990. The graph shows the depth d (in ft) of a retention pond, t days after recording began. y 5 4x 1 4 c. The t-intercept is (60, 0) and means that after 60 months, the amount owed is $0. This is represented by y 5 3000 for 0 # x # 20,000 Answers 8. For example, if an x-intercept is (24, 0), then the x-intercept may be stated simply as 24 (the y-coordinate is understood to be zero). A C B 75. 2 81y x22 Student Answer Appendix 27. ¢C represents the change in cost per change in time. 4 To write an equation in slope-intercept form, isolate the y variable. Determine the time required for the object to reach its maximum height. The function given by y 5 f (x) shows the value of $8000 invested at 6% interest compounded continuously, x years after the money was originally invested. y 5 4 3 2 (25.1, 22.5) 2 1y54 3 1 25 24 23 22 21 21 22 23 24 25 1 2 3 4 5 x Arbitrarily select negative and positive values for x such as 23, 22, 21, 0, 1, 2, and 3. f(x) 5 0 x 0 1 b. Find the midpoint of the line segment whose endpoints are the given points. Be sure that the window is set to accommodate x values between 17 and 70, and y values between 110 and 142, inclusive. We also know that the outcome of the first event (heads up) does not affect the outcome of the second event (also heads up). Male Female Total Yes No 92 7 4 103 36 102 24 162 128 109 28 265 P(N or F) 5 P(N) 1 P(F) 2 P(N ¨ F) 5 162 102 109 1 2 265 265 265 162 102 P(N) 5 109 265 , P(F) 5 265 , and P(N ¨ F) 5 265 5 169 265 The 102 females who answered "No" are the elements in the intersection of N and F. P1 is true because 1 5 21 2 1. T(80,000) 5 1692 means that the property tax is $1692 for a home with a taxable value of $80,000. Sn 5 Section 8.2 709 Arithmetic Sequences and Series Objective 1: Identify Specific and General Terms of an Arithmetic Sequence For Exercises 7–14, determine whether the sequence is arithmetic. C(x) 5 16x b. That is, the difference between consecutive terms is not the same. x2 1 6x 2 27 61. a1 5 4 and a2 5 12. This means that if 80 cups of lemonade are produced and sold, the revenue and cost are both $160. P(K) 5 524 . If an antigen is absent from the recipient's blood, then the recipient cannot receive blood from a person who has that antigen. 5k11 2 3 5 5 ? Given an infinite geometric series with first term a1 and common ratio r, if 0 r 0 , 1, then the sum S is given by the . x18 (x 1 4) 1x 1 4 4(x 2 3) 3(x 2 4)2/3 1 2 19. Yes 25. A214, 12 B, A214, 212 B d. A dance studio has fixed monthly costs of $1500 that include rent, utilities, insurance, and advertising. 5 4 3 2 The domain is shown on the x-axis in green tint. 24 g. [24, `) c. A solution to an equation in the variables x and y is an ordered pair (x, y) that when substituted into the equation makes the equation a true statement. There is a 5.5% sales tax on the cost of merchandise and a fixed cost of $4.99 for shipping. 235 Reflection across the x-axis Reflection across the y-axis To graph a function requiring multiple transformations, use the following order. Show that 2 is a factor of 5k11 1 1. 3 1 1 5 3 n12 1 1 1p1 2 27 32 n3 79. The cost is $21.95 per box. 55% b. n2 5n Terms in the numerator are perfect squares: 12, 22, 32, 42, . m(a) 5 0 4 1 a 0 c. f (x) 5 e 2x2 1 1 2x 112. The Binomial Theorem Let n be a positive integer. n Sn(1 2 r) 5 a1(1 2 r) Factor each side of the equation. 743 • The number of permutations of n elements taken r at a time is given by nP r 5 n! or equivalently, nPr 5 n(n 2 1)(n 2 2) p (n 2 r 1 1) (n 2 r)! A combination is a collection of distinct items taken without regard to order. Graph N 3 4. Therefore, the graph of g is elongated or stretched vertically by a factor of 2. i11 i2 Look for a relationship between the term number and the values in the numerator and denominator. 12! 5 5 5 455 15C3 5 3! ? $772.20/yr c. 5 4 3 2 1 2 3 4 1 2 5 6 7 8 y 3 2 1 25 24 23 22 21 21 22 1 25 24 23 22 21 21 22 49. This line should be graphed only for x , 21 (that is to the left of x 5 21). 2}; (2, `); 221 iv 3 1 2 2xy3 7 f 3 83. (3, 0), (23, 0) e. 15. The value of m is given as 24. If the sequence is arithmetic, find the common difference d. Determine the value of the annuity if the employee waits to retire at age 65. Airlines often oversell seats on an airplane. 10 yr, 2 months 71. For example, during the summer months, hot ocean temperatures in the Atlantic Ocean often produce breeding grounds for hurricanes off the coast of Africa or in the Caribbean. 24 23 22 21 21 22 21028 26 24 22 22 24 F 26 28 210 x 17. {1} 33. Likewise, (x, 2y) is on the opposite side of and equidistant from the x-axis as (x, y). a2`, d ´ [5, `) 5 5 {23, 4} b. 2 good seeds and 2 defective seeds can be selected. 315 mg d. For consistency, the guided solutions match the style and voice of the original text as though the author is guiding the students through the problems. Graph J Section 4.4 Practice Exercises, pp. h(3) 5 9 f(t) 5 2t2 1 4t f(a 1 h) 5 2a2 2 2ah 2 h2 1 4a 1 4h Substitute x 1 h for x. Then Pn is true for all positive integers n $ j if 1. (Note that the reflections in steps 2 and 3 can be applied in either order.) v(x) 5 212x 1 2 reflect across x-axis y 5 4 3 (21, 1) 2 1 (22, 0) y 5 4 y 5 Î2x 1 2 3 2 y 5 Îx 1 2 y 5 Îx 25 24 23 22 21 21 22 1 2 3 4 5 Reflect over the y-axis: Replace x by 2x. b is the fixed cost. 2x 2 1 , x 1 5 The solution set is the set of x values for which Y1 , Y2. In how many ways can 4 people who bought tickets be selected if each is to receive a $20 gift certificate to a restaurant? We can check the solution graphically by determining where the related function Y1 5 6x 2 2(x 1 2) 2 5 intersects the x-axis. x12 3 17. x 5 5 and x 5 2 51. g(x) 5 3x 2 12 78. an 5 (n 1 1)! n! 4. 1 2 3 4 5 x (0, 21) 23 24 25 Skill Practice 7 Given the function defined by f(x) 5 x3 1 2, determine the average rate of change from x1 5 23 to x2 5 0. y 5 2.28x 2 4.08 45. 3 4 5 4 3 2 1 1 2 y 5 4 3 2 25 24 23 22 21 21 22 1 c. Using the property anam 5 an1m gives (xy)k11 5 xk11yk11 as desired. Over what interval(s) does the depth increase? P ´ Q R.2. Given: M 5 {24, 22, 1, 3, 5} and N 5 {25, 24, 23, 22, 21} List the elements of the following sets. a2`, 2 b ´ a0, b ´ a , 4b 43. 123 d. (2`, 2) ´ (2, `) c. We have 5k11 1 1 5 5 ? 3 10 1. 0.85 b. £ 8 0 2 0 2 21 4 4 † 12 § 25 1 15. The frequency increases, making the pitch of the siren higher to the observer. h(x) 5 0 x 0 2 4 11. {24} 13. Find the average rate of change on the interval [1, 3]. x 5 0 and x 5 3 c. Given an arithmetic sequence with a12 5 276 and a51 5 2193, find a1 and d. Given f (x) 5 022x3 2 4 0 , define functions m, n, h, and k such that f (x) 5 (m + n + h + k)(x). z(t) 5 3 101. Use the model from part (b) to predict the longevity for an animal with an 80-day gestation period. h Finding a Difference Quotient 2 Given f (x) 5 22x 1 4x 2 1, a. A ¨ B 5 {x 0 4 # x , 11} c. Use the second rule in the function: f (x) 5 23. A set that contains no elements is called the empty set (or null set) and is denoted by { } or [. left 7. 1 144b8 2u12 33. Rationalize the numerator of the expression in part (a) and simplify. £ 212 213 8 224 4 41. ax 1 b 1 ay 2 b 5 7 5 9 For Exercises 17–32, information about a circle is given. 2 210 28 26 24 22 22 24 2 4 6 8 10 x 25 24 23 22 21 21 22 28 210 57. g(x) 5 2 1x 15. 33 18. floor(2.8) d. Determine the value of the annuity at the end of the 25-yr period. 179 Reference SECTION 2.3 Functions and Relations A set of ordered pairs (x, y) is called a relation in x and y. in Standard Form 2. Determine the interval(s) over which f is constant. f 21(x) 5 3 A 2 y 9. Then write the equation using function notation where y 5 f (x). Section 8.3 Substitute a1 5 40.96 5 40.96 5 0.512 5 r5 80 a1 5 5 r 715 Geometric Sequences and Series 80 from the first equation into the second equation: 40.96 5 a1r4. m 5 210 27. a1 5 212, d 5 5 b. (22, 2) At x 5 1, the function has a relative minimum of 23. (f 2 g)(3) 14. This matches equation (1). g(x) 5 2 1x 1 4 1 3 y a. a2 , 0b and (1, 27) 2 Solution: a. For example, the expansion of (a 1 b)4 has five terms. 1 2 3 4 5 6 7 8 9 n 5 4 3 2 1 1 21 21 1 2 3 4 5 6 7 8 9 n 21 21 22 23 24 25 1 2 3 4 5 6 7 8 9 n 95. u2 1 2uv 1 v2 2 w2 51. Take the cube root of both sides. If the slope of one line is the opposite of the reciprocal of the slope of the other line, then the lines are perpendicular. Explain why many graphing utilities give an error message for the expression 120! . In such a case, are the events of selecting comedies on the first and second picks independent events? However, g(x) can also be written as g(x) 5 0 2 0 ? There are 5 candidates for the $1000 scholarship, which leaves 4 students left over for the $500 scholarship. y 25 24 23 22 21 22 3 4 1 x 23 85. x1 5 128 vehicles per hour; x2 5 173 vehicles per hour b. Moving up the pyramid, the number of cups in each row decreases by 1. 2k and show that (k 1 1)! . 13,200 a. Domain: (2`, `); Range: [0, `) 7 6 5 4 13. Consider a relation that defines the height y of a tree for a given time t after it is planted. We call each selection a combination of n elements taken r at a time and denote the number of such combinations as nCr. Number of Combinations of n Elements Taken r at a Time The number of combinations of n elements taken r at a time is given by nCr EXAMPLE 7 5 n! nPr , or equivalently, nCr 5 r! ? h(x), the function is not even. In this case, the monthly income is $3000 plus 5% of sales over $20,000. x-intercepts: A2 13, 0B, A22 13, 0B; y-intercept: (0, 12) 81. Section 8.2 Practice Exercises, pp. 71. 183 Given a relation in x and y, we say that y is a function of x if for each value of x in the domain, there is exactly one value of y in the range. See the blue portion of the graph in Figure 2-33. Determine if the relation defines y as a function of x. 2 y 81. a 24. (Hint: This means that the first digit cannot be zero.) 76. 5 57. Each condition in parentheses is an inequality and the calculator assigns it a value of 1 or 0 depending on whether the inequality is true or false. 256c5d3 8 4 2 Student Answer Appendix 33. Job 1 for 10 yr: $784,000; Job 2 for 10 yr: $825,000 67. † 22 5 211 † 5 0 1 25 13 b. (23, 21) ´ (0, `) 81. Determine the break-even point. Find the probability that the committee will consist of all men. As a result, P(A ´ B) can be . x 5 0 a. Write 0.34 as a fraction. Y2 to the right of x 5 2. x2 1 y2 2 8x 1 2y 2 8 5 0 Not all equations of the form x2 1 y2 1 Ax 1 By 1 C 5 0 represent the graph of a circle. 280 large trees and 120 small trees would maximize profit. 23, 25, 211, 229, 283 27. y(x) 5 x Zx 1 1Z 1 4 c. Then the number of distinguishable permutations of the n elements of the set is: p. 7! 5 5040 11! b. 1 4 3 b. x 246 Chapter 2 Functions and Relations Skill Practice 3 Determine if the function is even, odd, or neither. x2 1 4x 1 3 20x 2 30 107. 201 a. 9, 12, 16, 21, 27, … 21. The y-intercept. Use a recursive formula to find the amount in the account an in terms of an–1 for each subsequent year, n $ 2. A2`, 215D ´ C 15, `B 3 b. 93. Write the diameter d of the cone as a function of the radius r. How would you go about estimating the probability of winning the game? The value n is called the upper of summation. t(1.99) d. y 2 2 y1 27 27 2 0 2 5 7 5 27 ? 3 3 By the inductive hypothesis, [1 ? an 5 n 1 b. 117 8. A law office orders business stationery. y 45. Point of Interest Swiss mathematician and physicist Leonhard Euler (1707–1783) is credited with the use of the modern symbol S to represent a sum, i to represent the imaginary unit, and e to represent the base of the natural logarithmic function. Find a n b(x) and write the domain of n in interval notation. Center: (23, 1); Vertices: A23 1 15, 1B, A23 2 15, 1B; Foci: A23 1 2 13, 1B, A23 2 2 13, 1B (y 2 4)2 (x 2 2)2 5 2 51 a. TIP In Example 4(b), we suspect that g is an odd function because each term is of the form xodd. {17} 2 {223} 53. R a. Skill Practice 2 Use mathematical induction to prove that Pn: 1 1 1 n 1 1 1p1 5 . 1 1 23. A molasses cookie is selected. [0, 1] b. (29, 1) Radical equation and an equation in quadratic form b. x 5 2y or x 5 2y 123. 54. Therefore, the term x is not first degree and the equation is not a first-degree equation. The domain is (2`, `). 2 1 1. 3y 5 1.5x 2 5 c. True 5 3 4 5 2 3 4 5 x 9 8 7 m(x) 5 ⎛ 32 ⎞ 1 25 24 23 22 21 21 1 y y 8 7 6 5 4 3 2 x ⎝ ⎠ 1 2 3 4 23. Suppose that a roll of wire has 200 ft. f (21.5) y a. EXAMPLE 5 Finding the Number of Terms in an Arithmetic Sequence Find the number of terms of the finite arithmetic sequence 7, 3, 21, 25, … , 2113. x 5 25 g. With each bounce, the ball rebounds to 50% of its original height. 5 4 3 2 2 3 4 5 25 24 23 22 21 21 22 23 23 24 25 24 25 22. Functions 3. 22x 1 4y 5 12 53. If a fair coin is flipped H H n times, the number of HT T head/tail arrangements H TH follows a geometric T T sequence. Determine the percent difference between the approximate value and the actual value. y 5 2f (x 1 1) 2 3 1 25 24 23 22 21 21 22 0 166 82. Dividend: 6x2 1 9x 1 5; 2x 2 5 Divisor: 2x 2 5; Quotient: 3x 1 12; Remainder: 65 c. The fixed monthly cost for use of a Health Department–approved kitchen and rental space at the farmer's market is $790. 2 c 2 3 3 2 2 c. a b(1) f e. 76. a g b(24) For Exercises 19–26, refer to the functions r, p, and q. 59.75 in. y 5 20.000838t2 1 0.0812t 1 0.040 b. The profit function P is shown for producing and selling x items. A1 2 17, 2B, A1 1 17, 2B 17 e. 4x 1 3 a. h(t) 5 12 2 t Solution: The domain is all real numbers except those that make the denominator zero. 8 y 52 3 x 1 1 1 1 x 23 22 21 21 22 7 y 524 x 1 7 1 2 3 4 5 6 7 x d. $103,974 $42,560 73. f(a) 5 8 2 Za 2 2Z b. e 2 6 f 2 2 2 6 6 a 5 1, b 5 27, c 5 4 53. Use the binomial theorem to find the value of (3 1 2i) where i is the imaginary unit. 22x2 2 4xh 2 2h2 1 7x 1 7h 2 3 c. Avoiding Mistakes The only functions that are symmetric with respect to the x-axis are functions whose points lie solely on the x-axis. What type of symmetry does an even function have? {730} b. C(x) 5 1.49x 2 1.00; x $ 1 The cost function is a linear function with $1.49 as the variable rate per song. Therefore, to graph an equation of a circle such as (x 1 5)2 1 (y 2 3)2 5 9, from Example 3, we first solve for y. 67. Find the sum of the integers from 220 to 256. {(6, 28, 2)} {(1, 12, 17)} 29. {x 0 0 # x , 2} c. 244 Chapter 2 Functions and Relations EXAMPLE 1 Testing for Symmetry Determine whether the graph is symmetric with respect to the y-axis, x-axis, or origin. Evaluate a (ai 2 a)2. ElnA4 6 110B F; x < 1.9688, x < 20.1771 5 5 125. { } 57. Find (g 2 h)(x) and write the domain of g 2 h in interval notation. Round to the nearest tenth of an inch. (2`, 2) ´ (2, `) b. Parent function: y 5 5 x y 5 f(x) 86. C1x2 5 e 7.99x 799 1 6.991x 2 1002 for 1 # x # 100 for x . Write the equation in standard form. Substitute n 5 20, a1 5 75,000, and a20 5 151,000. y2 5 x y c. 2 23. Two fire observation platforms are located at points A and B. A scatter plot is a visual representation of a set of points. Using the "Auto" setting means that the table of values for X and Y1 will be automatically generated. If the measure of one angle is x degrees, write a relationship representing the measure of the other angle C(x) as a function of x. Our intuition tells us that the probability should be less than 12 because it is more unlikely that the desired outcome will happen twice in a row than one time. The point (21, 25) is the lowest point in a small interval surrounding x 5 21. l 5 13 w 7 73. 5 y y 5 f(2x) 4 3 2 1 29 28 27 26 25 24 23 22 21 21 22 1 x 24 25 g(x) 5 2x2 y y5f 1 2 5 x 1 23 24 25 1 2 3 4 1 x 5 x (24, 2) g(x) 5 Î2x Reflect across the y-axis (4, 2) 1 25 24 23 22 21 21 22 f(x) 5 Îx 1 2 23 (2, 24) Figure 2-26 4 3 2 29 28 27 26 25 24 23 22 21 21 22 Reflect across the x-axis 23 24 25 5 4 3 2 (2, 4) 1 25 24 23 22 21 21 22 23 b. f (0) 5 3(0)2 1 12(0) 1 5 55 1 25 24 23 22 21 21 22 5 To find the x-intercept(s), find the real solutions to the equation f (x) 5 0. Suppose that an infinite series a1 1 a2 1 a3 1 1 an approaches a value L as n S `. Let Pn be the statement a1 2 b a1 2 b p a1 2 b5 . 1 • If m1 and m2 represent the slopes of two nonvertical perpendicular lines, then m1 5 2 or equivalently m2 m1m2 5 21. This is not a function. v 5 12gh 123. y2(y 1 1) 5x 1 21 1 49. 1 5 1 1 5 < 0.0000305 73. (See Example 3) 21. The resulting equation is equivalent to the original equation. $158.89 125. s(x) 5 x2 2 4x 2 12 x11 c. 1.656 Section 8.6 Practice Exercises, pp. Yes; r 5 15 2 2 17. Center: (27, 5); Radius: 2 Yes 5. Proof by mathematical indicates that Pn is true for all positive integers n if (1) is true, and (2) the truth of Pk implies . {10,000} 123. 0.025 11 1331 y b. The point-slope formula is useful to build an equation of a line given a point on the line and the slope of the line. x 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 24 25 24 25 33. (3n 2 1)! 4. { } {0} 51. Determine the distance Joe travels in 40 min. Write the formula for the slope of a line between the two distinct points (x1, y1) and (x2, y2). z 5 y2; This is an equation of a parabola in the yz-plane. 7 1 69. f (2) 5 22 and f (3) 5 1. 191–197 R.1. E215, 15F 5 R.2. e 2 , 3 f 4 R.3. [28, `) 7 3 R.4. e 2 , 2 f R.5. a. Therefore, n(E) 5 6 and n(E) 6 1 5 5 . f (x) 5 • x x for x . Slant asymptote: y 5 2x 2 5 17. The radius should be no more than 1.9 in. a b(3) g f. z 5 97 146 (p 2 6)3 (2r 1 1)3 1 R.2. 5 R.3. 18 R.4. R.5. 3 (r 2 2)2 p3 sequence; finite 3. That is, there are 20 permutations of 5 people taken 2 at a time. 4! 40. (24, 21) b. 0 7. If a person is selected at random from the population of China, what is the probability that the person is over 60 years old? c 55. 13.2 ft y 23. The general shape of y 5 x is similar to the graph of y 5 x2 for even values of n greater than 1. Shrink y 5 x6 vertically by a factor of . (24, `) 12. {14} 33 f 27. {5} 75. $36,000 b. x 5 14 23. 24(x 2 5) 1 3x 5 23x 1 1 b. a b 3 5 e. Determine the probability that there will not be enough seats. e , 2 f 2 2 27. a cai 5 c a ai i51 i51 n n n 3. Never decreasing 3 h. 236 23. 0, y.0 71. It travels 60 mph for 1 min and then decelerates for 20 sec until it comes to rest. 90 # d # 110 yd 73. See the red portion of the graph in Figure 2-34. ¢C What does represent? However, in the case of the Pythagorean theorem, the converse is a true statement. Section 8.7 EXAMPLE 7 757 Introduction to Probability Computing an Empirical Probability of (A or B) The safety and security department at a college asked a sample of 265 students to respond to the following question. an TIP In some cases, we may define a sequence with a domain beginning at zero or some other whole number. a1 5 4, d 5 22 18. g(f (23)) 5 g(3) 5 21 c. 0 3 2 (24) 0 or 0 24 2 3 0 ; 7 73. Write P as a function of A. 1 5 1; This represents the graph of an ellipse in the xy-plane. z 5 2.4x 1 0.55y 35. 8 a. 2t(t 2 4)(t 2 10) 27. symbol. Foci: Q 1149 R, Q2 1149 4 , 0R 4 ,0 e. a21, b 25. log12 p 2 log12 q 15. Each swing (one way) thereafter makes an arc of 85% of the length of the previous swing. No; Focal length is a distance and gives no information regarding the orientation of a parabola. 21 5. Therefore, the total number of passwords is given by There are 26 choices for each letter. (x 2 4)2 1 (y 2 6)2 5 16 y b. An equation of the form y 5 k where k is a constant represents the graph of a line. 5 4 3 2 5 4 3 2 1 1 25 24 23 22 21 21 22 1 2 3 4 5 x 25 24 23 22 21 21 22 23 4 5 1 2 3 4 5 1 2 3 4 1 2 3 4 x 24 25 24 25 c. 23(x 1 2) 1 1 5 2x 1 5 b. g(f (24)) y 5 g(x) 23 24 25 g. { } 3 9 4 1 110 4 2 110 d ´ c , `b a2`, 2 2 {9}; The value 23 does not check. See nth term of sequence Geometric sequences explanation of, 712, 765 nth partial sum of, 715 nth term of, 714–715 terms of, 713–714 Geometric series finite, 715–716 infinite, 716–718, 765 Geometry. increases e. The number of elements in E is the number of possible ways to select 2 women from a group of 5 women without regard to order. 48. For example, if a y-intercept is (0, 2), then it may be stated simply as 2. True 91. Days after Adoption Weight (lb) 40 30 (0, 11) 20 (40, 22) 10 0 0 10 20 30 40 Number of Days 50 60 a. TIP In Example 8 there are 8 elements in the sample space: BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG The event BBB occurs 1 time. Power Points present key concepts and definitions with fully editable slides that follow the textbook. t(3.001) c. identity 7. To Elka Block, Jennifer Blue, and the team at DiacriTech, many thanks for doing multiple levels of accuracy checking. Evaluate 10P3 and 10C3 and compare the results. 7 13 P(A ´ K) 5 P(A) 1 P(K) There are 4 aces in the deck out of 52 cards. {(210, 1, 0, 1)} SA-36 Student Answer Appendix 61. 156 265 b. 1 25 24 23 22 21 211 222 1 2 3 4 5 x 23 The range is shown on the y-axis in red tint. • The Guided Lecture Notes are keyed to the objectives in each section of the text. This is the inductive hypothesis. These equations represent the top and bottom semicircles. Linear Equation in Two Variables Let A, B, and C represent real numbers such that A and B are not both zero. £ 0.2 223 7 7 6 6 1 12 § 31. 2 x 12 x 19 29. {(3, 1), (2, 5), (24, 2), (21, 0), (3, 24)} b. To verify, we can write several terms of the sum. Find an equation of the median of a triangle drawn from vertex A(5, 22) to the side formed by B(22, 9) and C(4, 7). 5 4 3 2 25 24 23 22 21 21 22 y 5 f(x) 1 x 25 24 23 22 21 21 22 23 24 25 y 5 f(x) 1 2 3 4 5 x Section 2.7 y 95. f (0.1) b. Relative maximum of 3.726 at x 5 0.667; Relative minimum of 22.625 at x 5 22.500 10 10 210 10 210 210 10 210 b. 25 4 79. Domain: (2`, `); Range: (2`, 8] 2 4 3 2 1 25 24 23 22 21 21 1 2 3 4 5 x 2 3 4 5 x 11. • Sections R.1, R.2, 1.7 & 1.8 have been streamlined to provide greater clarity. 21 c. The kitchen is 14 ft by 10 ft. 12r Sn 5 a1 rSn 5 a1r 1 a1r2 1 a1r3 1 a1r 1 a1r2 nth Partial Sum of a Geometric Sequence The sum Sn of the first n terms of a geometric sequence is given by a1(1 2 rn) 12r where a1 is the first term of the sequence and r is the common ratio, r fi 1. horizontal f (x2) 2 f (x1) 7. g(0) b. 0 t 2 5 0 or 0 5 2 t 0 3. Vertical asymptote: x 5 1; Horizontal asymptote: y 5 0 f. (3, `) g. 5 34,650 27. one 31. Graph I 10. Section 8.4 Skill Practice Answers 1 Let Pn denote the statement that 2 1 4 1 … 1 2n 5 n(n 1 1). Is this an arithmetic or geometric sequence? Find (g + f)(x) and write the domain in interval notation. This image is symmetric with respect to the y-axis. an 5 1n 1 3 3ln n 12. 2 1 2 x x 17 x 15 (x 1 5)2 3 3x 1 1 x25 2x 1 1 1 2 37. Reference SECTION 8.3 Geometric Sequences and Series A geometric sequence is a sequence in which each term after the first is the product of the preceding term and a fixed nonzero real number, called the common ratio. Likewise, if we solve for y, we have y 5 k 6 2r 2 2 (x 2 h)2. (f + h + g)(2) 62. (9, 28) 29. Using a1(1 2 r n) , the total amount invested for t years is given by the relationship Sn 5 12r P[1 2 (1 1 r)t] P[(1 1 r)t 2 1] P[1 2 (1 1 r)t] 5 or simply A 5 A5 2r r 1 2 (1 1 r) If deposits are made n times per year, then the interest rate per compounding period is nr , and the total number of times the money is compounded is nt. Furthermore, the sum of the exponents must equal n. Write a linear revenue function that represents the revenue R(x) for selling x items. y 210 210 10 10 210 210 133. f (x) 5 1x 11. y 49. Apply the equivalence property of exponential expressions. (x 1 1)3 2 (x 2 1)3 f (x 1 h) 2 f (x) h 51. x 5 7, x 5 22 b. The equation x2 1 y2 5 z2 has infinitely many positive integer solutions for a, b, and c. 22 2 59. w 1 (23) 93. 24x 1 2 for x , 21 for 21 # x # 2 f (x) 5 • x2 5 for x . f (x) 5 8x 1 4 35. 6n4 2 36n3 1 58n2 1 12n 2 20 17. a (3k 1 7) k51 4 17. (g + f)(24) 59. x 1 5 The solution set is the set of x values for which Y1 . 8 b. a g b(8) h 16. (25i)2 1 25 5 0 ✓ 2 a. So instead of graphing a single smooth curve, it graphs a series of short line segments. (2`, 22) ´ (0, 2) e. 7 yr 19. 3, 6, 12, 24, … 1 1 28. Assume that Pk is true; that is, assume that 3 is a factor of 4k 2 1. 1 25 24 23 22 21 21 22 1 2 3 4 5 x f (x) 5 e 0 x 0 for 24 # x , 2 2x 1 2 for x $ 2 y 5 f(x) 23 24 25 We now look at a special category of piecewise-defined functions called step functions. 30 lb 31. (1.2, 2.8); m 5 2.4 For Exercises 75–78, a. (0, 6) y f. r k ! p. 14 30 420 ? x13 x22 (x 2 2)2 67. Section 8.2 701 Arithmetic Sequences and Series Expanding Your Skills 109. y 2 y1 5 m(x 2 x1) y 2 (23) 5 22(x 2 2) y 1 3 5 22x 1 4 The slope of a line perpendicular to the given line is 22. c(x) 5 0.125x c. y 8 7 F 6 5 4 3 2 1 28 27 26 25 24 23 22 21 22 1 2 x Student Answer Appendix 41. Each pen can be 25 yd by 10 yd, or it can be 15 yd by 3 Section 1.6 Practice Exercises, pp. 1, 5, 10, 16, 23, … a2 2 a1 5 5 2 1 5 4 a3 2 a2 5 10 2 5 5 5 The sequence is arithmetic because the difference between each term and its predecessor is the same constant. Cherise has a job that pays $48,000 the first year. 25 L of 36% solution and 15 L of 20% solution should be mixed. No; The element on the main diagonal in the second row is not 1. The graph of y 5 f A 12xB is the graph of y 5 f (x) stretched horizontally. Use slope-intercept form to write an equation of the line that passes through the two given points. By the inductive hypothesis, 3 3 C 34 1 163 1 p 1 4k D 1 4k 1 1 5 C1 2 A 14 B k D 1 34 A 14 B k 1 1 k 1 k11 5 1 2 4 A4 B 5 1 2 A4 B as desired. This is written in the form g(x) 5 a f (x) with a . E3: A white marble is selected. In such a case, the outcomes are called combinations (rather than permutations). 0.052x 2 0.013y 5 0.39 Technology Connections For Exercises 109–112, solve the equation in part (a) and verify the solution on a graphing calculator. The multiple-choice questions each have 5 possible responses (a, b, c, d, e) of which only one is correct. Passes through (24, 0) and m 5 . How many different types of pizza can be made? Applying an Arithmetic Sequence A park ranger in Everglades National Park measures the water level in one region of the park for a 5-day period during a drought. Find 1P + P2 1x2 and interpret the result. parabola; directrix; focus 3. log(a2 1 b2) 2 4 5 ln x 1 2 ln y 2 ln w 2 ln z 3 2 3 2 a6 2 c b 24. The length must be 300 ft or less. 2 3 4 x 5 25 21. (12, 68) ´ (184, 200) c. F1 5 1, F2 5 1, F3 5 2 33. See Real number line Numbers. If the vendor produces and sells 80 cups of lemonade, the cost and revenue will be equal, resulting in a profit of $0. 6 9 12 15 5 4 F 2 x 15 e. [2, 14] 34. inversely 9. Given (y 1 2)2 5 28(x 2 1), a. 0, then the graph will be a circle with radius r 5 1c. f (x) 5 2x2 1 4x 2 5 The parabola opens downward. 51. Graph y 5 f (2x). The slope of both lines is 214 . n 5 38 21. 1st Generation 2nd Generation 2 parents 4 grandparents 3rd Generation 8 great-grandparents The terms of the sequence 2, 4, 8, 16, … give the additional number of ancestors for each generation back in time. 382 1. Directrix: y 5 22; Axis of symmetry: x 5 26 c. Notice that a quadratic function has a leading term of second degree. and your students. Millage rate is the amount per $1000 that is often used to calculate property tax. EXAMPLE 4 Finding a Specific Term of a Sequence Given the sequence defined by bn 5 n2 , find b6. 5 6 y 23 22 21 21 2 15. 5 1 10 1 20 1 … 1 5120 Solution: The common ratio is 2 and a1 5 5. If four people are randomly selected, find the probability that all four have the A antigen. {x 0 x , 9} d. f (2) x 281 Review Exercises 0 x 0 for x # 2 2 for x . k(x) 5 1x 1 3 a. a1 5 3, d 5 10 16. 3 15. (22, 0) 1 3 11 1 2 x 1 x b. EXAMPLE 1 Identifying Elements of a Set Given A 5 E 13, 0.83, 2197, 0.39, 216, 0, 11, 0 .2020020002p , 0 .444F, determine which elements belong to the following sets. Suppose that an object starts with an initial velocity of v0 (in ft/sec) and moves under a constant acceleration a (in ft/sec2). • Concept Connections prompt students to review the vocabulary and key concepts presented in the section. The maximum protein content is 1140 g. A 5 c 1 c. 2 5 1; x $ 0 or x 5 2 1 1 2 2 4 81 B 81 (372) (334) 12 microns 65. A21 5 ≥ 20.12 0.15 b a ad 2 bc a ` 1 a 2ac 0 d 1 ad 2 bc 2ad 2b bc d a ad 2 bc 2b d , provided ad 2 bc fi 0. (2, 0) d. b 5 2a2 2 c2 t5 v0 6 2v 02 1 128 32 29. If the sequence is arithmetic, find d. This is consistent with the solution x 5 94 . x 5 3 Geometric; r 5 2a3 51. Vertex: (2, 0); Focus: (2, 24); Endpoints of latus rectum: (10, 24), (26, 24) Directrix: y 5 4; Axis of symmetry: x 5 2 12 10 F y 8 7 6 5 x y C(23, 2) p 5 32 b. 0 (multiplicity 1), 22 (multiplicity 3), 24 (multiplicity 1) 5 9 31. {(1, 2, 3)} 49. decreasing 5. Center: (0, 0) 23. If the interest rate is 5.5%, find the value of the annuity when the employee retires at age 62. 1 3. 25y2 2 4x2 2 12x 2 9 3 2 55. Yes; d 5 211 11. 11 11 c. (x 1 1) (x 1 2) 3 47. (y 2 4) (x 2 3) 1 51 4 9 62. (2.6, 4.1) and (9.5, 23.7) 2 3 34. 1 5 1 4 7 58. (3x 1 1)2y3(8x 1 1) 87. Combine like terms. b. 75. a6 5 2 16 an 5 a1rn21 80 5 a1r(221) 40.96 5 a1r(521) 80 5 a1r 40.96 5 a1r4 Substitute a2 5 80. x 1 y 61. In her first week of training, Sandy walks for 10 min on a treadmill every day. • f is an even function if f (2x) 5 f (x) for all x in the domain of f. 4 hr 35. 5 Fk13 2 1 as desired. A musician plans to perform 9 selections. k(x) 1x 2 1 k 5 2 c. e ax, ea 12 2 3z 4 2 z , , zb ` z is any real number f 5 5 37. Use the graph of y 5 f (x) to estimate 15. Given a 2.5% grade, write this as a slope in fractional form. In geometry, it is known that the tangent line to a circle at a given point A on the circle is perpendicular to the radius drawn to point A. (0, 3) e. Find the length of the 5 diagonal shown. In Example 5, we determine the number of permutations from a group of n items in which fewer than n items are selected at one time. The person is 61 or older. Informally, a function is increasing on an interval in its domain if its graph rises from left to right. in. E 5 n 1n kmn 5 c5 3 21. (23, 0) and a , 0b 2 p(x) 52 1 2 3 4 d. Therefore, 4 is a factor of 9k11 2 1. an an an 5 5 5 5 a1 1 (n 2 1)d 75,000 1 (n 2 1)(4000) 75,000 1 4000n 2 4000 4000n 1 71,000 b. Number of Views by Day Number 25 20 15 10 0 2 24 25 35 5 1 23 y 99. Shift 3.7 units to the right. {(4, 7)} 45. 1 23 e ax, 2 x, 2 xb ` x is any real number f or 5 5 E(25y, y, 23y) @ y is any real numberF or 5 1 e a2 z, z, zb ` z is any real number f 23 23 She put $2000 in savings, and invested $12,000 in the bond fund and $6000 in the stock fund. Then Pn is true for all positive integers n if 1. Suppose that a box of DVDs contains 10 action movies and 5 comedies. 261 120. Further suppose that an expensive 8 ft by 10 ft oriental rug is placed on the floor. 6a 1 5ab 2 4b 2a2 b. Write 0.5 as a fraction. [$1820]; The value $1820 represents the total revenue from the sale of these four items. If two cards are drawn at random with replacement from a standard deck, what is the probability that both are hearts? The Fibonacci sequence is defined recursively as a1 5 1, a2 5 1, an 5 an22 1 an21 Section 8.1 Sequences and Series 693 The first two terms of the Fibonacci sequence are 1, and each term thereafter is the sum of its two predecessors. 729 • First prove the statement for n 5 j. {21 1 ln 20} (2`, 24) ´ [3, `) 17. The manager should mix 4 lb of peanuts with 16 lb of the 45% mixture. This value (roughly 1 in 23 million) means that it is highly grand prize is 22,957,480 unlikely to win the grand prize. Suppose that we superimpose the x-axis at the waterline. [y 5 h(x) The domain is shown on the x-axis in green tint. a (21)n11 n 2 n52 5 c. S2(x) 5 πx2 a. g(3) e. (g ? EXAMPLE 1 Graphing Linear Equations Graph the line represented by each equation. $39,000 b. 40,000 (25, 35,854) 30,000 (10, 14,577) 20,000 10,000 0 y 54. cn 5 12A212 B n 8. To Patricia Steele, the best copy editor ever, thank you for mentoring us and for ensuring consistency throughout our work. Find the average rate of change in speed between waves that are between 1 m and 4 m in length. There is a sales tax of 5.5% and a processing fee of $8.00 for a group of tickets. Write the first five terms of an arithmetic sequence with the given first term and common difference. Objective 2: Prove a Statement Using the Extended Principle of Mathematical Induction For Exercises 25–28, use trial-and-error to determine the smallest positive integer n for which the given statement is true. The data in the graph show Dodger's weight y (in lb), x days after adoption. 4 Furthermore, from Section 2.6 we know that the graph 3 2 2 of f (x) 5 a(x 2 h) 1 k is related to the graph of 1 y 5 x2 by a vertical shrink or stretch determined by a, x 25 24 23 22 21 1 2 3 4 5 a horizontal shift determined by h, and a vertical shift 21 Vertex 22 determined by k. Shift 1 unit to the left. Therefore, the exponent on a must be 3 so that the sum of the exponents is 10. x 5 25 e. That is, the two events do not overlap. a , b 21. False 5. Engaging. Yes; The center of Hawthorne is 15 km from the earthquake. Yes 9. (2`, 12) 5 Quadratic equation b. 188 • The x-intercepts are the real solutions to f (x) 5 0. Relation Is a Function Apply Function Notation Determine x- and y-Intercepts of a Function Defined by y 5 f(x) Determine Domain and Range of a Function Interpret a Function Graphically • The cost of mailing a package is related to the weight of a package. 1 2 3 4 5 x This is a function. < 10.8 in. t 1 (3 1 9); t 1 12 1 95. 3x2 1 3xh 1 h2 d. Center: (0, 21) 31. (m 1 p)(1) b. Find 1A + A2 1x2 and interpret the result. Explain the difference between the graphs of f (x) 5 0 x 2 2 0 2 3 and g(x) 5 0 x 2 3 0 2 2. Insert three arithmetic means between 4 and 28. Solution: an 5 a1 1 (n 2 1)d The first term of the sequence is 7. c 1.1 79 c. is needed. Dividend: 2x4 2 4x3 1 x 2 5; Divisor: x2 2 3x 1 1; Quotient: 2x2 1 2x 1 4; Remainder: 11x 2 9 7. Event E is certain to happen. f 21(x) 5 211 2 x Domain: (2`, 1]; Range: (2`, 0] Domain: (0, `); Range: (2`, `) b. EXAMPLE 5 Finding the nth Term of a Sequence Find the nth term an of a sequence whose first four terms are given. y 1 1 11. (6 2 0)! 0! ? (n 1 1)! 3! 4! 2! 1 1 1p1 7 14 21 7n 1 8 27 64 b. 0 2x 2 3.8 0 2 4.6 $ 7.2 c. (23, 0) and (1, 0) d. 5 4 3 2 5 4 3 2 y 5 f(x) 1 x 25 24 23 22 21 21 22 1 2 3 4 5 5 4 3 2 y 5 f(x) 1 x 25 24 23 22 21 21 22 y 91. Vertex: (1, 25); p 5 21; Focus: (1, 26); Focal diameter: 4 b. Show that x, x 1 2, x 1 4, x 1 6, … is not a geometric sequence. 61, 62, 63, 64, 66, 612, 6 , 6 , 6 3 3 3 c. An object in free fall is dropped from a tall cliff. 16 81. y 5 4 3 2 1 2 3 4 5 x 129. Compute the sum of the first 50 positive integers that are exactly divisible by 5. 18, 6, 2, , … 3 Solution: 2 a. ex2h d. a3 5 2a2 1 1 5 2(9) 1 1 5 19 Substitute a2 5 9. 1 23 100 Height vs. If not, how are they different? Show that Pk11 is true; that is, show that (k 1 1)2 2 (k 1 1) is even. y 5 1x 3. a3 5 72 and a6 5 722 Chapter 8 Sequences, Series, Induction, and Probability Objectives 2–3: Evaluate Finite and Infinite Geometric Series For Exercises 49–72, find the sum of the geometric series, if possible. f (8) 5 3 b. Enter 55 for x and press the ENTER key. 1) Horizontal stretch (if 0 , a , 1) 2) Replace (x, y) by A ax , yB. 22, 5, 25; each of multiplicity 1 5 25. Skill Practice 1 A sock drawer has 6 blue socks, 2 white socks, and 12 black socks. What does A1(x) 5 π(x 1 5)2 represent? R 97. 0, , 2 , 613; each of multiplicity 1 3 2 33. g(x) 5 (x 2 2)2 c. Refer to the graph of the sequence {an}. R 93. m 5 0 43. • SmartBook content has been revised and enriched. {0, 3, 4, 6, 8, 9, 12} b. 0 200 400 600 Calories 800 b. Write the equation in slope-intercept form if possible, and determine the slope and y-intercept. Center: (0, 0) Vertices: A 17, 0B, A217, 0B Foci: A2 13, 0B, A22 13, 0B 135 y 5 135 7 x and y 5 2 7 x b. The probability of selecting a blue marble is 103 . Yes c. then m1 5 2 m2 3 5 Section 2.5 215 Applications of Linear Equations and Modeling In Examples 3 and 4, we use the point-slope formula to find an equation of a line through a specified point and parallel or perpendicular to another line. (0, 0) and a2 , 0b f. Passes through (3, 24) and m 5 0. y 5 4 6 5 4 x 8) 22.4 5.8 9 R.4. Interval notation: c 2 , `b 2 9 2 2 1. (x 2 h) 5 4p(y 2 k) 8. p logb x 5. If there are 9 women and 7 men in the class, in how many ways can the instructor choose 3 men and 3 women? X 5 c d 17. If 82 private lessons are held during a given month, how much money will the studio make or lose? m 5 130 12 1 41. 61. 5 x c. 1 1 13. Let a represent a positive real number. Scenario 1: The salesperson sells $20,000 or less. There are two drawbacks to this method. {(8, 1), (5, 22)} 135 4 2 2 43. Given an equation in the variables x and y, use the following rules to determine if the graph is symmetric with respect to the x-axis, the y-axis, or the origin. For Exercises 31–36, evaluate nPr. 31. An investment earns 4.5% interest paid at the end of 1 yr. Shift y 5 x3 to the left 2 units. principle; counting; m ? Maximum: 1 2 h. To find the number of terms n, substitute 5120 for an. 4 6 i, 3 1 4 37. 0 x2 2 x1 ¢x change in x (run) EXAMPLE 2 Finding the Slope of a Line Through Two Points Find the slope of the line passing through the given points. 1 f. Next, test whether h is an odd function. 25 24 23 22 21 21 22 23 24 25 c. Undefined c. For example, for a recent year, a single person with taxable income of more than $36,250 but not more than $87,850 pays $4991.25 plus 25% of the amount over $36,250 in federal income tax. That is, a byte is a sequence of 8 binary digits. 21 d. (24, 2), (22, 2) d. e a , 2 b f 61 61 31 24 22 4 3 g(x) 5 ln(x 1 4) 2 1 1 25 24 23 22 21 21 22 1 2 3 4 x 5 25 24 23 22 21 21 22 2 3 4 5 x 24 y b. 24 23 22 21 21 22 212 27. 2, 4, 8, 16, … 9. 5 23 24 25 59. 2 a b 1 ab 2 2 4 t b 3 4 3 13. The expression n2 2 n 1 11 is prime for all positive integers n. 5 a. a 5 5 12 12 d ´ c , `b 33. g(x 1 h) For Exercises 57–62, find and simplify f (x 1 h). See also nth roots; Square roots Roster method, 2 Row-echelon form, of matrix, 566–569 Row equivalent matrices, 565 Row matrix, 586 Rudolff, Christoff, 39 S Scalar, 588 Scalar multiplication, 588–589 Scatter plot, 197 Scientific notation explanation of, 22, 73 on graphing utility, 24 multiplying and dividing numbers in, 23 writing numbers in, 22 Secant lines, 203 Second-degree equations. The reason is that for each combination of 3 items, such as A, B, and C, there are 3! 5 6 permutations: ABC, ACB, BAC, BCA, CAB, CBA. g(1) e. The x-intercepts are a 212 6 2 121 5 6 2. Find the average rate of change in the number of new flu cases between months 0 and 2, and interpret the result. 2 ? After a service call by a plumber, the company follows up with a survey to rate the service and professionalism of the technician. 534 cm3 The divisor must be of the form (x 2 c), where c is a constant. 12 people 32 A 41. g(x) 5 x2 2 c. 212 30. x2 1 11x 2 34 A2y 2 1B 3y4 A9 2 x2 B 1y2 2. This will help you remember that a rational number is a ratio of integers. 5! Solution: b. (225, `) 49. 0 x 2 1.7 0 1 4.95 $ 11.15 c. a b ? Directrix: y 5 24; Axis of symmetry: x 5 1 c. h(g(2)) 49. x 1 2y 2 z 5 25 y 1 3z 5 13 x 1 2z 5 5 49. Write an expression for the nth term of an arithmetic sequence that represents the salary as a function of the number of years of employment, n. is a subset of the sample space of an of event E. y 5 x 2 1 3 88. Determine the range of f. The value 1206! is too large to evaluate on most calculators. 21x2 2 x1 2 2 1 1y2 2 y1 2 2 5 d 2(x 2 h)2 1 (y 2 k)2 5 r (x 2 h)2 1 (y 2 k)2 5 r2 Distance between (h, k) and (x, y) Squaring both sides of the equation results in the standard form of an equation of a circle. f (29) 80. 256, 268, 280, 292, … 12. Horizontal stretch (shift) Horizontal and vertical stretch and shrink Reflections across the x- and y-axes Vertical translation (shift) Section 2.6 EXAMPLE 7 237 Transformations of Graphs Using Transformations to Graph a Function 1 Use transformations to graph the function defined by n(x) 5 2 (x 2 2)2 1 3. f (x) 5 15x3 2 53x2 2 30x 1 8 11. c21 5 211.16, c116 5 27.36; Find c505. Interpret the meaning of the slope in the context of this problem. Write the expansion of (x 2 y)4. Use the least-squares regression line to approximate the systolic blood pressure for a healthy 55-year-old. P 5 2l 1 2w 7. If the money is respent in the community over and over again at a rate of 68%, determine the total amount spent. {4} d. An individual with questionable integrity prints and spends $12,000 in counterfeit money. Not possible 46. If the height of a girl at age 11 is 90% of her full-grown adult height, use the result of part (c) to estimate the average height of adult women. An ancestor is a person from whom an individual is descended (a parent, a grandparent, a great-grandparent, and so on). Find the absolute value of the slope of the storm drainage pipe. In how many different ways can the survey be filled in? Expanded Chapter Summary available at www.mhhe.com/millercollegealgebra. A pediatrician records the age x (in yr) and average height y (in inches) for girls between the ages of 2 and 10. 4 3 2 f(x) 5 x2 2 3; x # 0 1 y R.3. 23 f(x) 5 !x 1 1 f(x) 5 x2 2 3; x # 0 22 1 79. The graph of an even function is symmetric with respect to the y-axis. Prove a Statement Using the Extended Principle of Mathematical Induction 1 1 1 1 1 1 1 1 1p1 1?2 2?3 3?4 4?5 n(n 1 1) The sequence of terms that make up the sum is neither arithmetic nor geometric. 4 5, 47. Over what interval(s) does the height increase? fraction decomposition 3. 29. a5 5 2a4 1 1 5 2(39) 1 1 5 79 The first five terms are 4, 9, 19, 39, 79. 243(right): © McGraw-Hill Education; p. Determine the exact length and width of the rectangle shown. The graph of y 5 13 f (x) is the graph of y 5 f (x) with a (choose one: vertical stretch, vertical shrink, horizontal stretch, horizontal shrink). y 1 2 3 4 5 x 23 24 25 1 2 3 4 x b. b2 b Therefore, y 5 2b2 or y 5 . Center: (3, 0) b. E2 5 {B1, B2, B3} The number of blue marbles is 3. 7, 14, 42, 88, … 15. A slot machine in a casino has three wheels that all spin independently. 4 15 1 2 13 103. y 5 2 x 1 3 y5 x2 4 2 2 2S 2 an 3V 2S 2 a or d 5 81. {21}; The value 4 does not check. For Exercises 27–28, determine the x- and y-intercepts for the given function. This is because the point (1, 2) is not included in the graph of the function as denoted by the open dot. Expression; ; for x ? 1x 2 2 ? exponential 37. The ALEKS® Initial Assessment is an artificially intelligent (AI), diagnostic assessment that identifies precisely what a student knows. A quiz consists of 6 true/false questions and 4 multiplechoice questions. We can use a similar process to find the sum Sn of the first n terms of an arithmetic sequence: a1 1 a2 1 a3 1 … 1 an21 1 an. 2wz 2 z 6 x 75. s(d) 5 or s(d) 5 e. an 5 2n 1 1 8. E2: A blue marble is selected. (7, 23) and (4, 1) 78. 0 v 2 16 0 , 0.01 or equivalently 0 16 2 v 0 , 0.01 b. 26.4 yr a. c 2c3 3 4 65. y 5 f(x) For Exercises 89–94, determine if the function is even, odd, or neither. [1, 2) 153. 213 67. (multiplicity 1) and 21 (multiplicity 2) 2 5 c. n(x) 5 • x 2x2 1 4 for x $ 2 71. an 5 5 1 12n 5. 53 5 125 b. The flower shown in Figure 2-30 is symmetric with respect to the point at its center.

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