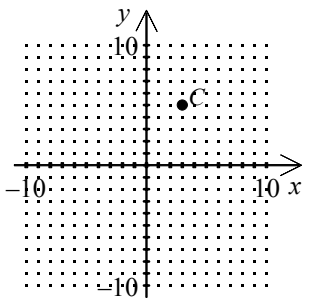
Chapter 2: Functions and Graphs

Section 2.1 A Two-Dimensional Coordinate System and Graphs

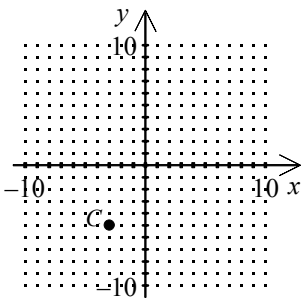
Cartesian Coordinate Systems

1. Plot the point $C(-3, 5)$ on a rectangular coordinate system.

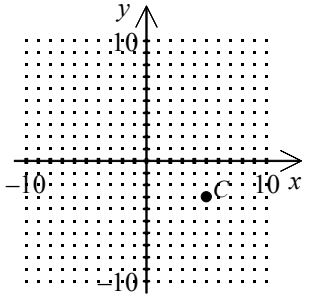
(a)



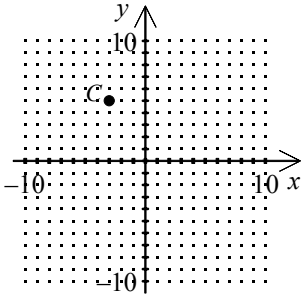
(b)



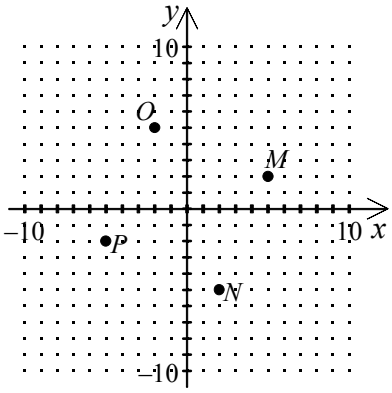
(c)



(d)



2. Identify the point at $(-5, -2)$. (a) M (b) P (c) O (d) N



3. Determine the quadrant in which (x, y) is located so that the conditions are satisfied.

$x > 0$ and $y = 5$

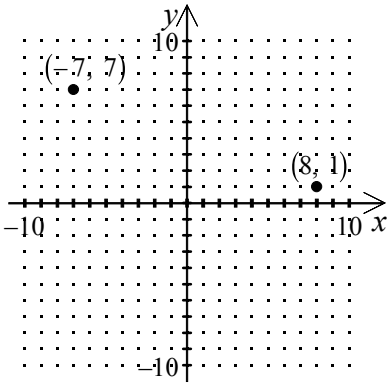
(a) Quadrant I (b) Quadrant II (c) Quadrant III (d) Quadrant IV

4. Determine the quadrant in which the point $(4, 1)$ is located, or the axis on which it is located.

(a) Quadrant I (b) Quadrant II (c) x-axis (d) y-axis

The Distance and Midpoint Formulas

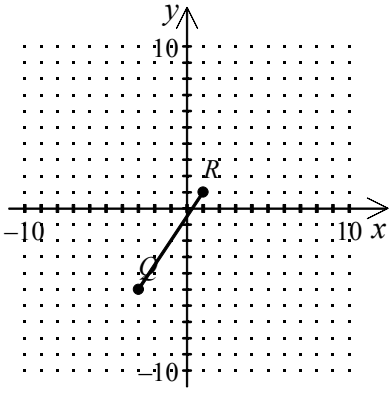
5. Find the distance between the two plotted points. (a) 9.1 (b) 17.2 (c) 16.2 (d) 8.1



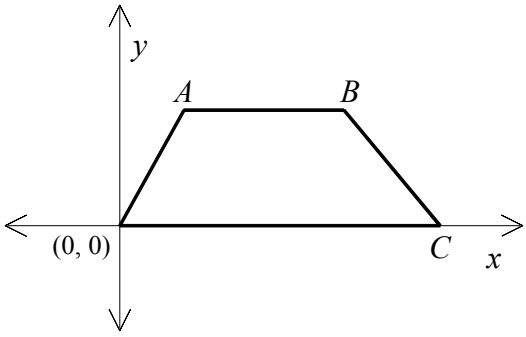
6. Find the possible values of y if the points $(8, 11)$ and $(-7, y)$ are a distance $d = \sqrt{229}$ apart.

(a) $10, -15$ (b) $10, 15$ (c) $9, -13$ (d) $9, 13$

7. Find the midpoint of $\overline{QR}$. (a) $(1, 2)$ (b) $(2, 1)$ (c) $(-2, -1)$ (d) $(-1, -2)$



8. The midsegment of a trapezoid connects the midpoints of the two non-parallel sides. Find the midpoint of the midsegment of the trapezoid if $A = (4e, 4f)$, $B = (4g, 4f)$, and $C = (4h, 0)$.

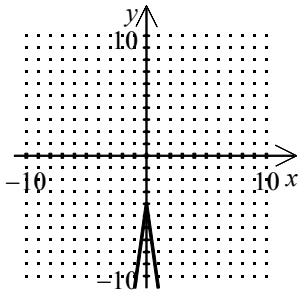


(a) $(2e+2g, 2f+2f)$ (b) $(f+g+h, f)$ (c) $(e+g+h, 2f)$ (d) $(g+2h, 2f)$

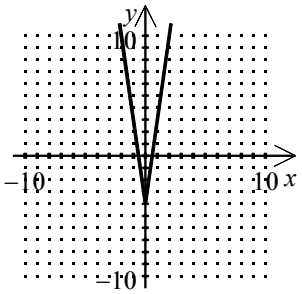
Graph of an Equation

9. Which is the graph of $y = -7|x| - 4$?

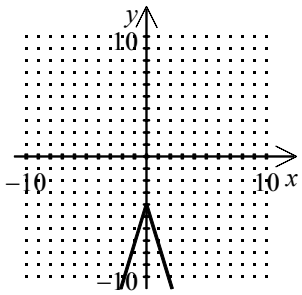
(a)



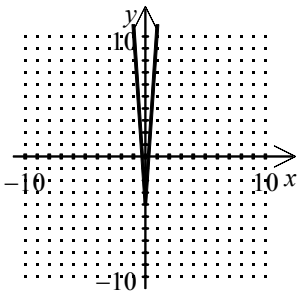
(b)



(c)



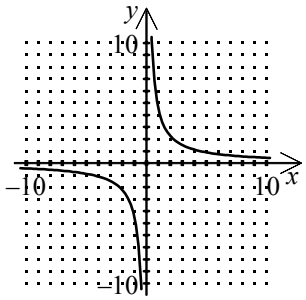
(d)



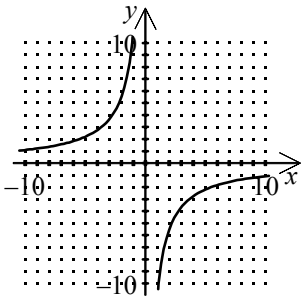
Graph:

10. $y = \dfrac{9}{x}$

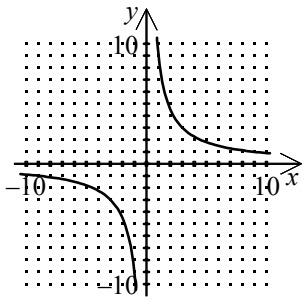
(a)



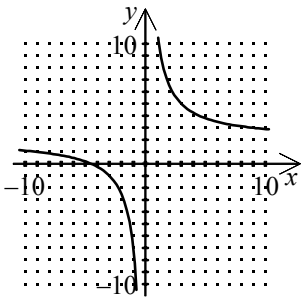
(b)



(c)



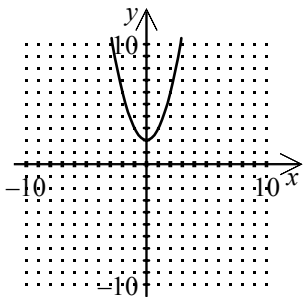
(d)



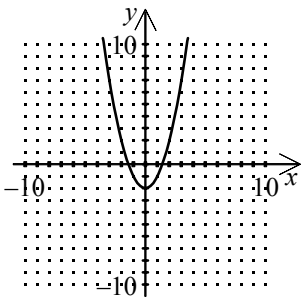
Graph:

11. $y = x^2 + 2$

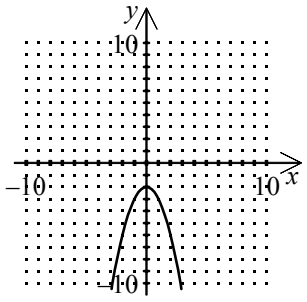
(a)



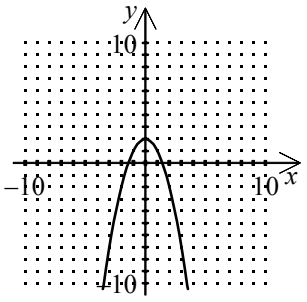
(b)



(c)



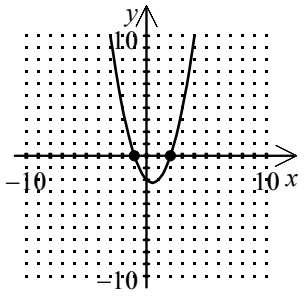
(d)



12. Identify the graph of the quadratic function and list any x-intercepts.

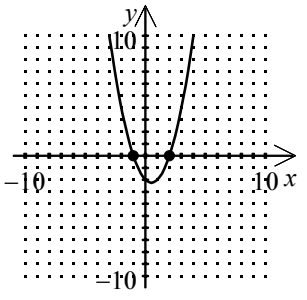
$f(x) = x^2 - 4x + 4$

(a)



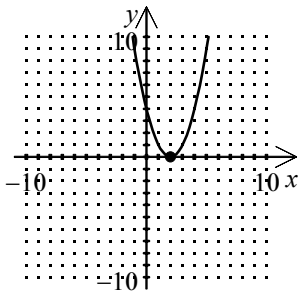
$(-1, 0), (2, 0)$

(b)



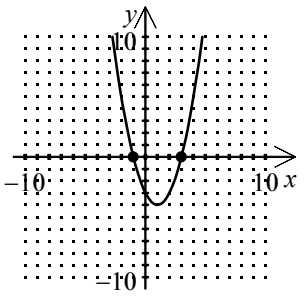
$(2, 0)$

(c)



$(2, 0)$

(d)



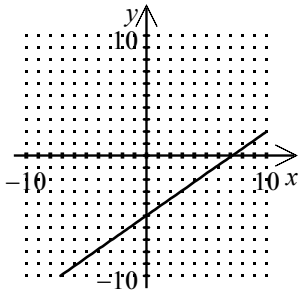
$(-1, 0), (3, 0)$

Intercepts

13. Identify the graph of the function and find the y-intercept.

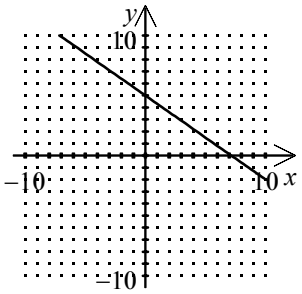
$f(x) = 0.7x + 5$

(a)



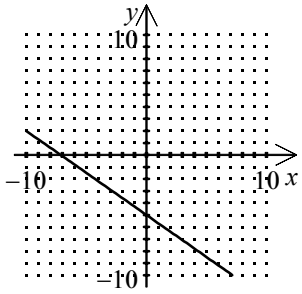
y-intercept: $(0, -5)$

(b)



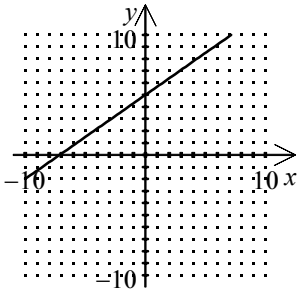
y-intercept: $(0, 5)$

(c)



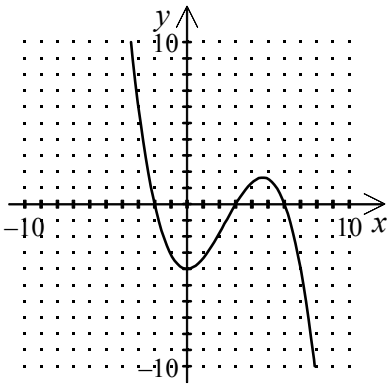
y-intercept: $(0, -5)$

(d)



y-intercept: $(0, 5)$

14. Identify the x- and y-intercepts.



(a) x-intercept: $(0, 4)$
y-intercepts: $(-2, 0), (3, 0), (6, 0)$

(b) x-intercepts: $(-2, 0), (3, 0), (-6, 0)$
y-intercept: $(0, 4)$

(c) x-intercept: $(0, -4)$
y-intercepts: $(-2, 0), (3, 0), (6, 0)$

(d) x-intercepts: $(-2, 0), (3, 0), (6, 0)$
y-intercept: $(0, -4)$

15. Identify the x- and y-intercepts of the graph of the equation.

$y = x^3\sqrt{64 - x^2}$

(a) x-intercepts: $(0,\ 0),\ (-64,\ 0),\ (64,\ 0),\ (8,\ 0),\ (-8,\ 0)$
y-intercept: $(0,\ 0)$

(b) x-intercepts: $(0,\ 0),\ (-64,\ 0),\ (64,\ 0)$
y-intercept: $(0,\ 0)$

(c) x-intercepts: $(8,\ 0),\ (-8,\ 0),\ (-64,\ 0)$
y-intercepts: none

(d) x-intercepts: $(0,\ 0),\ (8,\ 0),\ (-8,\ 0)$
y-intercept: $(0,\ 0)$

16. Find the x- and y-intercepts of the graph of the equation. $\frac{1}{2}x = 3$

(a) 6, none (b) 0, 6 (c) none, 2 (d) 3, 0

Circles, Their Equations, and Their Graphs

17. Find the standard form of the equation of the specified circle.
Center: $(3, -5)$; Radius: $3\sqrt{3}$

(a) $(x-3)^2 + (y+5)^2 = 27$ (b) $(x+3)^2 + (y-5)^2 = 9\sqrt{3}$

(c) $(x-3)^2 + (y+5)^2 = 9\sqrt{3}$ (d) None of these

18. Find the center and radius of the circle with the given equation.

$(x+4)^2 + (y+4)^2 = 9$

(a) $(-4, -4)$; 9 (b) $(4, 4)$; 3 (c) $(-4, -4)$; 3 (d) $(-4, 4)$; 3

19. Find the equation of a circle where $C(6, 5)$ and $D(-4, 3)$ are endpoints of a diameter.

(a) $(x-1)^2 + (y-4)^2 = 28$ (b) $(x-1)^2 + (y-4)^2 = 26$

(c) $(x-5)^2 + (y-1)^2 = 17$ (d) none of these

20. Find the standard form of the equation of the specified circle.
Center: $(-2,\ 3)$; Radius: 2

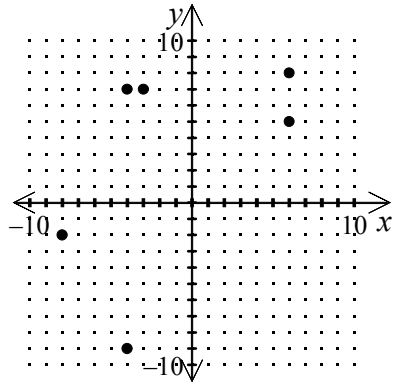
(a) $(x-2)^2 + (y+3)^2 = 2$ (b) $(x+2)^2 + (y+3)^2 = 4$

(c) $(x-2)^2 - (y+3)^2 = 2$ (d) $(x+2)^2 + (y-3)^2 = 4$

Section 2.2 Introduction to Functions

Relations

21. Choose a table that represents each relation shown.



(a)

x	y
−3	7
6	5
6	8
−8	−2
−4	7
−4	−9

(b)

x	y
−3	7
6	5
6	8
−8	−9
−4	7
−4	−2

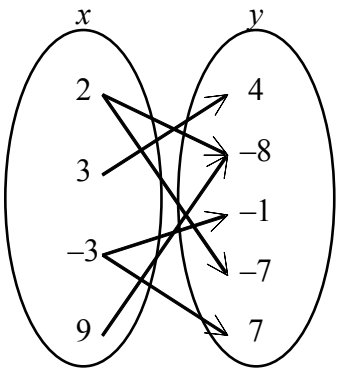
(c)

x	y
−3	7
6	5
6	−2
−8	8
−4	7
−4	−9

(d)

x	y
−3	5
6	7
6	8
−8	−2
−4	7
−4	−9

22. Choose a table that represents each relation shown.



(a)

x	y
9	−8
−3	7
−3	−1
3	4
2	−8
2	−7

(b)

x	y
9	−8
−3	7
−3	−1
3	−7
2	−8
2	4

(c)

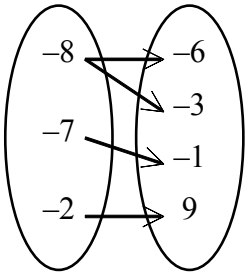
x	y
9	−8
−3	7
−3	4
3	−1
2	−8
2	−7

(d)

x	y
9	7
−3	−8
−3	−1
3	4
2	−8
2	−7

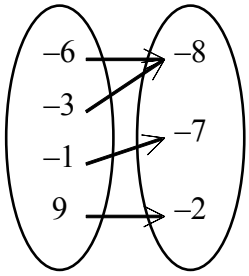
23. Construct a model of the relation $\{(-8,-6),(-7,-1),(-8,-3),(-2,9)\}$. Determine whether the relation is a function.

(a)



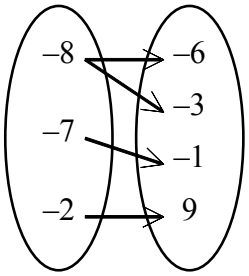
Function

(b)



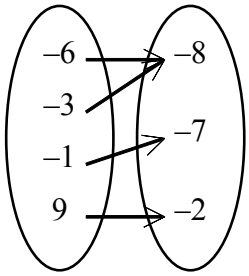
Function

(c)



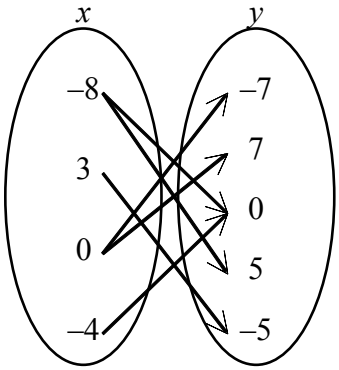
Not a function

(d)



Not a function

24. Find the domain and range of the relation.



(a) $D = \{0,\ 7,\ -7,\ -5,\ 5\}$
$R = \{-4,\ 0,\ 3,\ -8\}$

(b) $D = \{-4,\ 0,\ 3\}$
$R = \{0,\ 7,\ -5,\ 5\}$

(c) $D = \{-4,\ 0,\ 3,\ -8\}$
$R = \{0,\ 7,\ -7,\ -5,\ 5\}$

(d) $D = \{0,\ 7,\ -5,\ 5\}$
$R = \{-4,\ 0,\ 3\}$

Functions

25. Which set of ordered pairs $(x,\ y)$ represents y as a function of x?

(a) $\{(-2,\ 2),\ (4,\ -4),\ (4,\ -2),\ (-4,\ 4)\}$

(b) $\{(-2,\ 2),\ (2,\ 4),\ (-2,\ -4)\}$

(c) $\{-2,\ 2,\ 4,\ -4\}$

(d) $\{(-2,\ 2),\ (2,\ -2),\ (-4,\ -4)\}$

26. Which of the following relations is *not* a function?

(a)

x	y
–6	8
–5	6
–4	4

(b) $\{(3, 4), (3, 8), (5, 7), (7, 6)\}$

(c)

x	y
–6	4
–5	1
–4	0

(d) $\{(3, 4), (6, 4), (5, 7), (7, 3)\}$

27. Which of the following relations is *not* a function?

(a)

x	y
–8	3
–7	1
–7	8

(b) $\{(7, 8), (1, 3), (9, 2), (2, 8)\}$

(c)

x	y
–7	1
–6	1
–5	13

(d)

x	y
–7	–1
–6	–4
–5	4

28. Which of the following relations is also a function?

(a)

x	y
–7	6
–7	4
–8	2

(b)

x	y
–9	6
–8	4
–8	2

(c)

x	y
–8	6
–7	4
–8	2

(d)

x	y
–8	4
–7	4
–6	7

Functional Notation

Evaluate the function at the specified value(s) of the independent variable and simplify.

29. $f(x) = |x| + 4;\ f(6)$ (a) 10 (b) –2 (c) 2 (d) –10

30. $f(x) = 9x^2 - \sqrt{-3x}\ ;\ f(-2)$ (a) 39.464 (b) 33.551 (c) 40.243 (d) 30

31. $g(x) = \dfrac{x^2 - 3}{4x};\ g(n-5)$ (a) $\dfrac{n^2 - 3}{4n} - 5$ (b) $\dfrac{n^2 - 10n + 22}{4n - 5}$ (c) $\dfrac{n^2 - 8}{4n - 20}$ (d) $\dfrac{n^2 - 10n + 22}{4n - 20}$

32. Evaluate the function and simplify the results.

$$f(x)=\begin{cases}-\frac{3}{4}x & \text{if } x<-1\\ 7-8x & \text{if } x\ge -1\end{cases}$$

a. $f(-1)$ b. $f(0)$

c. $f(5)$ d. $f(-0.5)$

(a) a. 15 b. 0 c. $-3\frac{3}{4}$ d. 11

(b) a. $\frac{3}{4}$ b. 0 c. $-3\frac{3}{4}$ d. $\frac{1}{2}$

(c) a. 15 b. 7 c. -33 d. 11

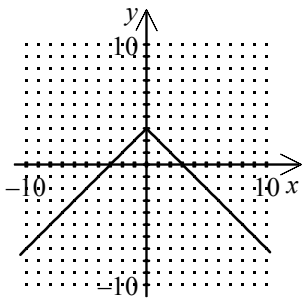
(d) a. $\frac{3}{4}$ b. 7 c. -33 d. $\frac{1}{2}$

Identifying Functions

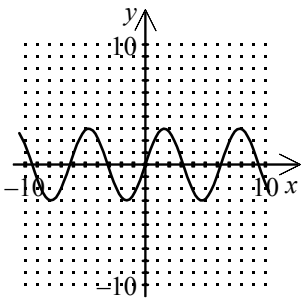
33. Which equation defines y as a function of x? (a) $x=-6y^2$ (b) $x=3$ (c) $x=10$ (d) $y=3$

34. Identify the graph that does *not* represent a function.

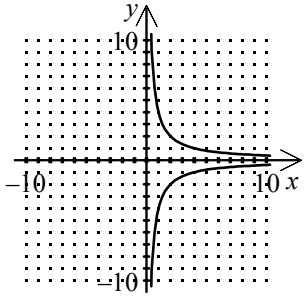
(a)



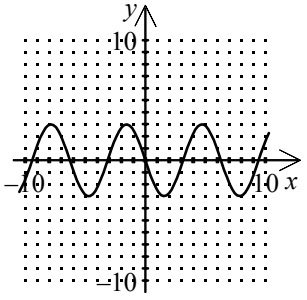
(b)



(c)



(d)



35. Which of the following is *not* a polynomial function?

(a) $f(x)=\frac{3}{5}x^4+\frac{x^{-3}}{5}$ (b) $f(x)=\frac{x-5}{4}-\frac{x}{5}$ (c) $f(x)=2x^4-x^3+2$ (d) $f(x)=\frac{1}{3}x^5-\frac{x}{3}$

36. Determine which relation is a function with the correct domain and range.

(a)

x	y
–7	2
–6	9
–5	7

domain: $\{-7,\ -6,\ -5\}$

range: $\{2,\ 9,\ 7\}$

(b) $\{(6,\ 7),\ (6,\ 2),\ (8,\ 1),\ (1,\ 9)\}$

domain: $\{6,\ 8,\ 1\}$

range: $\{7,\ 2,\ 1,\ 9\}$

(c)

x	y
–6	2
–6	9
–7	7

domain: $\{2,\ 9,\ 7\}$

range: $\{-6,\ -7\}$

(d)

x	y
–8	2
–7	9
–8	3

domain: $\{-8,\ -7\}$

range: $\{2,\ 9,\ 3\}$

Graphs of Functions

37. Determine the intervals over which the function is increasing, decreasing or constant. $f(x) = \dfrac{1}{x^2 + 4x}$

(a) increasing on $(-2,\ \infty)$; decreasing on $(-\infty,\ -2)$

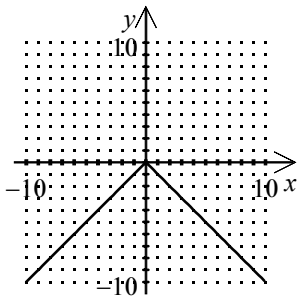
(b) increasing on $(-2,\ 0)$ and $(0,\ \infty)$; decreasing on $(-\infty,\ -4)$ and $(-4,\ -2)$

(c) increasing on $(-\infty,\ -4)$ and $(-4,\ -2)$; decreasing on $(-2,\ 0)$ and $(0,\ \infty)$

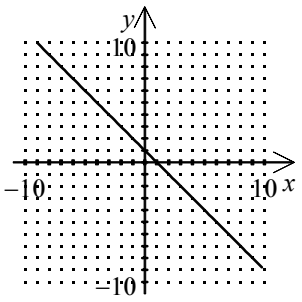
(d) increasing on $(-\infty,\ -2)$; decreasing on $(-2,\ \infty)$

38. Use the Vertical Line Test to determine which graph does *not* represent y as a function of x.

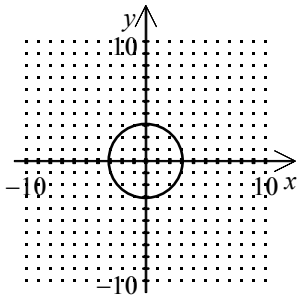
(a)



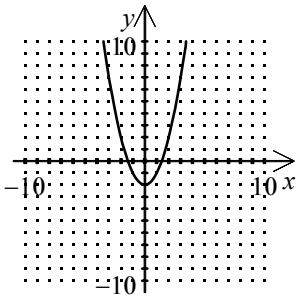
(b)



(c)

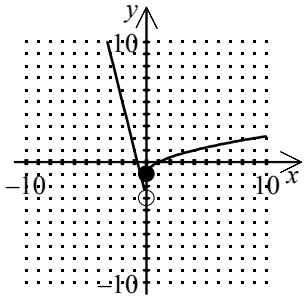


(d)

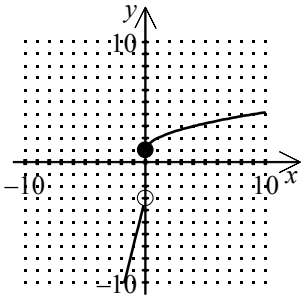


39. Graph: $f(x) = \begin{cases} \sqrt{x} + 1, & x \geq 0 \\ -4x - 3, & x < 0 \end{cases}$

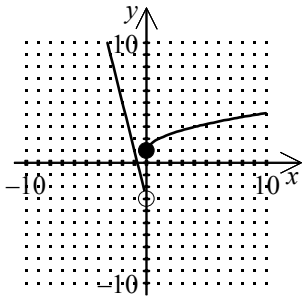
(a)



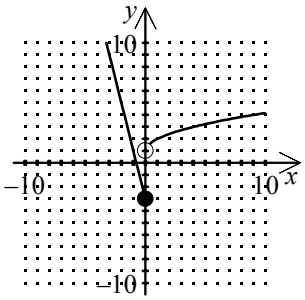
(b)



(c)

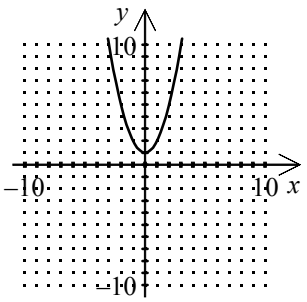


(d)

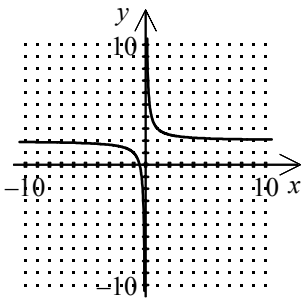


40. Determine which of the following are one-to-one functions.

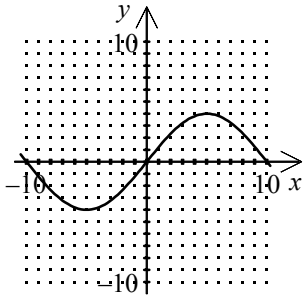
i.



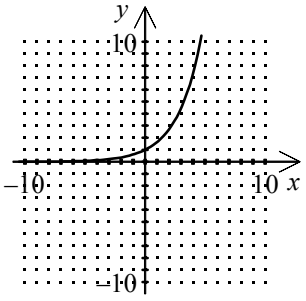
ii.



iii.



iv.



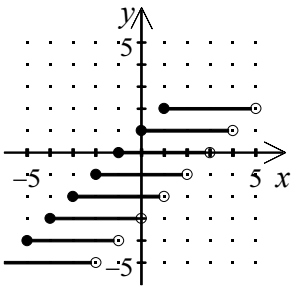
(a) i and iv only (b) i, ii, and iv only (c) iv only (d) ii and iv only

The Greatest Integer Function

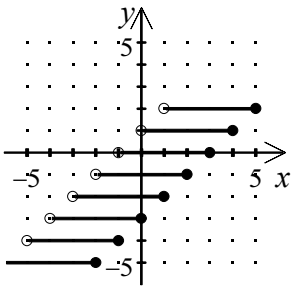
41. Identify the graph of the function. (The symbol $[\![\ ]\!]$ represents the greatest integer function.)

$$f(x) = \left[\!\left[\frac{1}{4}x\right]\!\right] - 3$$

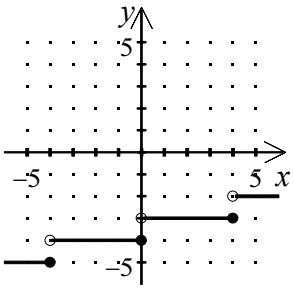
(a)



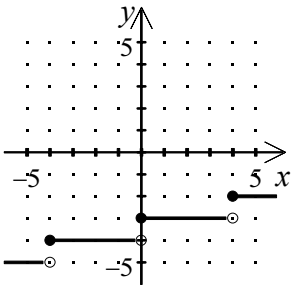
(b)



(c)



(d)



42. A team-building incentive program for workers in an athletic shoe factory gives them a \$10,000 bonus to share for every 45,000 pairs of shoes completed. The basic production cost of a pair of high-quality shoes is \$45 before bonuses. Using $[[\ ]]$ to denote the greatest integer function, find the equation that gives the cost, $C(x)$, for producing x high-quality shoes.

(a) $C(x) = 10{,}000\left[\left[\frac{x}{45{,}000}\right]\right] + 45x$

(b) $C(x) = 45{,}000\left[\left[\frac{x}{10{,}000}\right]\right] + 45x$

(c) $C(x) = 10{,}000\left[\left[\frac{x+1}{45{,}000}\right]\right] + 45x$

(d) $C(x) = 45x + 10{,}000\left[\left[\frac{x-44{,}999}{45{,}000}\right]\right]$

43. A taxi company charges \$5.45 for a ride of up to 3 miles, plus \$1.20 for each additional mile or fraction thereof. Using $[[\ ]]$ to denote the greatest integer function, find the equation for the cost, $C(x)$, of a ride of x miles, given that $x \geq 3$ miles.

(a) $C(x) = 5.45 + 1.20[[x-3]]$

(b) $C(x) = 5.45 - 1.20[[3-x]]$

(c) $C(x) = 1.20 - 5.45[[3-x]]$

(d) $C(x) = 1.20[[x+3]] + 5.45[[x-3]]$

44. A wireless telephone company that does not distinguish between local and long-distance calls charges \$26.95 per month and a per minute charge for use beyond 40 minutes. Fractions of a minute count as whole minutes. Using $[[\ ]]$ to denote the greatest integer function, the cost, $C(x)$, for x minutes of use can be calculated using the following:

$$C(x) = \begin{cases} 26.95, & x \leq 40 \\ 26.95 - 0.28[[40-x]], & x > 40 \end{cases}$$

Find the cost for a person who uses 72.7 minutes in one month.

(a) \$36.19 (b) \$47.11 (c) \$36.09 (d) \$37.19

Applications

45. A music club membership costs \$21.00 to join and \$6 per CD. Find an equation that shows y, the cost for joining and buying x CDs .

(a) $y = 21 + 6(x+1)$ (b) $y = 27 + 6(x+1)$ (c) $y = 27 + 6(x-1)$ (d) $y = 21 + 6(x-1)$

46. Debbie is 36 years old, which is 12 less than 4 times Minnie's age. Which equation could be used to solve for Minnie's age? How old is Minnie?

(a) $4x + 12 = 36;\ 6$ yr (b) $4x - 12 = 36;\ 12$ yr (c) $12x - 4 = 36;\ 3.3$ yr (d) $12x - 4 = 36;\ 2.7$ yr

47. Ms. Espinoza put away \$269 for a party fund. Each time her class did well on a big project, \$5 was deducted from the fund so that she could buy supplies for a class party. Choose the equation that represents the value remaining in her account after x withdrawals from the fund. Find the value remaining in the fund after 9 parties.

(a) $V = 269 - 5x;$ \$224 (b) $V = 5 - 269x;$ \$224 (c) $V = 269 - 5x;$ \$1354 (d) $V = 269 - 5x;$ \$1340

48. A sweatshirt printing business spends \$450 on equipment and supplies for each new batch of sweatshirts. In addition to these one time charges, the cost of printing each sweatshirt is \$4.25. Let x be the number of sweatshirts printed.
a. Write the total cost C as a function of the total number of sweatshirts printed.

b. Write the average cost per unit, $\overline{C} = \dfrac{C}{x}$, as a function of x.

c. Find the average cost of printing 9000 sweatshirts.

(a) a. $C = 4.25x - 450$
b. $\overline{C} = \dfrac{4.25x - 450}{x}$
c. \$3.50

(b) a. $C = 4.25x + 450$
b. $\overline{C} = \dfrac{4.25x + 450}{x}$
c. \$4.30

(c) a. $C = 4.25x + 450$
b. $\overline{C} = \dfrac{4.25x + 450}{x}$
c. \$5.30

(d) a. $C = 450x + 4.25$
b. $\overline{C} = \dfrac{450x + 4.25}{x}$
c. \$4.50

Section 2.3 Linear Functions

Slopes of Lines

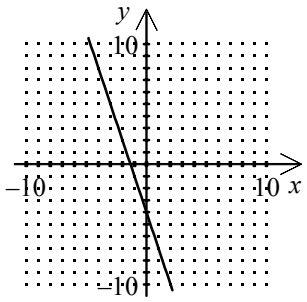
49. Find the slope of the line passing through the pair of points. $(2, -8), (-8, -8)$

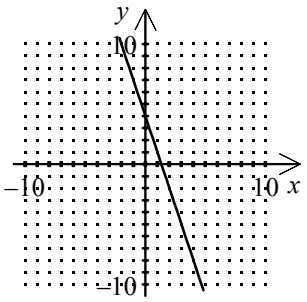
(a) 0 (b) $\dfrac{5}{3}$ (c) $\dfrac{8}{5}$ (d) Undefined

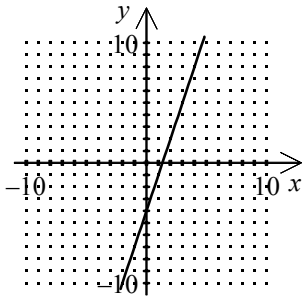
50. Find the slope of the line passing through the given points. $\left(\dfrac{1}{2}, -3\right)$ and $\left(\dfrac{4}{5}, -1\right)$

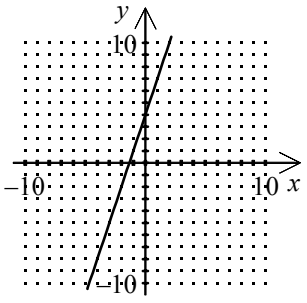
(a) $\dfrac{18}{35}$ (b) $\dfrac{35}{18}$ (c) $\dfrac{20}{3}$ (d) $\dfrac{3}{20}$

51. Which is the graph of the line with a y-intercept of 4 and slope of 3?

(a)


(b)


(c)


(d)


52. Determine the value of r so the line that passes through each pair of points has the given slope.

$(4, 2), (-2, r); \; m = -\dfrac{1}{3}$

(a) -12 (b) 4 (c) 20 (d) $-6\dfrac{2}{3}$ (e) None of these

Find the Equation of a Line

53. Which shows the equation of a line, in slope-intercept form, that passes through the point $(4, -5)$ with slope 4?

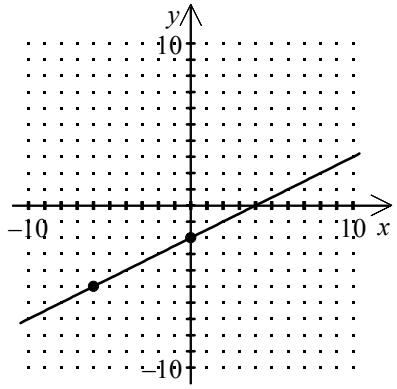
(a) $y = 4x - 21$ (b) $y = 4x - 2$ (c) $y = -4x - 2$ (d) $y = -4x - 21$

54. Determine the equation of the line that has the given slope and contains the given point.

$m = -\frac{1}{3}, (5, -3)$

(a) $3x + y = 14$ (b) $x + 3y = 14$ (c) $3x + y = -4$ (d) $x + 3y = -4$

55. Determine the slope-intercept form of the equation of the line.



(a) $y = \frac{1}{2}x - 2$ (b) $y = 2x - 2$ (c) $y = -\frac{1}{2}x - 2$ (d) $y = -2x - 2$

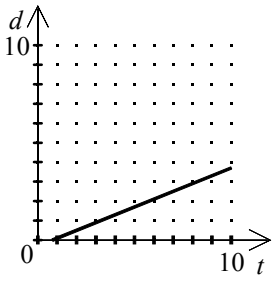
56. Given $f(x) = 6x^2 - 5,$ find the value of x which gives $f(x) = 49.$

(a) $-3, 3$ (b) $-8.49, 3$ (c) $-18, 18$ (d) $4.5, -2.5$

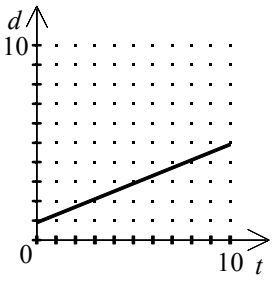
Applications

57. A sloth travels at a rate of 0.4 meter per minute. Let t be the number of minutes spent traveling.
a. Find the distance d traveled by the sloth as a function of t.
b. Find the distance traveled by the sloth in 2 minutes.
c. Construct a graph illustrating the distance traveled by the sloth versus time.

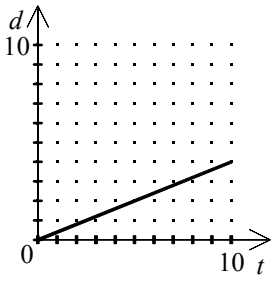
(a) a. $d(t) = t + 0.4$
b. 0.5 m
c.



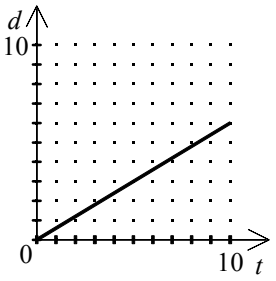
(b) a. $d(t) = 0.4t + 1$
b. 0.9 m
c.



(c) a. $d(t) = 0.4t$
b. 0.8 m
c.



(d) a. $d(t) = 0.4d$
b. 0.6 m
c.



58. Casey McDonald plans to decorate vases to sell at a crafts fair. The decorations for all of the vases cost \$47.50 and the vases cost \$8.50 each.
a. Write a function expressing the cost, $C(x)$ of the project in terms of the number of vases decorated, x.
b. Determine the cost of decorating 60 vases.
c. How many vases can be decorated with a budget of \$642.50?

(a) a. $C(x) = 8.50x + 47.50$
b. \$557.50
c. 70

(b) a. $C(x) = 47.50x + 8.50$
b. \$2858.50
c. 72

(c) a. $C(x) = 8.50x$
b. \$510.00
c. 71

(d) a. $C(x) = 8.50 + 47.50$
b. \$56.00
c. 73

59. A monthly phone bill, b, in dollars, consists of a \$22 service fee plus \$0.12 per minute, m, of long distance calls. Find an equation that relates the total cost to the number of minutes used. Then plot the total costs for using 8, 28, 45, and 58 minutes.

(a) $b = 0.12 + 22m$ (b) $b = 22 + 0.12m$ (c) $22 = b + 0.12m$ (d) $0.12 = 22 + bm$

60. In 1992 the average price of a house in a small town was \$97,000. By 1998, the average price of a home was \$109,000. Find a linear model for the price of such a house, P, if $t = 0$ represents the year 1992.

(a) $P = 2000t + 97{,}000$ (b) $P = 109{,}000 - 2000t$ (c) $P = 109{,}000 - 12{,}000t$

(d) $P = 12{,}000t + 97{,}000$ (e) None of these

Parallel and Perpendicular Lines

61. Determine whether the graphs of the equations are parallel, perpendicular, or neither.

$-2x + 6y = -3$

$12x + 4y = 0$

(a) Parallel (b) Perpendicular (c) Neither

62. Which best describes the relationship between the lines with equations $-4x + 7y = -5$ and $-8x + 14y = 0$?

(a) Perpendicular (b) Parallel (c) Same line (d) Neither parallel nor perpendicular

63. A woman standing in the middle of a large field was spinning a rock attached at the end of a rope, counterclockwise above her head. When she let go of the rope, the rock traveled along a linear path perpendicular to the radius created by the woman's position and the point of the rock's release. The rock traveled directly over a wall in the field. If the field is represented on a coordinate axis system with the woman at the origin, the point of release at $(6,\ 3),$ and the wall represented by the line $y = x + 8,$ at what point was the ball directly over the wall?

(a) $\left(\frac{7}{3},\ \frac{31}{3}\right)$ (b) $\left(5,\ \frac{25}{3}\right)$ (c) $\left(23,\ \frac{31}{3}\right)$ (d) $\left(\frac{7}{3},\ -\frac{1}{2}\right)$

64. A boy is playing with a ball suspended from a string, spinning it counterclockwise about the origin. He accidentally lets go of the ball and it hits the trunk of a tree in the adjoining backyard, after travelling along a path perpendicular to its radius of oscillation and the point at which it was released. If the point at which the ball was released is $P(-2,\ 8),$ and the equation representing the tree is $y = x + 6,$ what is the point of contact of the ball and the trunk of the tree?

(a) $\left(\frac{10}{3},\ -40\right)$ (b) $\left(\frac{10}{3},\ \frac{28}{3}\right)$ (c) $\left(\frac{34}{3},\ -12\right)$ (d) $\left(\frac{29}{2},\ \frac{28}{3}\right)$

Section 2.4 Quadratic Functions

Vertex of a Parabola

65. Find the vertex of the graph of the function.

$f(x) = -(x-2)^2 - 2$

(a) $(2,\ 2)$ (b) $(-2,\ 2)$ (c) $(2,\ -2)$ (d) $(-2,\ -2)$

66. Which is the standard form of the function $f(x) = x^2 + 6x + 15$?

(a) $f(x) = (x+3)^2 - 6$ (b) $f(x) = (x+3)^2 + 6$ (c) $f(x) = (x+6)^2 - 9$ (d) $f(x) = (x+6)^2 + 9$

67. Write the equation of the quadratic function in standard form and find the vertex of the graph.
$f(x) = 30x + 4 + 3x^2$

(a) $f(x) = 3(x+5)^2 - 71$
Vertex: $(-5, -71)$

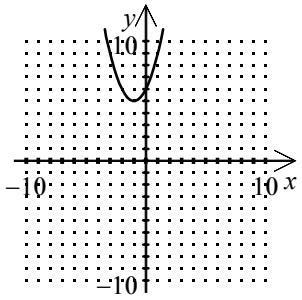
(b) $f(x) = 3(x-5)^2 - 71$
Vertex: $(5, -71)$

(c) $f(x) = 3(x-5)^2 - 71$
Vertex: $(71, -5)$

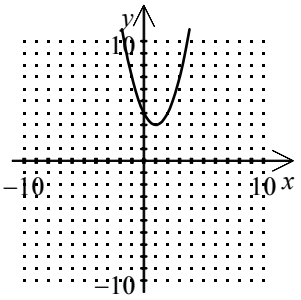
(d) $f(x) = 3(x+5)^2 - 71$
Vertex: $(-71, -5)$

68. Write the equation in standard form. Then graph the equation. $y = x^2 - 2x + 4$

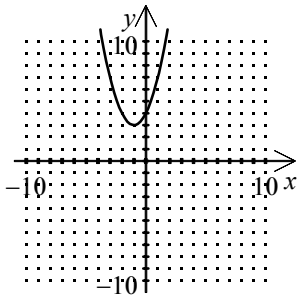
(a) $y = (x+1)^2 + 5$



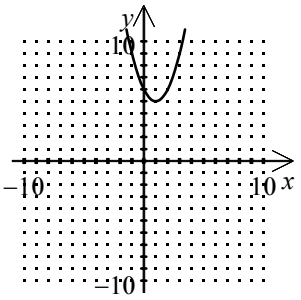
(b) $y = (x-1)^2 + 3$



(c) $y = (x+1)^2 + 3$



(d) $y = (x-1)^2 + 5$



Maximum and Minimum of a Quadratic Function

69. Find the domain and range of the function.
$f(x) = 5x^2 + 3$

(a) Domain: $(-\infty, \infty)$; Range: $[3, \infty)$

(b) Domain: $(-\infty, \infty)$; Range: $(-\infty, 3]$

(c) Domain: $[3, \infty)$; Range: $(-\infty, \infty)$

(d) Domain: $(-\infty, 3]$; Range: $(-\infty, \infty)$

State whether the function has a minimum or a maximum value and find the value.

70. $f(x) = -x^2 + 4x$ (a) minimum: 2 (b) maximum: 2 (c) maximum: 4 (d) minimum: 4

71. $f(x) = x^2 + 2x + 4$ (a) maximum: –1 (b) minimum: 3 (c) minimum: –1 (d) maximum: 3

72. Use a calculator to find the maximum or minimum value of the parabola.
$y = -x^2 + 5$

(a) min at $y = 5$ (b) max at $y = -5$ (c) max at $y = 5$ (d) max at $y = 6$ (e) min at $y = -5$

Applications

73. Find the maximum revenue for the revenue function $R(x) = 450x - 0.05x^2$.

(a) 5000 (b) 1,012,500 (c) 171,000 (d) 4500

74. Moe estimates that the cost, C, to his company (in thousands of dollars) of producing x boxes of his computer chips can be modeled by $C = 360{,}000 + 0.01x + 0.0064x^2$. How many boxes should Moe's company produce to pay the minimum cost per box?

(a) 7500 (b) 75 (c) 230,400 (d) 5625 (e) None of these

75. The area of a rectangle with a perimeter of 64 units is given by
$A = x(32 - x)$
where x represents the width of the rectangle. A farmer has available 64 yards of fencing and wishes to enclose a rectangular area. Use a graphing utility to graph the equation for the area of the rectangle and find the value of x that gives the largest area.

(a) 24 yd (b) 21 yd (c) 16 yd (d) 11 yd

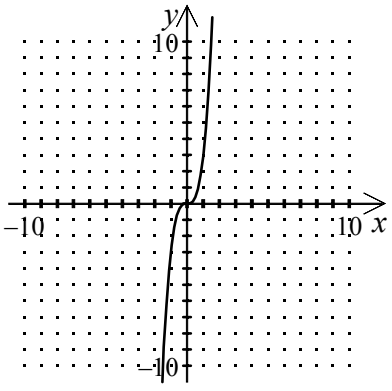
76. Macro Manufacturing estimates that its weekly profit, P, in hundreds of dollars, can be approximated by the formula $P(x) = -5x^2 + 40x + 2$, where x is the number of units produced per week, in thousands. How many units should the company produce per week to earn the maximum profit? Find the maximum weekly profit.

(a) 3200 units, \$8800 (b) 4000 units, \$8200 (c) 4 units, \$8300 (d) 32 units, \$7800

Section 2.5 Properties of Graphs

Symmetry

77. Use symmetry tests to verify any of the three symmetries (x-axis, y-axis, or origin) the graph suggests.



(a) The graph is symmetrical with respect to the origin.

(b) The graph is symmetrical with respect to the x-axis, the y-axis, and the origin.

(c) The graph is symmetrical with respect to the y-axis.

(d) The graph has none of the three symmetries.

78. Identify the equation whose graph is symmetric with respect to the the origin.

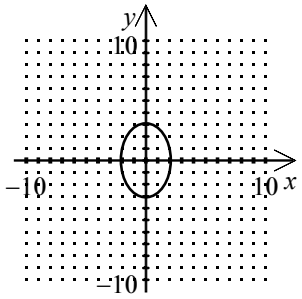
(a) $x = |y - 4|$ (b) $y^3 = 9x^4 - 7$ (c) $y = x^3 - 4$ (d) $9x^2 + 16y^2 = 144$

79. Which symmetries does the graph of $-3x^3y^4 - 6xy^6 = -5$ possess?

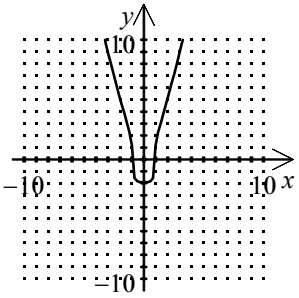
(a) x-axis, y-axis, and the origin (b) origin only (c) x-axis only (d) y-axis only

80. Find the equation whose graph is symmetric with respect to the the origin.

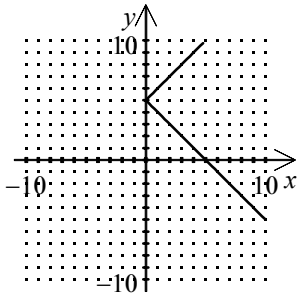
(a) $9x^2 + 4y^2 = 36$



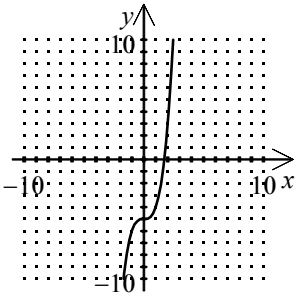
(b) $y^3 = 9x^4 - 7$



(c) $x = |y - 5|$

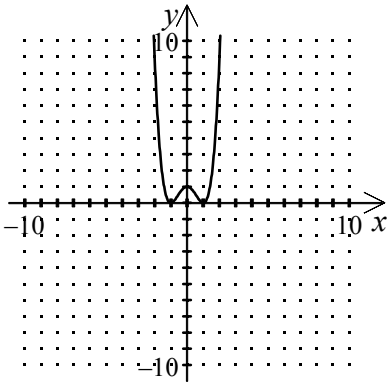


(d) $y = x^3 - 5$



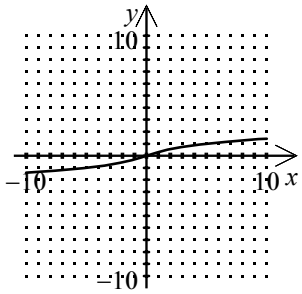
Even and Odd Functions

81. Use the graph to determine if the function is even, odd, or neither. (a) Even (b) Odd (c) Neither

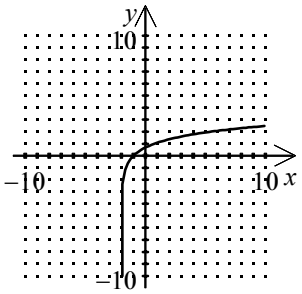


82. Which is the graph of a function that is neither even nor odd?

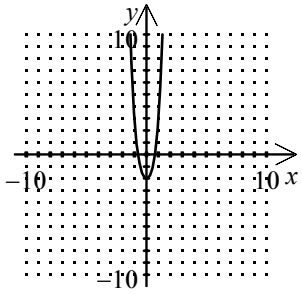
(a)



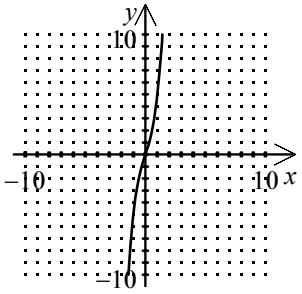
(b)



(c)



(d)



83. One of the following functions is neither odd nor even. Which one?

(a) $2x^2 - |x^2| - 3$ (b) $x^5 - 3x^3 + 2x$ (c) $x^4 - 3x + 2 + |x - 2|$ (d) $-11x^3 - 3x$

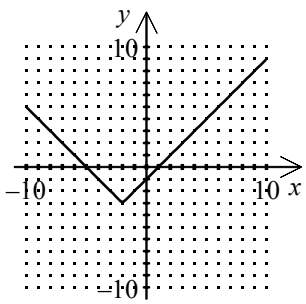
84. Which of the following functions is even?

(a) $g(x) = 2x^7 + 5x^3$ (b) $F(x) = -2x^6 + 5x^2 - 5$ (c) $f(x) = |-2x + 2| - 2$ (d) $h(x) = \dfrac{-2x^3}{-2x^2 + 2}$

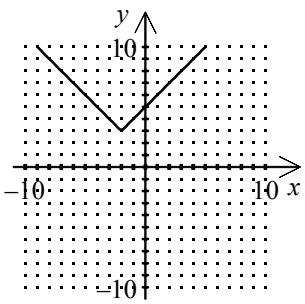
Translations of Graphs

85. Use the graph of $f(x) = |x|$ to identify the graph of $f(x) = |x - 2| - 3$.

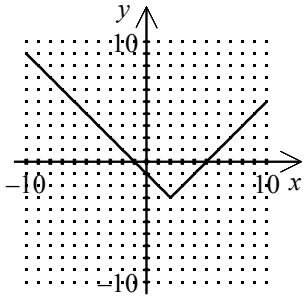
(a)



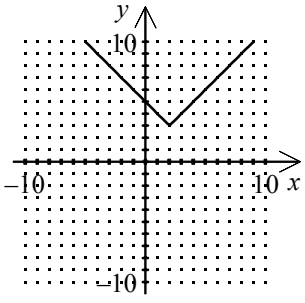
(b)



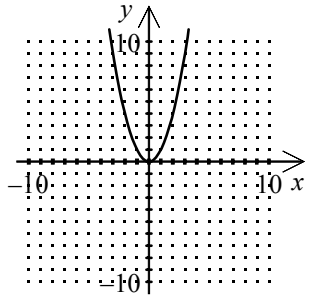
(c)



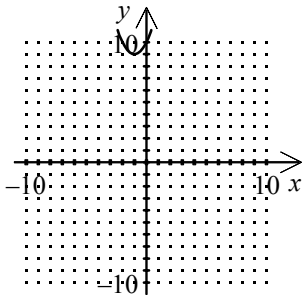
(d)



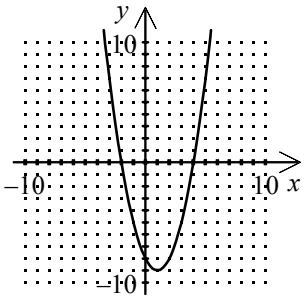
86. Use transformations of the graph of $y = x^2$ to determine the graph of $y = (x+1)^2 - 9$.



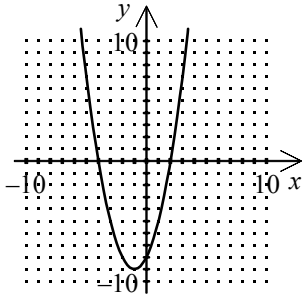
(a)



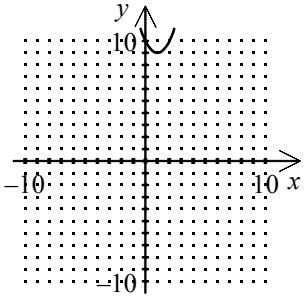
(b)



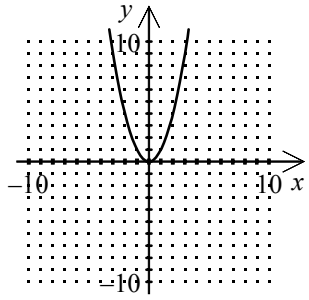
(c)



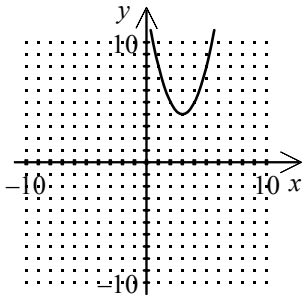
(d)



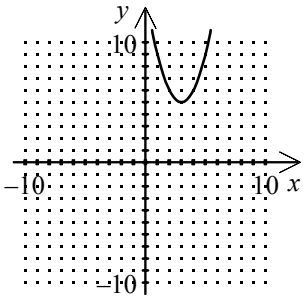
87. Using the graph of $f(x) = x^2$ as a guide, graph the function $g(x) = (x-3)^2 + 5$.



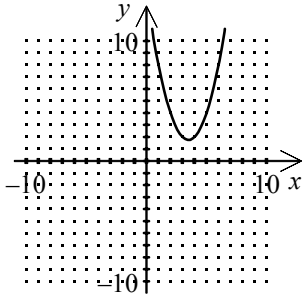
(a)



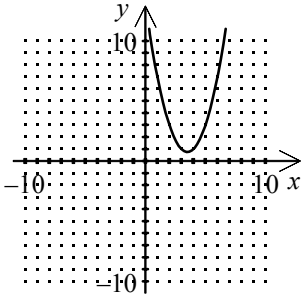
(b)



(c)

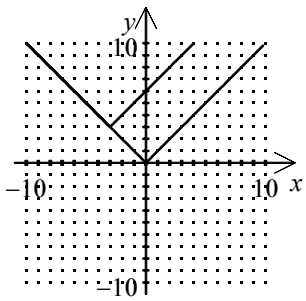


(d)

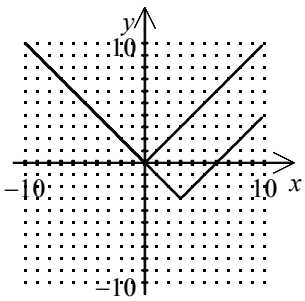


88. Without using graphing technology, sketch the parent graph and translate it to obtain the graph of $y - 3 = |x + 3|$.

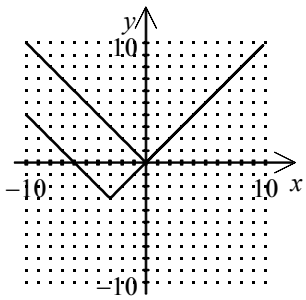
(a)



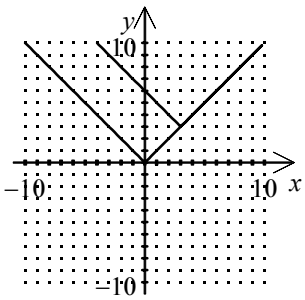
(b)



(c)

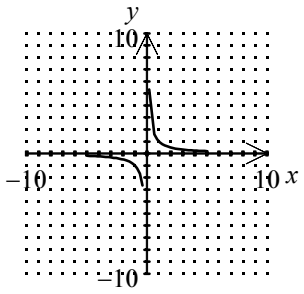


(d)

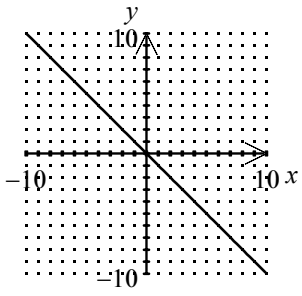


Reflections of Graphs

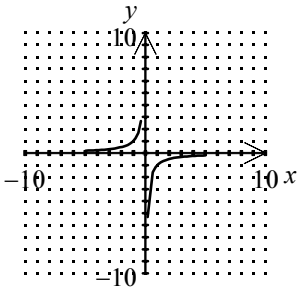
89. The graph of the function $f(x) = \dfrac{1}{x}$ is shown below. Find the equation and the graph of the function $g(x)$ which is the reflection of $f(x)$ in the y-axis.



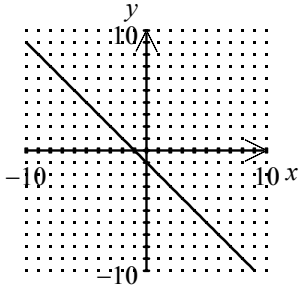
(a) $g(x) = -x$



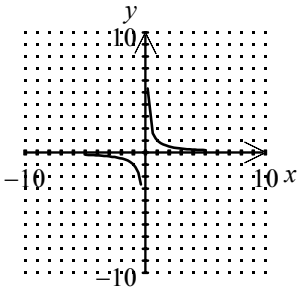
(b) $g(x) = -\left(\dfrac{1}{x}\right)$



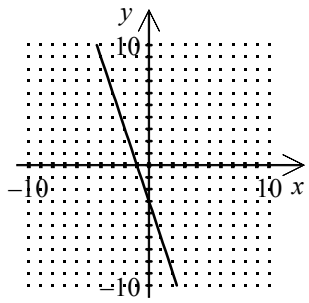
(c) $g(x) = x$



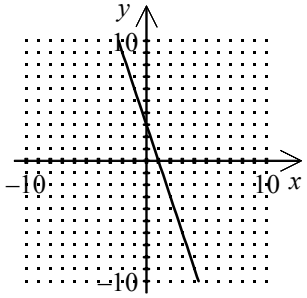
(d) $g(x) = \dfrac{-1}{-x}$



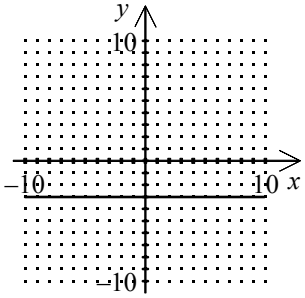
90. Use the graph of $f(x)$ to identify the graph of $-f(x)$.



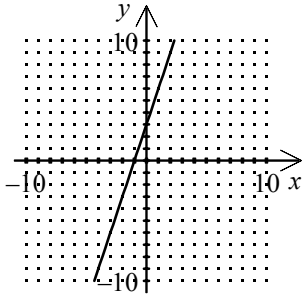
(a)



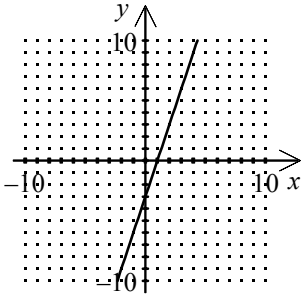
(b)



(c)



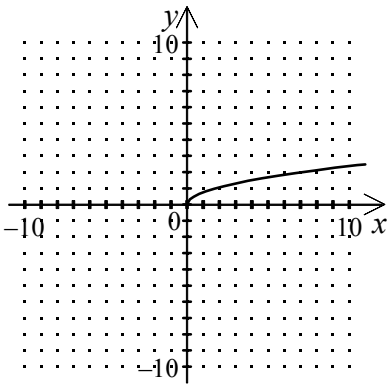
(d)

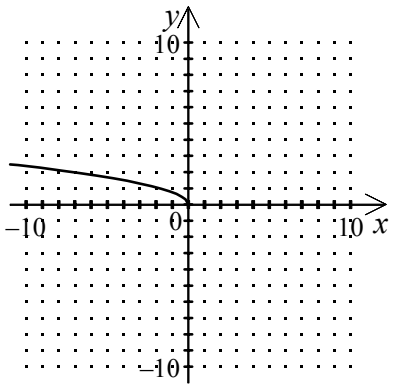


91. Which of these functions is the reflection of $f(x) = x^2$ across the y-axis?

(a) $g(x) = (-x)^2$ (b) $g(x) = -x^{-2}$ (c) $g(x) = x^{-2}$ (d) $g(x) = -x^2$

92. The graph of the function $f(x)=\frac{3}{4}\sqrt{x}$ is shown on the left below. The graph on the right is the same graph reflected over the y-axis. Find the equation of the graph on the right.

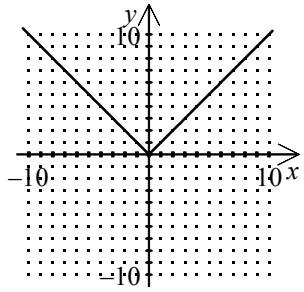




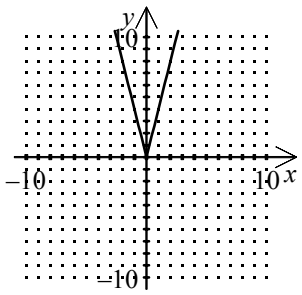
(a) $f(x)=\frac{3}{4}\sqrt{x}$ (b) $f(x)=-\frac{3}{4}\sqrt{x}$ (c) $f(x)=-\frac{3}{4}\sqrt{-x}$ (d) $f(x)=\frac{3}{4}\sqrt{-x}$

Compressing and Stretching Graphs

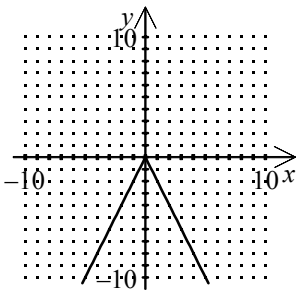
93. Given is the graph of a function $l(x)$. Identify the graph of $2l(x)$.



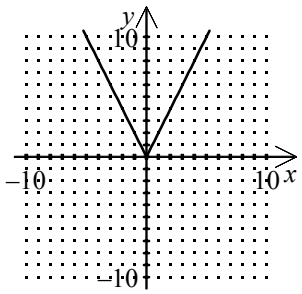
(a)



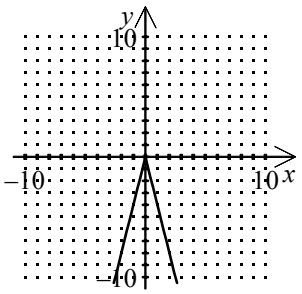
(b)



(c)

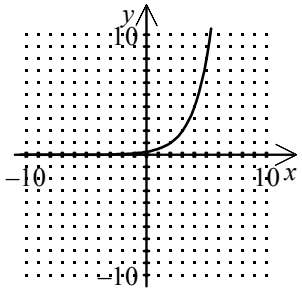


(d)

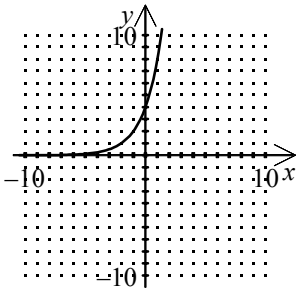


94. Given $f(x) = 2^x$, consider a dilation by a factor of 4. Find the dilated function and its graph.

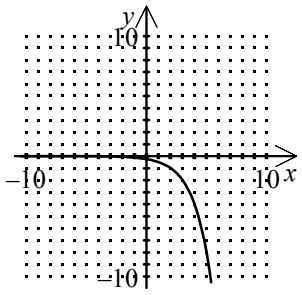
(a) $f(x) = \frac{1}{4}\left(2^x\right)$



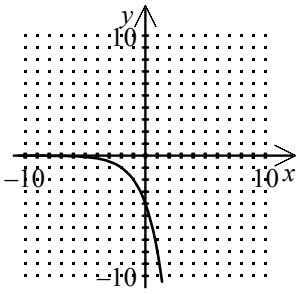
(b) $f(x) = 4\left(2^x\right)$



(c) $f(x) = -\frac{1}{4}\left(2^x\right)$

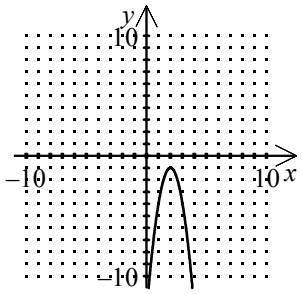


(d) $f(x) = -4\left(2^x\right)$

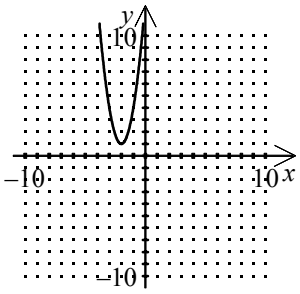


95. Find the graph of $f(x) = 3(x+2)^2 + 1$.

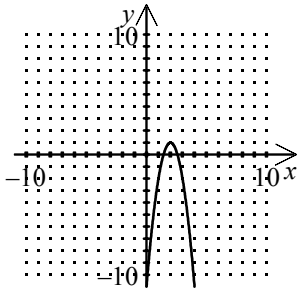
(a)



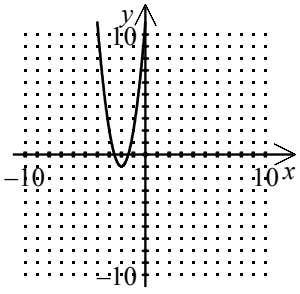
(b)



(c)



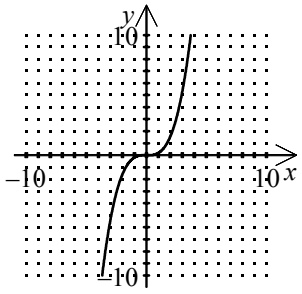
(d)



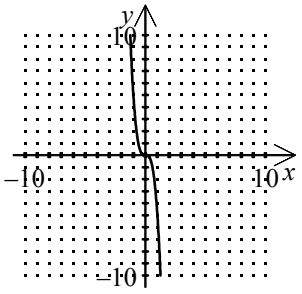
96. Find an equation and graph for the function that is described by the given characteristics.

The shape of $f(x) = x^3$, with a vertical shrink of $\frac{1}{5}$.

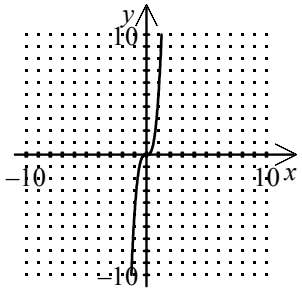
(a) $g(x) = \frac{1}{5}x^3$



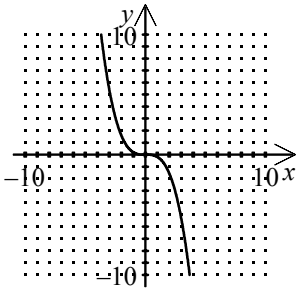
(b) $g(x) = -5x^3$



(c) $g(x) = 5x^3$



(d) $g(x) = -\frac{1}{5}x^3$



Section 2.6 The Algebra of Functions

Operations on Functions

97. Given $f(x) = \frac{7}{x-5}$ and $g(x) = \frac{9}{x+7}$, find $(f+g)(x)$.

(a) $\frac{-16x-4}{(x-5)(x+7)}, x \neq 5, -7$ (b) $-\frac{2}{2x+2}, x \neq -1$ (c) $\frac{16x+4}{(x-5)(x+7)}, x \neq 5, -7$ (d) $\frac{16}{2x+2}, x \neq -1$

98. If $f(x) = 4 - x^2$ and $g(x) = 2 - x$, find $(f \cdot g)(x)$.

(a) $-x^2 - x + 6$ (b) $2 + x$ (c) $x^3 - 2x^2 - 4x + 8$ (d) $-x^2 + x + 2$

99. Find $(f+g)(x)$ for $f(x) = \frac{1}{x^3}$ and $g(x) = x$. (a) x^4 (b) $\frac{1-x}{x^4}$ (c) $\frac{x^3}{1+x^4}$ (d) $\frac{1+x^4}{x^3}$

100. Given $f(x) = 81 - x^2$, and $g(x) = 9 - x$, find $\frac{f}{g}(x)$.

(a) $x - 9$ (b) $x^2 - 81$ (c) $9 + x$ (d) $-x^2 + x + 72$

The Difference Quotient

101. Which is the difference quotient of the function $f(x) = -2x + 2$?

(a) $\left[-2(x+h)+2\right]-(-2x+2)$

(b) $(-2x+2+h)-(-2x+2)$

(c) $\dfrac{\left[-2(x+h)+2\right]-(-2x+2)}{h}$

(d) $\dfrac{(-2x+2+h)-(-2x+2)}{h}$

102. Find the difference quotient $\dfrac{f(x+\Delta x)-f(x)}{\Delta x}$ for the function.

$f(x) = x^2 + x + 3$

(a) $2x + 2\Delta x + 4$ (b) $2x + 2\Delta x + 1$ (c) $2x + \Delta x + 1$ (d) $2x + \Delta x + 1 + \dfrac{2x^2 + 2x + 6}{\Delta x}$

103. Find the difference quotient for the function $f(x) = -4x^2 - 3x + 3$.

(a) $-8x - 4h - 3$ (b) $-8hx - 4h^2 - 3h$ (c) $-4x - 8h - 3$ (d) $-4hx - 8x^2 - 3x$

104. The position of a moving body is given by the formula $s = -t^2 + 5t + 3$ where s is measured in meters and t in seconds. Find the average velocity for the time interval from $t = 3$ to $t = 6$ seconds.

(a) –4 m/sec (b) –8 m/sec (c) 0 m/sec (d) 65 m/sec

Composition of Functions

105. Find $(f \circ g)(x)$ for the pair of functions. $f(x) = x - 3$ and $g(x) = \sqrt{x+4}$, $x \geq -4$

(a) $\sqrt{x+1}$ (b) $\sqrt{x-3}+4$ (c) $\sqrt{x+4}-3$ (d) $\sqrt{x+4}$

106. Find $(g \circ f)(x)$ and $(f \circ g)(x)$ for $f(x) = x + 4$ and $g(x) = \sqrt{x+1}$.

(a) $(g \circ f)(x) = \sqrt{x+1}+4$
$(f \circ g)(x) = \sqrt{x+5}$

(b) $(g \circ f)(x) = \sqrt{x+5}$
$(f \circ g)(x) = \sqrt{x+1}+4$

(c) $(g \circ f)(x) = \sqrt{x+1}$
$(f \circ g)(x) = \sqrt{x+4}-1$

(d) $(g \circ f)(x) = \sqrt{x+4}-1$
$(f \circ g)(x) = \sqrt{x+1}+5$

107. If $f(x) = 5 + 3x$ and $g(x) = x^2 - 2$, find (a) $(f \circ g)(x)$ and (b) $(g \circ f)(x)$.

(a) (a) $3x^2 - 1$
(b) $9x^2 + 30x + 23$

(b) (a) $9x^2 + 30x + 23$
(b) $x^2 + 3x - 3$

(c) (a) $x^2 + 3x - 3$
(b) $3x^2 + 23x$

(d) (a) $x^2 + 3x + 3$
(b) $3x^2 - 1$

108. For the pair of functions, evaluate $(g \circ f)(-8)$. $f(x) = \dfrac{x-4}{x}$, $g(x) = x^2 - 5$

(a) $\dfrac{55}{59}$ (b) $-\dfrac{11}{4}$ (c) $-\dfrac{41}{9}$ (d) $-\dfrac{7}{2}$

Section 2.7 Modeling Data Using Regression

Linear Regression Models

109. Use the regression feature of a graphing utility to find the least squares regression line that fits these data.

x	10	23	28	19	13	14	30	32	36	42	41
y	35	38	39	37	36	36	39	39	40	41	41

(a) $y = 0.1634x + 30.1667$ (b) $y = 0.1816x + 33.5186$

(c) $y = 0.1634x + 33.5186$ (d) $y = 0.1816x + 30.1667$

110. Early in the 1900s, an airplane manufacturer was able to increase the time its planes could stay aloft by constantly refining its techniques. Use the regression feature of a graphing utility to find the least squares regression line that fits these data. Assume t is the time aloft and y is the number of years after 1910.

Years after 1910	1	2	3	4	5	6
Time aloft (hrs)	0.84	1.3	2.1	3.6	4.5	5.9

(a) $t = 1.03y - 0.51$ (b) $t = 1.04y - 0.60$ (c) $t = 1.02y - 0.57$ (d) $t = 0.93y - 0.48$

111. A restaurant owner wants to know the demand for the family special as a function of price. The daily sales for four different prices are listed in the table.

Price, x	\$9.00	\$9.75	\$10.25	\$11.25
Demand, y	41	33	26	19

Use the least squares regression line to estimate the demand for the family special at \$8.00.

(a) 60 (b) 54 (c) 50 (d) 38

112. An auto manufacturer wants to determine the relation between average speed and miles per gallon for her new economy vehicle. The table shows the results from six average speed tests.

Average Speed (mph), x	35	41	46	53	59	66
Miles Per Gallon, y	59	54	49	50	40	39

Use the least squares regression line to estimate the miles per gallon for 31 mph.

(a) 66 (b) 59 (c) 61 (d) 51

Correlation Coefficient and the Coefficient of Determination

113. A radio disc jockey kept track of the number of requests for songs by a certain artist and the time of day the request calls were made. The data is displayed below.

requests	9	0	5	10	0	10	1	5
time of day	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.

If the data were displayed on a scatter plot, could the correlation of the data be represented by a linear model? If there is a linear correlation, is there a positive or negative correlation?

(a) It is a linear model with a positive correlation. (b) The data have no reliable correlation.

(c) It is a linear model with a negative correlation. (d) It is not a linear model.

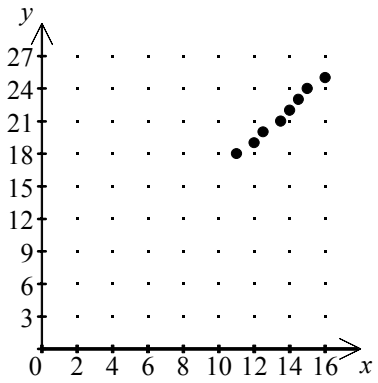
114. A real estate agent believes that the selling price of a house for a particular town is directly related to the number of square feet the house has. In order to justify his assumption, he took a sample of 8 homes that had been recently sold, and recorded the price and size. Using the data collected, compute r, the correlation coefficient.

House Size $\left(100 \text{ ft}^2\right)$	Selling Price (in thousands)
12.6	134
12.7	154
13.5	181
14.3	188
14.9	213
16.0	230
16.5	250
17.7	311

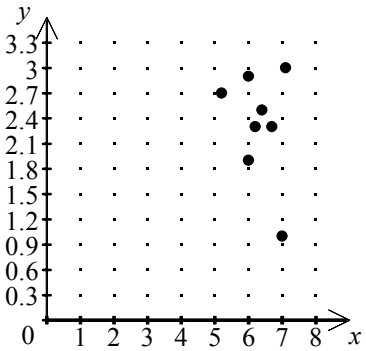
(a) –0.87 (b) 0.87 (c) 0.98 (d) –0.98

115. Which of the following graphs has a coefficient of determination close to 1?

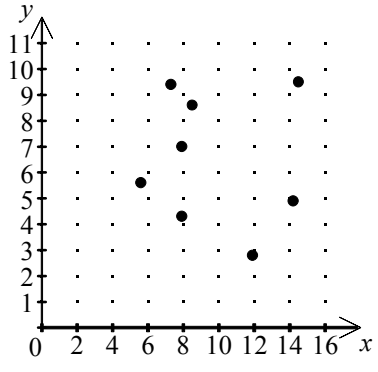
(a)



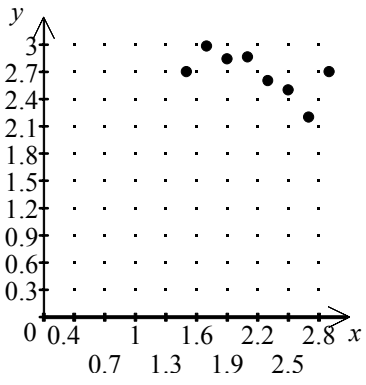
(b)



(c)



(d)



116. Do the results of the linear regression shown below seem to indicate a linear correlation between the variables? If they do, is it strong or moderate, positive or negative? If graphed, would the points tend to rise or fall as the value of the x variable increases?

LinReg
$y = ax + b$
$a = 0.5369047619$
$b = -1.1047619048$
$r^2 = 0.3563168857$
$r = 0.5969228474$

(a) There seems to be a moderately strong positive linear relationship between the variables.

(b) There is a strong positive linear relationship between the variables.

(c) There is a strong negative linear relationship between the variables.

(d) A linear model may not be appropriate for the data.

Quadratic Regression Models

Use a graphing utility with a least squares regression program to find the least squares regression quadratic for the given points.

117. $(-3, -4)$, $(-2, 2)$, $(-1, 3)$

(a) $f(x) = -\frac{5}{2}x^2 + x + 1$

(b) $f(x) = -\frac{5}{2}x^2 - \frac{13}{2}x - 1$

(c) $f(x) = -\frac{5}{2}x^2 + x + \frac{1}{10}$

(d) $f(x) = -\frac{5}{2}x^2 - \frac{13}{2}x + \frac{1}{10}$

118. $(-1, 0)$, $(0, -4)$, $(1, -9)$, $(2, -8)$, $(3, -9)$

(a) $f(x) = \frac{6}{7}x^2 - \frac{137}{35}x + \frac{164}{175}$

(b) $f(x) = \frac{6}{7}x^2 + \frac{41}{9}x + \frac{163}{35}$

(c) $f(x) = \frac{6}{7}x^2 - \frac{137}{35}x - \frac{163}{35}$

(d) $f(x) = \frac{6}{7}x^2 + \frac{41}{9}x + \frac{164}{175}$

119. A small manufacturing firm collected the following data on advertising expenditures (in thousands of dollars) and total revenue (in thousands of dollars).

Advertising (x)	Total Revenue (y)
20	6311
23	6310
26	6313
27	6313
29	6313
34	6309
39	6305
42	6293

Find the quadratic function that will best model the data.

(a) $y = -0.08x^2 + 4.32x + 6255$

(b) $y = -1.01x^2 + 2.53x + 6129$

(c) $y = -0.04x^2 + 3.2x + 6123$

(d) $y = -0.01x^2 + 9.34x + 6006$

120. A biologist took a count of the the number of migrating waterfowl at a particular lake, and recounted the lake's population of waterfowl on each of the next six weeks. Use the regression capabilities of your graphing utility to find a quadratic model for the data which expresses the population as a function of *x*, the number of weeks.

Week	0	1	2	3	4	5	6
Population	522	449	478	609	842	1177	1614

(a) $P(x) = 50x^2 - 117x + 516$

(b) $P(x) = 53x^2 - 136x + 522$

(c) $P(x) = 51x^2 - 124x + 522$

(d) $P(x) = 54x^2 - 136x + 516$

Chapter 2: Functions and Graphs (Answer Key)

Section 2.1 A Two-Dimensional Coordinate System and Graphs

Cartesian Coordinate Systems

[1] (d)

[2] (b)

[3] (a)

[4] (a)

The Distance and Midpoint Formulas

[5] (c)

[6] (d)

[7] (d)

[8] (c)

Graph of an Equation

[9] (a)

[10] (c)

[11] (a)

[12] (c)

Intercepts

[13] (d)

[14] (d)

[15] (d)

[16] (a)

Circles, Their Equations, and Their Graphs

[17] (a)

[18] (c)

[19] (b)

[20] (d)

Section 2.2 Introduction to Functions

Relations

[21] (a)

[22] (a)

[23] (c)

[24] (c)

Functions

[25] (d)

[26] (b)

[27] (a)

[28] (d)

Functional Notation

[29] (a)

[30] (b)

[31] (d)

[32] (c)

Identifying Functions

[33] (d)

[34] (c)

[35] (a)

[36] (a)

Graphs of Functions

[37] (c)

[38] (c)

[39] (c)

[40] (d)

The Greatest Integer Function

[41] (d)

[42] (a)

[43] (b)

[44] (a)

Applications

[45] (c)

[46] (b)

[47] (a)

[48] (b)

Section 2.3 Linear Functions

Slopes of Lines

[49] (a)

[50] (c)

[51] (d)

[52] (b)

Find the Equation of a Line

[53] (a)

[54] (d)

[55] (a)

[56] (a)

Applications

[57] (c)

[58] (a)

[59] (b)

[60] (a)

Parallel and Perpendicular Lines

[61] (b)

[62] (b)

[63] (a)

[64] (b)

Section 2.4 Quadratic Functions

Vertex of a Parabola

[65] (c)

[66] (b)

[67] (a)

[68] (b)

Maximum and Minimum of a Quadratic Function

[69] (a)

[70] (c)

[71] (b)

[72] (c)

Applications

[73] (b)

[74] (a)

[75] (c)

[76] (b)

Section 2.5 Properties of Graphs

Symmetry

[77] (a)

[78] (d)

[79] (c)

[80] (a)

Even and Odd Functions

[81] (a)

[82] (b)

[83] (c)

[84] (b)

Translations of Graphs

[85] (c)

[86] (c)

[87] (b)

[88] (a)

Reflections of Graphs

[89] (b)

[90] (c)

[91] (a)

[92] (d)

Compressing and Stretching Graphs

[93] (c)

[94] (b)

[95] (b)

[96] (a)

Section 2.6 The Algebra of Functions

Operations on Functions

[97] (c)

[98] (c)

[99] (d)

[100] (c)

The Difference Quotient

[101] (c)

[102] (c)

[103] (a)

[104] (a)

Composition of Functions

[105] (c)

[106] (b)

[107] (a)

[108] (b)

Section 2.7 Modeling Data Using Regression

Linear Regression Models

[109] (b)

[110] (b)

[111] (c)

[112] (c)

Correlation Coefficient and the Coefficient of Determination

[113] (b)

[114] (c)

[115] (a)

[116] (d)

Quadratic Regression Models

[117] (b)

[118] (c)

[119] (a)

[120] (c)