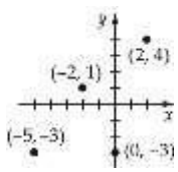
Solution Manual for Algebra and Trigonometry 8th Edition Aufmann Nation 1285449428 9781285449425

Solutions Manual for Algebra and Trigonometry 8th Edition by Richard N.Aufmann and Richard D.Nation

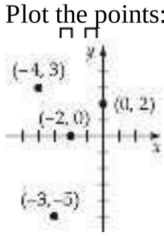
Chapter 2 Functions and Graphs

Section 2.1 Exercises

1. Plot the points:

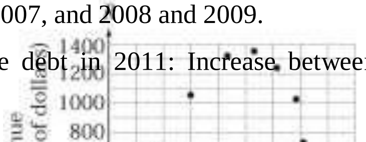


2. Plot the points:



3. **a.** Find the decrease: The average debt decreased between 2006 and 2007, and 2008 and 2009.

b. Find the average debt in 2011: Increase between



8 8 80· = 640
15 15 70· =1050
22 22 60· =1320
27 27 50· =1350
31 31 40· =1240
34
36
37 34 30· =102
0 36 20· = 720

2009 to 2010: 22.0 20.1
1.9

Then the increase from 2010 to 2011:

22.0 1.9 23.9 , or $23,900.

4. **a.** When the cost of a game is $22, 60 million games can be sold.

b. The projected numbers of sales decreases as the price of this game increases.

c. .Create a table and scatter diagram:

p $R = p\,N\cdot$

$37 \cdot 10 = 370$

d. The revenue increases to a certain point and then decreases as the price of the game increases.

5. Determine whether the ordered pair is a solution

$$2x + 5y = 16$$
$$2(-2) + 5(4) \stackrel{?}{=} 16$$
$$-4 + 20 \stackrel{?}{=} 16$$
$$16 = 16 \quad \text{True}$$

(–2, 4) is a solution.

6. Determine whether the ordered pair is a solution

$$2x^2 - 3y = 4$$
$$2(1)^2 - 3(-1) \stackrel{?}{=} 4$$
$$2 + 3 \stackrel{?}{=} 4$$
$$5 = 4 \quad \text{False}$$

(1,–1) is not a solution.

7. Determine whether the ordered pair is a solution

$$y = 3x^2 - 4x + 2$$
$$17 \stackrel{?}{=} 3(-3)^2 - 4(-3) + 2$$
$$17 \stackrel{?}{=} 27 + 12 + 2 \quad 17 = 41 \quad \text{False}$$

(–3, 17) is not a solution.

8. Determine whether the ordered pair is a solution

$x^2 + y^2 = 169$

$(-2)^2 + (12)^2 \overset{?}{=} 169$

$d = \sqrt{(-10-(-5))^2 + (14-8)^2}$

$= \sqrt{(-5)^2 + (6)^2}$

$= \sqrt{25+36}$

$\sqrt{61}$

11. Find the distance: (–4, –20), (–10, 15)

$= \sqrt{(-10-(-4))^2 + (15-(-20))^2}$

$= \sqrt{(-6)^2 + (35)^2}$

$= \sqrt{36+1225}$

$\sqrt{1261}$

12. Find the distance: (40, 32), (36, 20)

$= \sqrt{(36-40)^2 + (20-32)^2}$

$= \sqrt{(-4)^2 + (-12)^2}$

$= \sqrt{16+144}$

$\sqrt{160}$

$= 4\sqrt{10}$

13. Find the distance: (5, –8), (0, 0)

$= \sqrt{(0-5)^2 + (0-(-8))^2}$

$= \sqrt{(-5)^2 + (8)^2}$

$= \sqrt{25+64}$

$\sqrt{89}$

14. Find the distance: (0, 0), (5, 13)

$= \sqrt{(5-0)^2 + (13-0)^2}$

$= \sqrt{5^2 + 13^2}$

$= \sqrt{25+169}$

$= \sqrt{194}$

15. Find the distance: $(\sqrt{3}, \sqrt{8}), (\sqrt{12}, \sqrt{27})$

$= \sqrt{(\sqrt{12}-\sqrt{3})^2 + (\sqrt{27}-\sqrt{8})^2}$

$= \sqrt{(2\sqrt{3}-\sqrt{3})^2 + (3\sqrt{3}-2\sqrt{2})^2}$

$= \sqrt{(\sqrt{3})^2 + (3\sqrt{3}-2\sqrt{2})^2}$

$= \sqrt{3+(27-12\sqrt{6}+8)}$

$= \sqrt{3+27-12\sqrt{6}+8}$

$= \sqrt{38-12\sqrt{6}}$

4 +144=169

148 =169

False

(–2, 12) is not a solution.

9. Find the distance: (6, 4), (–8, 11)

$d = \sqrt{(-8-6)^2 + (11-4)^2}$

$= \sqrt{(-14)^2 + (7)^2}$

$= \sqrt{196+49}$

$= \sqrt{245}$

$= 7\sqrt{5}$

10. Find the distance: (–5, 8), (–10, 14)

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=

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d =

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d = =

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d = =

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d = =

d = =

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16. Find the distance: $(\sqrt{125}, 2\sqrt{5}), (6, \sqrt{20})$

$d = \sqrt{(6-\sqrt{125})^2 + (2\sqrt{5}-\sqrt{20})^2}$

$= \sqrt{(6-5\sqrt{5})^2 + (2\sqrt{5}-2\sqrt{5})^2}$

$= \sqrt{(6-5\sqrt{5})^2 + 0^2}$

$= \sqrt{(6-5\sqrt{5})^2} = |6-5\sqrt{5}| = 5\sqrt{5}-6$

Note: for another form of the solution,

$d = \sqrt{(\ldots - 5\sqrt{5})^2}$

$= \sqrt{36 - 60\sqrt{5} + 125} = \sqrt{161 - 60\sqrt{5}}$

17. Find the distance: (a, b), $(-a, -b)$

$d = \sqrt{(-a-a)^2 + (-b-b)^2}$

$= \sqrt{(-2a)^2 + (-2b)^2}$

$= \sqrt{4a^2 + 4b^2}$

$= \sqrt{4(a^2 + b^2)}$

$= 2\sqrt{a^2 + b^2}$

18. Find the distance: $(a - b, b)$, $(a, a + b)$

$d = \sqrt{(a-(a-b))^2 + (a+b-b)^2}$

$= \sqrt{(a-a+b)^2 + (a)^2}$

$= \sqrt{b^2 + a^2}$

$= \sqrt{a^2 + b^2}$

19. Find the distance: $(x, 4x)$, $(-2x, 3x)$

$d = \sqrt{(-2x-x)^2 + (3x-4x)^2}$ with $x < 0$

$= \sqrt{(-3x)^2 + (-x)^2}$

$= \sqrt{9x^2 + x^2}$

$\sqrt{10x^2}$

$= -x\sqrt{10}$ (Note: since $x < 0, \sqrt{x^2} = -x$)

20. Find the distance: $(x, 4x)$, $(-2x, 3x)$

$d = \sqrt{(-2x-x)^2 + (3x-4x)^2}$ with $x > 0$

$= \sqrt{(-3x)^2 + (-x)^2}$

$= \sqrt{9x^2 + x^2}$

$\sqrt{10x^2}$

$= x\sqrt{10}$ (since $x > 0, \sqrt{x^2} = x$)

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d = =

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d

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=

d

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=

=

=

d

=

=

21. Find the midpoint: (1, –1), (5, 5)

M = æççè *x*1+2 *x*2, *y*1+2 *y*2ö÷÷ø

= æççè1+2 5, -12+5ö÷÷ø

= æççè62 , 42ö÷÷ø

= (3, 2)

22. Find the midpoint: (–5, –2), (6, 10)

M = æççè *x*1+2 *x*2, *y*1+2 *y*2ö÷÷ø

= æççè-52+ 6, -22+10ö÷ø÷÷

= æççè12 , 82ö÷÷ø

= æççè 1 2 , 4ö÷÷ø

23. Find the midpoint: (6, –3), (6, 11)

M = æççè6+2 6, -32+11ö÷÷ø

= æççè122 , 82ö÷÷ø

= (6, 4)

24. Find the midpoint: (4, 7), (–10, 7)

M = ççèçæ4+ -(10)2, 7+2 7÷÷ø÷ö

= ççèæ-26, 142 ö÷÷ø

= -(3, 7)

25. Find the midpoint: (1.75, 2.25), (–3.5, 5.57)

$M = \left(\frac{1.75 + (-3.5)}{2}, \frac{2.25 + 5.57}{2}\right)$

$= \left(\frac{-1.75}{2}, \frac{7.82}{2}\right)$

$= (-0.875, 3.91)$

26. Find the midpoint: (–8.2, 10.1), (–2.4, –5.7) $\left(\frac{-8.2 + (-2.4)}{2}, \frac{10.1 + (-5.7)}{2}\right)$

$= \left(\frac{-10.6}{2}, \frac{4.4}{2}\right)$

$= (-5.3, 2.2)$

27. Find other endpoint: endpoint (5, 1), midpoint (9, 3)

$\left(\frac{x+5}{2}, \frac{y+1}{2}\right) = (9, 3)$

therefore $\frac{x+5}{2} = 9$ and $\frac{y+1}{2} = 3$

$x + 5 = 18$ $\quad$ $y + 1 = 6$

$x = 13$ $\quad$ $y = 5$

Thus (13, 5) is the other endpoint.

28. Find other endpoint: endpoint (4, –6), midpoint (–2, 11)

$\left(\frac{x+4}{2}, \frac{y+(-6)}{2}\right) = (-2, 11)$

therefore $\frac{x+4}{2} = -2$ and $\frac{y+(-6)}{2} = 11$

$x + 4 = -4$ $\quad$ $y - 6 = 22$

$x = -8$ $\quad$ $y = 28$

Thus (–8, 28) is the other endpoint.

29. Find other endpoint: endpoint (–3, –8), midpoint (2, –7)

$\left(\frac{x+(-3)}{2}, \frac{y+(-8)}{2}\right) = (2, -7)$

therefore $\frac{x-3}{2} = 2$ and $\frac{y-8}{2} = -7$

$x - 3 = 4$ $\quad$ $y - 8 = -14$

$x = 7$ $\quad$ $y = -6$

Thus (7, –6) is the other endpoint.

30. Find other endpoint: endpoint (5, –4), midpoint (0, 0) $\left(\frac{x+5}{2}, \frac{y+(-4)}{2}\right) = (0, 0)$

therefore $\frac{x+5}{2} = 0$ and $\frac{y-4}{2} = 0$

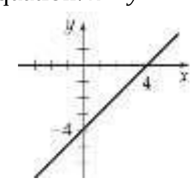
$x + 5 = 0$ $\quad$ $y - 4 = 0$

$x = -5$ $\quad$ $y = 4$

Thus (–5, 4) is the other endpoint.

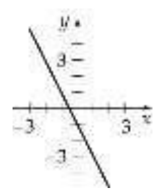
31. Graph the equation: $x - y = 4$

x	y
0	−4
2	−2
4	0



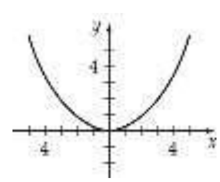
32. Graph the equation: $2x + y = -1$

x	y
-2	3
0	-3
2	1



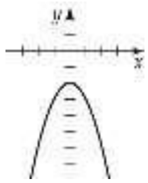
33. Graph the equation: $y = 0.25x^2$

x	y
−4	4
−2	1
0	0
2	1
4	4



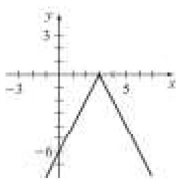
34. Graph the equation: $3x^2 + 2y = -4$

x	y
−2	−8
−1	−3.5
0	−2
1	−3.5
2	−8

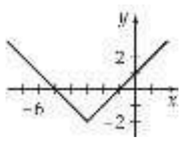


35. Graph the equation: $y = -2|x - 3|$

x	y
0	−6
2	−2
3	0
4	−2
6	−6



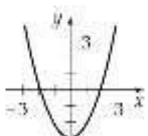
36. Graph the equation: $y = |x + 3| - 2$



x	y
-6 -	1
5 -3	0
-1	-2
0	0
	1

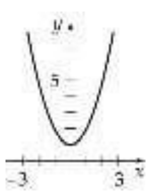
37. Graph the equation: $y = x^2 - 3$

x	y
-2	1
-1	-2
0	-3
1	-2
2	1

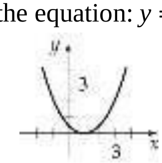


38. Graph the equation: $y = x^2 + 1$

x	y
−2	5
−1	2
0	1
1	2
2	5



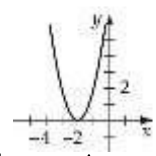
39. Graph the equation: $y = \frac{1}{2}(x-1)^2$



x	y
-1	2
0	0.
1	5
2	0
3	0.5
	2

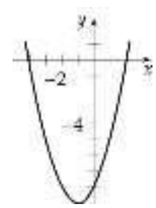
40. Graph the equation: $y = 2(x + 2)^2$

x	y
−4	8
−3	2
−2	0
−1	2
0	8



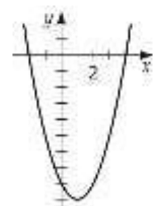
41. Graph the equation: $y = x^2 + 2x - 8$

x	y
-4	0
-2	-8
-1	-9
0	-8
2	0

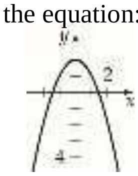


42. Graph the equation: $y = x^2 - 2x - 8$

x	y
-2	0
0	-8
1	-9
2	-8
4	0



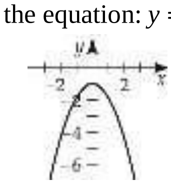
43. Graph the equation: $y = -x^2 + 2$



x	y
-2	-2
-1	1
0	2
1	1
2	-2

44. Graph the equation: $y = -x^2 - 1$

x	y
-2	-5
-1	-2
0	-1
1	-2 -
2	5



45. Find the x- and y-intercepts and graph: $2x + 5y = 12$

For the y-intercept, let $x = 0$ and solve for y.

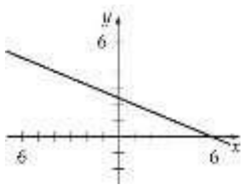
$2(0) + 5y = 12$

$y = \frac{12}{5}$, y-intercept: $\left(0, \frac{12}{5}\right)$

For the x-intercept, let $y = 0$ and solve for x.

$2x + 5(0) = 12$

$x = 6$, x-intercept: $(6, 0)$



46. Find the x- and y-intercepts and graph: $3x - 4y = 15$

For the y-intercept, let $x = 0$ and solve for y.

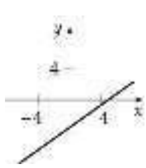
$3(0) - 4y = 15$

$y = -\frac{15}{4}$, y-intercept: $\left(0, -\frac{15}{4}\right)$

For the x-intercept, let $y = 0$ and solve for x.

$3x - 4(0) = 15$

$x = 5$, x-intercept: $(5, 0)$



47. Find the x- and y-intercepts and graph: $x = -y^2 + 5$

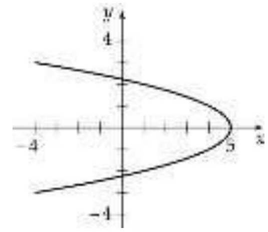
For the y-intercept, let $x = 0$ and solve for y.

$0 = -y^2 + 5$ $\quad y = \pm\sqrt{5}$, y-intercepts: $\left(0, -\sqrt{5}\right)$, $\left(0, \sqrt{5}\right)$

For the x-intercept, let $y = 0$ and solve for x.

$x = -(0)^2 + 5$

$x = 5$, x-intercept: $(5, 0)$



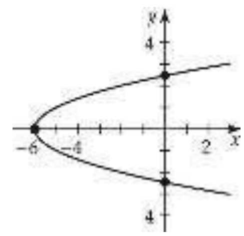
48. Find the x- and y-intercepts and graph: $x = y^2 - 6$

For the y-intercept, let $x = 0$ and solve for y.

$0 = y^2 - 6$ $\quad y = \pm\sqrt{6}$, y-intercepts: $\left(0, -\sqrt{6}\right)$, $\left(0, \sqrt{6}\right)$

For the x-intercept, let $y = 0$ and solve for x.

$x = (0)^2 - 6$ $\quad x = -6$, x-intercept: $(-6, 0)$



49. Find the x- and y-intercepts and graph: $x = |y| - 4$

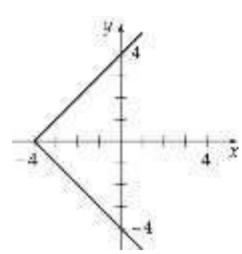
For the y-intercept, let $x = 0$ and solve for y.

$0 = |y| - 4$ $\quad y = \pm 4$, y-intercepts: $(0, -4)$, $(0, 4)$

For the x-intercept, let $y = 0$ and solve for x.

$x = |0| - 4$

$x = -4$, x-intercept: $(-4, 0)$



50. Find the x- and y-intercepts and graph: $x = y^3 - 2$

For the y-intercept, let $x = 0$ and solve for y.

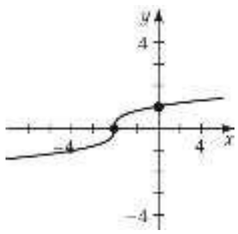
$0 = y^3 - 2$

$y = \sqrt[3]{2}$, -intercept: 0, y $\sqrt{(}$ $^3 2)$

For the x-intercept, let $y = 0$ and solve for x.

$x = ( )0\ ^3 - 2$

$x = -2$, -intercept: x $(-2, 0)$



51. Find the x- and y-intercepts and graph: $x^2 + y^2 = 4$

For the y-intercept, let $x = 0$ and solve for y.

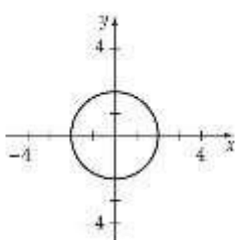
$( )0\ ^2 + y^2 = 4$

$y = \pm 2$, -intercepts: $0, y(-2)\ (, 0, 2)$

For the x-intercept, let $y = 0$ and solve for x.

$x^2 + ( )0\ ^2 = 4$

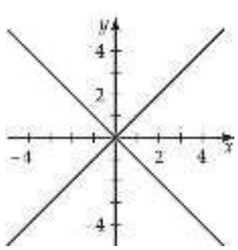
$x = \pm 2$, -intercepts: x $(-2, 0\ , 2,)\ (\ 0)$



52. Find the x- and y-intercepts and graph: $x^2 = y^2$ For the y-intercept, let $x = 0$ and solve for y.

For the x-intercept, let $y = 0$ and solve for x.

Intercept: (0, 0)



53. Find center and radius: $x^2 + y^2 = 36$

center (0, 0), radius 6

54. Find center and radius: $x^2 + y^2 = 49$

center (0, 0), radius 7

55. Find center and radius: $(x-1)^2 + -(y\ \ 3)^2 = 49$

center (1, 3), radius 7

56. Find center and radius: $(x-2)^2 + (y-4)^2 = 25$

center (2, 4), radius 5

57. Find center and radius: $(x+2)^2 + (y+5)^2 = 25$

center (□2, □5), radius 5

58. Find center and radius: $(x + 3)^2 + (y + 5)^2 = 121$

center (□3, □5), radius 11

59. Find center and radius: $(x - 8)^2 + y^2 = \frac{1}{4}$

center (8, 0), radius $\frac{1}{2}$

60. Find center and radius: $x^2 + (y - 12)^2 = 1$

center (0, 12), radius 1

61. Find circle equation: center (4, 1), radius 2

$(x - 4)^2 + (y - 1)^2 = 2^2$

$(x - 4)^2 + (y - 1)^2 = 4$

62. Find circle equation: center (5, –3), radius 4

$(x - 5)^2 + (y + 3)^2 = 4^2$

$(x - 5)^2 + (y + 3)^2 = 16$

63. Find circle equation: center $\left(\frac{1}{2}, \frac{1}{4}\right)$, radius $\sqrt{5}$

$\left(x - \frac{1}{2}\right)^2 + \left(y - \frac{1}{4}\right)^2 = (\sqrt{5})^2$

$$\left(x-\frac{1}{2}\right)^2+\left(y-\frac{1}{4}\right)^2=5$$

64. Find circle equation: center $\left(0, \frac{2}{3}\right)$, radius $\frac{\sqrt{11}}{3}$

$$(x-0)^2+\left(y-\frac{2}{3}\right)^2=\left(\frac{\sqrt{11}}{3}\right)^2$$

$$(x-0)^2+\left(y-\frac{2}{3}\right)^2=11$$

65. Find circle equation: center (0, 0), through (–3, 4)

$$(x-0)^2+(y-0)^2=r^2$$
$$(-3-0)^2+(4-0)^2=r^2$$
$$(-3)^2+4^2=r^2$$
$$9+16=r^2$$
$$25=5^2=r^2$$
$$(x-0)^2+(y-0)^2=25$$

66. Find circle equation: center (0, 0), through (5, 12)

$$(x-0)^2+(y-0)^2=r^2$$
$$(5-0)^2+(12-0)^2=r^2$$
$$5^2+12^2=r^2$$
$$25+144=r^2$$
$$169=13^2=r^2$$
$$(x-0)^2+(y-0)^2=169$$

67. Find circle equation: center (1, 3), through (4, –1)

$$(x+2)^2+(y-5)^2=r^2$$
$$(x-1)^2+(y-3)^2=r^2$$
$$(4-1)^2+(-1-3)^2=r^2$$
$$3^2+(-4)^2=r^2$$
$$9+16=r^2$$
$$25=5^2=r^2$$
$$(x-1)^2+(y-3)^2=25$$

68. Find circle equation: center (–2, 5), through (1, 7)

$$(1+2)^2+(7-5)^2=r^2$$
$$3^2+2^2=r^2$$
$$9+4=r^2$$
$$13=\left(\sqrt{13}\right)^2=r^2$$
$$(x+2)^2+(y-5)^2=13$$

69. Find circle equation: center (-2, 5), diameter 10 diameter 10 means the radius is 5 $\Rightarrow r^2=25$.

$$(x+2)^2+(y-5)^2=25$$

70. Find circle equation: center (0,-1), diameter 8

diameter 8 means the radius is 4 $\Rightarrow r^2=16$.

$$(x-0)^2+(y+1)^2=16$$

71. Find circle equation: endpoints (2, 3) and (–4, 11)

$$d=\sqrt{(-4-2)^2+(11-3)^2}$$
$$=\sqrt{36+64}=\sqrt{100}$$
$$=10$$

Since the diameter is 10, the radius is 5. The center is the midpoint of the line segment from (2, 3) to (–4, 11). $\left(\frac{2+(-4)}{2}, \frac{3+11}{2}\right)$

$=(-1, 7)$ center

$(x+1)^2 + (y-7)^2 = 25$

72. Find circle equation: endpoints (7, –2) and (–3, 5)

$d = \sqrt{(3- \quad -7)^2 + (5- -(2))^2} = \sqrt{100+49} = \sqrt{149}$

Since the diameter is $\sqrt{149}$, the radius is $\frac{\sqrt{149}}{2}$.

Center is çççèæ7 + (2-3) (2), - 2+5øö÷÷÷ = (2, 23)

2 æç

=

$(x-2)^2 + y - 2^3$) çèç 1492ö÷÷÷ø2

2

$(x-2)2 + (y - 32) = 1494$

73. Find circle equation: endpoints (5,–3) and (–1,–5)

$d = \sqrt{(5- \quad -(3))^2 + -(1 \quad 5)^2} = \sqrt{4+36} = \sqrt{40}$

Since the diameter is $\sqrt{40}$, the radius is $\frac{\sqrt{40}}{2} = \sqrt{10}$.

Center is çççèæ5+ (2-1) (3), -+ -2 (5)øö÷÷÷ = (2,-4)

$(x-2)^2 + (y+4)^2 = (\sqrt{10})^2$

$(x-2)^2 + (y+4)^2 = 10$

74. Find circle equation: endpoints (4,–6) and (0,–2)

$\sqrt{\quad}$ d = - -- + - = + =(2 (6))² (0 √4)²

16 16 32

Since the diameter is $\sqrt{32}$, the radius is $\frac{\sqrt{32}}{2} = 2\sqrt{2}$.

Center is çæççè4 +2 0 , (6)-+ -2 (2)ö÷÷÷ø = (2,-4)

$(x-2)^2 + (y+4)^2 = (2\sqrt{2})^2$

$(x-2)^2 + (y+4)^2 = 8$

75. Find circle equation: center (7, 11), tangent to *x*-axis Since it is tangent to the *x*-axis, its radius is 11.

$(x-7)^2 + (y-11)^2 = 11^2$

76. Find circle equation: center (–2, 3), tangent to *y*-axis Since it is tangent to the *y*-axis, its radius is 2.

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

77. Find center and radius: $x^2 + y^2 - 6x + 5 = 0$

$x^2 - 6x \quad + y^2 = -5$ $x^2 - 6x +$

$9 + y^2 = -5 + 9$

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

center (3, 0), radius 2

78. Find center and radius: $x^2 + y^2 - 6x - 4y + 12 = 0$

$x^2 - 6x \quad + y^2 - 4y \quad = -12$

$x^2 - 6x + 9 + y^2 - 4y + 4 = -12 + 9 + 4$

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

center (3, 2), radius 1

79. Find center and radius: $x^2 + y^2 - 14x + 8y + 53 = 0$ $x^2 - 14x \quad + y^2 + 8y \quad = -53$ $x^2 - 14x + 49 +$

$y^2 + 8y + 16 = -53 + 49 + 16$

$(x-7)^2 + (y+4)^2 = 12$

center (7, □4), radius $\sqrt{12} = 2\sqrt{3}$

80. Find center and radius: $x^2 + y^2 - 10x + 2y + 18 = 0$ $x^2 - 10x \quad + y^2 + 2y \quad = -18$

$x^2 - 10x + 25 + y^2 + 2y + 1 = -18 + 25 + 1$

$(x-5)^2 + (y+1)^2 = 8$

center (5, □1), radius $\sqrt{8} = 2\sqrt{2}$

81. Find center and radius: $x^2 + y^2 - x + 3y - \frac{15}{4} = 0$

$x^2 - x \qquad + y^2 + 3y \qquad = \frac{15}{4}$

$x^2 - x + \frac{1}{4} + y^2 + 3y + \frac{9}{4} = \frac{15}{4} + \frac{1}{4} + \frac{9}{4}$

æççèx - 12ö÷÷÷ø^2 +èæçç y + 2^3÷÷÷øö^2 =

æççè2^{5}ö÷÷ø÷^{2} center ççèæ12 , - 23ö÷÷÷ø,

radius 25

82. Find center and radius: $x^2 + y^2 + 3x - 5y + \frac{25}{4} = 0$

$x^2 + 3x \qquad + y^2 - 5y \qquad = -\frac{25}{4}$

$x^2 + 3x + \frac{9}{4} + y^2 - 5y + \frac{25}{4} = -\frac{25}{4} + \frac{9}{4} + \frac{25}{4}$ æççèx +

2^{3}ö÷÷÷ø^2 +æèçç y - 2^5÷÷÷øö^2 = æççè2^{3}ö÷÷ø÷^{2}

center çæçè- 23, 25ö÷÷÷ø, radius 23

83. Find center and radius: $x^2 + y^2 + 3x - 6y + 2 = 0$ x^2 +

$3x \qquad + y^2 - 6y \qquad = -2$

$x^2 + 3x + \frac{9}{4} + y^2 - 6y + 9 = -2 + \frac{9}{4} + 9$

4 4 çèçæx + 3÷÷øö÷2 +(y -

3)2 = ççèæç 237 ÷÷÷ø÷ö2

2

center çæçè- 23, 3 , radius ö÷÷÷ø $\sqrt{\ }$ 237

84. Find center and radius: $x^2 + y^2 - 5x - y - 4 = 0$ $x^2 -$

$5x \quad + y^2 - y \quad = 4$

$x^2 - 5x + \frac{25}{4} + y^2 - y + \frac{1}{4} = 4 + \frac{25}{4} + \frac{1}{4}$

4 4 4 4 æççèx - 2 5 ö÷÷ø² +æççè y -

12ö÷÷ø² = æçèçç 2 42 ö÷÷ø÷²

center ççèæ25, 12ö÷÷ø, radius 242

85. Find the points:

$\sqrt{(4-x)^2 + (6-0)^2} = 10$

$\left(\sqrt{(4-x)^2 + (6-0)^2}\right)^2 = 10^2$

$16 - 8x + x^2 + 36 = 100$ $x^2 - 8x -$

$48 = 0$

$(x - 12)(x + 4) = 0$ x

$= 12$ or $x = -4$

The points are (12, 0), (-4, 0).

86. Find the points:

$\sqrt{(5-0)^2 + (y - (-3))^2} = 12$

$\left(\sqrt{(5)^2 + (y+3)^2}\right)^2 = 12^2$

$25 + y^2 + 6y + 9 = 144$

$y^2 + 6y - 110 = 0$

$y = \frac{-6 \pm \sqrt{6^2 - 4(1)(-110)}}{2(1)}$ $y = -\frac{6 \pm 2\sqrt{119}}{2}$

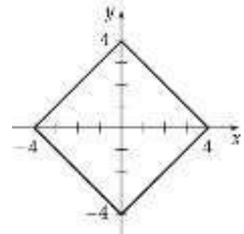
$y = \frac{-6 \pm \sqrt{36 + 440}}{2}$ $y = -3 \pm \sqrt{119}$

$y = \frac{-6 \pm \sqrt{476}}{2}$

The points are $(0, -3 + \sqrt{119})$, $(0, -3 - \sqrt{119})$.

87. Find the x- and y-intercepts and graph: $|x| + |y| = 4$

Intercepts: (0, ± 4), (± 4, 0)



88. Find the x- and y-intercepts and graph: $|x - 4y| = 8$

For the y-intercept, let $x = 0$ and solve for y.

$|0 - 4y| = 8$

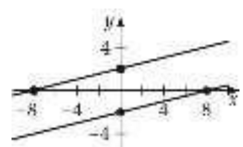
$4y = \pm 8$

$y = \pm 2$, y-intercepts: (0, −2), (0, 2)

For the x-intercept, let $y = 0$ and solve for x.

$|x - 4(0)| = 8$

$x = \pm 8$, -interce



89. Find the formula:

$\sqrt{(3-x)^2 + (4-y)^2} = 5$

$(3-x)^2 + (4-y)^2 = 5^2$

$9 - 6x + x^2 + 16 - 8y + y^2 = 25$ $x^2 - 6x +$

$y^2 - 8y = 0$

90. Find the formula:

$\sqrt{(-5-x)^2 + (12-y)^2} = 13$

$(-5-x)^2 + (12-y)^2 = 13^2$

$25 + 10x + x^2 + 144 - 24y + y^2 = 169$ $x^2 + 10x$

$+ y^2 - 24y = 0$

Prepare for Section 2.2

P1. $x^2 + 3x - 4$

$(3)-^2 + 3(3)- \quad -4 = 9-9-4 = -4$

P2. $D = -\{3,-2,-1, 0, 2\}$

$R = \{1, 2, 4, 5\}$

P3. $d = \sqrt{(3- -(4))^2 + -(2-1)^2} = \sqrt{49+9} = \sqrt{58}$

P4. $2x-6 ^3 0$

$2x \ ^3$

$6\ x$

$^3\ 3$

P5. $x^2 - x - 6 = 0$

$(x + 2)(x - 3) = 0$

$x + 2 = 0 \qquad x - 3 = 0$

$x = -2 \qquad x = 3$

–2, 3

P6. $a = 3x + 4, \qquad a = 6x - 5$

$3x + 4 = 6x - 5$

$9 = 3x$

$3 = x\ a =$

$+ \qquad =3(3)$

4

13

Section 2.2 Exercises

1. Write the domain and range. State whether a relation.

Domain: {–4, 2, 5, 7}; range: {1, 3, 11} Yes. The set of ordered pairs defines *y* as a function of *x* since each *x* is paired with exactly one *y*.

2. Write the domain and range. State whether a relation.

Domain: {3, 4, 5}; range: {–2, 7, 8, 10} No. The set of ordered pair does not define *y* as a function of *x* since 5 is paired with 10 and 8.

3. Write the domain and range. State whether a relation.

Domain: {4, 5, 6}; range: {–3, 1, 4, 5} No. The set of ordered pair does not define *y* as a function of *x* since 4 is paired with 4 and 5.

4. Write the domain and range. State whether a relation.

Domain: {1, 2, 3}; range {0}

Yes. The set of ordered pairs defines *y* as a function of *x* since each *x* is paired with exactly one *y*.

5. Determine if the value is in the domain.

$f(\ )0 = \frac{3(0)}{0+4} = 0$

Yes, 0 is in the domain of the function.

6. Determine if the value is in the domain.

$g(\ )-1 = 1- -(1)^2 = 0$

Yes, –1 is in the domain of the function.

7. Determine if the value is in the domain.

$F(\ )0 = \frac{1\ \ 1}{-1+1} \quad \frac{2}{0} =$ undefined

No, –1 is not in the domain of the function.

8. Determine if the value is in the domain.

$y(\ )2 \sqrt{= 2(2)- } = -8 \sqrt{\ \ 4}$

No, 2 is not in the domain of the function.

9. Determine if the value is in the domain. $g(\ )- =1\ ($

$1)5(- +- -1)_2\ 11 = =-26\ 3$

Yes, –1 is in the domain of the function.

10. Determine if the value is in the domain.

$F_{(- =2)}\ \overline{(2)- +^1{}_3\ 8} = {}^1{}_0$

No, 0 is not in the domain of the function.

11. Is *y* a function of *x*?

$2x+ =3y \ \ 7$

$3y =- +2x \ \ 7$

$y =- +\frac{2}{\ }x \quad \frac{7}{\ },$ is a function of $.y \qquad x$

12. Is y a function of x?

$5x + y = 8$

$y = -5x + 8$, is a function of x.

13. Is y a function of x?

$-x + y^2 = 2$

$y^2 = x + 2$

$y = \pm\sqrt{x + 2}$, y is not a function of x.

14. Is y a function of x?

$x^2 - 2y = 2$

$-2y = -x^2 + 2$

$y = \frac{1}{2}x^2 - 1$, y is a function of x.

15. Is y a function of x?

$x^2 + y^2 = 9$

$y^2 = 9 - x^2$

$y = \pm\sqrt{9 - x^2}$, y is not a function of x.

16. Is y a function of x? $y = \sqrt[3]{x}$, y is a function of x.

17. Is y a function of x? $y = |x| + 5$, y is a function of x.

18. Is y a function of x?

$y = \sqrt{x^2 + 4}$, y is a function of x.

19. Determine if the value is a zero. $f(-2) = 3(-2) + 6 = 0$

Yes, –2 is a zero.

20. Determine if the value is a zero.

$f(0) = 2(0)^3 - 4(0)^2 + 5(0) = 0$

Yes, 0 is a zero.

21. Determine if the value is a zero. $G\left(-\frac{1}{3}\right) = 3\left(-\frac{1}{3}\right)^2 + 2\left(-\frac{1}{3}\right) - 1 = -\frac{4}{3}$

No, $-\frac{1}{3}$ is not a zero.

22. Determine if the value is a zero.

$s(-1) = \frac{2(-1) + 6}{-1 + 1} = \frac{4}{0}$ undefined

No, –1 is not a zero.

23. Determine if the value is a zero.

$y(1) = 5(1)^2 - 2(1) - 2 = 1$

No, 1 is not a zero.

24. Determine if the value is a zero. $g(-3) = \frac{3(-3)}{(-3)^2 + 5} = -\frac{9}{4}$

$g(-3) = \frac{-9}{4} \ne 0$... [as printed: $\pm$-94 = 05 = 0]

Yes, –3 is a zero.

25. Evaluate the function $f(x) = 3x - 1$,

a. $f(2) = 3(2) - 1$
$= 6 - 1$
$= 5$

b. $f(-1) = 3(-1) - 1$
$= -3 - 1$
$= -4$

c. $f(0) = 3(0) - 1$
$= 0 - 1 = -1$

d. $f\left(\frac{2}{3}\right) = 3\left(\frac{2}{3}\right) - 1$
$= 2 - 1$
$= 1$

e. $f(k) = 3(k) - 1$
$= 3k - 1$

f. $f(k + 2) = 3(k + 2) - 1$
$= 3k + 6 - 1$
$= 3k + 5$

26. Evaluate the function $g(x) = 2x^2 + 3$,

a. $g(3) = 2(3)^2 + 3 = 18 + 3 = 21$

b. $g(-1) = 2(-1)^2 + 3 = 2 + 3 = 5$

c. $g(0) = 2(0)^2 + 3 = 0 + 3 = 3$

d. $g\left(\frac{1}{2}\right) = 2\left(\frac{1}{2}\right)^2 + 3 = \frac{1}{2} + 3 = \frac{7}{2}$

e. $g(c) = 2(c)^2 + 3 = 2c^2 + 3$

f. $g(c+5) = 2(c+5)^2 + 3$

$= 2c^2 + 20c + 50 + 3$

$= 2c^2 + 20c + 53$

27. Evaluate the function $A(w) = \sqrt{w^2 + 5}$,

a. $A(0) = \sqrt{(0)^2 + 5} = \sqrt{5}$

b. $A(2) = \sqrt{(2)^2 + 5} = \sqrt{9} = 3$

c. $A(-2) = \sqrt{(-2)^2 + 5} = \sqrt{9} = 3$

d. $A(4) = \sqrt{4^2 + 5} = \sqrt{21}$

e. $A(r+1) = \sqrt{(r+1)^2 + 5}$

$= \sqrt{r^2 + 2r + 1 + 5}$

$= \sqrt{r^2 + 2r + 6}$

30. Evaluate the function $T(x) = 5$,

a. $T(-3) = 5$

b. $T(0) = 5$

f. $A(-=-+=+c)$ $(c)^2$ 5 c^2 5 **c.** T çè ç 7 ÷÷ø = 5

28. Evaluate the function $J(\ )t = 3t^2 - t$, **d.** $T(3)+T(1) = 5+5 = 10$

a. $J(4)-\ = 3(4)-^2 - -(4) = 48+4 = 52$ **e.** $T\,x(+h) = 5$

2 **f.** $T(3k+5) = 5$

b. $J(0) = 3(0) -(0) = 0-0 = 0$ æ ö÷ = 3ççèæ 1 3÷÷÷øö2 - 1 3 = 1 3- 1 3 = 0 **31.** Evaluate the function

| |

$s\,x(\ ) = \frac{x}{x}$, **c.** J çèç 1 3÷÷ø

d. $J(-c) = 3(-c)^2 - -(c) = 3c^2 + c$ **a.** $s(4) = \frac{4}{4} = = 4\frac{4}{\ }1$

e. $J\,x(+1) = 3(x+1)^2 -(x+1)$ **b.** $s(5) = \frac{5}{\ } = \frac{5}{\ } = 1$

2 5 | | 5

$= 3x + 6x + 3 - x - 1$

$= 3x^2 + 5x + 2$ **c.** $s(2)- = \frac{-2}{-2} = \frac{-2}{2} = -1$

f. $J\,x(+h) = 3(x+h)^2 -(x+h)$

$= 3x^2 + 6xh + 3h^2 - x - h$ **d.** $s(3)- = \frac{-3}{-3} = \frac{-3}{3} = -1$

| |

29. Evaluate the function $f\,x(\ ) = 1x$, **e.** Since $t > 0$, $t = t$.

a. $f(2) = \frac{1}{\ } = \frac{1}{2}$ $s\,t(\ ) = \frac{t}{t} = \frac{t}{t} = 1$ | |

2

b. $f(2)- = \frac{1}{\ } = 1$ **f.** Since $t < = -0$, $tt.$ -2 2

$s\,t(\ ) = \frac{t}{\ } = \frac{t}{\ } = -1$

| | | |

c. f çèçæ-53÷÷øö÷ = -153 **32.** Evaluate the function $t-t$ $r\,x(\ ) = \frac{x}{x+4}$,

$= 3\frac{1}{5}$ **a.** $r(0) = \frac{0}{0+4} = \frac{0}{4} = 0$

$= 1 \cdot \frac{3}{5} = 1 \cdot \frac{5}{3}$ **b.** $r(-1) = \frac{-1}{-1+4} = \frac{-1}{3} = -\frac{1}{3}$

$= \frac{5}{3}$

$(2) + (-2) = \frac{1}{2} + \frac{1}{2} = 1$ **c.** $r(-3) = \frac{-3}{-3+4} = \frac{-3}{1} = -3$

d. f

f $\boxed{c^2+4}$

e. $f\,c(2+4) =$ 1 $= c^2 1+4$ **d.** $r$æççè öø $\left(\frac{1}{2}\right) = \frac{\frac{1}{2}}{\frac{1}{2}+4} = \frac{\left(\frac{1}{2}\right)}{\left(\frac{9}{2}\right)} = \frac{1}{2} \div \frac{9}{2} = \frac{1}{2} \cdot \frac{2}{9} = \frac{1}{9}$

æ2ö

e. $r(0.1) = \frac{0.1}{0.1+4} = \frac{0.1}{4.1} = \frac{1}{41}$

f. $r(10{,}000) = \frac{10{,}000}{10{,}000+4} = \frac{10{,}000}{10{,}004} = \frac{2500}{2501}$

33. **a.** Since $x = -4 < 2$, use $P(x) = 3x + 1$.

$P(-4) = 3(-4) + 1 = -12 + 1 = -11$

b. Since $x = \sqrt{5} \geq 2$, use $P(x) = -x^2 + 11$. $P(\sqrt{5}) = -(\sqrt{5})^2 + 11 = -5 + 11 = 6$

c. Since $x = c < 2$, use $P(x) = 3x + 1$.

$P(c) = 3c + 1$

d. Since $k \geq 1$, then $x = k + 1 \geq 2$, so use $P(x) = -x^2 + 11$.

$P(k+1) = -(k+1)^2 + 11 = -(k^2 + 2k + 1) + 11$

$= -k^2 - 2k - 1 + 11$

$= -k^2 - 2k + 10$

34. **a.** Since $t = 0$ and $0 \leq t \leq 5$, use $Q(t) = 4$.

$Q(0) = 4$

b. Since $t = e$ and $6 < e < 7$, then $5 < t \leq 8$, so use $Q(t) = -t + 9$.

$Q(e) = -e + 9$

c. Since $t = n$ and $1 < n < 2$, then $0 \leq t \leq 5$, so use $Q(t) = 4$

$Q(0) = 4$

d. Since $t = m^2 + 7$ and $1 < m \leq 2$, then $1^2 < m^2 \leq 2^2$

$1^2 + 7 < m^2 + 7 \leq 2^2 + 7$

$1 + 7 < m^2 + 7 \leq 4 + 7$

$8 < m^2 + 7 \leq 11$

thus $8 < t \leq 11$,

so use $Q(t) = \sqrt{t - 7}$

$Q(m^2 + 7) = \sqrt{(m^2 + 7) - 7}$

$= \sqrt{m^2} = |m| = m$ since $m > 0$

35. For $f(x) = 3x - 4$, the domain is the set of all real numbers.

36. For $f(x) = -2x + 1$, the domain is the set of all real numbers.

37. For $f(x) = x^2 + 2$, the domain is the set of all real numbers.

38. For $f(x) = 3x^2 + 1$, the domain is the set of all real numbers.

39. For $f(x) = \frac{4}{x+2}$, the domain is $\{x \mid x \neq -2\}$.

40. For $f(x) = \dfrac{6}{x-5}$, the domain is $\{x \mid x \neq 5\}$.

41. For $f(x) = +7\ x$, the domain is $\{x \mid x \geq -7\}$.

42. For $f(x) = -4\ x$, the domain is $\{x \mid x \leq 4\}$.

43. For $f(x) = 4 - x^2$, the domain is $\{x \mid -2 \leq x \leq 2\}$.

44. For $f(x) = 12 - x^2$, the domain is

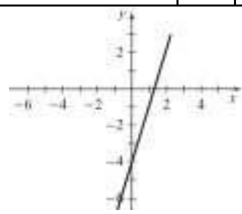
$\{x \mid -2\ 3 \leq x \leq 2\ 3\}$.

45. For $f(x) = \dfrac{1}{x+4}$, the domain is $\{x \mid x > -4\}$.

46. For $f(x) = \frac{1}{\sqrt{5-x}}$ the domain is $\{x \mid x<5\}$.

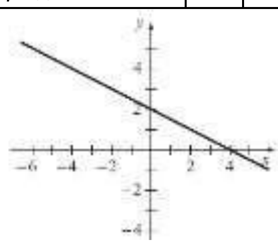
47. To graph $f(x) = 3x-4$, plot points and draw a smooth graph.

x	-1	0	1	2
$y = f(x) = 3x-4$	-7	-4	-1	2



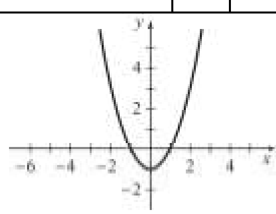
48. To graph $f(x) = 2-\frac{1}{2}x$, plot points and draw a smooth graph.

x	-4	-2	0	4
$y = f(x) = 2-\frac{1}{2}x$	4	3	2	0



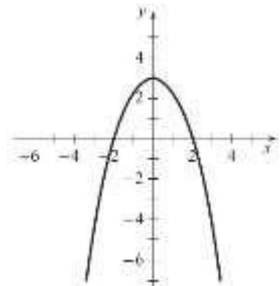
49. To graph $g(x) = x^2-1$, plot points and draw a smooth graph.

x	-2	-1	0	1	2
$y = g(x) = x^2-1$	3	0	-1	0	3



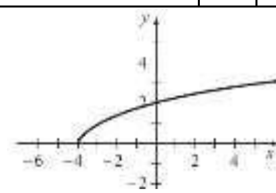
50. To graph $g(x) = 3-x^2$, plot points and draw a smooth graph.

x	-3	-1	0	1	3
$y = g(x) = 3-x^2$	-6	2	3	2	-6



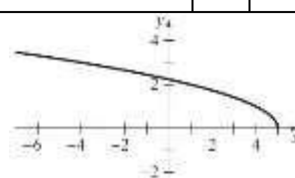
51. To graph $f(x) = \sqrt{x+4}$, plot points and draw a smooth graph.

x	-4	-2	0	2	5
$y = f(x) = \sqrt{x+4}$	0	$\sqrt{2}$	2	$\sqrt{6}$	3



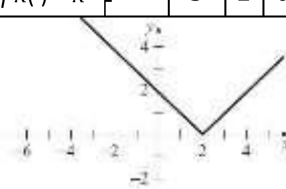
52. To graph $h(x) = \sqrt{5-x}$, plot points and draw a smooth graph.

x	-4	0	1	3	5
$y = h(x) = \sqrt{5-x}$	3	$\sqrt{5}$	2	$\sqrt{2}$	0



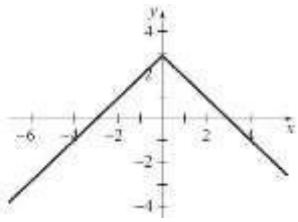
53. To graph $f(x) = |x-2|$, plot points and draw a smooth graph.

x	-3	0	2	4	6
$y = f(x) = \|x-2\|$	5	2	0	2	4



54. To graph $h(x) = 3-|x|$, plot points and draw a smooth graph.

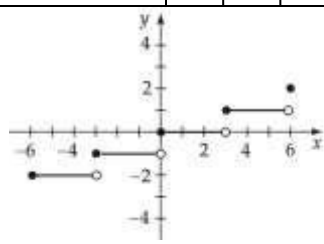
x	-3	-1	0	1	3
$y = h(x) = 3-\|x\|$	0	2	3	2	0



55. To graph $L(x) = \left[\!\left[\frac{1}{3}x \right]\!\right]$ for $-6 \le x \le 6$, plot points

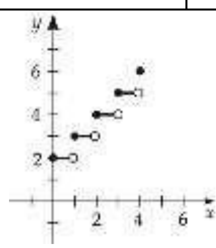
and draw a smooth graph.

x	-6	-4	-3	-1	0	4	6
$y = L(x) = \left[\!\left[\frac{1}{3}x \right]\!\right]$	-2	-2	-1	-1	0	1	2

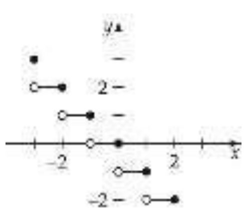


56. To graph $L(x) = [\![x]\!] + 2$ for $0 \le x \le 4$, plot points and draw a smooth graph.

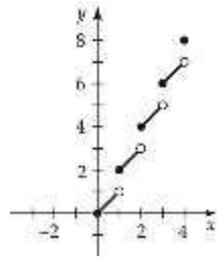
x	0	1	2	3	4
$y = L(x) = [\![x]\!] + 2$	2	3	4	5	6



57. To graph $N(x) = -\text{int}(x)$ for $-3 \le x \le 3$, plot points and draw a smooth graph.

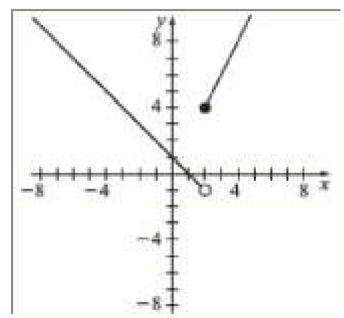


58. To graph $N(x) = \text{int}(x) + x$ for $0 \le x \le 4$, plot points and draw a smooth graph.



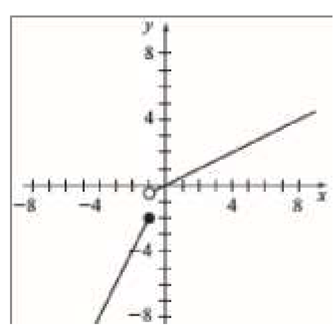
59. Graph $f(x) = \begin{cases} 1-x, & x < 2 \\ 2x, & x \ge 2 \end{cases}$.

Graph $y = 1 - x$ for $x < 2$ and graph $y = 2x$ for $x \ge 2$.



60. Graph $f(x) = \begin{cases} 2x, & x \le -1 \\ \frac{x}{2}, & x > -1 \end{cases}$.

Graph $y = 2x$ for $x \le -1$ and graph $y = \frac{x}{2}$ for $x > -1$.

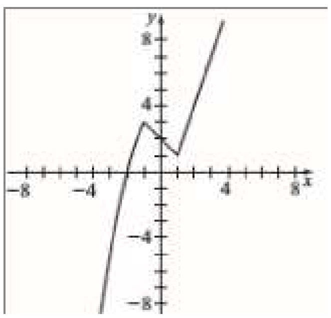


61. Graph $r\,x(\,) =$ ìï¡ïíïîï--3xxx-2++22,,4, -xx1>£< -

1x £1 1. îïï

Graph $y = -x^2 + 4$ for $x < -1$, graph $y = -x + 2$ for -1£

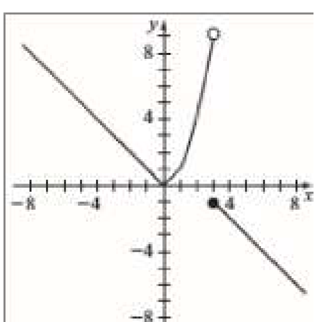
£x 1, and graph $y = 3x-2$ for $x > 1$.



62. Graph $A\,x(\,) =$ ìï¡ïíïîï|-xx^2x|,,+ 2, xx1£<³13x < 3. ïîï

Graph $y = |\,x\,|$ for $x < 1$, graph $y = x^2$ for 1£ $x < 3$,

and graph $y = - + x$ 2 for x ³ 3.



63. Find the value of a in the domain of $f\,x(\,) = 3x - 2$

for which $f\,a(\,) = 10$.

$3a - 2 = 10$ Replace $f\,a(\,)$ with $3a - 2$

3a

=1

2 a

= 4

64. Find the value of a in the domain of $f\,(x) = 2-5x$ for

which $f\,a(\,) = 7$.

$2-5a = 7$ Replace $f\,a(\,)$ with $2-5a$

-5a =

5 a

= -

1

65. Find the values of a in the domain of

$f\,(\,)x = x^2 + 2x - 2$ for which $f\,a(\,) = 1$.

$a^2 + 2a - 2 = 1$ Replace $f\,a(\,)$ with $a^2 + 2a - 2$

$a^2 + 2a - 3 = 0$ $(a + 3)(a - 1) = 0$

$a + 3 = 0$ $a - 1 = 0$

$a = -3$ $a = 1$

66. Find the values of a in the domain of

$f\,(\,)x = x^2 - 5x - 16$ for which $f\,a(\,) = -2$.

$a^2 - 5a - 16 = -2$ Replace $f\,a(\,)$ with $a^2 - 5a - 16$ a^2

$-5a - 14 = 0$ $(a + 2)(a - 7) = 0$

$a + 2 = 0$ $a - 7 = 0$

a = -2

$a = 7$

67. Find the values of a in the domain of $f\,(x) = |x|$ for

which $f\,a(\,) = 4$.

$|a| = 4$ Replace $f\,a(\,)$ with $|a|$

$= -4$ $a = 4$

68. Find the values of a in the domain of $f\,(x) = |x + 2|$ for

which $f\,a(\,) = 6$. $|a + 2| = 6$ Replace $f\,a(\,)$ with $|a + 2|$

$a + 2 = -6$ $a + 2 = 6$ $a =$

-8 $a = 4$

69. Find the values of a in the domain of $f(x) = x^2 + 2$ for which $f(a) = 1$.

$a^2 + 2 = 1$ Replace $f(a)$ with $a^2 + 2$ $a^2 =$

-1

There are no real values of a.

70. Find the values of a in the domain of $f(x) = |x| - 2$ for which $f(a) = -3$.

$|a| - 2 = -3$ Replace $f(a)$ with $|a| - 2$ $|a| = -1$

There are no real values of a.

71. Find the zeros of f for $f(x) = 3x - 6$.

$f(x) = 0$

$3x - 6 = 0$

$3x = 6$

$x = 2$

72. Find the zeros of f for $f(x) = 6 + 2x$.

$f(x) = 0$

$6 + 2x = 0$

$2x = -6$

$x = -3$

73. Find the zeros of f for $f(x) = 5x + 2$.

$f(x) = 0$

$5x + 2 = 0$

$5x = -2$ $x = -\frac{2}{5}$

74. Find the zeros of f for $f(x) = 8 - 6x$.

$f(x) = 0$ $8 - 6x = 0$

$-6x = -8$ $x = \frac{4}{3}$

75. Find the zeros of f for $f(x) = x^2 - 4$.

$f(x) = 0$

$x^2 - 4 = 0$ $(x + 2)(x - 2) = 0$

$x + 2 = 0$ $x - 2 = 0$ $x = -2$ $x = 2$

76. Find the zeros of f for $f(x) = x^2 + 4x - 21$.

$f(x) = 0$

$x^2 + 4x - 21 = 0$ $(x + 7)(x - 3) = 0$

$x + 7 = 0$ $x - 3 = 0$ $x = -7$ $x = 3$

77. Find the zeros of f for $f(x) = x^2 - 5x - 24$.

$f(x) = 0$

$x^2 - 5x - 24 = 0$ $(x + 3)(x - 8) = 0$

$x + 3 = 0$ $x - 8 = 0$ $x = -3$ $x = 8$

78. Find the zeros of f for $f(x) = 2x^2 + 3x - 5$.

$f(x) = 0$

$2x^2 + 3x - 5 = 0$

$(2x + 5)(x - 1) = 0$

$2x + 5 = 0$ $x - 1 = 0$

$x = -\frac{5}{2}$ $x = 1$

79. Determine which graphs are functions.

a. Yes; every vertical line intersects the graph in one point.

b. Yes; every vertical line intersects the graph in one point.

c. No; some vertical lines intersect the graph at more than one point.

d. Yes; every vertical line intersects the graph in one point.

80. **a.** Yes; every vertical line intersects the graph in one point.

b. No; some vertical lines intersect the graph at more than one point.

c. No; a vertical line intersects the graph at more than one point.

d. Yes; every vertical line intersects the graph in one point.

81. Determine where the graph is increasing, constant, or decreasing. Decreasing on (□□, 0] ; increasing on [0, □)

82. Determine where the graph is increasing, constant, or decreasing. Decreasing on (-¥ ¥,)

83. Determine where the graph is increasing, constant, or decreasing. Increasing on (-¥, ¥)

84. Determine where the graph is increasing, constant, or decreasing. Increasing on (-¥, 2]; decreasing on [2, ¥)

85. Determine where the graph is increasing, constant, or decreasing. Decreasing on (-¥, -3]; increasing on

[3- , 0] ; decreasing on [0, 3] ; increasing on [3, ¥)

86. Determine where the graph is increasing, constant, or decreasing. Increasing on (-¥, ¥)

87. Determine where the graph is increasing, constant, or decreasing. Constant on (-¥, 0]; increasing on

[0, ¥)

88. Determine where the graph is increasing, constant, or decreasing. Constant on (-¥, ¥)

89. Determine where the graph is increasing, constant, or decreasing. Decreasing on (-¥, 0] ; constant on [0, 1]; increasing on [1, ¥)

90. Determine where the graph is increasing, constant, or decreasing. Constant on (-¥, 0] ; decreasing on [0, 3] ; constant on [3, ¥)

91. Determine which functions from 77-81 are one-to-one. *g* and *F* are one-to-one since every horizontal line intersects the graph at one point.

f, *V*, and *p* are not one-to-one since some horizontal lines intersect the graph at more than one point.

92. Determine which functions from 82-86 are one-to-one. *s* is one-to-one since every horizontal line intersects the graph at one point.

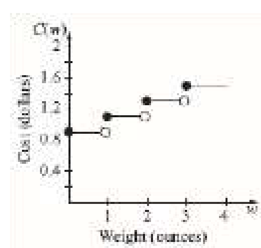
t, *m*, *r* and *k* are not one-to-one since some horizontal lines intersect the graph at more than one point.

93. **a.** *C*(2.8) = 0.90-0.20int(1-2.8) = 0.90-0.20int(1.8)= 0.90-0.20(2)-

= 0.90 + 0.4

= $1.30

b. Graph *C*(*w*).



94. **a.** Domain: [0, ¥)

b. *T*(50,020) = 0.25(50,020-35,350) + 4867.50

= 0.25(14,670) + 4867.50

= 3667.50 + 4867.50

= $8535

c. *T*(123,500) = 0.28(123,500-85,650) +17,442.50

$= 0.28(37,850) + 17,442.50$

$= 10,598 + 17,442.50$

$= \$28,040.50$

95. a. Write the width.

$2l + 2w = 50$

$2w = 50 - 2l$

$w = 25 - l$

b. Write the area.

$A = lw$

$A = l(25 - l)$

$A = 25l - l^2$

96. a. Write the length.

$\frac{4}{l} = \frac{12}{d + l}$

$4(d + l) = 12l$

$4d + 4l = 12l$

$4d =$

$8l \quad \frac{1}{2}d$

$= l \; l \; d($

$) = \frac{1}{2}d$

b. Find the domain. Domain: [0, ¥)

c. Find the length. $l(8) = \frac{1}{2}(8) = 4$ ft

97. Write the function.

$v\ t(\ ) = 80,000 - 6500t, \quad 0 £ £t \quad 10$

98. Write the function.

$v\ t(\ ) = 44,000 - 4200t, \quad 0 £ £t \quad 8$

99. a. Write the total cost function.

$C\ x(\ ) = 5(400) + 22.80x$

$= 2000 + 22.80x$

b. Write the revenue function. $R\ x(\ ) = 37.00x$

c. Write the profit function.

$P\ x(\ ) = 37.00x - C\ x(\ )$

$= 37.00 - [2000 + 22.80\ ]x$

$= 37.00x - 2000 - 22.80x$

$= 14.20x - 2000$

Note x is a natural number.

100.a. Write the volume function.

$V = lwh$

$V = (30 - 2\ )(30x \quad -2\ )(\ )x \qquad x$

$V = (900 - 120x + 4x^2)(\ )x$

$V = 900x - 120x^2 + 4x^3$

b. State the domain.

$V = lwh$ ⁇ the domain of V is dependent on the domains of l, w, and h. Length, width and height must be positive values⁇ $30 - 2x > 0$ and $x > 0$.

$-2x > -30\ x$

< 15

Thus, the domain of V is $\{x \mid 0 < x < 15\}$.

101. Write the function.

$\frac{15}{h} = \frac{15 - r}{3}$

$5 = \frac{15 - r}{h}\ h$

$5r = 15 - h$

$h = 15 - 5r \ \ h$

$r(\ ) = 15 - 5r$

102.a. Write the function.

$\frac{h}{r} = \frac{2}{4}$

$r =$

$\frac{2}{4}h \ \ r$

$= \frac{1}{2}h$

b. Write the function.

$V = \frac{1}{3}\pi r^2 h$

$V = \frac{1}{3}\pi\left(\frac{1}{2}h\right)^2 h = \frac{1}{3}\pi\left(\frac{1}{4}h^2\right)h$

$V = \frac{1}{12}\pi h^3$

103. Write the function.

$d = \sqrt{(3t)^2 + (50)^2}$

$d = \sqrt{9t^2 + 2500}$ meters, $0 \le t \le 60$

104. Write the function.

$t = \frac{d}{r}$

$t = \frac{\sqrt{1+x^2}}{2} + \frac{3-x}{8}$ hours

105. Write the function.

$d = \sqrt{(45-8t)^2 + (6t)^2}$ miles

where t is the number of hours after 12:00 noon

106. Write the function.

$d = \sqrt{(60-7t)^2 + (10t)^2}$ miles

where t is the number of hours after 12:00 noon

107. a. Write the function.

Left side triangle $c^2 = 20^2 + (40-x)^2$

$c = \sqrt{400 + (40-x)^2}$

Right side triangle

$c^2 = 30^2 + x^2$

$c = \sqrt{900 + x^2}$

Total length $= \sqrt{900 + x^2} + \sqrt{400 + (40-x)^2}$

b. Complete the table.

x	0	10	20	30	40
Total Length	74.72	67.68	64.34	64.79	70

c. Find the domain. Domain: [0, 40].

108. Complete the table.

x	5	10	12.5	15	20
$Y(x)$	275	375	385	390	394

Answers accurate to the nearest apple.

110. Complete the table.

x	100	200	500	750	1000
$C(x)$	57,121	59,927	65,692	69,348	72,507

Answers accurate to the nearest dollar.

111. Find c.

$f(c) = c^2 - c - 5 = 1$

$c^2 - c - 6 = 0$

$(c-3)(c+2) = 0$

$c - 3 = 0$ or $c + 2 = 0$

$c = 3$ $\quad$ $c = -2$

112. Find c.

$g(c) = -2c^2 + 4c - 1 = 4$

$-2c^2 + 4c + 3 = 0$

$c = \frac{-4 \pm \sqrt{4^2 - 4(-2)(3)}}{2(-2)}$

$c = \frac{-4 \pm \sqrt{16 + 24}}{-4} = \frac{-4 \pm \sqrt{40}}{-4}$

$c = \frac{-4 \pm 2\sqrt{10}}{-4}$

$c = \frac{2 \pm \sqrt{10}}{2}$

113. Determine if 1 is in the range.

1 is not in the range of $f(x)$, since $1 = \frac{x-1}{x+1}$ only if $x + 1 = x - 1$ or $1 = -1$.

114. Determine if 0 is in the range.

0 is not in the range of $g(x)$, since

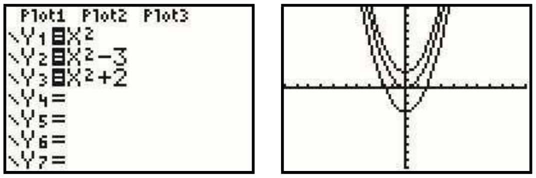
$0 = \frac{1}{x-3}$ only if $(x-3)(0) = 1$ or $0 = 1$.

115. Graph functions. Explain how the graphs are related.

p	40	50	60	75	90
$f(p)$	4900	4300	3800	3200	2800

Answers accurate to nearest 100 feet.

109. Complete the table.

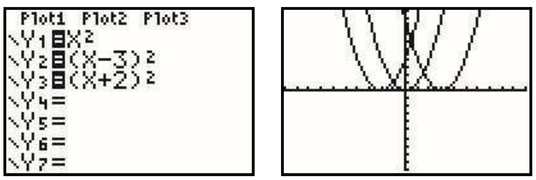


The graph of $g\ x(\ )= -x^2\ 3$ is the graph of $f\ x(\ )= x^2$

shifted down 3 units. The graph of $h\ x(\ )= +x^2\quad 2$

is the graph of $f\ x(\ )= x^2$ shifted up 2 units.

116. Graph functions. Explain how the graphs are related.



The graph of $g\ x(\ )= -(x\quad 3)^2$ is the graph of

$f\ x(\ )= x^2$ shifted 3 units to the right. The graph

of $h\ x(\ )= +(x\ 2)^2$ is the graph of $f\ x(\ )= x^2$ shifted

2

units to the left.

117. Find all fixed points.

$a^2 + 3a\ -3 = a\ \ a^2 + 2a\ -3 = 0$

$(a\ -1)(a + 3) = 0$

$a = 1$ or $a = -3$

118. Find all fixed points.

$\underline{a}$

$a\ +5 = a$

$a = a\ a(\ +5)\ a = a^2 + 5a$

$0 = a^2 + 4a$

$0 = a\ a(\ + 4)$

$a = 0$ or $a = -4$

119.a. Write the function.

$A = xy$

$A\ x(\ ) = x\left(-\frac{1}{2}x + 4\right)$

$A(\ )x = -\frac{1}{2}x^2 + 4x$

b. Complete the table.

x	1	2	4	6	7
Area	3.5	6	8	6	3.5

c. Find the domain. Domain: [0, 8].

120.a. Write the function.

$m_{PB} = \underline{0}x\underline{-}-\underline{2}2 = x\underline{-}-\underline{2}2\ \ m_{AB} = 0x\underline{-}-0y$

$= \underline{-}xy\ \ m_{PB} = m_{AB}\ x\text{-}2 = \underline{-}xy\ \underline{-2}$

$x\underline{2}\text{-}\underline{x}2 = y$

Area $= \frac{1}{2}bh = \frac{1}{2}xy$

$= \underline{1}2\ x\ x\underline{2}\text{-}\underline{x}2$

$= \overline{xx\text{-}22}$

b. Find the domain. Domain: (2,¥)

121.a. Write the function.

Circle Square $C = 2\square r$ $C = 4s$ $x = 2\square r$ $20 - x = 4s$ $r = \frac{x}{2\square}$ $s = 5 - \frac{x}{4}$

Area $= \square\ \square r^2 = \left(\frac{x}{2\square}\right)^2$ Area $= s^2 = \left(5 - \frac{x}{4}\right)^2$

$= \frac{x^2}{4\square}$ $= 25 - \frac{5}{2}x + \frac{x^2}{16}$

Total Area $= \frac{x^2}{4\square} + 25 - \frac{5}{2}x + \frac{x^2}{16}$

$= \left(\frac{1}{4\square} + \frac{1}{16}\right)x^2 - \frac{5}{2}x + 25$

b. Complete the table.

x	0	4	8	12	16	20
Total Area	25	17.27	14.09	15.46	21.37	31.83

c. Find the domain. Domain: [0, 20].

122.a. Let $m = 10$, $d = 7$, $c = 19$, and $y = 41$. Then $z = \left\lfloor \frac{13m-1}{5} \right\rfloor + \left\lfloor \frac{y}{4} \right\rfloor + \left\lfloor \frac{c}{4} \right\rfloor + d + y - 2c$

$= \left\lfloor \frac{13 \cdot 10 - 1}{5} \right\rfloor + \left\lfloor \frac{41}{4} \right\rfloor + \left\lfloor \frac{19}{4} \right\rfloor + 7 + 41 - 2 \cdot 19$

$= 25 + 10 + 4 + 7 + 41 - 38$

$= 49$

The remainder of 49 divided by 7 is 0.

Thus December 7, 1941, was a Sunday.

b. This one is tricky. Because we are finding a date in the month of January, we must use 11 for the month and we must use the previous year, which is 2019.

Thus we let $m = 11$, $d = 1$, $c = 20$, and $y = 19$. Then

$z = \left\lfloor \frac{13m-1}{5} \right\rfloor + \left\lfloor \frac{y}{4} \right\rfloor + \left\lfloor \frac{c}{4} \right\rfloor + d + y - 2c$

$= \left\lfloor \frac{13 \cdot 11 - 1}{5} \right\rfloor + \left\lfloor \frac{19}{4} \right\rfloor + \left\lfloor \frac{20}{4} \right\rfloor + 1 + 19 - 2 \cdot 20$

$= 28 + 4 + 5 + 1 + 19 - 40$

$= 17$

The remainder of 17 divided by 7 is 3.

Thus January 1, 2020, will be a Wednesday.

c. Let $m = 5$, $d = 4$, $c = 17$, and $y = 76$. Then $z = \left\lfloor \frac{13m-1}{5} \right\rfloor + \left\lfloor \frac{y}{4} \right\rfloor + \left\lfloor \frac{c}{4} \right\rfloor + d + y - 2c$

$= \left\lfloor \frac{13 \cdot 5 - 1}{5} \right\rfloor + \left\lfloor \frac{76}{4} \right\rfloor + \left\lfloor \frac{17}{4} \right\rfloor + 4 + 76 - 2 \cdot 17$

$= 12 + 19 + 4 + 4 + 76 - 34$

$= 81$

The remainder of 81 divided by 7 is 4.

Thus July 4, 1776 was a Thursday.

d. Answers will vary.

Prepare for Section 2.3

P1. $d = 5 - (-2) = 7$

P2. The product of any number and its negative reciprocal is –1. For example,

$-7 \cdot \frac{1}{7} = -1$

P3. $\frac{-4-4}{2-(-3)} = \frac{-8}{5}$

P4. $y - 3 = -2(x - 3)$

$y - 3 = -2x + 6$

$y = -2x + 9$

P5. $3x - 5y = 15$

$-5y = -3x + 15$

$y = \frac{3}{5}x - 3$

P6. $y = 3x - 2(5 - x)$

$0 = 3x - 2(5 - x)$

$0 = 3x - 10 + 2x$

$10 = 5x$

$2 = x$

Section 2.3 Exercises

1. If a line has a negative slope, then as the value of y increases, the value of x decreases.

2. If a line has a positive slope, then as the value of y decreases, the value of x decreases.

3. The graph of a line with zero slope is horizontal.

4. The graph of a line whose slope is undefined is vertical.

5. Determine the slope and y-intercept. $y = -4x$ 5: $m = 4$, y-intercept: (0,–5)

6. Determine the slope and y-intercept.

$y = 3 - 2$:x $m = -2$, y-intercept: (0, 3)

7. Determine the slope and y-intercept.

$f\,x(\ ) = \frac{2}{3}x$: $m = \frac{2}{3}$, y-intercept: (0, 0)

8. Determine the slope and y-intercept.

$f\,x(\ ) = -1$: $m = 0$, y-intercept: (0,–1)

9. Determine whether the graphs are parallel, perpendicular, or neither. $y = 3x - 4$: $m = 3$,

$y = -3x + 2$: $m = -3$

The graphs are neither parallel nor perpendicular

10. Determine whether the graphs are parallel, perpendicular, or neither.

$y = -\frac{2}{3}x + 1$: $m = -\frac{2}{3}$,

$y = 2 - \frac{2}{3}x$: $m = -\frac{2}{3}$

The graphs are parallel.

11. Determine whether the graphs are parallel, perpendicular, or neither.

$f\,x(\ ) = 3x - 1$: $m = 3$, $y = -\frac{x}{3} -$

1: $m = -\frac{1}{3}$

$3\left(-\frac{1}{3}\right) = -1$

The graphs are perpendicular.

12. Determine whether the graphs are parallel, perpendicular, or neither.

$f\,x(\ ) = \frac{4}{3}x + 2$: $m = \frac{4}{3}$, $f\,x(\ ) =$

$2 - \frac{3}{4}x$: $m = -\frac{3}{4}$ $4\left(-\frac{3}{4}\right) = -1$

3

The graphs are perpendicular.

13. Find the slope.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 3}{1 - 4} = \frac{4}{-3} = -\frac{4}{3}$

14. Find the slope.

$m = 5 - -1 - (2)4 = -\frac{7}{3} = -\frac{7}{3}$

15. Find the slope.

$m = 02\ 40 = -\frac{1}{2}$

16. Find the slope.

$m = 2\ 4\ (3)4 = \frac{0}{5} = 0$

17. Find the slope.

$m = \frac{7 - 2}{-3 - -3} = \frac{9}{0}$ undefined

18. Find the slope.

$m = 03\ 00 = \frac{0}{3} = 0$

19. Find the slope.

$m = -4 - -2 - (3)4 = \frac{-6}{-1} = 6$

20. Find the slope.

$m = -43 - - -(1)(5) = \frac{2}{5}$

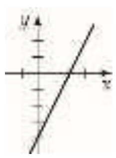
21. Find the slope.

$$m = \frac{\frac{7}{2}-\frac{1}{2}}{\frac{7}{3}-(-4)} = \frac{\frac{6}{2}}{\frac{19}{3}} = 3\cdot\frac{3}{19} = \frac{9}{19}$$

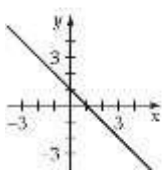
22. Find the slope.

m = 742--412 = -452 = -85

23. Find the slope, *y*-intercept, and graph. *y* = -2*x* 4 *m* = 2, *y*-intercept (0, –4)

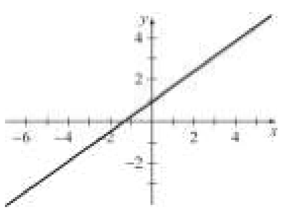


24. Find the slope, *y*-intercept, and graph. *y* = -*x* +1 *m* = –1, *y*-intercept (0, 1)



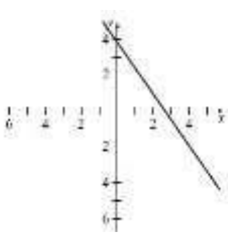
25. Find the slope, *y*-intercept, and graph. $y = \frac{3}{4}x + 1$

$m = \frac{3}{4}$, *y*-intercept (0, 1)

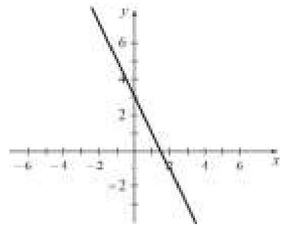


26. Find the slope, *y*-intercept, and graph. $y = -\frac{3}{2}x + 4$

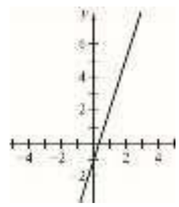
$m = -\frac{3}{2}$, *y*-intercept (0, 4)



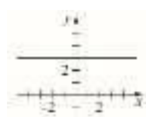
27. Find the slope, *y*-intercept, and graph. *y* = -2*x* + 3 *m* = –2, *y*-intercept (0, 3)



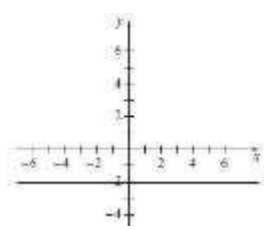
28. Find the slope, *y*-intercept, and graph. *y* = 3*x* -1 *m* = 3, *y*-intercept (0, –1)



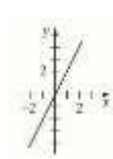
29. Find the slope, *y*-intercept, and graph. *y* = 3 *m* = 0, *y*-intercept (0, 3)



30. Find the slope, *y*-intercept, and graph. *y* =-2 *m* = 0, *y*-intercept (0, –2)

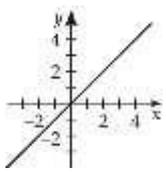


31. Find the slope, *y*-intercept, and graph. *y* = 2*x* *m* = 2, *y*-intercept (0, 0)

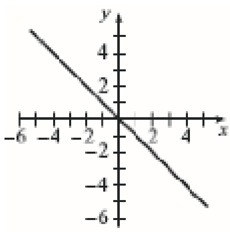


32. Find the slope, *y*-intercept, and graph. *y* = -3*x* *m* = –3, *y*-intercept (0, 0)

33. Find the slope, y-intercept, and graph. $y = x$ $m = 1$, y-intercept (0, 0)



34. Find the slope, y-intercept, and graph. $y = -x$ $m = -1$, y-intercept (0, 0)



35. Write slope-intercept form, find intercepts, and graph.

$2x + y = 5$ $y = -2x + 5$

x-intercept $\left(\frac{5}{2}, 0\right)$, y-intercept (0, 5)

36. Write slope-intercept form, find intercepts, and graph.

$x - y = 4$ $y = x - 4$

x-intercept (4, 0), y-intercept (0, –4)

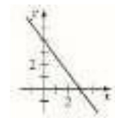
37. Write slope-intercept form, find intercepts, and graph.

$4x + 3y - 12 = 0$

$3y = -4x + 12$

$y = -\frac{4}{3}x + 4$

x-intercept (3, 0), y-intercept (0, 4)



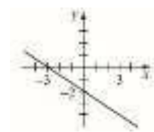
38. Write slope-intercept form, find intercepts, and graph.

$2x + 3y + 6 = 0$

$3y = -2x - 6$

$y = -\frac{2}{3}x - 2$

x-intercept (–3, 0), y-intercept (0, –2)



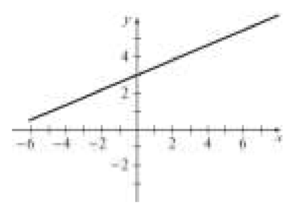
39. Write slope-intercept form, find intercepts, and graph.

$2x - 5y = -15$

$-5y = -2x - 15$

$y = \frac{2}{5}x + 3$

x-intercept $\left(-\frac{15}{2}, 0\right)$, y-intercept (0, 3)

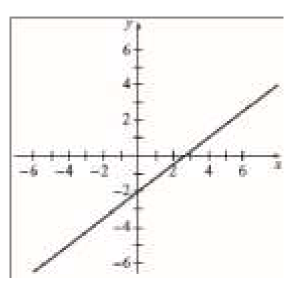


40. Write slope-intercept form, find intercepts, and graph.

$3x - 4y = 8$

$-4y = -3x + 8$ $y = \frac{3}{4}x - 2$

x-intercept $\left(\frac{8}{3}, 0\right)$, y-intercept (0, –2)

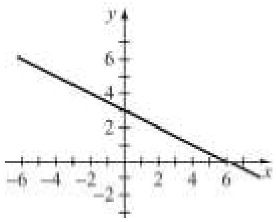


41. Write slope-intercept form, find intercepts, and graph.

$x + 2y = 6$

$y = -\frac{1}{2}x + 3$

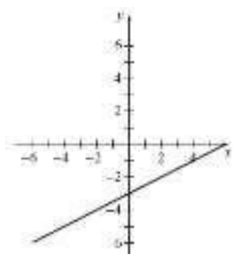
x-intercept (6, 0), y-intercept (0, 3)



42. Write slope-intercept form, find intercepts, and graph.

$x - 3y = 9$ $\quad y = \frac{1}{3}x - 3$

x-intercept (9, 0), y-intercept (0, –3)



Find the equation.
Find the equation.

43.

Use $y = mx + b$ with $m = 1$, $b = 3$.

$y = x + 3$

44. Find the equation.

Use $y = +mx \quad b$ with $m = -2$, $b = 5$.

$y = -2x + 5$

45. Find the equation.

Use $y = mx + b$ with $m = 4 3$, $b = 1 2$.

$y = 43\ x + 12$

46. Find the equation.

Use $y = mx + b$ with $m = - 2 3$, $b = 4 3$.

$y = - 23\ x + 43$

47. Find the equation.

Use $y = mx + b$ with $m = 0$, $b = 4$.

$y = 4$

48. Find the equation.

Use $y = +mx \quad b$ with $m = 1 2$, $b = -1$.

$y = 1 2\ x - 1$

49. Find the equation.

$y - 2 = -4(x - -(3))$ $y - 2 = -4x - 12$ $y = -4x - 10$

50. Find the equation. $y + 1 = -3(x + 5)$ $y = -3x -$

1

5

-

1

y

51. Find the equation.

$m = - -41-13 = -34 = - 43$

$y - 1 = - 4 3(x - 3)$ $y = - 43\ x + 94 + 44$ $y =$

$- 43\ x + 134$

52. Find the equation.

$m = -82 - -(6)5 = - -23 = 23$

$y - -(6) = 2 3(x - 5)$ $y + 6 = 23\ x - 103$

$y = 23\ x - 103 - 6$ $y = 23$

$x - 283$

53. Find the equation.

$m = - -21-711 = --125 = 125$

$y - 11 = 12 5\ (x - 7)$ $y - 11 = 125\ x - 845$

Find the equation.
Find the equation.

$$y = \frac{12}{5}x - \frac{84}{5} + \frac{55}{5}$$

$$= \frac{12}{5}x - \frac{29}{5}$$

54. Find the equation.

$$m = \frac{-4-6}{-3-(-5)} = \frac{-10}{2} = -5$$

$y - 6 = -5(x + 5)$
$y - 6 = -5x - 25$

$y = -5x - 25 + 6$ $y = -5x - 19$

55. Find the equation. $y = 2x + 3$ has slope $m = 2$.

$$y - y_1 = 2(x - x_1)$$

Find the equation.

Find the equation.

2

x

-

8

56. Find the equation. $y = -x + 1$ has slope $m = -$

1

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y

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y

1

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x

-

x

1

)

y

-

Find the equation.
Find the equation.

+

57. **61.** Find the equation.

$y = -\frac{3}{4}x + 3$ has slope $m = -\frac{3}{4}$. $y = 2x-5$ has perpendicular slope $m = -\frac{1}{2}$.

$y - y_1 = -\frac{3}{4}(x - x_1)$ $y - y_1 = -\frac{1}{2}(x - x_1)$ $y - 2 = -\frac{3}{4}(x + 4)$ $y + 4 = -\frac{1}{2}(x - 3)$ $y - 2 = -\frac{3}{4}$

$x-3$ $y + 4 = -\frac{1}{2}x + \frac{3}{2}$ $y = -\frac{3}{4}x - 1$ $y = -\frac{1}{2}x - \frac{5}{2}$

58. Find the equation.

62. Find the equation. $y = \frac{2}{3}x - 1$ has slope $m = \frac{2}{3}$. $y = -x + 3$ has perpendicular slope $m = 1$.

$y - y$

$y - y_1 = \frac{2}{3}(x - x_1)$ $y - 2 = 1(x + 5)$

$y + 5 = \frac{2}{3}(x + 3)$

$y - 2 = x + 5$
$y = x + 7$

$y + 5 = \frac{2}{3}x + 2$

63. Find the equation.

$y = \frac{2}{3}x - 3$ $y = -\frac{3}{4}x + 1$ has perpendicular slope $m = \frac{4}{3}$.

59. Find the equation. $y - y_1 = \frac{4}{3}(x - x_1)$

$2x - 5y = 2$

$-5y = -2x + 2$

$y - 0 = \frac{4}{3}(x + 6)$

$y = \frac{2}{5}x - \frac{2}{5}$ has slope $m = \frac{2}{5}$.

$y = \frac{4}{3}x + 8$

$y - y_1 = \frac{2}{5}(x - x_1)$ **64.** Find the equation.

$y - 2 = \frac{2}{5}(x - 5)$

$3x - 2y = 5$
$-2y = -3x + 5$

$y - 2 = \frac{2}{5}x - 2$

$y = \frac{3}{2}x - \frac{5}{2}$ has perpendicular slope $m = -\frac{2}{3}$.

$y = \frac{2}{5}x$ $y - y_1 = -\frac{2}{3}(x - x_1)$

60. Find the equation.

$x + 3y = 4$ $y - 4 = -\frac{2}{3}(x + 3)$ $3y = -x + 4$ $y - 4 = -\frac{2}{3}x - 2$

Find the equation.

$y = -\frac{1}{3}x + \frac{4}{3}$ has slope $m = -\frac{1}{3}$. $y = -\frac{2}{3}x + 2$

$y - y_1 = -\frac{1}{3}(x - x_1)$ $y + 1 = -\frac{1}{3}(x + 3)$ $y + 1 = -\frac{1}{3}x - 1$

$y = -\frac{1}{3}x - 2$

65.

$-x - 4y = 6$

$-4y = x + 6$

$y = -\frac{1}{4}x - \frac{3}{2}$ has perpendicular slope $m = 4$. $y - y_1 = 4(x - x_1)$ $y - 2 = 4(x - 5)$ $y - 2 = 4x - 20$ $y = 4x - 18$

66. Find the equation.

$5x - y = 2$

$-y = -5x + 2$

$y = 5x - 2$ has perpendicular slope $m = -\frac{1}{5}$. $y - y_1 = -\frac{1}{5}(x - x_1)$ $y + 2 = -\frac{1}{5}(x - 10)$ $y + 2 = -\frac{1}{5}x + 2$

$y = -\frac{1}{5}x$

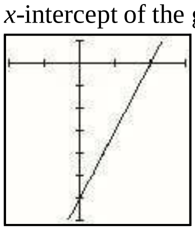
67. Find the zero of f. $f(x) = 3x - 12$

$3x - 12 = 0$

$3x = 12$

$x = 4$

The x-intercept of the graph of $f(x)$ is (4, 0).



Xmin = □□4, Xmax = 6, Xscl=2,

Ymin = □12.2, Ymax = 2, Yscl = 2

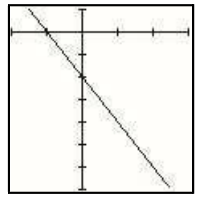
68. Find the zero of f. $f(x) = -2x - 4$

$-2x - 4 = 0$

$-2x = 4$

$x = -2$

The x-intercept of the graph of $f(x)$ is (–2, 0).



Xmin = □□4, Xmax = 6, Xscl=2,

Ymin = □12.2, Ymax = 2, Yscl = 2

69. Find the zero of f.

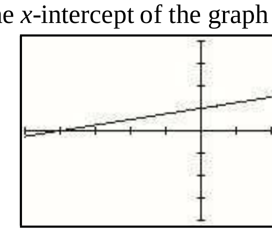
$f(x) = \frac{1}{4}x + 5$

$\frac{1}{4}x + 5 = 0$

$\frac{1}{4}x = -5$

$x = -20$

The x-intercept of the graph of $f(x)$ is (-20,0).



Xmin =-30, Xmax = 30, Xscl = 10,

Ymin = -10, Ymax = 10, Yscl = 1

70. Find the zero of f.

$f(x) = -\frac{1}{3}x + 2$

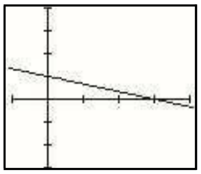
$-\frac{1}{3}x + 2 = 0$

$-\frac{1}{3}x = -2$

$x = 6$

The x-intercept of the graph of $f(x)$ is (6,0).

Find the equation.



Xmin = □2, Xmax = 8, Xscl = 2,

Ymin = □6, Ymax = 8, Yscl = 2

71. Find the slope and explain the meaning.

$$m = \frac{1505 - 1482}{28 - 20} = 2.875$$

The value of the slope indicates that the speed of sound in water increases 2.875 m/s for a one-degree Celsius increase in temperature.

72. Find the slope and explain the meaning.

$m = \frac{40-10}{100-25} = 0.4$

The value of the slope indicates that the file is being downloaded at 0.4 megabytes per second.

73. **a.** $m = \frac{31-20}{23-12} = 1$

$H(c) - 20 = 1(c - 12)$

$H(c) = c + 8$

b. $H(19) = (19) + 8 = 27$ mpg

74. **a.** $m = \frac{864.9-1008.1}{2011-2007} = -35.8$

$C(t) - 864.9 = -35.8(t - 2011)$

$C(t) = -35.8t + 72{,}858.7$

b. $750 = -35.8t + 72{,}858.7$

$-72{,}108.7 = -35.8t$

2014.2 » t

The debt will fall below $750 billion in 2014.

75. **a.** $m = \frac{316{,}500-279{,}200}{2020-2010} = 3730$

$N(t) - 279{,}200 = 3730(t - 2010)$

$N(t) = 3730t - 7{,}218{,}100$

b. $300{,}000 = 3730t - 7{,}218{,}100$

$7{,}518{,}100 = 3730t$

2015.6 » t

The number of jobs will exceed 300,000 in 2015.

76. **a.** $m = \frac{2200-2150}{15-20} = -10$

$T(t) - 2200 = -10(t - 15)$

$T(t) = -10t + 2350$

b. The value of the slope means that the temperature is decreasing at a rate of 10°F per minute.

c. $T(180) = -10(180) + 2350 = 550$°F

After 3 hours, the temperature will be 550°F.

77. **a.** $m = \frac{240 \quad 180}{18-16} = 30$

$B(d) - 180 = 30(d - 16)$

$B(d) = 30d - 300$

b. The value of the slope means that a 1-inch increase in the diameter of a log 32 ft long results in an increase of 30 board-feet of lumber that can be obtained from the log.

c. $B(19) = 30(19) - = 300$ 270 board feet

78. **a.** $m = \frac{1640-800}{60-40} = 42$

$E(T) - 800 = 42(T - 40)$

$E(T) = 42T - 880$

b. The value of the slope means that an additional 42 acre-feet of water evaporate for a one°F increase in temperature.

c. $E(75) = 42(75) - = 880$ 2270 acre-feet

79. Line *A* represents Michelle.

Line *B* represents Amanda.

Line *C* represents the distance between Michelle and Amanda.

80. **a.** $m_{AB} = \frac{1 \quad 9}{8-6} = -4$°F

b. $m_{AB} = \frac{1 \quad 9}{8-6} = -4$ F $m_{DE} = -\frac{4 \quad 5}{5-6} - =$ 9°F

The temperature changed most rapidly between points *D* and *E*.

c. The temperature remained constant (zero slope) between points *C* and *D*.

81. **a.** $m = \frac{80.5-19.9}{0-65}$ » -0.9323

$y - 80.5 = -0.9323(x - 0)$

$y = -0.9323x + 80.5$

b. $y = -0.9323(25) + 80.5 = 57.19$ » 57 years

82. a. $m = \frac{75.5-17.2}{0-65} \approx -0.8969$

$y - 75.5 = -0.8969(x - 0)$ $y = -0.8969x + 75.5$

b. $y = -0.8969(25) + 75.5 = 53.08 \approx 53$ years

83. Determine the profit function and break-even point.

$P(x) = 92.50x - (52x + 1782)$

$P(x) = 92.50x - 52x - 1782$ $P(x) = 40.50x - 1782$

$40.50x - 1782 = 0$

$40.50x = 1782$

$x = \frac{1782}{40.50}$

$x = 44$, the break-even point

84. Determine the profit function and break-even point.

$P(x) = 124x - (78.5x + 5005)$

$P(x) = 124x - 78.5x - 5005$ $P(x) = 45.5x - 5005$

$45.5x - 5005 = 0$

$45.5x = 5005$

$x = \frac{5005}{45.5}$

$x = 110$, the break-even point

85. Determine the profit function and break-even point.

$P(x) = 259x - (180x + 10,270)$

$P(x) = 259x - 180x - 10,270$ $P(x) = 79x - 10,270$

$79x - 10,270 = 0$

$79x = 10,270$

$x = \frac{10,270}{79}$

$x = 130$, the break-even point

86. Determine the profit function and break-even point.

$P(x) = 14,220x - (8010x + 1,602,180)$

$P(x) = 14,220x - 8010x - 1,602,180$ $P(x) = 6210x - 1,602,180$

$6210x - 1,602,180 = 0$

$6210x = 1,602,180$

$x = \frac{1,602,180}{6210}$

$x = 258$, the break-even point

87. a. $C(0) = 8(0) + 275 = 0 + 275 = \$275$

b. $C(1) = 8(1) + 275 = 8 + 275 = \$283$

c. $C(10) = 8(10) + 275 = 80 + 275 = \$355$

d. The marginal cost is the slope of $C(x) = 8x + 275$, which is \$8 per unit.

88. a. $R(0) = 210(0) = \$0$

b. $R(1) = 210(1) = \$210$

c. $R(10) = 210(10) = \$2100$

d. The marginal revenue is the slope of $R(x) = 210x$,

which is \$210 per unit.

89. a. $C(t) = 19,500.00 + 6.75t$

b. $R(t) = 55.00t$

c. $P(t) = R(t) - C(t)$

$P(t) = 55.00t - (19,500.00 + 6.75t)$

$P(t) = 55.00t - 19,500.00 - 6.75t$

$P(t) = 48.25t - 19,500.00$

d. $48.25t = 19,500.00$ $t = \frac{19,500.00}{48.25}$

$t = 404.1451$ days ≈ 405 days

90. $m = \frac{117,500 - 98,000}{35,000 - 32,000} = \frac{19,500}{3000} = 6.5$

a. $P(s) - 98,000 = 6.5(s - 32,000)$

$P(s) = 6.5s - 208{,}000 + 98{,}000$

$P(s) = 6.5s - 110{,}000$

b. $P(50{,}000) = 6.5(50{,}000) - 110{,}000$

$= 325{,}000 - 110{,}000$

$= \$215{,}000$

c. Let $6.5s - 110{,}000 = 0$. Then

$6.5s = 110{,}000$

$s = \frac{110{,}000}{6.5} \approx 16{,}924$ subscribers

91. The equation of the line through (0,0) and $P(3,4)$ has slope $\frac{4}{3}$.

The path of the rock is on the line through $P(3,4)$ with slope $-\frac{3}{4}$, so $y - 4 = -\frac{3}{4}(x-3)$. $y - 4 = -\frac{3}{4}x + \frac{9}{4}$ $y = -\frac{3}{4}x + \frac{9}{4} + 4$ $y = -\frac{3}{4}x + \frac{25}{4}$

The point where the rock hits the wall at $y = 10$ is the point of intersection of $y = -\frac{3}{4}x + \frac{25}{4}$ and $y = 10$.

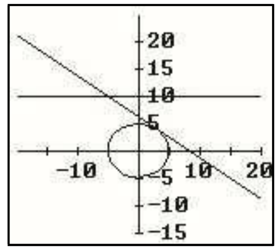
$-\frac{3}{4}x + \frac{25}{4} = 10$

$-3x + 25 = 40$

$-3x = 15$

$x = -5$ feet

Therefore the rock hits the wall at (5- , 10).
The x-coordinate is –5.



92. The equation of the line through (0,0) and $P(\sqrt{15}, 1)$ has slope $\frac{1}{\sqrt{15}}$.

The path of the rock is on the line through $P(\sqrt{15}, 1)$ with slope $-\sqrt{15}$ so

$y - 1 = -\sqrt{15}(x - \sqrt{15})$ $y - 1 = -\sqrt{15}x + 15$ $y = -\sqrt{15}x + 15 + 1$ $y = -\sqrt{15}x + 16$

The point of impact with the wall at $y = 14$ is the point of intersection of $y = -\sqrt{15}x + 16$ and $y = 14$ intersect.

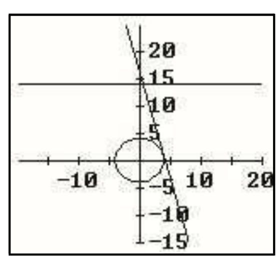
$-\sqrt{15}x + 16 = 14$

$-\sqrt{15}x = -2$

$x = \frac{2}{\sqrt{15}} \approx 0.52$ feet

Therefore, the rock hits the wall at $\left(\frac{2}{\sqrt{15}}, 14\right)$.

The x-coordinate is $\frac{2}{\sqrt{15}}$ or approximately 0.52.



93. Find a.

$f(a) = 2a + 3 = -1$

$2a = -4$ $a = -2$

94. Find a.

$f(a) = 4 - 3a = 7$

$-3a = 3$ $a = -1$

95. Find a.

$f\ a(\ ) = 1\text{-}4a = 3$

$-4a = 2 \qquad a = -\frac{1}{2}$

96. Find a.

$f\ a(\ ) = {}^{2}3^{\underline{a}} + 2 = 4$

$\underline{2a} = 2$

3 a

$= 2(\ )2\underline{3}$

$a = 3$

97. **a.** $h = 1$ so

$Q(1+h,\ 1[\ +h]^2 +1) = Q(2,\ 2^2 +1) = Q(2,\ 5)$ $m =$

$\underline{5}2\underline{-}\text{-}\underline{2}1 = 1\underline{3} = 3$

b. $h = 0.1$ so

$Q(1+h,\ 1[\ +h]^2 +1) = Q(1.1,1.1^2 +1) = Q(1.1,\ 2.21)$ m

$=$ 2.211.1 12 = $\underline{0.21}0.1 = 2.1$

c. $h = 0.01$ so

$Q(1+h,\ 1[\ +h]^2 +1) = Q(1.01,1.01^2 +1)$

$= Q(1.01,\ 2.0201)$

$m =$ 2.02011.0112 = $\underline{0.0201}0.01 = 2.01$

d. As h approaches 0, the slope of PQ seems to be approaching 2.

e. $x_1 = =1,\ y_1\ 2,\ x_2 = +1 \qquad h\ y,\ _2 = + +[1 \qquad h]^2\ 1$

$m = yx^2_2 \text{ -- } xy1^{\underline{1}} = [1+(1h+]^2 h+)\text{-}1\text{-}1\ 2 = (1\underline{+}\ \underline{\ }2h\ \underline{+}hh^2)$ $\underline{+}1\underline{-}2$

$= \underline{2h\ +}h\ \underline{h}2 = 2 + h$

98. **a.** $h = 1$, so

$Q(\ 2\text{-} \ \ +h,\ 9\text{- -}[\ 2+h]^2) = Q(\ 2\text{-} \ \ +1{,}9\text{- -}[\ \ 2+1\ )]^2$

$= Q(\ 1\text{-}\ ,\ 8)$

$m =$ 18 (2)5 $= 1\underline{3} = 3$

b. $h = 0.1$ so

$Q(\ 2\text{-} \qquad +h{,}9\text{-} \quad \text{-}[\quad 2+h]^2) = Q(\quad 2\text{-}$

$+0.1{,}9\text{- -}[\ 2+0.1\ )]^2 = Q($

$1.9{,}5.39)\text{-}$

$m = \text{-}1.9\underline{5.39}\text{- -}\underline{\text{-}}(\ 2)\underline{5} = \underline{0.39}0.1 = 3.9$

c. $h = 0.01$ so

$Q(\ 2\text{-}\ \ +h{,}9\text{- -}[\ 2+h]^2) = Q(\ 2\text{-} \qquad +0.01{,}9\text{- -}[\ 2+0.01\ )]^2$

$= Q(\ 1.99{,}5.0399)\text{-}$

$m =$ 5.03991.99 (2)5 $= \underline{0.0399}0.01 =$ 3.99

d. As h approaches 0, the slope of PQ seems to be approaching 4.

e. $x_1 = -2,\ y_1 = 5,\ x_2 = -2 + h\ y,\ _2 = 9\text{- -}[\ 2+h]^2$

$m = yx\underline{2}2 \text{ -- } xy1\underline{1} = \frac{9-[-2+h]^2-5}{(\ \ 2\ \ \ \ )\ \ (\ \ 2)} - \quad +h\ \text{- -}$

$= 9\underline{-}(4\underline{-}4hh\underline{+}\ h^2)\underline{-}5$

$= \underline{4h\text{-}}h\ \underline{h}^2 = 4\text{-}h$

99. The slope of the line through (3, 9) and (x, y) is $\underline{15}2$,

so $yx\ \text{-}\underline{\text{-}}39 = \underline{15}2$.

Therefore

$2(y\ \text{-}9) = 15(x\text{-}3)$

$$2y - 18 = 15x - 45$$
$$2y - 15x + 27 = 0$$
$$2x^2 - 15x + 27 = 0 \quad \text{Substituting } y = x^2$$
$$(2x-9)(x-3) = 0 \quad x = \frac{9}{2} \quad \text{or} \quad x = 3$$

If $x = \frac{9}{2}$, $y = x^2 = \left(\frac{9}{2}\right)^2 = \frac{81}{4} \Rightarrow \left(\frac{9}{2}, \frac{81}{4}\right)$.

If $x = 3$, $y = x^2 = (3)^2 = 9 \Rightarrow (3, 9)$, but this is the point itself. The point $\left(\frac{9}{2}, \frac{81}{4}\right)$ is on the graph of $y = x^2$, and the slope of the line containing $(3, 9)$ and $\left(\frac{9}{2}, \frac{81}{4}\right)$ is $\frac{15}{2}$.

100. The slope of the line through $(3, 2)$ and (x, y) is $\frac{3}{8}$, so $\frac{y-2}{x-3} = \frac{3}{8}$.

Therefore

$$8(y - 2) = 3(x - 3).$$
$$8y - 16 = 3x - 9$$
$$8y = 3x + 7$$
$$8\sqrt{x+1} = 3x + 7 \quad \text{Substituting } y = \sqrt{x+1}$$
$$\left(8\sqrt{x+1}\right)^2 = (3x + 7)^2$$
$$64(x + 1) = 9x^2 + 42x + 49$$
$$64x + 64 = 9x^2 + 42x + 49$$
$$0 = 9x^2 - 22x - 15$$
$$0 = (9x + 5)(x - 3)$$

$x = -\frac{5}{9}$ or $x = 3$. If $x = -\frac{5}{9}$,

$y = \sqrt{x+1} = \sqrt{-\frac{5}{9} + \frac{9}{9}} = \sqrt{\frac{4}{9}} = \frac{2}{3} \Rightarrow \left(-\frac{5}{9}, \frac{2}{3}\right)$.

If $x = 3$, $y = \sqrt{x+1} = \sqrt{3+1} = \sqrt{4} = 2 \Rightarrow (3, 2)$, but this is the point itself.

The point $\left(-\frac{9}{5}, \frac{2}{3}\right)$ is on the graph of $y = \sqrt{x+1}$, and

line containing (3, 2) and $y = -\frac{2}{3}x + \frac{5}{3}$ has slope $m = -\frac{2}{3}$.

$\left(-\frac{9}{5}, \frac{2}{3}\right)$ is $\frac{8}{3}$.

Mid-Chapter 2 Quiz

1. Find the midpoint and length. - - = - 3

$M = \left(\frac{-3+1}{2}, \frac{4-2}{2}\right) = \left(\frac{-2}{2}, \frac{2}{2}\right) = (-1, 1)$

$d = \sqrt{(1-(-3))^2 + (-2-4)^2} = \sqrt{(4)^2 + (-6)^2}$

$= \sqrt{16+36} = \sqrt{52} = 2\sqrt{13}$

2. Find the center and radius.

$x^2 + y^2 - 6x + 4y - 2 = 0$

$x^2 - 6x \quad + y^2 + 4y \quad = 2$

$x^2 - 6x + 9 + y^2 + 4y + 4 = 2 + 9 + 4$

$(x-3)^2 + (y+2)^2 = 15$

center (3, –2), radius $\sqrt{15}$

3. Evaluate.

$f(x) = x^2 - 6x + 1$

$f(-3) = (-3)^2 - 6(-3) + 1 = 9 + 18 + 1 = 28$

4. Find the domain.

For $f(x) = \sqrt{2-x}$, the domain is $(-\infty, 2]$.

5. Find the zeros of f for $f(x) = x^2 - x - 12$.

$f(x) = 0$

$x^2 - x - 12 = 0$

$(x+3)(x-4) = 0$

$x + 3 = 0 \quad x - 4 = 0$

$x = -3 \quad x = 4$

6. Find the slope.

$m = \frac{-8-2}{3-(-2)} = \frac{-10}{5} = -2$

7. Find the equation.

$2x + 3y = 5$

$3y = -2x + 5$

$y = -\frac{2}{3}x + \frac{5}{3}$ the slope of the

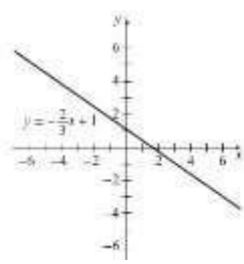
$y - y_1 = -\frac{2}{3}(x - x_1)$

$y - (-1) = -\frac{2}{3}(x - 3)$

$y + 1 = -\frac{2}{3}x + 2$

$y = -\frac{2}{3}x + 1$

8. $f(x) = -\frac{2}{3}x + 1$ has y-intercept (0, 1).



Prepare for Section 2.4

P1. $3x^2 + 10x - 8 = (3x - 2)(x + 4)$

P2. $x^2 - 8x = x^2 - 8x + 16 = (x - 4)^2$

P3. $f(-3) = 2(-3)^2 - 5(-3) - 7$

$= 18 + 15 - 7$

$= 26$

P4. $2x^2 - x = 1$

$2x^2 - x - 1 = 0$

$(2x + 1)(x - 1) = 0$

$x = -\frac{1}{2} \quad x = 1$

P5. $x^2 + 3x - 2 = 0$

$x = \frac{-3 \pm \sqrt{(3)^2 - 4(1)(-2)}}{2(1)}$

$= \frac{-3 \pm \sqrt{17}}{2}$

P6. $53 = -16t^2 + 64t + 5$

$16t^2 - 64t + 48 = 0$ $t^2 -$

$4t + 3 = 0$

$(t - 1)(t - 3) = 0$ t

$= 1, 3$

Section 2.4 Exercises

1. d

2. f

3. b

4. h

5. g

6. e

7. c

8. a

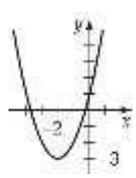
9. Write in standard form, find the vertex, the axis of symmetry and graph.

$f\,x(\;) = (x^2 + 4\;)x + 1$

$= (x^2 + 4x + 4) + 1 - 4$

$= (x + 2)^2 - 3$ standard form, vertex

(□2, □3), axis of symmetry x = □2



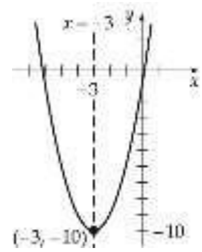
10. Write in standard form, find the vertex, the axis of symmetry and graph.

$f\,x(\;) = (x^2 + 6\;)x - 1$

$= (x^2 + 6x + 9) - -1 \quad 9$

$= (x + 3)^2 - 10$ standard form, vertex

(□3, □10), axis of symmetry x = □3



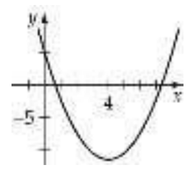
11. Write in standard form, find the vertex, the axis of symmetry and graph.

$f\,x(\;) = (x^2 - 8\;)x + 5$

$= (x^2 - 8x + 16) + 5 - 16$

$= (x - 4)^2 - 11$ standard form, vertex

(4, □11), axis of symmetry $x = 4$



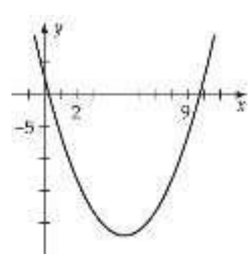
12. Write in standard form, find the vertex, the axis of symmetry and graph.

$f\,x(\;) = (x^2 - 10\;)x + 3$

$= (x^2 - 10x + 25) + 3 - 25$

$= (x - 5)^2 - 22$ standard form, vertex (5,

□□□), axis of symmetry $x = 5$



13. Write in standard form, find the vertex, the axis of symmetry and graph.

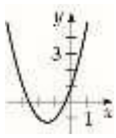
$f\,x(\;) = (x^2 + 3\;)x + 1$

$= \left(x^2 + 3x + \frac{9}{4}\right) + 1 - \frac{9}{4}$

$= \left(x + \frac{3}{2}\right)^2 + \frac{4}{4} - \frac{9}{4}$

$= \left(x + \frac{3}{2}\right)^2 - \frac{5}{4}$ standard form,

vertex $\left(-\frac{3}{2}, -\frac{5}{4}\right)$, axis of symmetry $x = -\frac{3}{2}$



14. Write in standard form, find the vertex, the axis of symmetry and graph.

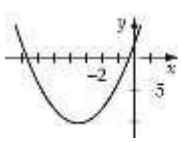
$f(x) = (x^2 + 7x) + 2$

$= \left(x^2 + 7x + \frac{49}{4}\right) + 2 - \frac{49}{4}$

$= \left(x + \frac{7}{2}\right)^2 + \frac{8}{4} - \frac{49}{4}$

$= \left(x + \frac{7}{2}\right)^2 - \frac{41}{4}$ standard form,

vertex $\left(-\frac{7}{2}, -\frac{41}{4}\right)$, axis of symmetry $x = -\frac{7}{2}$



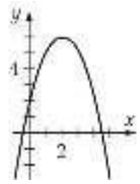
15. Write in standard form, find the vertex, the axis of symmetry and graph.

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

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

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

$= -(x - 2)^2 + 6$ standard form, vertex (2, 6), axis of symmetry $x = 2$



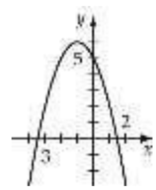
16. Write in standard form, find the vertex, the axis of symmetry and graph.

$f(x) = -x^2 - 2x + 5$

$= -(x^2 + 2x) + 5$

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

$= -(x + 1)^2 + 6$ standard form, vertex $(-1, 6)$, axis of symmetry $x = -1$



17. Write in standard form, find the vertex, the axis of symmetry and graph.

$f(x) = -3x^2 + 3x + 7$

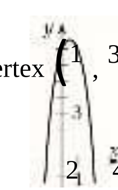
$= -3(x^2 - x) + 7$

$= -3\left(x^2 - x + \frac{1}{4}\right) + 7 + \frac{3}{4}$

$= -3\left(x - \frac{1}{2}\right)^2 + \frac{28}{4} + \frac{3}{4}$

$= -3\left(x - \frac{1}{2}\right)^2 + \frac{31}{4}$ standard form,

vertex $\left(\frac{1}{2}, \frac{31}{4}\right)$, axis of symmetry $x = \frac{1}{2}$



18. Write in standard form, find the vertex, the axis of symmetry and graph.

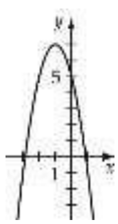
$f(x) = -2x^2 - 4x + 5$

$= -2(x^2 + 2x) + 5$

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

$= -2(x + 1)^2 + 7$ standard form, vertex

(□1, 7), axis of symmetry $x =$ □1



19. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = \frac{10}{2(1)} = 5$

$y = f(5) = (5)^2 - 10(5)$

$= 25 - 50 = -25$

vertex (5, -25)

$f(x) = (x - 5)^2 - 25$

20. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = \frac{6}{2(1)} = 3$ y

$= f(3) = (3)^2 - 6(3) =$

$9 - 18 = -9$

vertex (3, -9)

$f(x) = (x - 3)^2 - 9$

21. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = \frac{0}{2(1)} = 0$

$y = f(0) = (0)^2 - 10 = -10$

vertex (0, -10)

$f(x) = x^2 - 10$

22. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = \frac{0}{2(1)} = 0$

$y = f(0) = (0)^2 - 4 = -4$

vertex (0, -4)

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

23. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = -\frac{6}{2(-1)} = -\frac{6}{-2} = 3$

$y = f(3) = -(3)^2 + 6(3) + 1$

$= -9 + 18 + 1$

$= 10$

vertex (3, 10)

$f(x) = -(x - 3)^2 + 10$

24. Find the vertex, write the function in standard form.

$x = -\frac{b}{2a} = -\frac{4}{2(-1)} = -\frac{4}{-2} = 2$

$y = f(2) = -(2)^2 + 4(2) + 1$

$= -4 + 8 + 1$

$= 5$

vertex (2, 5)

$f(x) = -(x - 2)^2 + 5$

25. Find the vertex, write the function in standard form.

$x = \frac{-b}{2a} = \frac{3}{2(2)} = \frac{3}{4}$

$y = f\left(\frac{3}{4}\right) = 2\left(\frac{3}{4}\right)^2 - 3\left(\frac{3}{4}\right) + 7$

$= 2\left(\frac{9}{16}\right) - \frac{9}{4} + 7$

$= \frac{9}{8} - \frac{9}{4} + 7 = \frac{9}{8} - \frac{18}{8} + \frac{56}{8}$

$= \frac{47}{8}$

vertex $\left(\frac{3}{4}, \frac{47}{8}\right)$

$f(x) = 2\left(x - \frac{3}{4}\right)^2 + \frac{47}{8}$

26. Find the vertex, write the function in standard form.

$x = \frac{-b}{2a} = \frac{10}{2(3)} = \frac{10}{6} = \frac{5}{3}$

$y = f\left(\frac{5}{3}\right) = 3\left(\frac{5}{3}\right)^2 - 10\left(\frac{5}{3}\right) + 2$

$= 3\left(\frac{25}{9}\right) - \frac{50}{3} + 2$

$= \frac{25}{3} - \frac{50}{3} + 2 = \frac{25}{3} - \frac{50}{3} + \frac{6}{3}$

$= -\frac{19}{3}$

vertex $\left(\frac{5}{3}, -\frac{19}{3}\right)$

$f(x) = 3\left(x - \frac{5}{3}\right)^2 - \frac{19}{3}$

27. Find the vertex, write the function in standard form.

$x = \frac{-b}{2a} = \frac{-1}{2(-4)} = \frac{1}{8}$

$y = f\left(\frac{1}{8}\right) = -4\left(\frac{1}{8}\right)^2 + \left(\frac{1}{8}\right) + 1$

$= -4\left(\frac{1}{64}\right) + \frac{1}{8} + 1$

$= -\frac{1}{16} + \frac{1}{8} + 1 = -\frac{1}{16} + \frac{2}{16} + \frac{16}{16}$

$= \frac{17}{16}$

vertex $\left(\frac{1}{8}, \frac{17}{16}\right)$

$f(x) = -4\left(x - \frac{1}{8}\right)^2 + \frac{17}{16}$

28. Find the vertex, write the function in standard form.

$x = \frac{-b}{2a} = \frac{6}{2(-5)} = -\frac{6}{10} = -\frac{3}{5}$

$y = f\left(-\frac{3}{5}\right) = -5\left(-\frac{3}{5}\right)^2 - 6\left(-\frac{3}{5}\right) + 3$

$= -5\left(\frac{9}{25}\right) + \frac{18}{5} + 3$

$= -\frac{9}{5} + \frac{18}{5} + 3 = -\frac{9}{5} + \frac{18}{5} + \frac{15}{5}$

$= \frac{24}{5}$

vertex $\left(-\frac{3}{5}, \frac{24}{5}\right)$

$f(x) = -5\left(x + \frac{3}{5}\right)^2 + \frac{24}{5}$

2

29. Find the range, find x.

$f(x) = x^2 - 2x - 1$

$= (x^2 - 2x) - 1$

$= (x^2 - 2x + 1) - 1 - 1$

$= (x - 1)^2 - 2$

vertex $(1, -2)$ The y-value of the vertex is -2.

The parabola opens up since $a = 1 > 0$.

Thus the range is $\{y \mid y \ge -2\}$.

30. Find the range, find x.

$f(x) = -x^2 - 6x - 2$

$= -(x^2 + 6x) - 2$

$= -(x^2 + 6x + 9) - 2 + 9$

$= -(x + 3)^2 + 7$

vertex $(-3, 7)$

The y-value of the vertex is 7.

The parabola opens down since $a = -1 < 0$.

Thus the range is $\{y \mid y \le 7\}$.

31. Find the range, find x.

$f(x) = -2x^2 + 5x - 1$

$= -2\left(x^2 - \frac{5}{2}x\right) - 1$

$= -2\left(x^2 - \frac{5}{2}x + \frac{25}{16}\right) - 1 + 2\left(\frac{25}{16}\right)$

$= -2\left(x - \frac{5}{4}\right)^2 - \frac{8}{8} + \frac{25}{8}$

$= -2\left(x - \frac{5}{4}\right)^2 + \frac{17}{8}$

vertex $\left(\frac{5}{4}, \frac{17}{8}\right)$

The y-value of the vertex is $\frac{17}{8}$.

The parabola opens down since $a = -2 < 0$.

Thus the range is $\left\{y \mid y \le \frac{17}{8}\right\}$.

32. Find the range, find x.

$f(x) = 2x^2 + 6x - 5$

$= 2(x^2 + 3x) - 5$

$= 2\left(x^2 + 3x + \frac{9}{4}\right) - 5 - 2\left(\frac{9}{4}\right)$

$= 2\left(x + \frac{3}{2}\right)^2 - \frac{10}{2} - \frac{9}{2}$

$= 2\left(x + \frac{3}{2}\right)^2 - \frac{19}{2}$

vertex $\left(-\frac{3}{2}, -\frac{19}{2}\right)$

The y-value of the vertex is $-\frac{19}{2}$.

The parabola opens up since $a = 2 > 0$.

Thus the range is $\left\{y \mid y \ge -\frac{19}{2}\right\}$.

33. Find the real zeros and x-intercepts.

$f(x) = x^2 + 2x - 24 = (x + 6)(x - 4)$

$x + 6 = 0 \quad x - 4 = 0 \quad x = -6 \quad x = 4$

$(6, 0) \quad (4, 0)-$

34. Find the real zeros and x-intercepts.

$f\,x(\,) = -x^2 + 6x + 7$

$= -(x^2 - 6x - 7)$

$= -(x + 1)(x - 7)$

$x + 1 = 0 \quad x - 7 = 0 \quad x = -1 \quad x = 7$

(1, 0) (7, 0)-

35. Find the real zeros and x-intercepts.

$f\,x(\,) = 2x^2 + 11x + 12 = (x + 4)(2x + 3)$

$x + 4 = 0 \qquad 2x + 3 = 0$

$x = -4 \qquad x = -\frac{3}{2}$

(4, 0) - $\left(-\frac{3}{2}, 0\right)$

36. Find the real zeros and x-intercepts.

$f\,x(\,) = 2x^2 - 9x + 10$

$= -(x \quad 2)(2x - 5)$

$x - 2 = 0 \quad 2x - 5 = 0 \quad x = 2 \quad x = \frac{5}{2}$

(2, 0) $\left(\frac{5}{2}, 0\right)$

37. Find the minimum or maximum.

$f\,x(\,) = x^2 + 8x$

$= (x^2 + 8x + 16) - 16$

$= (x + 4)^2 - 16$

minimum value of –16 when $x =$ □4

38. Find the minimum or maximum.

$f\,x(\,) = -x^2 - 6x$

$= -(x^2 + 6\,)x$

$= -(x^2 + 6x + 9) + 9$

$= -(x + 3)^2 + 9$

maximum value of 9 when $x =$ □3

39. Find the minimum or maximum.

$f\,x(\,) = -x^2 + 6x + 2$

$= -(x^2 - 6\,)x + 2$

$= -(x^2 - 6x + 9) + 2 + 9$

$= -(x - 3)^2 + 11$

maximum value of 11 when $x = 3$

40. Find the minimum or maximum.

$f\,x(\,) = -x^2 + 10x - 3$

$= -(x^2 - 10\,)x - 3$

$= -(x^2 - 10x + 25) - 3 + 25$

$= -(x - 5)^2 + 22$

maximum value of 22 when $x = 5$

41. Find the minimum or maximum.

$f\,x(\,) = 2x^2 + 3x + 1$

$= 2\left(x^2 + 2\frac{3}{\;}x\right) + 1$

$= 2\left(x2 + 2\underline{3}\,x + 16\underline{9}\right) + 1 - 2\left(\;\right)16\underline{9}$

$= 2\left(x + 4\underline{3}\right)2 + \underline{8}8 - \underline{9}8$

$= 2\left(x + 4\underline{3}\right)2 - \underline{1}8$

minimum value of $-\frac{1}{8}$ when $x = -\frac{3}{4}$

42. Find the minimum or maximum.

$f\,x(\,) = 3x^2 + x - 1$

$= 3\left(x^2 + \frac{1}{\;}3\,x\right) - 1$

$= 3\left(x2 + \underline{1}3\,x + 36\underline{1}\right) - 1 - 3\left(36\underline{1}\right)$

$= 3\left(x + \underline{1}6\right)2 - \underline{12}12 - 12\underline{1}$

$= 3\left(x + \frac{1}{6}\right)^2 - \frac{13}{12}$

minimum value of $-\frac{13}{12}$ when $x = -\frac{1}{6}$

43. Find the minimum or maximum.

$f\,x(\ ) = 5x^2 - 11$

$= 5(x^2) - 11$

$= 5(x - 0)^2 - 11$

minimum value of –11 when $x = 0$

44. Find the minimum or maximum.

$f\,x(\ ) = 3x^2 - 41$

$= 3(x^2) - 41$

$= 3(x - 0)^2 - 41$

minimum value of –41 when $x = 0$

45. Find the minimum or maximum.

$f\,x(\ ) = -\frac{1}{2}x^2 + 6x + 17$

$= -\frac{1}{2}(x^2 - 12\ )x + 17$

$= -\frac{1}{2}(x^2 - 12x + 36) + 17 + 18$

$= -\frac{1}{2}(x - 6)^2 + 35$

maximum value of 35 when $x = 6$

46. Find the minimum or maximum.

$f\,x(\ ) = -4^{3}x^2 - {}^{2}5\,x + 7$

$= -4\underline{3}\left(x2 + 15\underline{8}\,x\right) + 7$

$= -4\underline{3}\left(x2 + 15\underline{8}\,x + 225\underline{16}\right) + 7 + 75\underline{4}$

2

$= -4\underline{3}\left(x + 15\underline{4}\right) + \underline{529}75$

maximum value of $^{529}75 = 7\ 75^{4}$ when $x = -\frac{4}{15}$

$= -$

47. $A\,t(\ ) = -4.9t^2 + 90t + 9000$

Microgravity begins and ends at a height of 9000 m.

$9000 = -4.9t^2 + 90t + 9000$

$4.9t^2 \quad -90t \quad = \quad 0$

$t(4.9t - 90) = 0$

$t = 0 \quad 4.9t - 90 = 0 \quad t = 0 \quad t =$

$4.9\underline{90} \approx 18.4$

The time of microgravity is 18.4 seconds.

48. $h\,t(\ ) \qquad 4.9t^2 + 12.8t$

$0 = -4.9t^2 + 12.8t$

$0 = t(-4.9t + 12.8)\ t = 0\ -4.9t$

$+12.8 = 0$

$t = 0 \quad t \quad = \approx \frac{12.8}{4.9} \quad 2.6$

The ball is in the air 2.6 seconds.

49. $h\,x(\ ) = -64^{3}\,x^2 + 27 = -64^{3}(x - 0)^2 + 27$

a. The maximum height of the arch is 27 feet.

b. $h(10) = -64\underline{3}\,(10)2 + 27$

$= -\frac{3}{64}(100) + 27$

$= -\frac{75}{16} + 27$

$= -16\underline{75} + \underline{432}16$

$= \underline{357}16 = 2216\underline{5}$ feet

c. $h\,x(\ ) = 8 = -64\underline{3}\,x2 + 27$

$8 - 27 = -\frac{3}{64}x^2$

$-19 = -\frac{3}{64}x^2$

$64(-19) = -3x^2$

$\frac{64(-19)}{-3} = x^2$

$\sqrt{\frac{64(-19)}{-3}} = x$

$8\sqrt{\frac{19}{3}} = x$

$\frac{8\sqrt{19}\sqrt{3}}{3} = x$

$\frac{8\sqrt{57}}{3} = x$

$20.1 \approx x$ $h(x) = 8$ when $x \approx$

20.1 feet

50. $l + w = 240$

a. $w = 240 - l$

b. $A = l(240 - l)$

$A = 240l - l^2$

c. $A = -l^2 + 240l$

$A = -(l^2 - 240l)$

$A = -(l^2 - 240l + 120^2) + 120^2$

$A = -(l - 120)^2 + 120^2$

Thus $l = 120$ and $w = 120$ produce the greatest area.

51. **a.** $3w + 2l = 600$

$3w = 600 - 2l$ $w = \frac{600 - 2l}{3}$

b. $A = w \cdot l$

$= \left(\frac{600 - 2l}{3}\right)l$

$A = 200l - \frac{2}{3}l^2$

c. $A = -\frac{2}{3}(l^2 - 300l)$

$A = -\frac{2}{3}(l^2 - 300l + 150^2) + 15{,}000$

$= -$

In standard form,

$A = -\frac{2}{3}(l - 150)^2 + 15{,}000$

The maximum area of 15,000 ft^2 is produced when

$l = 150$ ft and the width $w = \frac{600 - 2(150)}{3} = 100$ ft .

52. **a.** Find the temperature for maximum surviving larvae.

$N(t) = -0.6t^2 + 32.1t - 350$

$= -0.6\left(t^2 - \frac{32.1}{0.6}t\right) - 350$

$= -0.6(t^2 - 53.5t) - 350$

$= -0.6[t^2 - 53.5t + (26.75)^2] - 350 + 0.6(26.75)^2$

$= -0.6(t - 26.75)^2 + 79.3375$

$\approx -0.6(t - 27)^2 + 79$

The maximum number of larvae will survive at 27°C.

b. A maximum of 79 larvae will survive.

c. $N(t) = 0 = -0.6t^2 + 32.1t - 350$

$t = \frac{-32.1 \pm \sqrt{(32.1)^2 - 4(-0.6)(-350)}}{2(-0.6)}$.

$t = \frac{-32.1 \pm \sqrt{1030.41 - 840}}{-1.2}$

$t = \frac{-32.1 \pm \sqrt{190.41}}{-1.2} \approx \frac{-32.1 \pm 13.8}{-1.2}$

$t = \frac{-32.1 + 13.8}{-1.2}$ or $t = \frac{-32.1 - 13.8}{-1.2}$

$= 15.25 \approx 15$ $= 38.25 \approx 38$

Thus the x-intercepts to the nearest whole number for $N(t)$ are (15, 0) and (38, 0).

d. When the temperature is less than 15°C or greater than 38°C, none of the larvae survive.

53. **a.** $T\ t(\ ) = -0.7t^2 + 9.4t + 59.3 = -0.7\left(t^2 - \frac{9.4}{0.7}\right.$

$\left.t\right) + 59.3$

$= -0.7\left(t^2 - \frac{94}{7}t\right) + 59.3$

= -0.7æççèçt^2 - $\frac{94}{7}$ t + éêë$\frac{47}{7}$

ùúû^{2}ö÷÷÷ø÷+59.3+ 0.7 éêë$\frac{47}{7}$ úùû^2 » -0.7$\left(t -\right.$

$\left.\frac{47}{7}\right)$ + 90.857

2

2

» $-0.7\left(t - 6\ 7\frac{5}{}\right)$ + 91

The temperature is a maximum when $t = \frac{47}{7} = 6\ 7\frac{5}{}$

hours after 6:00 A.M. Note $\frac{5}{7}$ (60 min) » 43 min.

Thus the temperature is a maximum at 12:43 P.M.

b. The maximum temperature is approximately 91 F.

54. $h\ t(\ ) = -9.8t^2 + 100t$

$h\ t(\ ) = -9.8(t^2 - 10.2\ )t$ $h\ t(\ ) = -$

$9.8(t - 5.1)^2 + 254.9$

The maximum height is 255 m.

55. $t = -\ 2\underline{b}a = -\frac{82.86}{\_}$ 2(279.67) = 0.14814

$E(0.14814) = -279.67(0.14814)^2 + 82.86(0.14814)$

= -

» 6.1

The maximum energy is 6.1 joules.

56. $h\ x(\ ) = -0.0009x^2 + 6$

$h(60.5) = -0.0009(60.5)^2 + 6$ » 2.7

Since 2.7 is less than 5.4 and greater than 2.5, yes, the

pitch is a strike.

57. **a.** $E\ v(\ ) = -0.018v^2 + 1.476v + 3.4$

$= -0.018\left(v2 - \underline{1.476}0.018\ v\right) + 3.4$

$= -0.018(v^2 - 82\ )v + 3.4$

$= -0.018\left(v^2 - 82v + 41^2\right) + 3.4 + 0.018(41)^2$

$= -0.018(v - 41)^2 + 33.658$

The maximum fuel efficiency is obtained at a speed of 41 mph.

b. The maximum fuel efficiency for this car, to the nearest mile per gallon, is 34 mpg.

58. $h\ x(\ ) = -0.0002348x^2 + 0.0375x$

$= -0.0002348\left(x^2 - \frac{0.0375}{0.0002348}x\right)$

$= -$ 2 _ 0.0375 + 1 , 0.0375 =-

0.0002348ççèæçx -0.0002348 x+êëé2

0.0002348úûù2÷ø÷ö÷

+0.0002348éêë12 0.0002348· 0.0375 ùúû2

»-0.0002348æççç èx2 -0.00023480.0375 x+éêë12 0.0002348·

0.0375 ùúû2ö÷÷÷ø+1.5

The maximum height of the field, to the nearest tenth of a foot, is 1.5 feet.

59. $-\frac{b}{2a} = -\frac{296}{2(-0.2)} = 740$

$R(740) = 296(740) - 0.2(740)^2 = 109{,}520$

Thus, 740 units yield a maximum revenue of $109,520.

60. $-\frac{b}{2a} = -\frac{810}{2(-0.6)} = 675$

$R(675) = 810(675) - 0.6(675)^2 = 273{,}375$

Thus, 675 units yield a maximum revenue of $273,375.

61. $-\frac{b}{2a} = -\frac{1.7}{2(-0.01)} = 85$

$P(85) = -0.01(85)^2 + 1.7(85) - 48 = 24.25$

Thus, 85 units yield a maximum profit of $24.25.

62. - 2ba 2ççèæç-1.6814,0001 ÷÷øö÷ =11,760

$P(11{,}760) = -\frac{(11{,}760)^2}{14{,}000} + 1.68(11{,}760) - 4000$

$= 5878.40$

Thus, 11,760 units yield a maximum profit of $5878.40.

63. $P(x) = R(x) - C(x)$

$= x(102.50 - 0.1x) - (52.50x + 1840)$

$= -0.1x^2 + 50x - 1840$

The break-even points occur when $R(x) = C(x)$

or $P(x) = 0$.

Thus, $0 = -0.1x^2 + 50x - 1840$

$$x = \frac{-50 \pm \sqrt{50^2 - 4(-0.1)(-1840)}}{2(-0.1)}$$

$$= \frac{-50 \pm \sqrt{1764}}{-0.2}$$

$$= \frac{-50 \pm 42}{-0.2}$$

$x = 40$ or $x = 460$

The break-even points occur when $x = 40$ or $x = 460$.

= -

64. $P(x) = R(x) - C(x)$

$= x(210 - 0.25x) - (78x + 6399)$

$= -0.25x^2 + 132x - 6399$

$-\frac{b}{2a} = -\frac{132}{2(-0.25)} = 264$

$P(264) = -0.25(264)^2 + 132(264) - 6399$

$= \$11{,}025$, the maximum profit

The break-even points occur when $P(x) = 0$.

Thus, $0 = -0.25x^2 + 132x - 6399$

$$x = \frac{-132 \pm \sqrt{132^2 - 4(-0.25)(-6399)}}{2(-0.25)}$$

$$= \frac{-132 \pm \sqrt{11025}}{-0.5}$$

$$= \frac{-132 \pm 105}{-0.5}$$

$x = 54$ or $x = 474$

The break-even points occur when $x = 54$ or $x = 474$.

65. Let x = the number of people that take the tour.

a. $R(x) = x(15.00 + 0.25(60 - x))$

$= x(15.00 + 15 - 0.25x)$

$= -0.25x^2 + 30.00x$

b. $P(x) = R(x) - C(x)$

$= -(0.25x^2 + 30.00x) - (180 + 2.50x)$

$= -0.25x^2 + 27.50x - 180$

c. $-\frac{b}{2a} = -\frac{27.50}{2(-0.25)} = 55$

$P(55) = -0.25(55)^2 + 27.50(55) - 180 = \$576.25$

d. The maximum profit occurs when $x = 55$ tickets.

66. Let x = the number of parcels.

a. $R(x) = xp = x(22 - 0.01x) = -0.01x^2 + 22x$

b. $P(x) = R(x) - C(x)$

$= -(0.01x^2 + 22)x - (2025 + 7)x$

$= -0.01x^2 + 15x - 2025$

c. $-\frac{b}{2a} = -\frac{15}{2(0.01)} = 750$

$P(750) = -0.01(750)^2 + 15(750) - 2025 = \$3600$

d. $p(750) = 22 - 0.01(750) = \$14.50$

e. The break-even points occur when $R(x) = C(x)$.

$-0.01x^2 + 22x = 2025 + 7x$

$-0.01x^2 + 15x - 2025 = 0$

$x = -\frac{(15) \quad \sqrt{15^2 - 4(0.01)(2025)}}{2(0.01)}$

$x = 150$ or $x = 1350$ are the break-even points. Thus the minimum number of parcels the air freight company must ship to break even is 150 parcels.

67. Let x = the number of \$0.05 price reductions. Then the price per gallon is

$p(x) = 3.95 - 0.05x$

The number of gallons sold each day is

$q(x) = 10,000 + 500x$

Then the revenue is

$R(x) = (3.95 - 0.05)(10,000x + 500)x$

$= -25x^2 + 1475x + 39,500$

The cost is

$C(x) = 2.75(10,000 + 500)x = 27,500 + 1375x$

The profit equals revenue minus cost.

$P(x) = R(x) - C(x)$

$= -25x^2 + 1475x + 39,500 - (27,500 + 1375)x$

$= -25x^2 + 100x + 12,000$

$= -$

The maximum profit occurs when

$x = -\frac{b}{2a} = -\frac{100}{2(25)} = 2$

The price per gallon that maximizes profit is

$p(2) = 3.95 - 0.05(2) = \$3.85$

68. Let x = the number of \$10 price reductions. Then the price per ticket is

$p(x) = 390 - 10x$

The number of tickets sold each day is

$q(x) = 350 + 25x$

Then the revenue is

$R(x) = (390 - 10)(350x + 25)x$

$= -250x^2 + 6250x + 136,500$

The cost is

$C(x) = 150(350 + 25)x = 52,500 + 3750x$

The profit equals revenue minus cost.

$P(x) = R(x) - C(x)$

$= -250x^2 + 6250x + 136,500 - (52,500 + 3750)x$

$= -250x^2 + 2500x + 84,000$

The maximum profit occurs when

$x = -\frac{b}{2a} = -\frac{2500}{2(250)} = 5$

The price per ticket that maximizes profit is

$p(5) = 390 - 10(5) = \$340$

69. $h(t) = -16t^2 + 128t$

a. $-\frac{b}{2a} = -\frac{128}{2(16)} = 4$ seconds

b. $h(4) = -16(4)^2 + 128(4) = 256$ feet

c. $0 = -16t^2 + 128t$

$0 = -16t(t - 8)$

$-16t = 0$ or $t - 8 = 0$ $t = 0$

$t = 8$

The projectile hits the ground at $t = 8$ seconds.

70. $h\,t(\ ) = -16t^2 + 64t + 80$

a. $-\frac{b}{2a} = -\frac{64}{2(-16)} = 2$

$h(2) = -16(2)^2 + 64(2) + 80$

$= 144$ feet

b. $-\frac{b}{2a} = -\frac{64}{2(-16)}$

$= 2$ seconds

c. $0 = -16t^2 + 64t + 80$

$0 = -16(t^2 - 4t - 5)$

$0 = -16(t - 5)(t + 1)$ $t - 5 = 0$

or $t + 1 = 0$

$t = 5$ $t = -1$ No

The projectile has height 0 feet at $t = 5$ seconds.

71. $y\,x(\ ) = -0.014x^2 + 1.19x + 5$

$-\frac{b}{2a} = -\frac{1.19}{2(-0.014)}$

$= 42.5$ $y(42.5) = -0.014(42.5)^2$

$+1.19(42.5) + 5$

$= 30.2875$

» 30 feet

72. $h\,t(\ ) = -6.6t^2 + 430t + 28{,}000$

$-\frac{b}{2a} = -\frac{430}{2(-6.6)}$

$= 32.6$ $h(32.6) = -6.6(32.6)^2 + 430(32.6) +$

$28{,}000$

$= 35{,}0003.784$

» 35,000 feet

= -

73. $h\,x(\ )\ 0.002x^2 - 0.03x + 8$ $h(39) = -0.002(39)^2 -$

$0.03(39) + 8 = 3.788 > 3$

Solve for x using quadratic formula.

$-0.002x^2 - 0.03x + 8 = 0$

$x^2 + 15x - 4000 = 0$

$x = \frac{-15 \pm \sqrt{(15)^2 - 4(1)(-4000)}}{2(1)}$

$= \frac{-15 \pm \sqrt{16{,}225}}{2}$, use positive value of x

x » 56.2

Yes, the conditions are satisfied.

74. $4w + 2l = 1200$

$2l = 1200 -$

$4w$ $l =$

$\frac{1200 - 4w}{2}$

$l = 600 -$

$2w$

$A = w(600 - 2w)$

$A = 600w - 2w^2$

$A = -2w^2 + 600w$

$A = -2(w^2 - 300w)$

$A = -2(w^2 - 300w + 150^2) + 2 \cdot 150^2$

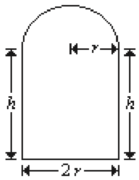
$A = -2(w - 150)^2 + 45{,}000$

Thus when $w = 150$, the length $l = \frac{1200 - 4(150)}{2} = 300$.

Thus the dimensions that yield the greatest enclosed area are $w = 150$ ft and $l = 300$ ft.

75. Find height and radius.

= -



The perimeter is $48 = \pi r + h + 2r + h$.

Solve for *h*.

$$48 - \pi r - 2r = 2h$$

$$\frac{1}{2}(48 - \pi r - 2r) = h$$

Area = semicircle + rectangle

$A = \frac{1}{2}\pi r^2 + 2rh$

$= \frac{1}{2}\pi r^2 + 2r\left(\frac{1}{2}(48 - \pi r - 2)r\right)$

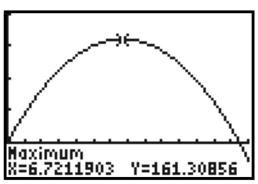
$= \frac{1}{2}\pi r^2 + r(48 - \pi r - 2)r$

$= \frac{1}{2}\pi r^2 + 48r - \pi r^2 - 2r^2$

$= \left(\frac{1}{2}\pi - \pi - 2\right) r^2 + 48r$

$= -\left(\frac{1}{2}\pi - 2\right) r^2 + 48r$

Graph the function A to find that its maximum occurs when r □ 6.72 feet.



Xmin = 0, Xmax = 14, Xscl = 1 Ymin = □50, Ymax = 200, Yscl = 50

$h = \frac{1}{2}(48 - \pi r - 2)r$

» $\frac{1}{2}(48 - \pi(6.72) - 2(6.72))$

» 6.72 feet

Hence the optimal window has its semicircular radius equal to its height.

Note: Using calculus it can be shown that the exact value of $r = h = \frac{48}{\pi + 4}$.

76. $y = a(x - h)^2 + k$ $y = a(x - 0)^2 + 6$ $y = ax^2 + 6$

$500 = a(2100)^2 + 6$

$494 = a(2100)^2$

$\frac{494}{2100^2} = a$

$0.000112018 \approx a$ $y = 0.000112018x^2 + 6$

Prepare for Section 2.5

P1. $f(x) = x^2 + 4x - 6$

$-\frac{b}{2a} = -\frac{4}{2(1)} = -2$ $x = -2$

P2. $f(3) = \frac{3(3)^4}{(3)^2 + 1} = \frac{243}{10} = 24.3$ $f(-3) = \frac{3(-3)^4}{(-3)^2 + 1} = \frac{243}{10} = 24.3$

$f(-3) = f(3)$

P3. $f(-2) = 2(-2)^3 - 5(-2) = -16 + 10 = -6$

$-f(2) = -[2(2)^3 - 5(2)] = -[16 - 10] = -6$ $f(-2) = -f(2)$

P4. $f(-2) - g(-2) = (-2)^2 - [-2 + 3] = 4 - 1 = 3$ $f(-1) - g(-1) = (-1)^2 - [-1 + 3] = 1 - 2 = -1$ $f(0) - g(0) = (0)^2 - [0 + 3] = 0 - 3 = -3$ $f(1) - g(1) = (1)^2 - [1 + 3] = 1 - 4 = -3$ $f(2) - g(2) = (2)^2 - [2 + 3] = 4 - 5 = -1$

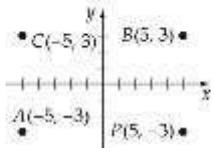
P5. $\frac{-a + a}{2} = 0$, $\frac{b + b}{2} = b$

midpoint is $(0, b)$

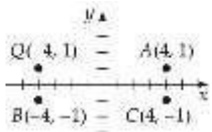
P6. $\frac{-a + a}{2} = 0$, $\frac{-b + b}{2} = 0$ midpoint is $(0, 0)$

Section 2.5 Exercises

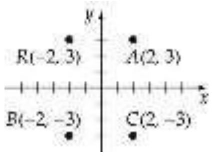
1. Plot the points.



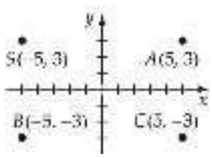
2. Plot the points.



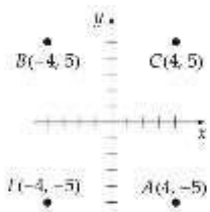
3. Plot the points.



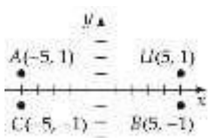
4. Plot the points.



5. Plot the points.



6. Plot the points.



7. Determine how the graph is symmetric.

The graph is symmetric with respect to the origin.

8. Determine how the graph is symmetric.

The graph is symmetric with respect to the *y*-axis.

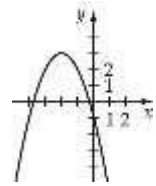
9. Determine how the graph is symmetric. The graph is symmetric with respect to the *x*-axis, the *y*-axis, and the origin.

10. Determine how the graph is symmetric.

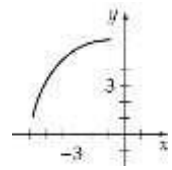
The graph is symmetric with respect to the *x*-axis.

11. Sketch the graph symmetric to the *x*-axis.

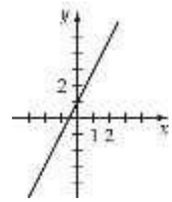
12. Sketch the graph symmetric to the *x*-axis.



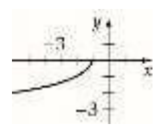
13. Sketch the graph symmetric to the *y*-axis.



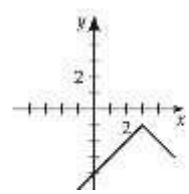
14. Sketch the graph symmetric to the *y*-axis.



15. Sketch the graph symmetric to the origin.



16. Sketch the graph symmetric to the origin.



17. Determine if the graph is symmetric.

a. No

b. Yes

18. Determine if the graph is symmetric.

a. Yes

b. No

19. Determine if the graph is symmetric.

a. No

b. No

20. Determine if the graph is symmetric.

a. No

b. No

21. Determine if the graph is symmetric.

a. Yes

b. Yes

22. Determine if the graph is symmetric.

a. Yes

b. Yes

23. Determine if the graph is symmetric.

a. Yes

b. Yes

24. Determine if the graph is symmetric.

a. No

b. No

25. Determine if the graph is symmetric.

a. Yes

b. Yes

26. Determine if the graph is symmetric to the origin. Not symmetric with respect to the origin since $(-y) = -(x)+1$ does not simplify to the original equation $y = x + 1$.

27. Determine if the graph is symmetric to the origin.

No, since $(-y) = 3(-x) - 2$ simplifies to

$(-y) = -3x - 2$, which is not equivalent to the original equation $y = 3x - 2$.

28. Determine if the graph is symmetric to the origin.

Yes, since $(-y) = (-x)^3 - (-x)$ simplifies to $-y = -x^3 + x$,

which is equivalent to the original equation $y = x^3 - x$.

29. Determine if the graph is symmetric to the origin.

Yes, since $(-y) = -(-x)^3$ implies

$-y = x^3$ or $y = -x^3$, which is the original equation.

30. Determine if the graph is symmetric to the origin. Yes, since

$(-y) = \frac{9}{(-x)}$ is equivalent to the original equation $y = \frac{9}{x}$.

31. Determine if the graph is symmetric to the origin.

Yes, since $(-x)^2 + (-y)^2 = 10$ simplifies to the original equation.

32. Determine if the graph is symmetric to the origin.

Yes, since $(-x)^2 - (-y)^2 = 4$ simplifies to the original equation.

33. Determine if the graph is symmetric to the origin.

Yes, since $-y = \frac{-x}{|-x|}$ simplifies to the original equation.

34. Determine if the graph is symmetric to the origin.

Yes, since $|-y| = |-x|$ simplifies to the original equation.

35. Determine if the function is odd, even or neither.

Even since $g(-x) = (-x)^2 - 7 = x^2 - 7 = g(x)$.

36. Determine if the function is odd, even or neither.

Even, since $h(-x) = (-x)^2 + 1 = x^2 + 1 = h(x)$.

37. Determine if the function is odd, even or neither.

Odd, since $F(-x) = (-x)^5 + (-x)^3 = -x^5 - x^3 = -F(x)$.

38. Determine if the function is odd, even or neither.

Neither, since $G(-x) \neq G(x)$ and $G(-x) \neq -G(x)$.

39. Determine if the function is odd, even or neither.
Even

40. Determine if the function is odd, even or neither.
Even

41. Determine if the function is odd, even or neither.
Even

42. Determine if the function is odd, even or neither.

Neither

43. Determine if the function is odd, even or neither.

Even

44. Determine if the function is odd, even or neither.

Even

45. Determine if the function is odd, even or neither.

Even

46. Determine if the function is odd, even or neither.

Neither

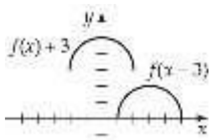
47. Determine if the function is odd, even or neither.

Neither

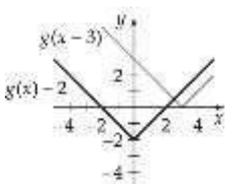
48. Determine if the function is odd, even or neither.

Odd

49. Sketch the graphs.

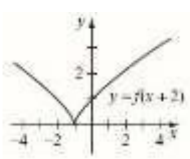


50. Sketch the graphs.

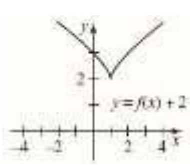


51. Sketch the graphs.

a. f x(+ 2)

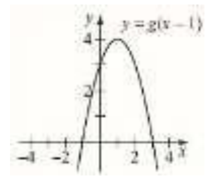


b. f x( )+2

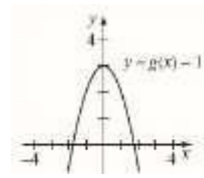


52. Sketch the graphs.

a. g x(-1)

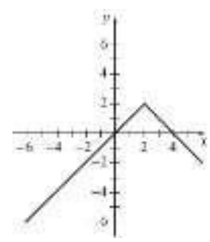


b. g x( )-1

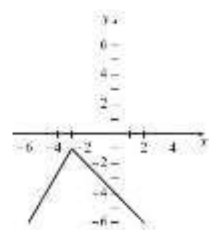


53. Sketch the graphs.

a. y = - +f x(2) 1

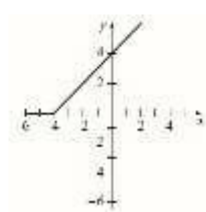


b. y = f x(+ 3)-2

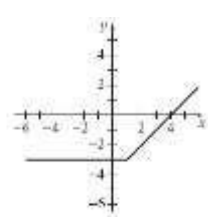


54. Sketch the graphs.

a. y = f x(+ 3)+ 2



b. y = - -f x(2) 1



55. **a.** Give three points on the graph. f x(+ 3)

(2- -3, 5) = -(5, 5)

(0-3, -2) = -(3, -2)

(1-3, 0) = -(2, 0)

b. Give three points on the graph. *f x*( )+1

(2- , 5+1) = -(2, 6)

(0, -2+1) = (0, -1)

(1, 0+1) = (1,1)

56. **a.** Give three points on the graph. *g x*(-2)

(3- + 2, -1) = -(1, -1)

(1+ 2, -3) = (3, -3)

(4+ 2, 2) = (6, 2)

b. Give three points on the graph. *g x*( )-2

(3- , - -1 2) = -(3, -3)

(1, -3-2) = (1, -5)

(4, 2-2) = (4, 0)

57. **a.** Give two points on the graph.

f (-*x*)

(--1, 3) = (1, 3)

(2- , -4)

b. Give two points on the graph.

- *f x*( )

(1- , -3)

(2, --4) = (2, 4)

58. **a.** Give two points on the graph.

-*g x*( )

(4, --5) = (4, 5)

(3- , -2)

b. Give two points on the graph.

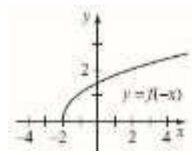
g(-*x*)

(4- , -5)

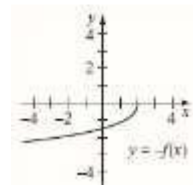
(--3, 2) = (3, 2)

59. Sketch the graphs.

a. *f* (□*x*)

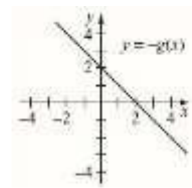


b. □ *f* ( )*x*

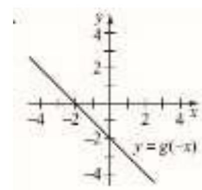


60. Sketch the graphs.

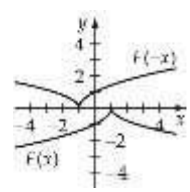
a. □*g*( )*x*



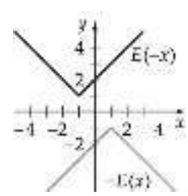
b. *g*(□*x*)



61. Sketch the graphs.

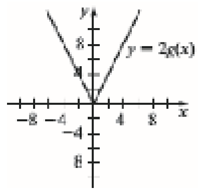


62. Sketch the graphs.

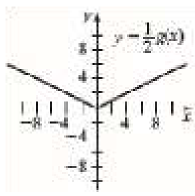


63. Sketch the graphs.

a. 2 ( )*g x*

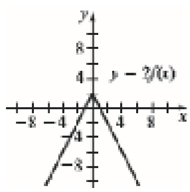


b. $\frac{1}{2}g(x)$

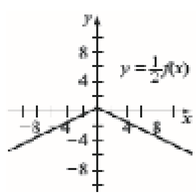


64. Sketch the graphs.

a. $2f(x)$

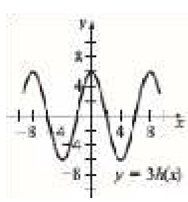


b. $\frac{1}{2}f(x)$

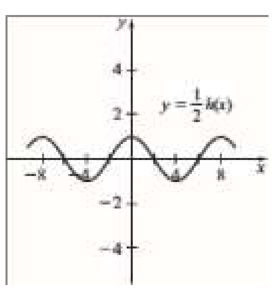


65. Sketch the graphs.

a. $3h(x)$

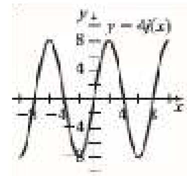


b. $\frac{1}{2}h(x)$

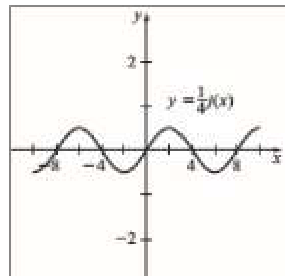


66. Sketch the graphs.

a. $4f(x)$

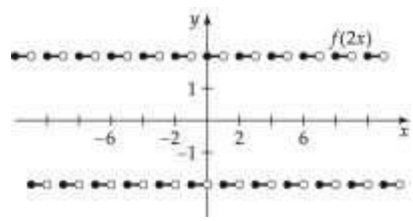


b. $\frac{1}{4}f(x)$

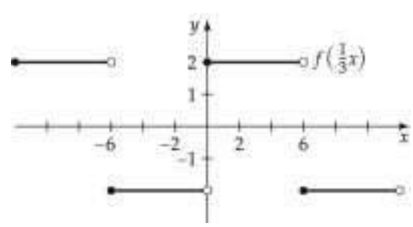


67. Sketch the graphs.

a. $f(2x)$

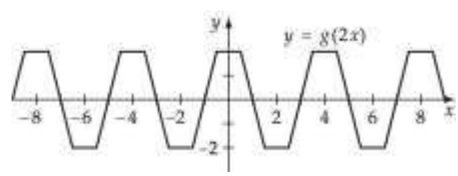


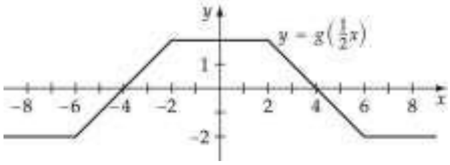
b. $f\left(\frac{1}{3}x\right)$



68. Sketch the graphs.

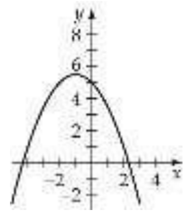
a. $g(2x)$





2

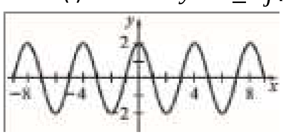
b. $g\left(\frac{1}{2}x\right)$



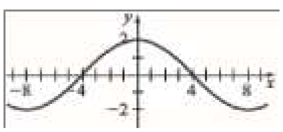
72. Sketch the graph.

69. Sketch the graphs.

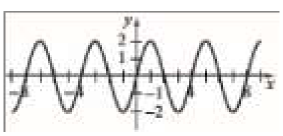
a. $h(2x)$ **a.** $y = -\frac{1}{2}j(x)+1$



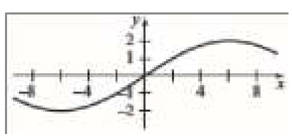
b. $h\left(\frac{1}{2}x\right)$



70. Sketch the graphs. **b.** $y = 2j(x)-1$ **a.** $j(2x)$

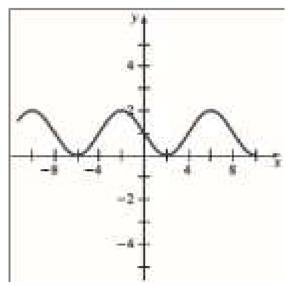


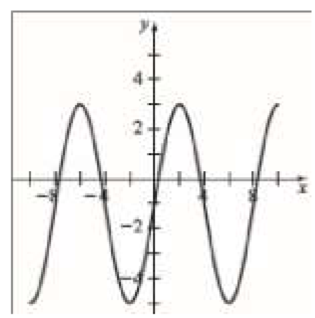
b. $j\left(\frac{1}{3}x\right)$



71. Sketch the graph.

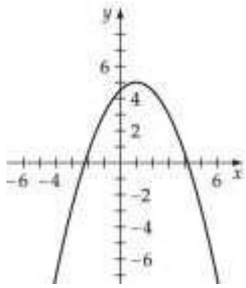
73. Sketch the graphs.



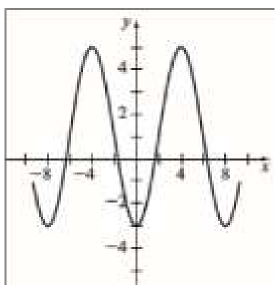


74. Sketch the graphs.

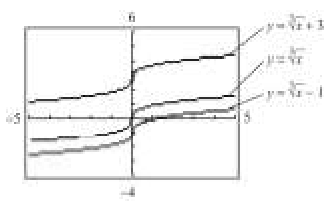
a. $y = \frac{1}{2}h(x)-1$



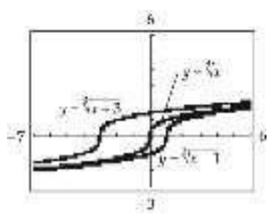
b. $y = -2h\,x(\ )+1$



75. Graph using a graphing utility.



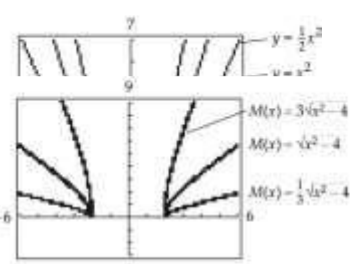
76. Graph using a graphing utility.

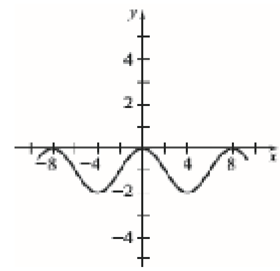


77. Graph using a graphing utility.

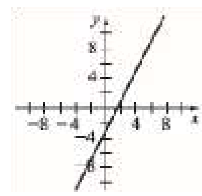
P1. $(2x^2 + 3x - 4) - (x^2 + 3x - 5) = x^2 + 1$

78.

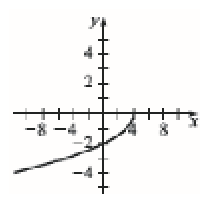




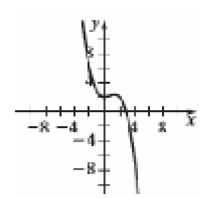
80. Reflect the graph about the origin and then about the y-axis.



81. Reflect the graph about the y-axis and then about the x-axis.



82. Reflect the graph about the x-axis and then about the origin.



Prepare for Section 2.6

P2. $(3x^2 - x + 2)(2x - 3) = 6x^3 - 2x^2 + 4x - 9x^2 + 3x - 6$

$= 6x^3 - 11x^2 + 7x - 6$

P3. $f(3)a = 2(3)a - 5(3)a + 2$

$= 18a^2 - 15a + 2$

2

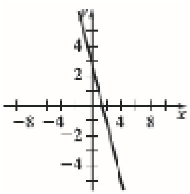
P4. $f(2+h) = 2(2+h)^2 - 5(2+h) + 2$

$= 2h^2 + 8h + 8 - 5h - 10 + 2$

$= 2h^2 + 3h$

P5. Domain: all real numbers except $x = 1$

79. Reflect the graph about the y-axis and then about the **P6.**



$2x - 8 = 0$ origin. $x = 4$

Domain: $x \geq 4$ or [4, ¥)

Section 2.6 Exercises

1. Evaluate.

$(f+g)(2)- \ = f(2)- \ + g(2)-$

$= 3+ -(6)$

$= -3$

2. Evaluate.

$(f-g)(2)- = f(2)- - g(2)- \ = 3- -($

$6)$

$= 9$

3. Evaluate.

$(f g\cdot)(2)- \ = f(2)- \cdot g(2)-$

$= 3(6)-$

$= -18$

4. Evaluate.

— f (2) $f(2)$-___

g -= $g(2)$-

$= \frac{3}{6} = -$

$\frac{1}{2}$

5. Evaluate.

$g\,f[(-5)] = g[7] = -2$

6. Evaluate. $f(4) = f\,g[(\,)0\,] = 3$

7. Simplify.

$f \ (2+h) = 3(2+h)-4$

$= 6 + 3h - 4$

$= 2 + 3h$

8. Simplify.

$f \ (2+h) = (2+h)^2 + 1$

$= 4 + 4h + h^2 + 1$

$= 5 + 4h + h^2$

9. Perform the operations and find the domain.

$f \ x(\,) + g\,x(\,) = (x^2 - 2x - 15) + (x+3)$

$= x^2 - x - 12$ Domain all real numbers $f\,x(\,) - g\,x(\,)$

$= (x^2 - 2x - 15) - (x+3)$

$= x^2 - 3x - 18$ Domain all real numbers

$f\,x\,g\,x(\,)\,(\,) = (x^2 - 2x - 15)(x+3)$

$= x^3 + x^2 - 21x - 45$

Domain all real numbers

$f\,x(\,) / g\,x(\,) = (x^2 - 2x - 15) / (x+3)$

$= x - 5$ Domain $\{x\ x| \ ^1 -3\}$

10. Perform the operations and find the domain.

$f\,x(\,) + g\,x(\,) = (x^2 - 25) + -(x \ \ 5)$

$= x^2 + -x \ \ 30$ Domain all real numbers

$f\,x(\,) - g\,x(\,) = (x^2 - 25) - (x - 5)$

$= x^2 - x - 20$ Domain all real numbers

$f\,x\,g\,x(\,)\,(\,) = (x^2 - 25)(x - 5)$

$= x^3 - 5x^2 - 25x + 125$

Domain all real numbers

$f\,x(\,) / g\,x(\,) = (x^2 - 25) / (x - 5)$

$= x + 5$ Domain $\{x\ x| \ ^1 5\}$

11. Perform the operations and find the domain.

$f\,x(\,) + g\,x(\,) = (2x + 8) + (x + 4)$

$= 3x + 12$ Domain all real numbers

$f\,x(\,) - g\,x(\,) = (2x + 8) - (x + 4)$

$= x + 4$ Domain all real numbers

$f\,x\,g\,x(\,)\,(\,) = (2x + 8)(x + 4)$

^{2}

$= 2x + 16x + 32$ Domain all real numbers f

$x(\,) / g\,x(\,) = (2x + 8) / (x + 4)$

$= [2(x+4)]/(x+4)$

$= 2$ Domain $\{x \mid x \neq -4\}$

12. Perform the operations and find the domain.

$f(x) + g(x) = (5x - 15) + (x - 3)$

$= 6x - 18$ Domain all real numbers

$f(x) - g(x) = (5x - 15) - (x - 3)$

$= 4x - 12$ Domain all real numbers

$(fg)(x) = (5x - 15)(x - 3)$

$= 5x^2 - 30x + 45$ Domain all real numbers

$f(x)/g(x) = (5x - 15)/(x - 3)$

$= [5(x-3)]/(x-3)$

$= 5$ Domain $\{x \mid x \neq 3\}$

13. Perform the operations and find the domain.

$f(x) + g(x) = (x^3 - 2x^2 + 7x) + x$

$= x^3 - 2x^2 + 8x$ Domain all real numbers

$f(x) - g(x) = (x^3 - 2x^2 + 7x) - x$

$= x^3 - 2x^2 + 6x$ Domain all real numbers

$(fg)(x) = (x^3 - 2x^2 + 7x)x$

$= x^4 - 2x^3 + 7x^2$ Domain all real numbers

$f(x)/g(x) = (x^3 - 2x^2 + 7x)/x$

$= x^2 - 2x + 7$ Domain $\{x \mid x \neq 0\}$

14. Perform the operations and find the domain.

$f(x) + g(x) = (x^2 - 5x - 8) + (-x)$

$= x^2 - 6x - 8$ Domain all real numbers

$f(x) - g(x) = (x^2 - 5x - 8) - (-x)$

$= x^2 - 4x - 8$ Domain all real numbers

$(fg)(x) = (x^2 - 5x - 8)(-x)$

$= -x^3 + 5x^2 + 8x$ Domain all real numbers

$f(x)/g(x) = (x^2 - 5x - 8)/(-x) = -x + 5 + \frac{8}{x}$ Domain $\{x \mid x \neq 0\}$

15. Perform the operations and find the domain.

$f(x) + g(x) = (4x - 7) + (2x^2 + 3x - 5)$

$= 2x^2 + 7x - 12$ Domain all real numbers

$f(x) - g(x) = (4x - 7) - (2x^2 + 3x - 5)$

$= -2x^2 + x - 2$ Domain all real numbers

$(fg)(x) = (4x - 7)(2x^2 + 3x - 5)$

$= 8x^3 - 14x^2 + 12x^2 - 20x - 21x + 35$

$= 8x^3 - 2x^2 - 41x + 35$

Domain all real numbers

$f(x)/g(x) = (4x - 7)/(2x^2 + 3x - 5)$

$= \frac{4x-7}{2x^2 + 3x - 5}$

Domain $\left\{x \mid x \neq 1, x \neq -\frac{5}{2}\right\}$

16. Perform the operations and find the domain.

$f(x) + g(x) = (6x + 10) + (3x^2 + x - 10)$

$= 3x^2 + 7x$ Domain all real numbers

$f(x) - g(x) = (6x + 10) - (3x^2 + x - 10)$

$= -3x^2 + 5x + 20$

Domain all real numbers

$(fg)(x) = (6x + 10)(3x^2 + x - 10)$

$= 18x^3 + 6x^2 - 60x + 30x^2 + 10x - 100$

$= 18x^3 + 36x^2 - 50x - 100$

Domain all real numbers

$f(x)/g(x) = (6x + 10)/(3x^2 + x - 10)$

$= \frac{6x+10}{3x^2+x-10}$

Domain $\{x \mid x \ne -2, x \ne \frac{5}{3}\}$

17. Perform the operations and find the domain.

$(f+g)(x) = \sqrt{x-3} + x$ Domain $\{x \mid x \geq 3\}$

$(f-g)(x) = \sqrt{x-3} - x$ Domain $\{x \mid x \geq 3\}$

$(f \cdot g)(x) = x\sqrt{x-3}$ Domain $\{x \mid x \geq 3\}$

$(f/g)(x) = \frac{\sqrt{x-3}}{x}$ Domain $\{x \mid x \geq 3\}$

18. Perform the operations and find the domain.

$(f+g)(x) = \sqrt{x-4} - x$ Domain $\{x \mid x \geq 4\}$

$(f-g)(x) = \sqrt{x-4} + x$ Domain $\{x \mid x \geq 4\}$

$(f \cdot g)(x) = -x\sqrt{x-4}$ Domain $\{x \mid x \geq 4\}$

$(f/g)(x) = -\frac{\sqrt{x-4}}{x}$ Domain $\{x \mid x \geq 4\}$

19. Perform the operations and find the domain.

$(f+g)(x) = \sqrt{4-x^2} + 2 + x$ Domain $\{x \mid -2 \leq x \leq 2\}$

$(f-g)(x) = \sqrt{4-x^2} - 2 - x$ Domain $\{x \mid -2 \leq x \leq 2\}$

$(f \cdot g)(x) = \left(\sqrt{4-x^2}\right)(2+x)$ Domain $\{x \mid -2 \leq x \leq 2\}$

$(f/g)(x) = \frac{\sqrt{4-x^2}}{2+x}$ Domain $\{x \mid -2 < x \leq 2\}$

20. Perform the operations and find the domain.

$(f+g)(x) = \sqrt{x^2-9} + x - 3$ Domain $\{x \mid x \leq -3 \text{ or } x \geq 3\}$

$(f-g)(x) = \sqrt{x^2-9} - x + 3$ Domain $\{x \mid x \leq -3 \text{ or } x \geq 3\}$

$(f \cdot g)(x) = \left(\sqrt{x^2-9}\right)(x-3)$ Domain $\{x \mid x \leq -3 \text{ or } x \geq 3\}$

$(f/g)(x) = \frac{\sqrt{x^2-9}}{x-3}$ Domain $\{x \mid x \leq -3 \text{ or } x > 3\}$

21. Evaluate the function.

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

$(f+g)(5) = (5)^2 - (5) - 2$

$= 25 - 5 - 2$

$= 18$

22. Evaluate the function.

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

$(f+g)(-7) = (-7)^2 - (-7) - 2$

$= 49 + 7 - 2$

$= 54$

23. Evaluate the function.

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

$(f+g)\left(\frac{1}{2}\right) = \left(\frac{1}{2}\right)^2 - \left(\frac{1}{2}\right) - 2$

$= \frac{1}{4} - \frac{1}{2} - 2$

$= -\frac{9}{4}$

24. Evaluate the function.

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

2

$(f+g)\left(\frac{2}{3}\right) = \left(\frac{2}{3}\right)^2 - \left(\frac{2}{3}\right) - 2$

$= \frac{4}{9} - \frac{2}{3} - 2$

$= -\frac{20}{9}$

25. Evaluate the function.

$(f-g)(x) = x^2 - 5x + 6$

$(f-g)(-3) = (-3)^2 - 5(-3) + 6$

$= 9 + 15 + 6$

$= 30$

26. Evaluate the function.

$(f-g)(x) = x^2 - 5x + 6$

$(f-g)(24) = (24)^2 - 5(24) + 6$

$= 576 - 120 + 6$

$= 462$

27. Evaluate the function.

$(f-g)(x) = x^2 - 5x + 6$

$(f-g)(-1) = (-1)^2 - 5(-1) + 6 = 1 + 5 + 6$

$= 12$

28. Evaluate the function.

$(f-g)(x) = x^2 - 5x + 6$

$(f-g)(0) = (0)^2 - 5(0) + 6$

$= 6$

29. Evaluate the function.

$(fg)(x) = \left(x^2 - 3x + 2\right)(2x - 4)$

$= 2x^3 - 6x^2 + 4x - 4x^2 + 12x - 8$

$= 2x^3 - 10x^2 + 16x - 8$

$(fg)(7) = 2(7)^3 - 10(7)^2 + 16(7) - 8$

$= 686 - 490 + 112 - 8$

$= 300$

30. Evaluate the function.

$(fg)(x) = 2x^3 - 10x^2 + 16x - 8$

$(fg)(-3) = 2(-3)^3 - 10(-3)^2 + 16(-3) - 8$

$= -54 - 90 - 48 - 8$

$= -200$

31. Evaluate the function.

$(fg)(x) = 2x^3 - 10x^2 + 16x - 8$

$(fg)\left(\frac{2}{5}\right) = 2\left(\frac{2}{5}\right)^3 - 10\left(\frac{2}{5}\right)^2 + 16\left(\frac{2}{5}\right) - 8$

$= \frac{16}{125} - \frac{40}{25} + \frac{32}{5} - 8$

$= -\frac{384}{125} = -3.072$

32. Evaluate the function.

$(fg)(x) = 2x^3 - 10x^2 + 16x - 8$

$(fg)(-100) = 2(-100)^3 - 10(-100)^2 + 16(-100) - 8$

$= -2{,}000{,}000 - 100{,}000 - 1600 - 8$

$= -2{,}101{,}608$

33. Evaluate the function. $\left(\frac{f}{g}\right)(x) = \frac{x^2 - 3x + 2}{2x - 4}$

$\left(\frac{f}{g}\right)(x) = \frac{1}{2}x - \frac{1}{2}$

$\left(\frac{f}{g}\right)(-4) = \frac{1}{2}(-4) - \frac{1}{2}$

$= -2 - \frac{1}{2}$

$= -2\frac{1}{2}$ or $-\frac{5}{2}$

34. Evaluate the function. $\left(\frac{f}{g}\right)(x) = \frac{1}{2}x - \frac{1}{2}$

$\left(\frac{f}{g}\right)(11) = \frac{1}{2}(11) - \frac{1}{2}$

$= \frac{11}{2} - \frac{1}{2}$

$= \frac{10}{2} = 5$

35. Evaluate the function. $\left(\frac{f}{g}\right)(x) = \frac{1}{2}x - \frac{1}{2}$

$\left(\frac{f}{g}\right)\left(\frac{1}{2}\right) = \frac{1}{2}\left(\frac{1}{2}\right) - \frac{1}{2}$

$= \frac{1}{4} - \frac{1}{2}$

$= -\frac{1}{4}$

36. Evaluate the function. $\left(\frac{f}{g}\right)(x) = \frac{1}{2}x - \frac{1}{2}$

$\left(\frac{f}{g}\right)\left(\frac{1}{4}\right) = \frac{1}{2}\left(\frac{1}{4}\right) - \frac{1}{2}$

$= \frac{1}{8} - \frac{1}{2}$

$= -\frac{3}{8}$

37. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h} = \frac{[2(x+h)+4] - (2x+4)}{h}$

$= \frac{2x + 2h + 4 - 2x - 4}{h}$

$= \frac{2h}{h}$

$= 2$

38. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h} = \frac{[4(x+h)-5] - (4x-5)}{h}$

$= \frac{4x + 4h - 5 - 4x + 5}{h}$

$= \frac{4h}{h}$

$= 4$

39. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h} = \frac{\left[(x+h)^2 - 6\right] - (x^2 - 6)}{h}$

$= \frac{x^2 + 2xh + h^2 - 6 - x^2 + 6}{h}$

$= \frac{2xh + h^2}{h}$

$= 2x + h$

40. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h} = \frac{\left[(x+h)^2 + 11\right] - (x^2 + 11)}{h}$

$= \frac{x^2 + 2xh + h^2 + 11 - x^2 - 11}{h}$

$= \frac{2xh + h^2}{h} = 2x + h$

41. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h}$

$= \frac{2(x+h)^2 + 4(x+h) - 3 - (2x^2 + 4x - 3)}{h}$

$= \frac{2x^2 + 4xh + 2h^2 + 4x + 4h - 3 - 2x^2 - 4x + 3}{h}$

$= \frac{4xh + 2h^2 + 4h}{h}$

$= 4x + 2h + 4$

42. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h}$

$= \frac{2(x+h)^2 - 5(x+h) + 7 - (2x^2 - 5x + 7)}{h}$

$= \frac{2x^2 + 4xh + 2h^2 - 5x - 5h + 7 - 2x^2 + 5x - 7}{h}$

$= \frac{4xh + 2h^2 - 5h}{h}$

$= 4x + 2h - 5$

43. Find the difference quotient.

$\frac{f(x+h) - f(x)}{h} = \frac{-4(x+h)^2 + 6 - (-4x^2 + 6)}{h}$

$= \frac{-4x^2 - 8xh - 4h^2 + 6 + 4x^2 - 6}{h}$

$= \frac{-8xh - 4h^2}{h}$

$= -8x - 4h$

44. Find the difference quotient.

$f(x) = -5x^2 - 4x$

$\frac{f(x+h) - f(x)}{h}$

$= \frac{-5(x+h)^2 - 4(x+h) - (-5x^2 - 4x)}{h}$

$= \frac{-5x^2 - 10xh - 5h^2 - 4x - 4h + 5x^2 + 4x}{h}$

$= \frac{-10xh - 5h^2 - 4h}{h}$

$= -10x - 5h - 4$

45. **a.** On $[0, 1]$, $a = 0$

$\Delta t = 1 - 0 = 1$

$C(a + \Delta t) = C(1) = 99.8$ (mg/L)/h

$C(a) = C(0) = 0$

Average rate of change $= \frac{C(1) - C(0)}{1} = 99.8 - 0 = 99.8$

This is identical to the slope of the line through $(0, C(0))$ and $(1, C(1))$ since

$m = \frac{C(1) - C(0)}{1 - 0} = C(1) - C(0)$

b. On $[0, 0.5]$, $a = 0$, $\Delta t = 0.5$

Average rate of change

$= \frac{C(0.5) - C(0)}{0.5} = \frac{78.1 - 0}{0.5} = 156.2$ (mg/L)/h

c. On $[1, 2]$, $a = 1$, $\Delta t = 2 - 1 = 1$

Average rate of change

$= \frac{C(2) - C(1)}{1} = \frac{50.1 - 99.8}{1} = -49.7$ (mg/L)/h

d. On $[1, 1.5]$, $a = 1$, $\Delta t = 1.5 - 1 = 0.5$

Average rate of change

$= \frac{C(1.5) - C(1)}{0.5} = \frac{84.4 - 99.8}{0.5} = \frac{-15.4}{0.5} = -30.8$ (mg/L)/h

e. On $[1, 1.25]$, $a = 1$, $\Delta t = 1.25 - 1 = 0.25$

Average rate of change

$= \frac{C(1.25) - C(1)}{0.25} = \frac{95.7 - 99.8}{0.25} = \frac{-4.1}{0.25} = -16.4$ (mg/L)/h

f. On $[1, 1 + \Delta t]$,

$Con(1 + \Delta t)$

$= 25(1 + \Delta t)^3 - 150(1 + \Delta t)^2 + 225(1 + \Delta t)$

$= 25(1 + 3\Delta t + 3(\Delta t)^2 + (\Delta t)^3) - 150(1 + 2(\Delta t) + (\Delta t)^2)$
$\quad + 225(1 + \Delta t)$

$= 25 + 75(\Delta t) + 75(\Delta t)^2 + 25(\Delta t)^3$

$\quad - 150 - 300(\Delta t) - 150(\Delta t)^2 + 225 + 225(\Delta t)$

$= 100 - 75(\Delta t)^2 + 25(\Delta t)^3$

$Con(1) = 100$

Average rate of change

$= \frac{Con(1+\Delta t)-Con(1)}{\Delta t}$

$= \frac{100-75(\Delta t)^2+25(\Delta t)^3-100}{\Delta t}$

$= \frac{-75(\Delta t)^2+25(\Delta t)^3}{\Delta t}$

$= -75(\Delta t)+25(\Delta t)^2$

As Δt approaches 0, the average rate of change over $[1, 1+\Delta t]$ seems to approach 0 (mg/L)/h.

46. **a.** On $[2, 3]$, $a = 2$

$\Delta t = 3-2 = 1$

$s(a+\Delta t) = s(3) = 6\cdot 3^2 = 54$

$s(a) = s(2) = 6\cdot 2^2 = 24$

Average velocity $= \frac{s(a+\Delta t)-s(a)}{\Delta t} = \frac{s(3)-s(2)}{1}$
$= 54-24 = 30$ feet per second

This is identical to the slope of the line through $(2, s(2))$ and $(3, s(3))$ since

$m = \frac{s(3)-s(2)}{3-2} = s(3)-s(2)$.

b. On $[2, 2.5]$, $a = 2$,

$\Delta t = 2.5-2 = 0.5$

$s(a+\Delta t) = s(2.5) = 6(2.5)^2 = 37.5$

Average velocity $= \frac{s(2.5)-s(2)}{0.5} = \frac{37.5-24}{0.5}$

$= \frac{13.5}{0.5} = 27$ feet per second

c. On $[2, 2.1]$, $a = 2$

$\Delta t = 2.1-2 = 0.1$

$s(a+\Delta t) = s(2.1) = 6(2.1)^2 = 26.46$

Average velocity $= \frac{s(2.1)-s(2)}{0.1} = \frac{26.46-24}{0.1}$

$= \frac{2.46}{0.1} = 24.6$ feet per second

d. On $[2, 2.01]$, $a = 2$

$\Delta t = 2.01-2 = 0.01$

$s(a+\Delta t) = s(2.01) = 6(2.01)^2 = 24.2406$

Average velocity $= \frac{s(2.01)-s(2)}{0.01} = \frac{24.2406-24}{0.01}$

$= \frac{0.2406}{0.01} = 24.06$ feet per second

e. On $[2, 2.001]$, $a = 2$

$\Delta t = 2.001-2 = 0.001$

$s(a+\Delta t) = s(2.001)$
$= 6(2.001)^2 = 24.024006$

Average velocity $= \frac{s(2.001)-s(2)}{0.001} = \frac{24.024006-24}{0.001}$

$= \frac{0.024006}{0.001} = 24.006$ feet per second

f. On $[2, 2+\Delta t]$,

$Con = \frac{s(2+\Delta t)-s(2)}{\Delta t} = \frac{6(2+\Delta t)^2-24}{\Delta t}$

$= \frac{6(4+4(\Delta t)+(\Delta t)^2)-24}{\Delta t}$

$= \frac{24+24(\Delta t)+6(\Delta t)^2-24}{(\Delta t)}$

$= \frac{24\Delta t+6(\Delta t)^2}{\Delta t} = 24+6(\Delta t)$

As □t approaches 0, the average velocity seems to approach 24 feet per second.

47. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$ $\quad$ $(f \circ g)(x) = f[g(x)]$

$= g[3x+5] = 2[3x+5]-7$ $\quad$ $= f[2x-7] = 3[2x-7]+5$

$= 6x+10-7$ $\quad$ $= 6x-21+5$

$= 6x+3$ $\quad$ $= 6x-16$

48. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$ $\quad$ $(f \circ g)(x) = f[g(x)]$

$= g[2x-7] = 3[2x-7]+2$ $\quad$ $= f[3x+2] = 2[3x+2]-7$

$= 6x-21+2$ $\quad$ $= 6x+4-7$

$= 6x-19$ $\quad$ $= 6x-3$

49. Find the composite functions. $(g \circ f)(x) = g\left[x^2+4x-1\right]$

$= \left[x^2+4x-1\right]+2$

$= x^2+4x+1$

$(f \circ g)(x) = f[x+2]$

$= [x+2]^2+4[x+2]-1$

$= x^2+4x+4+4x+8-1$

$= x^2+8x+11$

50. Find the composite functions.

$(g \circ f)(x) = g\left[x^2-11x\right]$

$= 2\left[x^2-11x\right]+3$

$= 2x^2-22x+3$

$(f \circ g)(x) = f[2x+3]$

$= [2x+3]^2 - 11[2x+3]$

$= 4x^2+12x+9-22x-33$

$= 4x^2-10x-24$

51. Find the composite functions.

$(g \circ f)(x) = g[f(x)] = g\left[x^3+2x\right] = -5\left[x^3+2x\right]$

$= -5x^3-10x$

$(f \circ g)(x) = f[g(x)]$

$= f[-5x] = [-5x]^3+2[-5x]$

$= -125x^3-10x$

52. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$

$= g\left[-x^3-7\right] = -\left[x^3-7\right]+1$

$= -x^3-6$

$(f \circ g)(x) = f[g(x)]$

$= f[x+1] = -[x+1]^3-7$

$= -x^3-3x^2-3x-1-7$

$= -x^3-3x^2-3x-8$

53. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$

$= g\left[\frac{2}{x+1}\right]$

$= 3\left[\frac{2}{x+1}\right]-5 = \frac{6}{x+1}-\frac{5(x+1)}{x+1}$

$= \frac{6-5x-5}{x+1}$

= 1x-+51x

$(f \circ g)(x) = f[g(x)]$

$= f[3x-5]$

= [3x -25]+1

$= \dfrac{2}{3x-4}$

54. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$

= g éêë √x + 4ùúû

= √x1+ 4

= xx++44

$(f \circ g)(x) = f[g(x)]$

$= f\left(\frac{1}{x}\right)$

$= \sqrt{\frac{1}{x} + 4}$

$= \dfrac{\sqrt{1+4x}}{\sqrt{x}}$

$= \dfrac{\sqrt{1+4x}}{\sqrt{x}}$

$= \dfrac{\sqrt{x}\sqrt{1+4x}}{x}$

$= \dfrac{\sqrt{x+4x^2}}{x}$

55. Find the composite functions.

(g ∘ f)( )x == g f x[é ( )12 ù]= g éêê x12 úúûú √ (f

∘g)( )x == ff g x[êé ( )x] ûùú

- 1

ë

ê úú -1 = ë 1 êë x û

= √1-2x² êëé x -1ùúû2

= 1|-x |x

-

56. Find the composite functions.

$(g \circ f)(x) = g[f(x)]$

= g éêë x -6 2ùúû

$= \dfrac{3}{5\left[\dfrac{6}{x-2}\right]} = \dfrac{3}{\left(\dfrac{30}{x-2}\right)}$

$= 3 \cdot \dfrac{x-2}{30}$

$= \dfrac{x-2}{10}$

$(f \circ g)(x) = f[g(x)]$

= f éêë53x ùúû

= 6 êëé3ú ù2 5x

$= \dfrac{6}{\left(\dfrac{3-10x}{5x}\right)}$

= 3-3010x x

57. Find the composite functions.

(g ∘ f)( )x = g êêëé 5-3x ùúúû

2

= - éêêë 5- 3 x ùúúû

x 2

= x -1 1

= -2 53- *x*

(*f* *g*)( )*x* = *f* éêë- 2 *x* ùúû

= 3

5- -éê2 *x*û

= 3

5+

2x

$= \frac{5x3+2}{x}$

3 x

$= 5x + 2$

58. Find the composite functions.

$(g \circ f)(x) = g[2x+1]$

$= 3[2x+1]^2 - 1$

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

$= 3(4x^2 + 4x + 1) - 1$

$= 12x^2 + 12x + 3 - 1$

$= 12x^2 + 12x + 2$

$(f \circ g)(x) = f[g(x)]$

$= f[3x^2 - 1] = 2[3x^2 - 1] + 1$

$= 6x^2 - 2 + 1$

$= 6x^2 - 1$

59. Evaluate the composite function.

$(g \circ f)(x) = 4x^2 + 2x - 6$

$(g \circ f)(4) = 4(4)^2 + 2(4) - 6 = 64 + 8 - 6$

$= 66$

60. Evaluate the composite function.

$(f \circ g)(x) = 2x^2 - 10x + 3$

$(f \circ g)(4) = 2(4)^2 - 10(4) + 3 = 32 - 40 + 3$

$= -5$

61. Evaluate the composite function.

$(f \circ g)(x) = 2x^2 - 10x + 3$

$(f \circ g)(-3) = 2(-3)^2 - 10(-3) + 3$

$= 18 + 30 + 3$

$= 51$

62. Evaluate the composite function.

$(g \circ f)(x) = 4x^2 + 2x - 6$

$(g \circ f)(-1) = 4(-1)^2 + 2(-1) - 6 = 4 - 2 - 6$

$= -4$

63. Evaluate the composite function.

$(g \circ h)(x) = 9x^4 - 9x^2 - 4$

$(g \circ h)(0) = 9(0)^4 - 9(0)^2 - 4$

$= -4$

64. Evaluate the composite function.

$(h \circ g)(x) = -3x^4 + 30x^3 - 75x^2 + 4$

$(h \circ g)(0) = -3(0)^4 + 30(0)^3 - 75(0)^2 + 4$

$= 4$

65. Evaluate the composite function.

$(f \circ f)(x) = 4x + 9 \quad (f \circ f)(8) = 4(8) + 9$

$= 41$

66. Evaluate the composite function.

$(f \circ f)(x) = 4x + 9 \quad (f \circ f)(-8) = 4(-8) + 9$

$= -23$

67. Evaluate the composite function.

$(h \circ g)(x) = -3x^4 + 30x^3 - 75x^2 + 4$

$(h \circ g)\left(\frac{2}{5}\right) = -3\left(\frac{2}{5}\right)^4 + 30\left(\frac{2}{5}\right)^3 - 75\left(\frac{2}{5}\right)^2 + 4$

$= -\frac{48}{625} + \frac{240}{125} - \frac{300}{25} + 4$

$= -\frac{48}{625} + \frac{1200}{625} - \frac{7500}{625} + \frac{2500}{625}$

$= -\frac{3848}{625}$

68. Evaluate the composite function.

$(g \circ h)(x) = 9x^4 - 9x^2 - 4$

$(g \circ h)\left(-\frac{1}{3}\right) = 9\left(-\frac{1}{3}\right)^4 - 9\left(-\frac{1}{3}\right)^2 - 4$

$= 9\left(\frac{1}{81}\right) - 9\left(\frac{1}{9}\right) - 4$

$= \frac{1}{9} - 1 - 4$

$= -4\frac{8}{9}$ or $-\frac{44}{9}$

69. Evaluate the composite function.

$(g \circ f)(x) = 4x^2 + 2x - 6$

$(g \circ f)(\sqrt{3}) = 4(\sqrt{3})^2 + 2(\sqrt{3}) - 6$

$= 12 + 2\sqrt{3} - 6$

$= 6 + 2\sqrt{3}$

70. Evaluate the composite function.

$(f \circ g)(x) = 2x^2 - 10x + 3$

$(f \circ g)(\sqrt{2}) = 2(\sqrt{2})^2 - 10(\sqrt{2}) + 3$

$= 4 - 10\sqrt{2} + 3$

$= 7 - 10\sqrt{2}$

71. Evaluate the composite function.

$(g \circ f)(x) = 4x^2 + 2x - 6$

$(g \circ f)(2c) = 4(2c)^2 + 2(2c) - 6$

$= 16c^2 + 4c - 6$

72. Evaluate the composite function.

$(f \circ g)(x) = 2x^2 - 10x + 3$

$(f \circ g)(3k) = 2(3k)^2 - 10(3k) + 3$

$= 18k^2 - 30k + 3$

73. Evaluate the composite function.

$(g \circ h)(x) = 9x^4 - 9x^2 - 4$

$(g \circ h)(k+1)$

$= 9(k+1)^4 - 9(k+1)^2 - 4$

$= 9(k^4 + 4k^3 + 6k^2 + 4k + 1) - 9k^2 - 18k - 9 - 4$

$= 9k^4 + 36k^3 + 54k^2 + 36k + 9 - 9k^2 - 18k - 13$

$= 9k^4 + 36k^3 + 45k^2 + 18k - 4$

74. Evaluate the composite function.

$(h \circ g)(x) = -3x^4 + 30x^3 - 75x^2 + 4$

$(h \circ g)(k-1)$

$= -3(k-1)^4 + 30(k-1)^3 - 75(k-1)^2 + 4$

$= -3k^4 + 12k^3 - 18k^2 + 12k - 3$

$+ 30k^3 - 90k^2 + 90k - 30 - 75k^2 + 150k - 75 + 4$

$= -3k^4 + 42k^3 - 183k^2 + 252k - 104$

75. Show $(g \circ f)(x) = (f \circ g)(x)$.

$(g \circ f)(x)$	$(f \circ g)(x)$
$= g[f(x)]$	$= f[g(x)] =$
$= g[2x+3]$	$f[5x+12]$
$= 5(2x+3) + 12$	$= 2(5x+12) + 3$
$= 10x + 15 + 12$	$= 10x + 24 + 3$
$= 10x + 27$	$= 10x + 27$

$(g \circ f)(x) = (f \circ g)(x)$

76. Show $(g \circ f)(x) = (f \circ g)(x)$.

$(g \circ f)(x) = g[f(x)]$ $\qquad$ $(f \circ g)(x) = f[g(x)]$

$= \frac{10x}{x-4} \cdot \frac{x\ \ 4}{x-12}$

= g[4x -2] = f [7x -4]

$= -\frac{10x}{x+3} \cdot \frac{x+3}{x-12}$

= 7(4x -2)-4 = 4(7x-4)-2

79. Show (g f)( )x = x and (f g)( )x =

= - x10-12x = 28x -14-4 = - x10- = 28x -16-2

x . (g f)( )x = g f x[( )] (f g)( )x = f g x[( )]

= 28x -18 12x = 28x -18

(g f)( )x = (f g)( )x

(g f)( )x = (f g)( )x

77. Show (g f)( )x = (f g)( )x .

(g f)( )x (f g)( )x

= [g2[x2+x +3]3-] 3 = f éêëéêëxx-2-23 3ùúûùûú+ 3

= g f x[( )] = f g x[( )]

= 2 = 2

= g éê x6-x1ûùú = f éêë x5-

ë x2ùúû

$= \frac{2}{2}x$

= x -3+ 3

= x = x

$= \frac{5\ \frac{6x}{x-1}}{\frac{6x}{x-1}-2}$ ( )) $= \frac{6\ \frac{5x}{x-2}}{5x}$ (

x

80. Show (g f)( )x = x and (f g)( )x = x . (g f)( )x = g f x[( )] (f g)( )x = f g x[( )]

x-2 -1

30 30x 30x 30x

= [g4[x4-x -5]5+] 5 = f ëéêéêëéxx+4+45 5ùúûúûù-5

-1 -1

x -2 -2

$= \frac{30x}{x-1} \cdot \frac{x-1}{2(2x+1)}$ $= \frac{30x}{x-2} \cdot \frac{x-2}{2(2x+1)}$

= 4 = 4

x

= 215x +x1 = 215x +x1

= x +5-5

(g f)( )x = (f g)( )x

= x = x

78. Show (g f)( )x = (f g)( )x .

81. Show (g f)( )x = x and (f g)( )x = x . (g f)( )x = g f x[( )] (f g)( )x = f g x[( )]

(g f)( )x (f g)( )x

= g f x[( )] = f g x[( )]

= g éêë x +4 1ùúû = f ëéê4-x x ùúû

= g éêë x5+x3ùúû = f éê- x2-x4ùúû

2

çç 5x ö

= 4-êë xéêë+4x +41ù1úùûú = êé4-x 4x ùú +1

= - 5çèæx+3÷÷ø

x/(x+3) −4

10x 10x -10 -10x

$= -\frac{x\ \ 3}{5x\ \ 4x\ \ 12} = -\frac{x\ \ 3}{x\ \ 12}$ + $= \frac{x\ \ 4}{2x\ \ 3x\ \ 12} = \frac{x\ \ 4}{x\ \ 12}$ $= \frac{4}{4}$

x x

4 x4 x

+3 +3 x-4 x-4 é + -úúû = ë - x+

$$= \frac{\frac{4x - 4 + 4}{x+1}}{4} \qquad = \frac{4}{\frac{4}{x}}$$

$$= \frac{4x}{x+1} \cdot \frac{x+1}{4} \qquad = 4 \cdot \frac{x}{4}$$

$= x \qquad = x$

82. Show $(g \circ f)(x) = x$ and $(f \circ g)(x) = x$. $(g \circ f)(x) = g[f(x)]$ $(f \circ g)(x) = f[g(x)]$

$$= g\left[1 - \frac{2}{x}\right] \qquad = f\left[\frac{2}{x - x^2}\right]$$

$$= \frac{-2}{1 - \left[1 - \frac{2}{x}\right]^2 - \left[1 - \frac{2}{x}\right]} \qquad = \frac{2}{x - x + 2}$$

$$= \frac{2 - 2 + 2x}{1 - 2x} \qquad = \frac{2}{2 - x} \cdot \frac{x - x + 2}{1}$$

$$= \frac{2x}{1 - x} \cdot \frac{1}{2} \qquad = \frac{2}{1} \cdot \frac{x}{2}$$

$= x \qquad = x$

83. $(Y \circ F)(x) = Y(F(x))$ converts x inches to yards. F takes x inches to feet, and then Y takes feet to yards.

84. $(I \circ F)(x) = I(F(x))$ converts x yards to inches. F takes x yards to feet, and then I takes feet to inches.

85. **a.** $r = 1.5t$ and $A = \pi r^2$ so $A(t) = \pi[r(t)]^2$

$= \pi(1.5t)^2$

$A(2) = 2.25\pi(2)^2$

$= 9\pi$ square feet

≈ 28.27 square feet

b. $r = 1.5t$

$h = 2r = 2(1.5t) = 3t$ and

$V = \frac{1}{3}\pi r^2 h$ so

$V(t) = \frac{1}{3}\pi(1.5t)^2[3t]$

$= 2.25\pi t^3$

Note: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}(\pi r^2)h = \frac{1}{3}Ah$

$= \frac{1}{3}(2.25\pi t^2)(3t) = 2.25\pi t^3$

$V(3) = 2.25\pi(3)^3$

$= 60.75\pi$ cubic feet

≈ 190.85 cubic feet

86. **a.** $l = 3 - 0.5t$ for $0 \le t \le 6$

$= -3 + 0.5t$ for $6 \le t \le 14$ or $l = |3 - 0.5t|$

$w = 2 - 0.2t$ for $0 \le t \le 10$

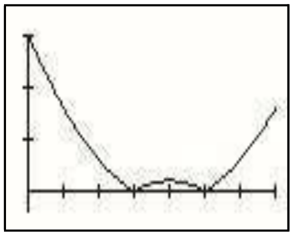
$= -2 + 0.2t$ for $10 \le t \le 14$ or $w = |2 - 0.2t|$

b. $A = lw = |3 - 0.5t|\,|2 - 0.2t|$

$= |(3 - 0.5t)(2 - 0.2t)|$

c. A is increasing on $[6, 8]$ and on $[10, 14]$; and A is decreasing on $[0, 6]$ and on $[8, 10]$.

d. The highest point on the graph of A occurs when $t = 0$ seconds.



Xmin = 0, Xmax =14, Xscl = 2,

Ymin = -1, Ymax = 6, Yscl = 2

87. a. Since

$d^2 + 4^2 = s^2$,

$d^2 = s^2 - 16$

$d = \sqrt{s^2 - 16}$

$d = \sqrt{(48-t)^2 - 16}$ Substitute 48-*t* for *s*

$= \sqrt{2304 - 96t + t^2 - 16}$

$= \sqrt{t^2 - 96t + 2288}$

b. $s(35) = 48 - 35 = 13$ ft

$d(35) = \sqrt{35^2 - 96(35) + 2288}$

$= \sqrt{153} \approx 12.37$ ft

88. The sides of the triangles are proportional, so we have

$\frac{22}{x} = \frac{16}{12 - \frac{t}{2}}$.

Solving for x: $x = \frac{12\left(22 - \frac{t}{2}\right)}{16t}$, or $\frac{33}{2t}$

Section 2.7 Exercises

1. The scatter diagram suggests no relationship between *x* and *y*.

2. The scatter diagram suggest a nonlinear relationship between *x* and *y*.

3. The scatter diagram suggests a linear relationship between *x* and *y*.

4. The scatter diagram suggests a linear relationship between *x* and *y*.

5. Figure A better approximates a graph that can be modeled by an equation than does Figure B. Thus Figure A has a coefficient of determination closer to 1.

6. Figure A better approximates a graph that can be modeled by an equation than does Figure B. Thus Figure A has a coefficient of determination closer to 1.

7. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

$y = -0.45x + 2.3$

Prepare for Section 2.7

P1. Slope: $-\frac{1}{3}$; y-intercept: (0, 4)

P2. $3x - 4y = 12 \qquad y = \frac{3}{4}x - 3$

Slope: $\frac{3}{4}$; y-intercept: (0, –3)

P3.

P4. $y + 4 = -\frac{2}{3}(x-3)$

$y = -\frac{2}{3}x - 2$

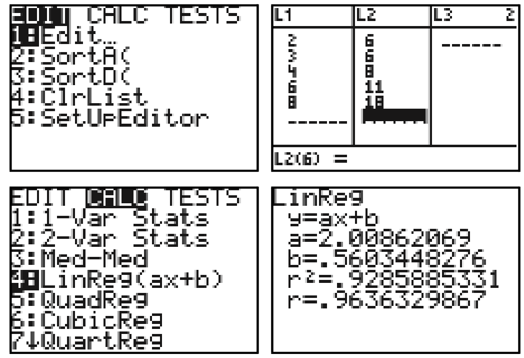
P5. $f(2) = 3(2)^2 + 4(2) - 1 = 12 + 8 - 1 = 19$

P6. $|f(x_1) - y_1| + |f(x_2) - y_2|$

$= |(2)^2 - 3 - (-1)| + |(4)^2 - 3 - 14|$

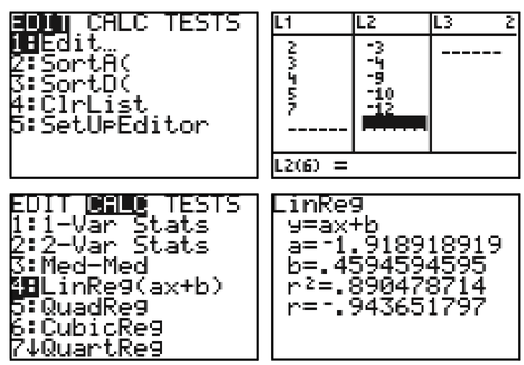
$= |4 - 3 + 1| + |16 - 3 - 14|$

$= 2 + 1 = 3$



$y = 2.00862069x + 0.5603448276$

8. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

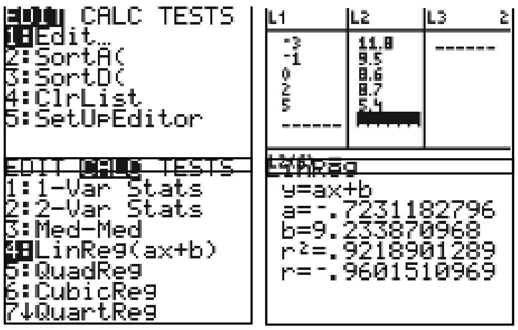


$y = -1.918918919x + 0.4594594595$

Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

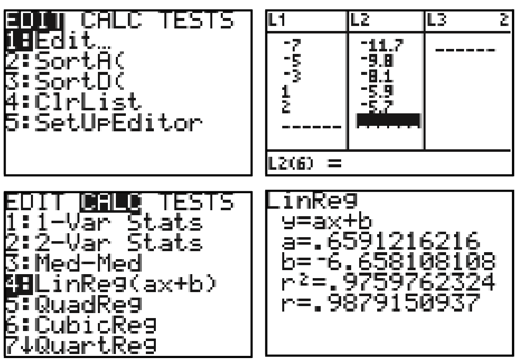
Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

9.



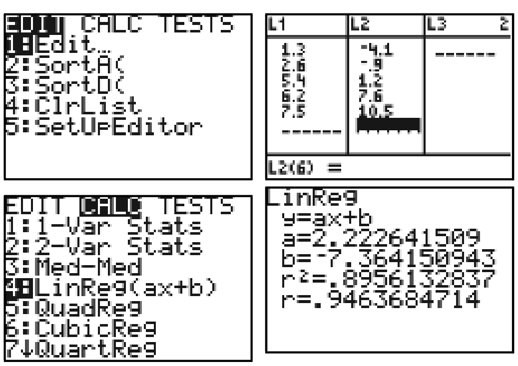
$y = -0.7231182796x + 9.233870968$

10. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



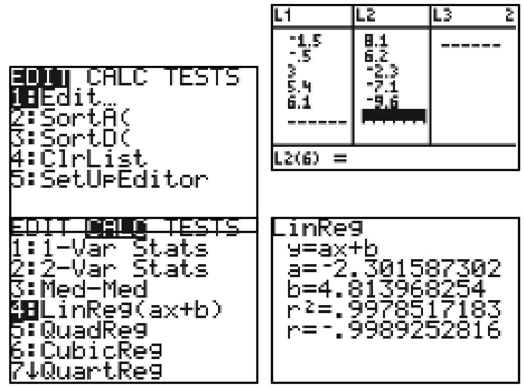
$y = 0.6591216216x - 6.658108108$

11. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



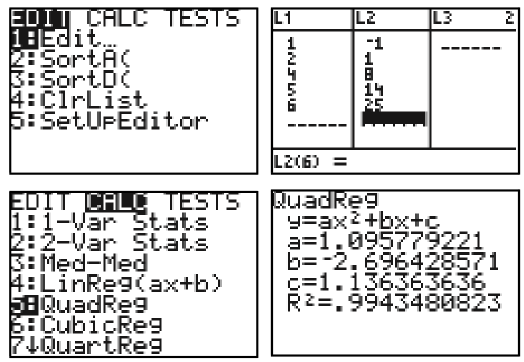
$y = 2.222641509x - 7.364150943$

12. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



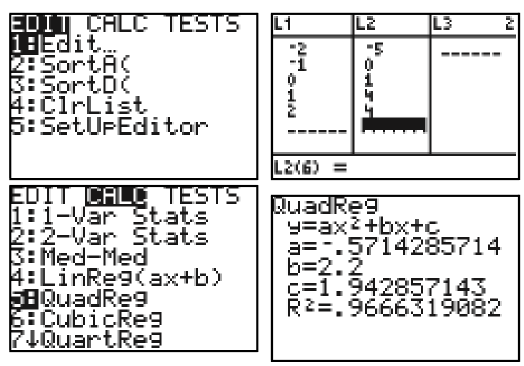
$y = -2.301587302x + 4.813968254$

13. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



$y = 1.095779221x^2 - 2.696428571x + 1.136363636$

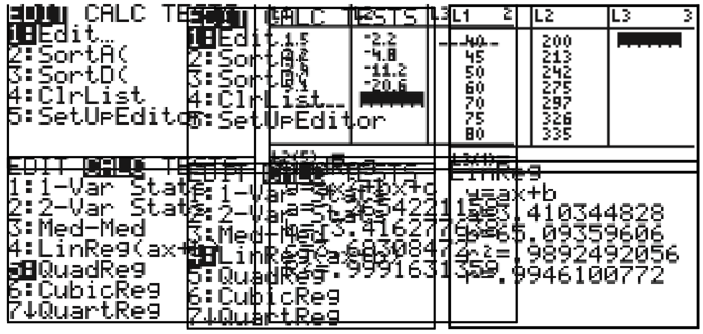
14. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



$y = -0.5714285714x^2 + 2.2x + 1.942857143$

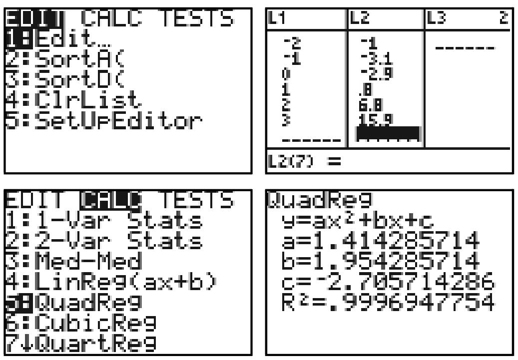
15.

Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



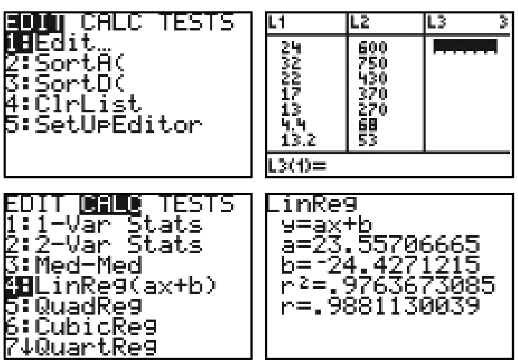
$y = □0.2987274717x^2 – 3.20998141x + 3.416463667$

16. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



$y = 1.414285714x^2 + 1.954285714x – 2.705714286$

17. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



a. $y = 23.55706665x – 24.4271215$

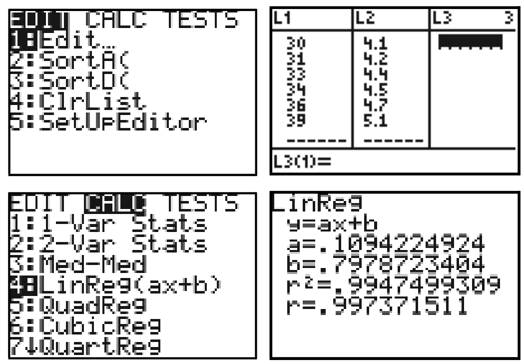
b. $y = 23.55706665(54) – 24.4271215$ □□1248 cm

18. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

a. $y = 3.410344828x + 65.09359606$

b. $y = 3.410344828(58) + 65.09359606$ □ 263 ft

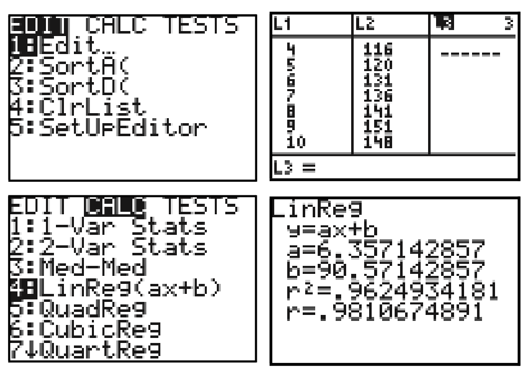
19. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



a. $y = 0.1094224924x + 0.7978723404$

b. $y = 0.1094224924(32) + 0.7978723404$ □ 4.3 m/s

20. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



a. $y = 6.357142857x + 90.57142857$

b. $y = 6.357142857(7.5) + 90.57142857$ □ 138.25 or

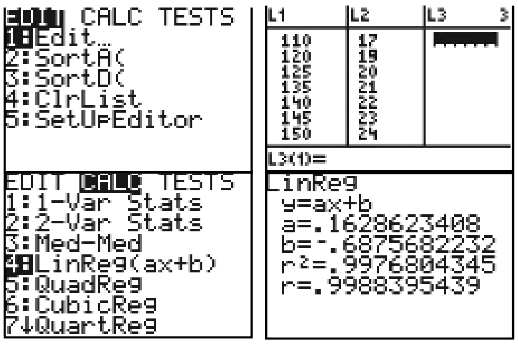
Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

138

,000 bacteria

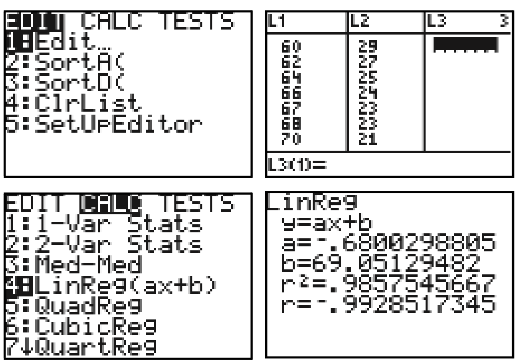
21.



a. $y = 0.1628623408x - 0.6875682232$

b. $y = 0.1628623408(158) - 0.6875682232 \approx 25$

22. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

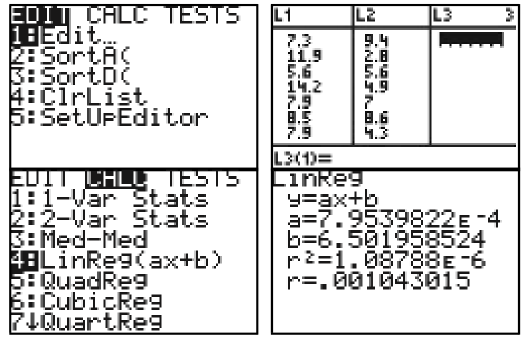


a. $y = -0.6800298805x + 69.05129482$

b. 5 feet 8 inches = 68 inches;

$y = -0.6800298805(68) + 69.05129482 \approx 23$

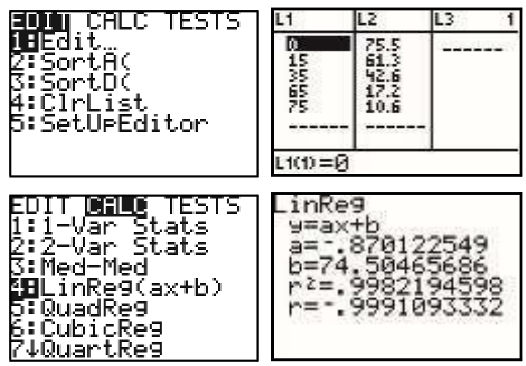
23. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



The value of r is close to 0. Therefore, no, there is not

a. strong linear relationship between the current and the torque.

24. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

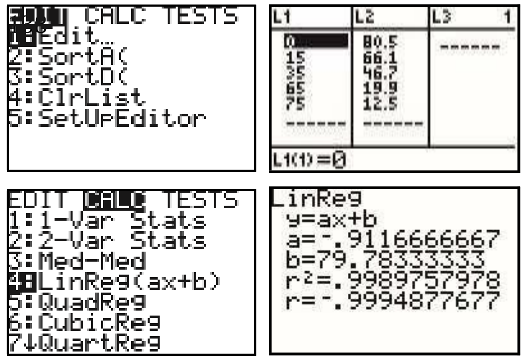


Yes, because the linear correlation coefficient is close to –1.

25. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

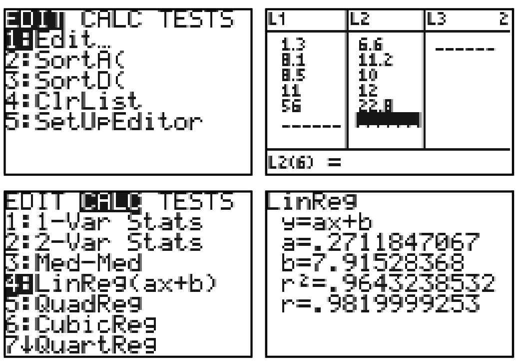


a. Yes, there is a strong linear correlation.

b. $y = -0.911\overline{6}x + 79.78\overline{3}$

c. $y = -0.911\overline{6}(25) + 79.78\overline{3} \approx 57$ years

26. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

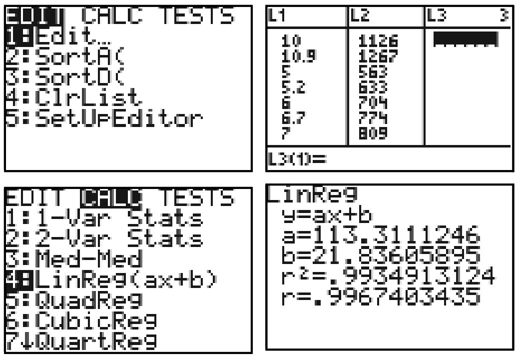


$y = 0.2711847067x + 7.91528368$ For 2006, $x = 1$, $y = 198.2272727(1)^2$

$y = 0.2711847067(41) + 7.91528368$

»19 meters per second

27. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



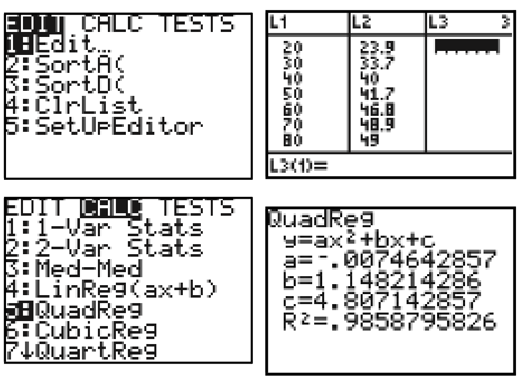
$y = 113.3111246x + 21.83605895$

a. Positively

b. $y = 113.3111246(9.5) + 21.83605895$

»1098 calories

28. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



a. $y = -0.0074642857x^2 + 1.148214286x$

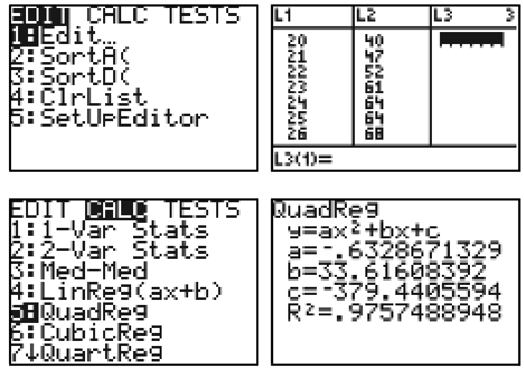
$+ 4.807142857$

b. $y = -0.0074642857(65)^2 + 1.148214286(65)$

$+ 4.807142857$

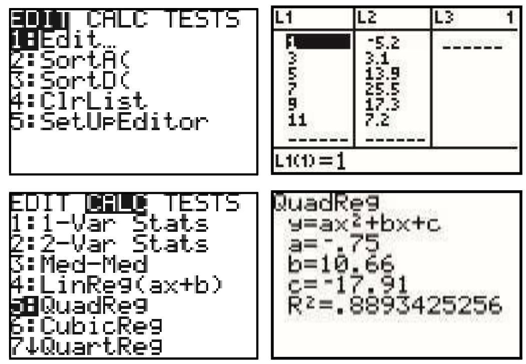
» 47.9 ft

29. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



$y = -0.6328671329x^2 + 33.61608329x - 379.4405594$

30. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



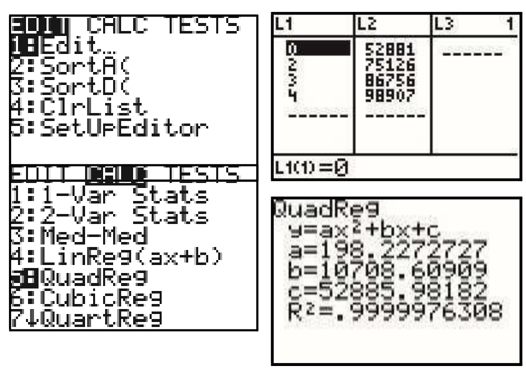
$y = -0.75x^2 + 10.66x - 17.91$

For August 2011, $x = 8$,

$y = -0.75(8)^2 + 10.66(8) - 17.91$

»19.4

31. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



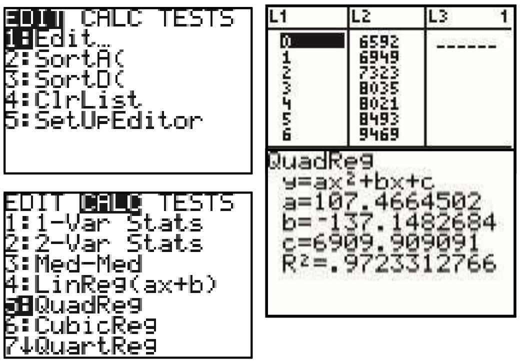
$y = 198.2272727x^2 + 10{,}708.60909x + 52{,}885.98182$

For $x = 1$, $y = 198.2272727(1)^2$

$+10{,}708.60909(1)+52{,}885.98182$

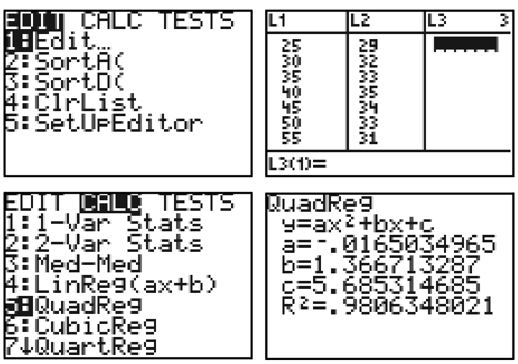
$\approx$ 63,793 thousand gallons

32. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



$y = 107.4664502x^2 - 137.1482684x + 6909.909091$

33. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

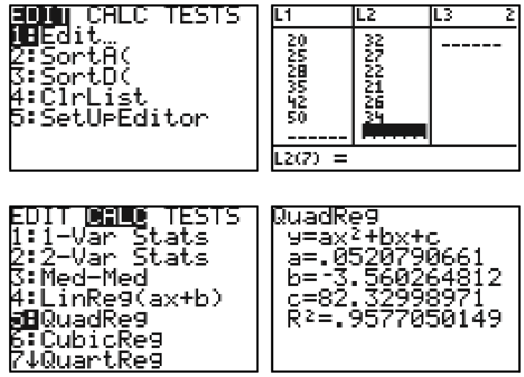


a. $y = -0.0165034965x^2 + 1.366713287x$
$+ 5.685314685$

b. $y = -0.0165034965(50)^2 + 1.366713287(50)$
$+ 5.685314685$

$\approx$ 32.8 mpg

34. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

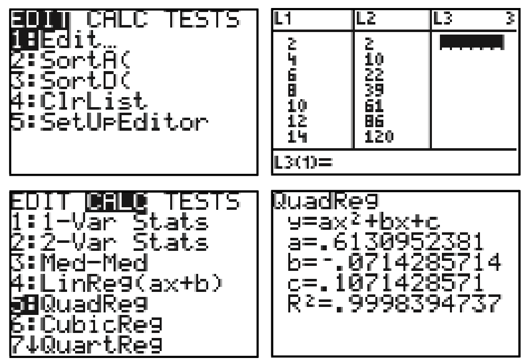


a. $y = 0.05208x^2 - 3.56026x + 82.32999$

b. $-\dfrac{b}{2a} = -\dfrac{-3.56026}{2(0.05208)} \approx 34$ kilometers per hour

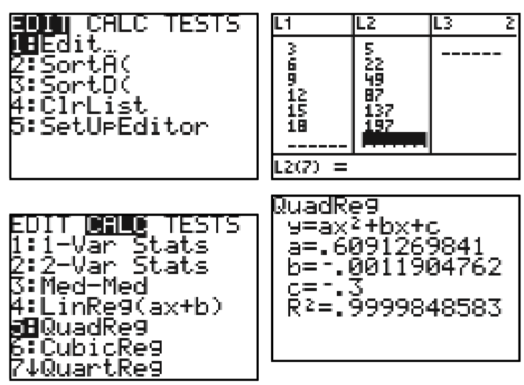
35. **a.** Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.

5-lb ball



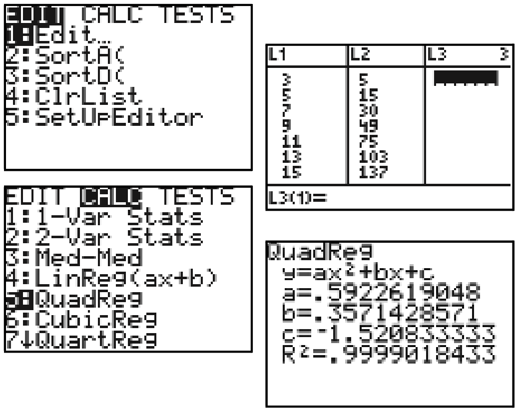
$y = 0.6130952381t^2 - 0.0714285714t + 0.1071428571$

10-lb ball



$y = 0.6091269841t^2 - 0.0011904762t - 0.3$

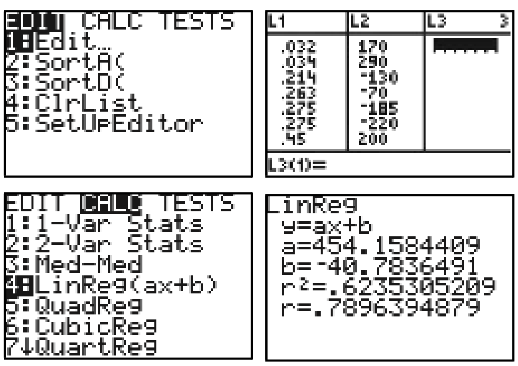
15-lb ball



$y = 0.5922619048t^2 + 0.3571428571t - 1.520833333$

b. All the regression equations are approximately the same. Therefore, there is one equation of motion.

36. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT.



a. $y = 454.1584409x - 40.78364910$

b. $y = 454.1584409(1.5) - 40.78364910$

≈ 640 kilometers per second

Chapter 2 Review Exercises

1. Finding the distance. [2.1]

$d = \sqrt{(7-(-3))^2 + (11-2)^2}$

$= \sqrt{10^2 + 9^2} = \sqrt{100+81} = \sqrt{181}$

2. Finding the distance. [2.1]

$d = \sqrt{(5-(-3))^2 + (4-(-8))^2}$

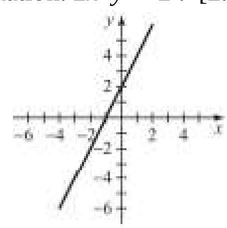
$= \sqrt{8^2 + 4^2} = \sqrt{64+16} = \sqrt{80} = 4\sqrt{5}$

3. Finding the midpoint: (2, 8), (–3, 12). [2.1] $M = \left(\frac{2+(-3)}{2}, \frac{8+12}{2}\right) = \left(-\frac{1}{2}, 10\right)$

4. Finding the midpoint: (–4, 7), (8, –11). [2.1] $M = \left(\frac{-4+8}{2}, \frac{7+(-11)}{2}\right) = (2,-2)$

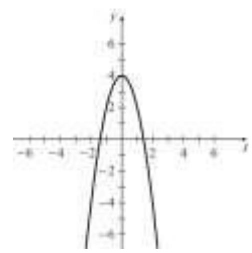
5. Graph the equation: $2x - y = -2$. [2.1]

x	y
−1	0
0	2
1	4



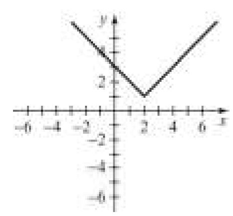
6. Graph the equation: $2x^2 + y = 4$. [2.1]

x	y
−2	−4
−1	2
0	4
1	2
2	−4



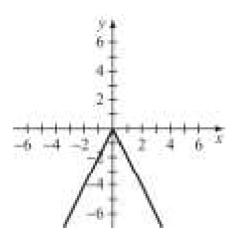
7. Graph the equation: $y = |x-2| + 1$. [2.1]

x	y
−1	4
0	3
2	1
3	2
4	3



8. Graph the equation: $y = -|2x|$. [2.1]

x	y
−2	−4
−1	−2
0	0
1	−2
2	−4



9. Finding x- and y-intercepts and graph: $x = y^2 - 1$ [2.1]

For the y-intercept, let $x = 0$ and solve for y.

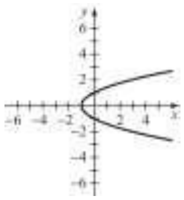
$0 = y^2 - 1 \quad y = \pm 1$, -intercepts: 0,$y$ (-1)

(, 0, 1)

For the x-intercept, let y = 0 and solve for x.

$x = (0)^2 - 1 \quad x = -1$, -intercept: x (-

1, 0)



10. Finding x- and y-intercepts and graph: $|x| - |y| = 4$ [2.1]

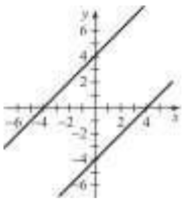
For the y-intercept, let x = 0 and solve for y.

$0 - |y| = 4 \quad |y| = \pm 4$, -intercepts: 0,$y$ (-4), 0, (4)

For the x-intercept, let y = 0 and solve for x.

$|x-(0)|=4$

$x=\pm 4$, x-intercepts: $(-4, 0)$, $(4, 0)$



11. Finding x- and y-intercepts and graph: [2.1]

$3x+4y=12$

For the y-intercept, let $x = 0$ and solve for y.

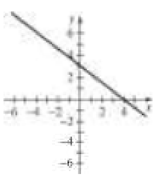
$3(0)+4y=12$

$y=3$, y-intercept: $(0, 3)$

For the x-intercept, let $y = 0$ and solve for x.

$3x+4(0)=12$

$x=4$, x-intercept: $(4, 0)$



12. Finding x- and y-intercepts and graph: $x=|y-1|+1$ [2.1]

For the y-intercept, let $x = 0$ and solve for y.

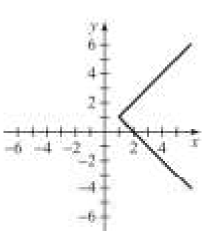
$0=|y-1|+1$

$-1=|y-1|$ since this statement is false, there is no y-intercept.

For the x-intercept, let $y = 0$ and solve for x.

$x=|0-1|+1$

$x=2$, x-intercept: $(2, 0)$



13. Finding the center and radius. [2.1]

$(x-3)^2+(y+4)^2=81$

center $(3, -4)$, radius 9

14. Finding the center and radius. [2.1]

$x^2+10x+y^2+4y=-20$

$x^2+10x+25+y^2+4y+4=-20+25+4$

$(x+5)^2+(y+2)^2=9$

center $(-5, -2)$, radius 3

15. Finding the equation. [2.1] Center: (2, –3), radius 5

$(x-2)^2+(y+3)^2=5^2$

16. Finding the equation. [2.1]

Center: (–5, 1), passing through (3, 1)

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

$(3+5)^2+(1-1)^2=r^2$

$8^2+0^2=r^2$

$8^2=r^2$

$(x+5)^2+(y-1)^2=8^2$

17. Is y a function of x? [2.2]

$x-y=4$

$y=x-4$, y is a function of x.

18. Is y a function of x? [2.2]

$x+y^2=4$ $y^2=-x+4$

$y=\pm\sqrt{-x+4}$, y is a not function of x.

19. Is y a function of x? [2.2]

$|x|+|y| = 4 \quad y = -|x| + 4$

$y = \pm(-|x| + 4)$, is a not function of y. x

20. Is y a function of x? [2.2]

$|x| + y = 4$

$y = -|x| + 4$, is a function of y. x

21. Evaluate the function $f(x) = 3x^2 + 4x - 5$, [2.2]

a. $f(1) = 3(1)^2 + 4(1) - 5$

$= 3(1) + 4 - 5$

$= 3 + 4 - 5$

$= 2$

b. $f(-3) = 3(-3)^2 + 4(-3) - 5$

$= 3(9) - 12 - 5$

$= 27 - 12 - 5 = 10$

c. $f(t) = 3t^2 + 4t - 5$

d. $f(x+h) = 3(x+h)^2 + 4(x+h) - 5$

$= 3(x^2 + 2xh + h^2) + 4x + 4h - 5$

$= 3x^2 + 6xh + 3h^2 + 4x + 4h - 5$

$\sqrt{64 - 3^2}$

$\sqrt{64 - 9}$

$\sqrt{55}$

$= \sqrt{64 - (5)^2}$

$= \sqrt{64 - 25}$

$= \sqrt{39}$

$\sqrt{64 - (8)^2}$

$\sqrt{64 - 64}$

$\sqrt{0}$

$\sqrt{64 - (-x)^2}$

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

$= 2\sqrt{64 - t^2}$

$\sqrt{64 - (2t)^2}$

$\sqrt{64 - 4t^2}$

e. $3f(t) = 3(3t^2 + 4t - 5)$

$= 9t^2 + 12t - 15$

f. $f(3t) = 3(3t)^2 + 4(3t) - 5$

$= 3(9t^2) + 12t - 5$

$= 27t^2 + 12t - 5$

22. Evaluate the function $g(x) = \sqrt{64 - x^2}$, [2.2]

a. $g(3) =$

$=$

$=$

b. $g(-5)$

c. $g(8) =$

$=$

$=$

$= 0$

d. $g(-x) =$

e. $2g(t)$

f. $g(2t) =$

$=$

$=$

23. Evaluate the function. [2.2]

a. Since $x = 3 \geq 0$, use $f(x) = x^2 - 3$.

$f(3) = (3)^2 - 3 = 9 - 3 = 6$

b. Since $x = -2 < 0$, use $f(x) = 3x + 2$. $f(-2) = 3(-2) + 2 = -6 + 2 = -4$

$$\sqrt{4(16-t^2)}$$
$$=2\sqrt{16-t^2}$$

c. Since $x = 0$ ³ 0, use $f x( ) = x^2 -3$. $f(0) = ( )0^2 -3$

$= 0-3 = -3$

24. Evaluate the function. [2.2]

a. Since $x = 0$ and -3£ $x < 5$, use $f x( ) = x^2 +1$. $f( )$

$( )0 = 0^2 +1=1$

b. Since $x = -3$ and -3£ $x < 5$, use $f x( ) = x^2 +1$.

$f(- = -3)\ (3)^2 + = + =1\ 9 \quad 1 \quad 10$

c. Since $x = 5$³ 5, use $f x( ) = x -7$.

$f(5) = 5-7 = -2$

25. Find the domain of $f x( ) = -2x^2 + 3$. [2.2]

Domain $\{x \mid x$ is a real number$\}$

26. Find the domain of $f( )x = \sqrt{6- x}$. [2.2]

Domain $\{x \mid x$ £ $6\}$

27. Find the domain of $f( )x = \sqrt{-25\ x^2}$. [2.2]

Domain $\{x \mid$ -5£ £$x \quad 5\}$

28. Find the domain of $f x( ) = {}_2 \overline{3}$. [2.2] $x -2x-15$

Domain $\{x \mid x$ ¹-3, x ¹5$\}$

29. Find the values of a in the domain of

$f x( ) = x^2 + 2x -4$ for which $f a( ) = -1$. [2.2]

$a^2 + 2a -4 = -1$ Replace $f a( )$ with $a^2 + 2a -4$

$a^2 + 2a -3 = 0$ $(a + 3)(a -1) = 0$

a. $+ 3 = 0$ $a -1= 0$ $a = -3$ $a =1$

30. Find the values of a in the domain of $f x( ) = \frac{4}{x+1}$ for which $f a( )= 2$. [2.2]

$\frac{4}{a+1} = 2$ Replace $f a( )$ with $\frac{4}{a+1}$

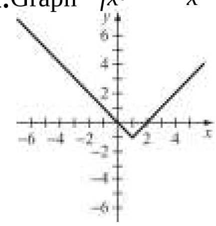
$4 = 2(a +1)$

$4 = 2a + 2$

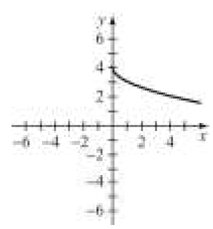
$2 = 2a$

$1= a$

31. Graph $f(x) = |x-1| - 1$ [2.2]



32. Graph $f(x) = 4 - \sqrt{x}$ [2.2]



33. Find the zeros of f for $f(x)= 2x+6$. [2.2] $f x( ) = 0$

$2x + 6 = 0$

$2x =$

$-6\ x$

$= -3$

34. Find the zeros of f for $f x( ) = x^2 -4x -12$. [2.2] $f x( )$

$= 0$

$x^2 -4x -12 = 0$

$(x + 2)(x -6) = 0$

$x + 2 = 0$ $x - 6 = 0$ x

$= -2$ $x = 6$

35. Evaluate the function $g(x)$=⌈2x⌉. [2.2]

a. g(□ □) = ⌈2 ⌉» ⌈6.283185307⌉ = 6

b. $g\left(-\frac{2}{}\right)$ = ⌈⌈⌈⌈2$\left(-\frac{2}{3}\right)$⌉⌉⌉⌉ = ⌈⌈⌈⌈- $\frac{4}{}$3⌉⌉⌉⌉ »

⌈-1.333333⌉ = -2

3

c. $g(-2)$ = ⌈2(-2)⌉ = -4

36. Evaluate the function $f(x)$= -⌈1 x⌉. [2.2]

a. $f(\sqrt{2})$ = ⌈1- $\sqrt{}$ 2⌉ » ⌈-0.4142⌉ = -1

b. $f(0.5)$ = ⌈1-0.5⌉ = ⌈0.5⌉ = 0

c. f(- = +□) ⌈1 □⌉»⌈4.14159265⌉= 4

37. Find the slope. [2.3]

m = - -41+ 36 = -77 = -1

38. Find the slope. [2.3]

m = -45-+25 = 02 Undefined

39. Find the slope. [2.3]

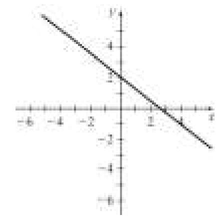
m = --23-+42 = -07 = 0

40. Find the slope. [2.3]

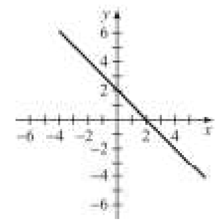
m = --41+-63 = -210 = -15

41. Graph $f(x) = -\frac{3}{4}x + 2$. [2.3]

$m = -\frac{3}{4}$, y-intercept (0, 2)



42. Graph $f(x) = 2 - x$. [2.3] $m = -1$, y-intercept (0, 2)

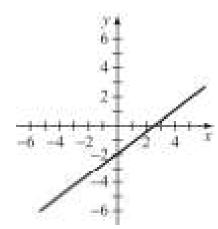


43. Graph $3x - 4y = 8$. [2.3]

$-4y = -3x + 8$

$y = \frac{3}{4}x - 2$

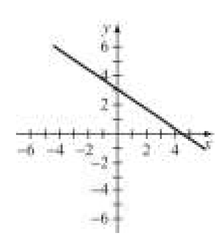
x-intercept $\left(\frac{8}{3}, 0\right)$, y-intercept (0, –2)



44. Graph $2x + 3y = 9$. [2.3] $3y = -2x + 9$

$y = -\frac{2}{3}x + 3$

x-intercept $\left(\frac{9}{2}, 0\right)$, y-intercept (0, 3)



45. Find the equation. [2.3]

$y - 2 = -\frac{2}{3}(x + 3)$ $y - 2 = -\frac{2}{3}x - 2$

$y = -\frac{2}{3}x$

46. Find the equation. [2.3] $y + 4 = -2(x - 1)$ $y + 4 = -2x + 2$ $y = -2x - 2$

47. Find the equation. [2.3]

$m = \frac{-1 + 6}{2 - 3} = \frac{3}{3} = 1$

$y - 6 = 1(x - 1)$ $y - 6 = x - 1$ $y = x + 5$

48. Find the equation. [2.3]

$m = \frac{15 - 6}{8 + 4} = \frac{21}{12} = \frac{7}{4}$

$y - 15 = \frac{7}{4}(x - 8)$

$y - 15 = \frac{7}{4}x - 14$ $y = \frac{7}{4}x + 1$

49. Find the equation. [2.3]

$y = \frac{2}{3}x - 1$ has slope $m = \frac{2}{3}$. $y - y_1 = \frac{2}{3}(x - x_1)$

$y - (-5) = \frac{2}{3}(x - 3)$

$y + 5 = \frac{2}{3}x - 2$ $y = \frac{2}{3}x - 7$

50. Find the equation. [2.3]

$2x - 5y = 2$

$-5y = -2x - 2$

$y = \frac{2}{5}x + \frac{2}{5}$ has slope $m = \frac{2}{5}$. $y - y_1 = \frac{2}{5}(x - x_1)$

$y - (-5) = \frac{2}{5}(x - (-1))$ $y + 5 = \frac{2}{5}x + \frac{2}{5}$ $y = \frac{2}{5}x - \frac{23}{5}$

51. Find the equation. [2.3]

$y = -\frac{3}{2}x - 2$ has perpendicular slope $m = \frac{2}{3}$. $y - y_1 = \frac{2}{3}(x - x_1)$

$y - (-1) = \frac{2}{3}(x - 3)$

$y + 1 = \frac{2}{3}x - 2$ $y = \frac{2}{3}x - 3$

52. Find the equation. [2.3]

$2x - 5y = 10$

$-5y = -2x + 10$

$y = \frac{2}{5}x - 2$ has perpendicular slope $m = -\frac{5}{2}$.

$y - y_1 = -\frac{5}{2}(x - x_1)$ $y - 6 = -\frac{5}{2}(x - 2)$ $y - 6 = -\frac{5}{2}x + 5$ $y = -\frac{5}{2}x + 11$

53. Find the function. [2.3] $m = \frac{118 - 175}{106 - 155} = \frac{1220}{...} = \frac{5}{3}$

$f(x) - 175 = \frac{5}{3}(x - 118)$ $f(x) - 175 = \frac{5}{3}x - \frac{590}{3}$ $f(x) = \frac{5}{3}x - \frac{65}{3}$

54. Find the function. [2.3]

$m = \frac{350 - 122}{10 - 2} = \frac{228}{8} = 28.5$

$f(t) - 350 = 28.5(t - 10)$ $f(t) - 350 = 28.5t - 285$ $f(t) = 28.5t + 65$

55. Write the quadratic equation in standard form. [2.4]

$f(x) = (x^2 + 6x) + 10$ $f(x) = (x^2 + 6x + 9) + 10 - 9$ $f(x) = (x + 3)^2 + 1$

56. Write the quadratic equation in standard form. [2.4]

$f(x) = (2x^2 + 4x) + 5$

$f(x) = 2(x^2 + 2x) + 5$ $f(x) = 2(x^2 + 2x + 1) + 5 - 2$ $f(x) = 2(x + 1)^2 + 3$

57. Write the quadratic equation in standard form. [2.4]

$f(x) = -x^2 - 8x + 3$

$f(x) = -(x^2 + 8x) + 3$ $f(x) = -(x^2 + 8x + 16) + 3 + 16$ $f(x) = -(x + 4)^2 + 19$

58. Write the quadratic equation in standard form. [2.4]

$f(x) = (4x^2 - 6x) + 1$ $f(x) = 4\left(x^2 - \frac{3}{2}x\right) + 1$ $f(x) = 4\left(x^2 - \frac{3}{2}x + \frac{9}{16}\right) + 1 - \frac{9}{4}$

$f(x) = 4\left(x - \frac{3}{4}\right)^2 - \frac{5}{4}$

$f(x) = -3x^2 + 4x - 5$ $f(x) = -3\left(x^2 - \frac{4}{3}x\right) - 5$ $f(x) = -3\left(x^2 - \frac{4}{3}x + \frac{4}{9}\right) - 5 + \frac{4}{3}$

$f(x) = -3\left(x - \frac{2}{3}\right)^2 - \frac{11}{3}$

60. Write the quadratic equation in standard form. [2.4]

$f(x) = x^2 - 6x + 9$

$f(x) = (x^2 - 6x) + 9$ $f(x) = (x^2 - 6x + 9) + 9 - 9$ $f(x) = (x - 3)^2 + 0$

61. Find the vertex. [2.4]

$\frac{-b}{2a} = -\frac{-6}{2(3)} = \frac{6}{6} = 1$

$f(1) = 3(1)^2 - 6(1) + 11$
$= 3(1) - 6 + 11$
$= 3 - 6 + 11$
$= 8$

Thus the vertex is (1, 8).

62. Find the vertex. [2.4]

$\frac{-b}{2a} = \frac{0}{2(4)} = 0$

$f(0) = 4(0)^2 - 10$
$= 0 - 10$
$= -10$

Thus the vertex is (0, −10).

63. Find the vertex. [2.4] $\frac{-b}{2a} = \frac{-60}{2(-6)} = \frac{-60}{-12}$

$f(x) = 4\left(x - \frac{3}{4}\right) - \frac{5}{4}$

59. Write the quadratic equation in standard form. [2.4]

$= 5$

$f(5) = -6(5)^2 + 60(5)+11$

= -6(25)+ 300+11
= -150+ 300+11
=161

Thus the vertex is (5, 161).

64. Find the vertex. [2.4]

-b = - -2(1)(8)- = -82 =
-4 2a

f (4)- =14-8(4)- - -(4)^2
=14+ 32-16
= 30

Thus the vertex is (4, 30).

65. Find the value. [2.4]

$f\ x(\ ) = -x^2 + 6x - 3$

$= -(x^2 - 6\ )x - 3$

$= -(x^2 - 6x + 9) - 3 + 9$

$= -(x - 3)^2 + 6$

maximum value of 6

66. Find the value. [2.4]

$f\ x(\ ) = 2x^2 + 3x - 4$

$= 2\left(x^2 - \frac{3}{2}x\right) - 4$

= 2(x2 - 23 x + 169)-4- 89

$= 2\left(x - \frac{3}{4}\right)^2 - 5.125$

minimum value of –5.125

67. Find the maximum height. [2.4]

h t( )=-16t^2+50t+4 - 2ba = -

2(-5016) = 1625

h(1625)=-16(1625)^2+50(1625)+ =443.0625

The ball reaches a maximum height of 43.0625 ft.

68. **a.** Revenue = 13x [2.5]

b. Profit = Revenue Cost

$P = 13x - (0.5x + 1050)$

$P = 13x - 0.5x - 1050$

$P = 12.5x - 1050$

c. Break even Revenue = Cost

$13x = 0.5x + 1050$

12.5x

=105

0 x =

84

The company must ship 84 parcels.

69. Find the maximum area. [2.4]

Let x be the width. Using the formula for perimeter for

three sides, P = 2w+ l 700 = 2x + l l =

700-2x

Using the formula for area, $A = lw$. Then

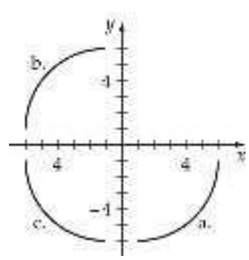
$A(x) = x(700 - 2x)$

$A(\ )x = -2x^2 + 700x$

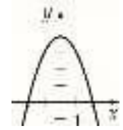
$-\frac{b}{2a} = -\frac{700}{2(-2)} = 175$

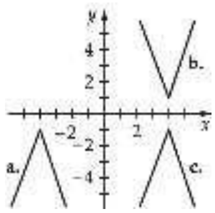
$A(175) = -2\ 175(\ )^2 + 700\ 175(\ ) = 61{,}250\ \text{ft}^2$

70. Sketch a graph with different kinds of symmetry. [2.5]



71. Sketch a graph with different kinds of symmetry. [2.5]





72. The graph of $y = x^2 - 7$ is symmetric with respect to the y-axis. [2.5]

73. The graph of $x = y^2 + 3$ is symmetric with respect to the x-axis. [2.5]

74. The graph of $y = x^3 - 4x$ is symmetric with respect to the origin. [2.5]

75. The graph of $y^2 = x^2 + 4$ is symmetric with respect to the x-axis, y-axis, and the origin. [2.5]

76. The graph of $\frac{x^2}{3^2} + \frac{y^2}{4^2} = 1$ is symmetric with respect to the x-axis, y-axis, and the origin. [2.5]

77. The graph of $xy = 8$ is symmetric with respect to the origin. [2.5]

78. The graph of $|y| = |x|$ is symmetric with respect to the x-axis, y-axis, and the origin. [2.5]

79. The graph of $|x| + |y| = 4$ is symmetric with respect to the origin. [2.5]

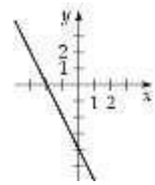
80. Sketch the graph $g(x) = -x^2 + 4$. [2.5]

a. Domain all real numbers

Range $\{y \mid y \le 4\}$

b. g is an even function

81. Sketch the graph $g(x) = -2x - 4$. [2.5]

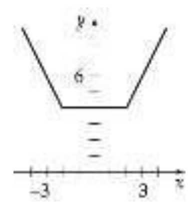


a. Domain all real numbers

Range all real numbers

b. g is neither even nor odd

82. Sketch the graph $g(x) = |x - 2| + |x + 2|$. [2.5]

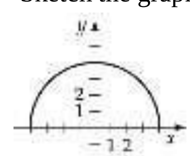


a. Domain all real numbers

Range $\{y \mid y \ge 4\}$

b. g is an even function

83. Sketch the graph $g(x) = \sqrt{16 - x^2}$. [2.5]

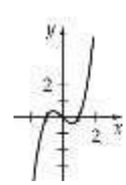


a. Domain $\{x \mid -4 \le x \le 4\}$

Range $\{y \mid 0 \le y \le 4\}$

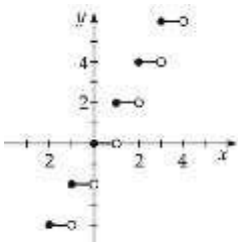
b. g is an even function

84. Sketch the graph $g(x) = x^3 - x$. [2.5]



a. Domain all real numbers Range all real numbers **b.** g is an odd function

85. Sketch the graph $g(x) = 2⟦x⟧$. [2.5]

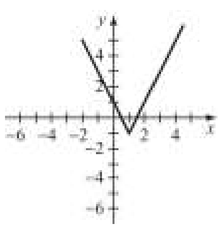


a. Domain all real numbers

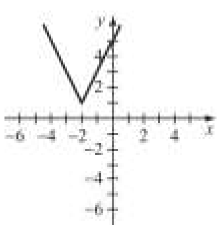
Range $\{y \mid y$ is an even integer$\}$

b. g is neither even nor odd

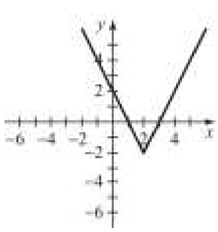
86. $g(x) = f(x) - 2$ [2.5]



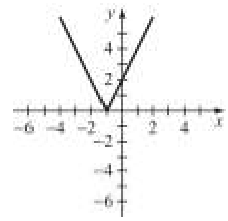
87. $g(x) = f(x+3)$ [2.5]



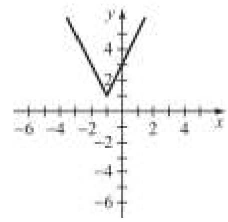
88. $g(x) = f(x-1) - 3$ [2.5]



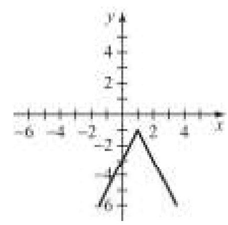
89. $g(x) = f(x+2) - 1$ [2.5]



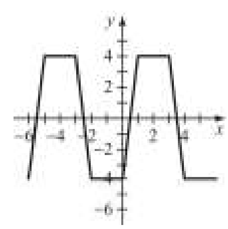
90. $g(x) = f(-x)$ [2.5]



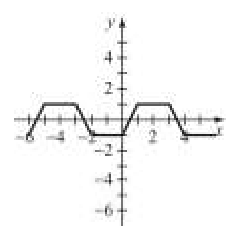
91. $g(x) = -f(x)$ [2.5]



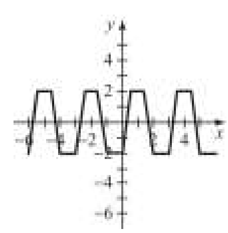
92. $g(x) = 2f(x)$ [2.5]



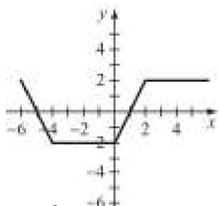
93. $g(x) = \frac{1}{2}f(x)$ [2.5]



94. $g(x) = f(2x)$ [2.5]



95. $g(x) = f\left(\frac{1}{2}x\right)$ [2.5]



96. Perform the operations. [2.6]

a. $(f+g)(2) = \left[2^2 + 2 - 2\right] + [3(2)+1]$

$= 4 + 7 = 11$

b. èçççæ $\frac{f}{g}$ ø÷÷÷ö(-1) = (-1 3)²(-+ -1 ()+1 1)-2 = -- 2 2 =1

c. $(f-g)(x) = (x^2+x-2)-(3x+1) = x^2-2x-3$

d. $(f\cdot g)(x) = (x^2+x-2)(3x+1)$

$= 3x^2 + 4x^2 - 5x - 2$

97. Find the difference quotient. [2.6]

$\frac{f(x+h)-f(x)}{h}$

$= \frac{4(x+h)^2 - 3(x+h) - 1 - (4x^2 - 3x - 1)}{h}$

$= \frac{4x^2 + 8xh + 4h^2 - 3x - 3h - 1 - 4x^2 + 3x + 1}{h}$

$= \frac{8xh + 4h^2 - 3h}{h}$

$= 8x + 4h - 3$

98. Find the difference quotient. [2.6]

$\frac{g(x+h)-g(x)}{h}$

$= \frac{(x+h)^3 - (x+h) - (x^3 - x)}{h}$

$= \frac{x^3 + 3x^2h + 3xh^2 + h^3 - x - h - x^3 + x}{h}$

$= \frac{3x^2h + 3xh^2 + h^3 - h}{h}$

$= 3x^2 + 3xh + h^2 - 1$

99. $s(t) = 3t^2$ [2.4]

a. Average velocity $= \frac{3(4)^2 - 3(2)^2}{4-2}$

$= \frac{3(16) - 3(4)}{2}$

$= \frac{48 - 12}{2}$

$= \frac{36}{2} = 18$ ft/sec

b. Average velocity $= \frac{3(3)^2 - 3(2)^2}{3-2}$

$= \frac{3(9) - 3(4)}{1}$

$= \frac{27 - 12}{1} = 15$ ft/sec

c. Average velocity $= \frac{3(2.5)^2 - 3(2)^2}{2.5-2}$

$= \frac{3(6.25) - 3(4)}{0.5}$

$= \frac{18.75 - 12}{0.5}$

$= \frac{6.75}{0.5} = 13.5$ ft/sec

d. Average velocity $= \frac{3(2.01)^2 - 3(2)^2}{2.01-2}$

$= \frac{3(4.0401) - 3(4)}{0.01}$

$= \frac{12.1203 - 12}{0.01}$

$= \frac{0.1203}{0.01} = 12.03$ ft/sec

e. It appears that the average velocity of the ball approaches 12 ft/sec.

100. Evaluate the composite functions. [2.6]

a. $(f \circ g)(3) = f\big(g(3)\big) = f(3-8)$

$= f(-5) = (-5)^2 + 4(-5)$

$= 25 - 20 = 5$

b. $(g \circ f)(-3) = g\big(f(-3)\big) = g\big((-3)^2 + 4(-3)\big)$

$= g(-3) = -3 - 8$

$= -11$

c. $(f \circ g)(x) = f\big(g(x)\big)$

$= (x-8)^2 + 4(x-8)$

$= x^2 - 16x + 64 + 4x - 32$

$= x^2 - 12x + 32$

d. $(g \circ f)(x) = g\big(f(x)\big)$

$= \big(x^2 + 4x\big) - 8$

$= x^2 + 4x - 8$

101. Evaluate the composite functions. [2.6]

a. $(f \circ g)(-5) = f\big(g(-5)\big) = f(|-5| - 1) = f(-6)$

$= f(6) = 2(6)^2 + 7$

$= 72 + 7 = 79$

b. $(g \circ f)(-5) = g\big(f(-5)\big) = g\big(2(-5)^2 + 7\big)$

$= g(57) = |57| - 1$

$= 56$

c. $(f \circ g)(x) = f\big(g(x)\big)$

$= 2(|x| - 1)^2 + 7$

$= 2x^2 - 4|x| + 2 + 7$

$= 2x^2 - 4|x| + 9$

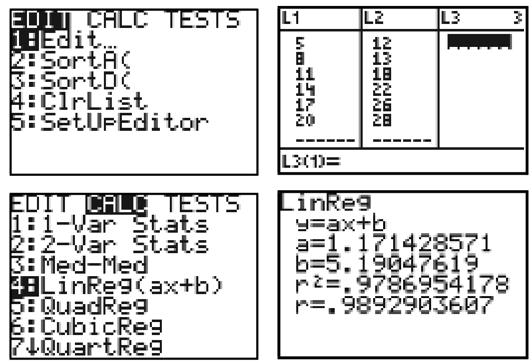
d. $(g \circ f)(x) = g\big(f(x)\big)$

$= |2x^2 + 7| - 1$

$= |2x^2 + 6|$

$= 2x^2 + 6$

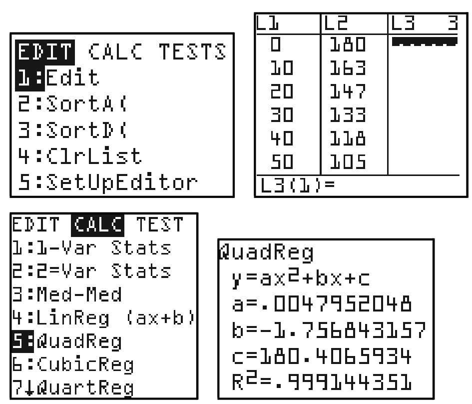
102. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT. [2.7]



a. $y = 1.171428571x + 5.19047619$

b. $y = 1.171428571(12) + 5.19047619 \approx 19$ m/s

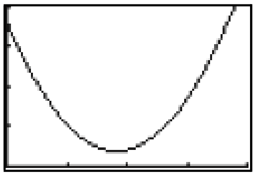
103. a. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT. [2.7]



$h = 0.0047952048t^2 - 1.756843157t + 180.4065934$

b. Empty $\Rightarrow y = 0 \Rightarrow$ the graph intersects the x-axis.

Graph the equation, and notice that it never intersects the x-axis.



Xmin = 0, Xmax = 400, Xscl = 100

Ymin = 0, Ymax = 200, Xscl = 50 Thus, no, on the basis of this model, the can never empties.

c. The regression line is a model of the data and is not based on physical principles.

Chapter 2 Test

1. Finding the midpoint and length. [2.1] midpoint =

$$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$= \left(\frac{-2+4}{2}, \frac{3+(-1)}{2}\right)$$

$$= \left(\frac{2}{2}, \frac{2}{2}\right) = (1, 1)$$

$$\text{length} = d = \sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$$

$$= \sqrt{(-2-4)^2+(3-(-1))^2}$$

$$= \sqrt{(-6)^2+4^2} = \sqrt{36+16} = \sqrt{52}$$

$$= 2\sqrt{13}$$

2. Finding the x- and y-intercepts and graphing. [2.1]

$x = 2y^2 - 4$ $\quad y = 0 \Rightarrow x = 2(0)^2 - 4$

$= -4$

Thus the x-intercept is $(-4, 0)$.

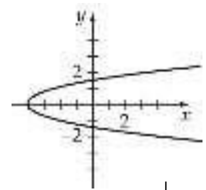
$x = 0 \Rightarrow 0 = 2y^2 - 4$

$4 = 2y^2$

$2 = y^2$

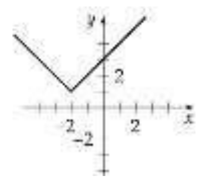
$\pm\sqrt{2} = y$

Thus the y-intercepts are $(0, -\sqrt{2})$ and $(0, \sqrt{2})$.



3. Graphing $y = |x+2| + 1$. [2.1]

x	y
−4	3
−3	2
−2	1
−1	2
0	3



4. Finding the center and radius. [2.1]

$$x^2 - 4x + y^2 + 2y - 4 = 0$$

$$(x^2 - 4\ )x + (y^2 + 2\ )y = 4$$

$$(x^2 - 4x + 4) + (y^2 + 2y + 1) = 4 + 4 + 1$$

$$(x-2)^2 + (y+1)^2 = 9$$

center (2, □1), radius 3

5. Determining the domain of the function. [2.2]

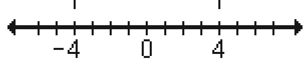
$x^2 - 16$ ³ 0

$(x-4)(x+4)$ ³ 0

The product is positive or zero.

The critical values are 4 and □4.

+++ |−−−−−−−|+++



The domain is $\{x x$ ³ 4 or x £ $-4\}$.

6. Find the values of a in the domain of $f\,x(\ ) = x^2 + 6x -$ 17 for which $f\,a(\ ) = -1$. [2.2] $a^2 + 6a - 17 = -1$ Replace $f\,a(\ )$ with $a^2 + 6a - 17$ $a^2 + 6a - 16 = 0$ $(a+8)(a-2) = 0$

$a + 8 = 0$ $a - 2 = 0$ $a = -8$

$a = 2$

7. Find the slope. [2.3]

m = 3- -- -1(2)5 = -56 = - 65

8. Find the equation. [2.3] $y - -(\ 3) = -2(x - 5)$ $y + 3 = -2x + 10$

$y = -2x + 7$

9. Finding the equation in slope-intercept form. [2.3]

$3x - 2y = 4$

$-2y = -3x + 4$

$y = \frac{3}{2}x - 2$

Chapter 2 Test

Slope of perpendicular line is $-\frac{2}{3}$.

$y - y_1 = m\,x(\ - x_1)$ y +

$2 = -\frac{2}{3}(x-4)$

$y + 2 = -\frac{2}{3}x + \frac{8}{3}$

$y = -\frac{2}{3}x + \frac{8}{3} - \frac{6}{3}$

$y = -\frac{2}{3}x + \frac{2}{3}$

10. Write in standard form, find the vertex and the axis of symmetry. [2.4]

$f\,x(\ ) = x^2 + 6x - 2$

$= (x^2 + 6x + 9) - 2 - 9$

$= (x+3)^2 - 11$ standard form, vertex

(□3, –11), axis of symmetry x = □3

11. Finding the maximum or minimum value. [2.4]

$-\frac{b}{2a} = -\frac{-4}{2(1)} = 2$

$f(2) = 2^2 - 4(2) - 8$

$= 4 - 8 - 8$

$= -12$

The minimum value of the function is –12.

12. Classifying the functions as even, odd or neither. [2.5]

a. $f\,x(\ ) = x^4 - x^2$ $f(-x) = -(\ x)^4 - -(\ x)^2 = x^4 -$ $x^2 = f\,x(\ )$

$f\,x(\ )$ is an even function.

b. $f\,x(\ ) = x^3 - x$ $f(-x) = -(\ x)^3 - -(\ x) = -x^3 + x$

$= -(x^3 - x) = -f\,x(\ )$ $f\,x(\ )$ is an odd function.

c. $f(x) = x - 1$ $\quad f(-x) = -x - 1 \neq f(x)$ not an even function $f(-x) = -x - 1 \neq -f(x)$ not an odd function neither

13. Identify the type of symmetry. [2.5]

a. $(-y)^2 = x + 1$

$y^2 = x + 1$ symmetric with respect to x-axis

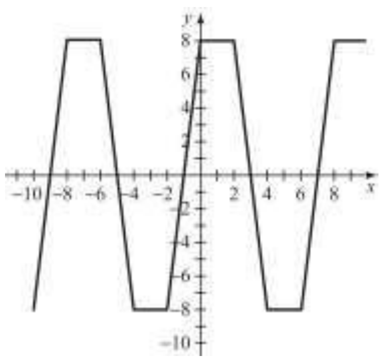
b. $-y = 2(-x)^3 + 3(-x)$

$y = 2x^3 + 3x$ symmetric with respect to origin

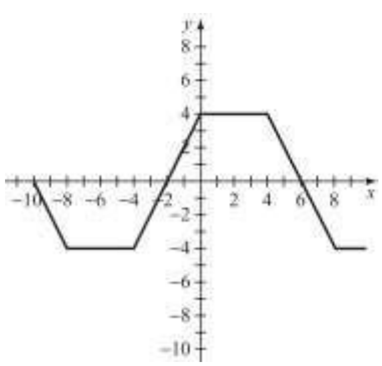
c. $y = 3(-x)^2 - 2$

$y = 3x^2 - 2$ symmetric with respect to y-axis

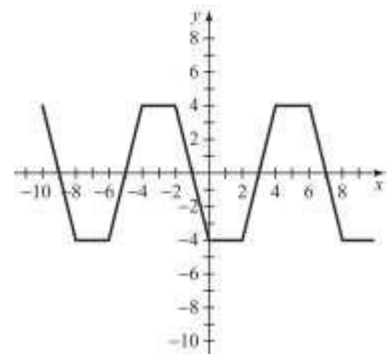
14. $g(x) = 2f(x)$ [2.5]



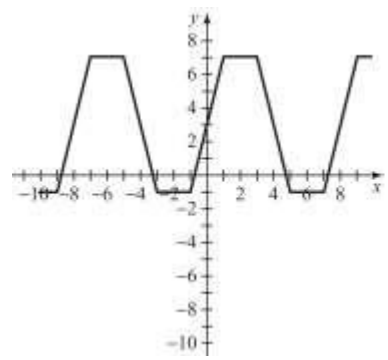
15. $g(x) = f\left(\frac{1}{2}x\right)$ [2.5]



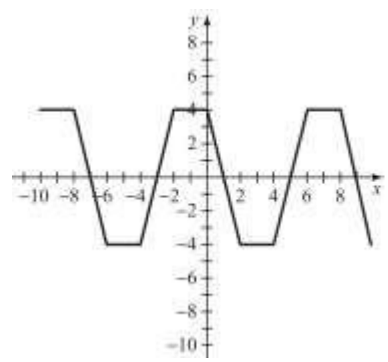
16. $g(x) = -f(x)$ [2.5]



17. $g(x) = f(x-1) + 3$ [2.5]



18. $g(x) = f(-x)$ [2.5]



19. Perform the operations. [2.6]

a. $(f - g)(x) = (x^2 - x + 2) - (2x - 1) = x^2 - 3x + 3$

b. $(f \cdot g)(-2) = ((-2)^2 - (-2) + 2)(2(-2) - 1)$

$= (8)(-5) = -40$

c. $(f \circ g)(3) = f(g(3)) = f(2(3) - 1)$

$= f(5) = 5^2 - 5 + 2$

$= 22$

d. $(g \circ f)(x) = g(f(x)) = 2(x^2 - x + 2) - 1$

$= 2x^2 - 2x + 3$

20. Finding the difference quotient of the function. [2.6]

$f(x) = x^2 + 1$

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

$$= \frac{x^2 + 2xh + h^2 + 1 - x^2 - 1}{h}$$

$$= \frac{2xh + h^2}{h} = \frac{h(2x + h)}{h}$$

$= 2x + h$

21. Find the maximum area. [2.4]

Using the formula for perimeter for three sides,

$P = 2w + l \Rightarrow 80 = 2x + y \quad y = 80 - 2x$

Using the formula for area, $A = xy$. Then

$A(x) = x(80 - 2x)$

$A(x) = -2x^2 + 80x$

$-\frac{b}{2a} = -\frac{80}{2(-2)} = 20 \quad y$

$= 80 - 2(20) = 40$

$x = 20$ ft and $y = 40$ ft

22. Evaluating the function, $s(t) = 5t^2$. [2.6]

a. Average velocity $= \frac{5(3)^2 - 5(2)^2}{3-2} = \frac{5(9) - 5(4)}{1}$

$= 45 - 20 = 25$ ft/sec

b. Average velocity $= \frac{5(2.5)^2 - 5(2)^2}{2.5-2}$

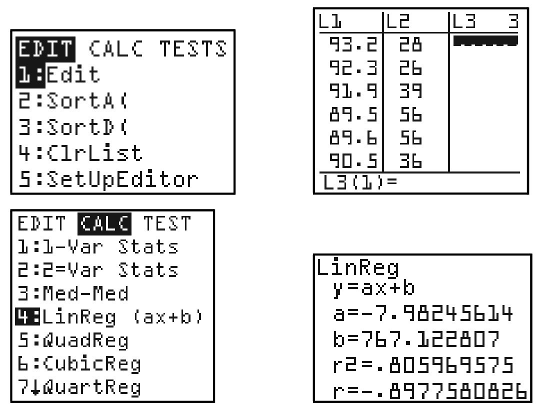
$= \frac{5(6.25) - 5(4)}{0.5} = \frac{31.25 - 20}{0.5} = 22.5$ ft/sec

c. Average velocity $= \frac{5(2.01)^2 - 5(2)^2}{2.01-2}$

$= \frac{5(4.0401) - 5(4)}{0.01}$

$= \frac{20.2005 - 20}{0.01} = 20.05$ ft/sec

23. a. Enter the data on your calculator. The technique for a TI-83 calculator is illustrated here. Press STAT. [2.7]



$y = -7.98245614x + 767.122807$

Cumulative Review Exercises

b. Evaluating the equation from part (a) at 89.

$y = -7.98245614(89) + 767.122807$

≈ 57 calories

Cumulative Review Exercises

1. Determine the property for $3(a + b) = 3(b + a)$. [P.1]

Commutative Property of Addition

2. $\frac{6}{\pi}$, $\sqrt{2}$ are not rational numbers [P.1]

3. Simplifying. [P.1]

$3 + 4(2x - 9)$

$= 3 + 8x - 36$

$= 8x - 33$

4. Simplifying. [P.2]

$(-4xy^{2})^{3}(-2x^{2}y^{4}) = (-64x^{3}y^{6})(-2x^{2}y^{4})$

$= (-64)(-2)(x^{3+2}y^{6+4})$

$= 128x^{5}y^{10}$

5. Simplifying. [P.2]

$$\frac{24a^4b^3}{18ab^5} = \frac{4a^{4-1}b^{3-5}}{3} = \frac{4a^3b^{-2}}{3} = \frac{4a^3}{3b^2}$$

6. Simplifying. [P.3]

$(2x+3)(3x-7) = 6x^2 - 5x - 21$

7. Simplifying. [P.5]

$$\frac{x^2+6x-27}{x^2-9} = \frac{(x+9)(x-3)}{(x+3)(x-3)} = \frac{x+9}{x+3}$$

8. Simplifying. [P.5]

$$\frac{4}{2x-1} - \frac{2}{x-1} = \frac{4(x-1)}{(2x-1)(x-1)} - \frac{2(2x-1)}{(2x-1)(x-1)}$$

$$= \frac{4x-4-4x+2}{(2x-1)(x-1)}$$

$$= \frac{-2}{(2x-1)(x-1)}$$

9. Solving for x. [1.1]

$6-2(2x-4) = 14$

$6-4x+8 = 14$

$-4x = 0$

$x = 0$

10. Solving for x. [1.3]

$x^2 - x - 1 = 0$

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-1)}}{2(1)}$$

$$= \frac{1 \pm \sqrt{1+4}}{2} = \frac{1 \pm \sqrt{5}}{2}$$

11. Solving for x. [1.3]

$(2x-1)(x+3) = 4$

$2x^2+5x-3 = 4$

$2x^2+5x-7 = 0$

$(2x+7)(x-1) = 0$

$x = -\frac{7}{2}$ or $x = 1$

12. Solving for x. [1.1]

$3x+2y = 15$

$3x = -2y+15$

$x = -\frac{2}{3}y + 5$

13. Solving for x. [1.4]

$x^4 - x^2 - 2 = 0$

Let $u = x^2$.

$u^2 - u - 2 = 0$

$(u-2)(u+1) = 0$

$u-2 = 0$ or $u+1 = 0$

$u = 2$ $u = -1$

$x^2 = 2$ $x^2 = -1$

$x = \pm\sqrt{2}$ $x = \pm i$

14. Solving for x. [1.5]

$3x-1 < 5x+7$

$-2x < 8$

$x > -4$

15. Finding the distance. [2.1]

$$\text{distance} = \sqrt{[2-(-2)]^2 + [-4-(-3)]^2}$$

$$= \sqrt{(4)^2 + (-1)^2} = \sqrt{16+1}$$

$$= \sqrt{17}$$

16. Finding $G(-2)$. [2.2]

$G(x) = 2x^3 - 4x - 7$

$G(-2) = 2(-2)^3 - 4(-2) - 7 = 2(-8) + 8 - 7 = -15$

17. Finding the equation of the line. [2.3]

The slope is $m = \frac{-1-(-3)}{-2-2} = \frac{-1+3}{-4} = \frac{2}{-4} = -\frac{1}{2}$

The equation is $y-(-3) = -\frac{1}{2}(x-2)$

$y = -\frac{1}{2}x - 2$

18. Solving a mixture problem. [1.1]

0	x
0.08	60

0.03	$60 + x$

$$0.08(60) + 0x = 0.03(60 + x)$$

$$4.8 = 1.8 + 0.03x$$

$$3 = 0.03x$$

$$100 = x$$

100 ounces of water

19. Evaluating a quadratic function. [2.4]

$$h(x) = -0.002x^2 - 0.03x + 8$$

$$h(39) = -0.002(39)^2 - 0.03(39) + 8$$
$$= 3.788 \text{ ft}$$

Yes.

20. Finding the rate, or slope. [2.3]

0.04°F/min