CHAPTER 2

Section 2-1

2. Calculate several solutions to the equation –how many generally depends on the complexity of the equation– plot the corresponding points, and connect them with a smooth curve.

4. If the equation is unchanged after x is replaced by $-x$ and y is replaced by $-y$, the graph is symmetric with respect to the origin.

6. The set of all points for which the x and y coordinates are both positive is quadrant I.

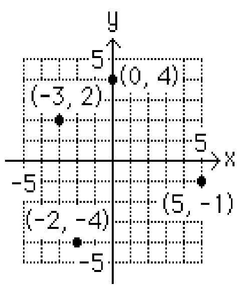
8. The set of all points for which the y coordinate is 0 is the x axis.

10. The set of all points for which y is negative, excluding those points for which $x = 0$ (negative y axis), includes quadrants III and IV.

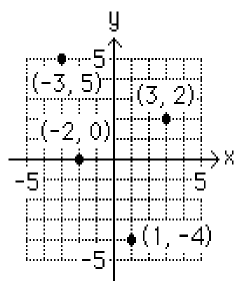
12. The set of all points for which x is negative and y is positive is Quadrant II.

14. The set of all points for which $xy > 0$ includes those points for which both coordinates are positive (Quadrant I) and also those points for which both coordinates are negative (Quadrant III).

16.



18.



20. Point A has coordinates (0, 3). Its reflection through the x axis is A' (0, –3).
Point B has coordinates (–4, –5). Its reflection through the x axis is B' (–4, 5).
Point C has coordinates (4, 1). Its reflection through the x axis is C' (4, –1).
Point D has coordinates (1, –3). Its reflection through the x axis is D' (1, 3).

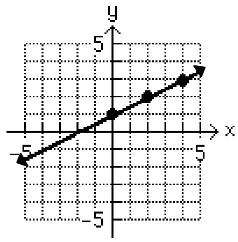
22. Point A has coordinates (4, 2). Reflection through the x axis gives (4, –2); reflection of this through the y axis gives A' (–4, –2).
Point B has coordinates (–2, –4). Reflection through the x axis gives (–2, 4); reflection of this through the y axis gives B' (2, 4).
Point C has coordinates (–4, 3). Reflection through the x axis gives (–4, –3); reflection of this through the y axis is C' (4, –3).
Point D has coordinates (5, 0). This is unchanged by reflection through the x axis; reflection through the y axis gives D' (–5, 0).

24. $y = \frac{1}{2}x + 1$

Test y axis	Test x axis	Test origin
Replace x with $-x$:	Replace y with $-y$:	Replace x with $-x$ and y with $-y$:
$y = \frac{1}{2}(-x) + 1$	$-y = \frac{1}{2}x + 1$	$-y = \frac{1}{2}(-x) + 1$
$y = -\frac{1}{2}x + 1$	$y = -\frac{1}{2}x - 1$	$y = \frac{1}{2}x - 1$

The graph has none of these symmetries.

x	*y*
0	1
2	2
4	3



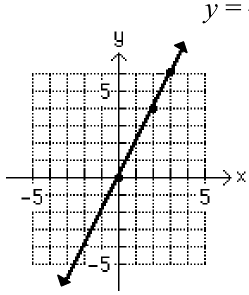
26. $y = 2x$

Test *y* axis
Replace *x* with $-x$:
$y = 2(-x)$
$y = -2x$

Test *x* axis
Replace *y* with $-y$:
$-y = 2x$
$y = -2x$

Test origin
Replace *x* with $-x$ and *y* with $-y$:
$-y = 2(-x)$
$y = 2x$

x	*y*
0	0
2	4
3	6



The graph has symmetry with respect to the origin.
We reflect the portion of the graph in quadrant I through the origin, using the origin symmetry.

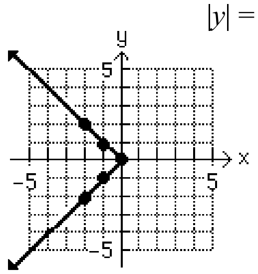
28. $|y| = -x$

Test *y* axis
Replace *x* with $-x$:
$|y| = -(-x)$
$|y| = x$

Test *x* axis
Replace *y* with $-y$:
$|-y| = -x$
$|y| = -x$

Test origin
Replace *x* with $-x$ and *y* with $-y$:
$|-y| = -(-x)$
$|y| = x$

x	*y*
0	0
–1	±1
–2	±2



The graph has symmetry with respect to the *x* axis.
We reflect the portion of the graph where $y \geq 0$ through the *x* axis, using the *x* axis symmetry.

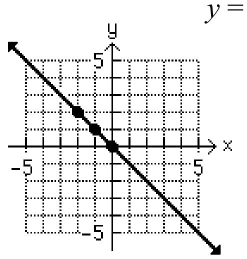
30. $y = -x$

Test *y* axis
Replace *x* with $-x$:
$y = -(-x)$
$y = x$

Test *x* axis
Replace *y* with $-y$:
$-y = -x$
$y = x$

Test origin
Replace *x* with $-x$ and *y* with $-y$:
$-y = -(-x)$
$y = -x$

x	*y*
0	0
–1	1
–2	2

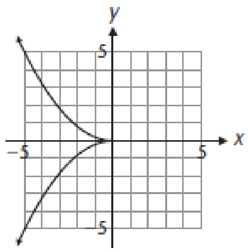


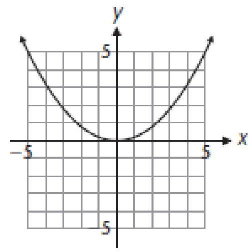
The graph has symmetry with respect to the origin.
We reflect the portion of the graph in quadrant II through the origin, using the origin symmetry.

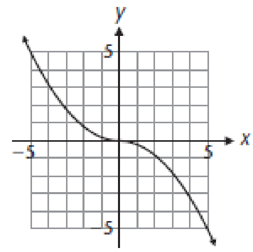
32. (A) 5 (B) –8 (C) 6 (D) –2, 4 (E) –4, 6 (F) –3, 5

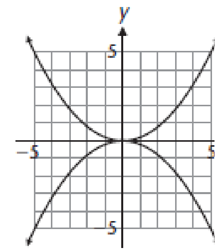
34. (A) –3 (B) 1 (C) 4 (D) 3, 6 (E) –6, –4, 2, 7 (F) –5, 2, 7

36.

(A)


(B)


(C)


(D)


38. $x^2 + 6y + y^2 = 25$

Test y axis
Replace x with $-x$:
$(-x)^2 + 6y + y^2 = 25$
$x^2 + 6y + y^2 = 25$

Test x axis
Replace y with $-y$:
$x^2 + 6(-y) + (-y)^2 = 25$
$x^2 - 6y + y^2 = 25$

Test origin
Replace x with $-x$ and y with $-y$:
$(-x)^2 + 6(-y) + (-y)^2 = 25$
$x^2 - 6y + y^2 = 25$

The graph has symmetry with respect to the y axis.

40. $3x - 5y = 2$

Test y axis
Replace x with $-x$:
$3(-x) - 5y = 2$
$-3x - 5y = 2$

Test x axis
Replace y with $-y$:
$3x - 5(-y) = 2$
$3x + 5y = 2$

Test origin
Replace x with $-x$ and y with $-y$:
$3(-x) - 5(-y) = 2$
$-3x + 5y = 2$

The graph has none of these symmetries.

42. $x^4 - y^4 = 16$

Test y axis
Replace x with $-x$:
$(-x)^4 - y^4 = 16$
$x^4 - y^4 = 16$

Test x axis
Replace y with $-y$:
$x^4 - (-y)^4 = 16$
$x^4 - y^4 = 16$

Origin symmetry
follows automatically

The graph has symmetry with respect to the x axis, the y axis, and the origin.

44. $x^2 + 2xy + 3y^2 = 12$

Test y axis
Replace x with $-x$:
$(-x)^2 + 2(-x)y + 3y^2 = 12$
$x^2 - 2xy + 3y^2 = 12$

Test x axis
Replace y with $-y$:
$x^2 + 2x(-y) + 3(-y)^2 = 12$
$x^2 - 2xy + 3y^2 = 12$

Test origin
Replace x with $-x$ and y with $-y$:
$(-x)^2 + 2(-x)(-y) + 3(-y)^2 = 12$
$x^2 + 2xy + 3y^2 = 12$

The graph has symmetry with respect to the origin.

46. $x^3 - 4y^2 = 1$

Test y axis
Replace x with -x:
$(-x)^3 - 4y^2 = 1$
$-x^3 - 4y^2 = 1$

Test x axis
Replace y with $-y$:
$x^3 - 4(-y)^2 = 1$
$x^3 - 4y^2 = 1$

Test origin
Replace x with $-x$ and y with $-y$:
$(-x)^3 - 4(-y)^2 = 1$
$-x^3 - 4y^2 = 1$

The graph has symmetry with respect to the x axis.

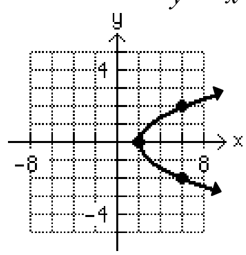
48. $y^2 = x - 2$

Test y axis
Replace x with $-x$:
$y^2 = -x - 2$

Test x axis
Replace y with $-y$:
$(-y)^2 = x - 2$
$y^2 = x - 2$

Test origin
Replace x with $-x$ and y with $-y$:
$(-y)^2 = (-x) - 2$
$y^2 = -x - 2$

x	y
2	0
6	± 2



The graph has symmetry with respect to the x axis. To obtain the portion of the graph for $y \ge 0$, we sketch $y = \sqrt{x-2}$, $x \ge 2$.We reflect the portion of the graph for $y \ge 0$ across the x axis, using the x axis symmetry.

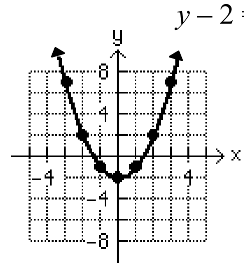
50. $y + 2 = x^2$

Test y axis
Replace x with $-x$:
$y + 2 = (-x)^2$
$y + 2 = x^2$

Test x axis
Replace y with $-y$:
$(-y) + 2 = x^2$
$y - 2 = -x^2$

Test origin
Replace x with $-x$ and y with $-y$:
$(-y) + 2 = (-x)^2$
$y - 2 = -x^2$

x	y
0	-2
± 1	-1
± 2	2
± 3	7



The graph has symmetry with respect to the y axis. We reflect the portion of the graph for $x \ge 0$ across the y axis, using the y axis symmetry.

52. $4x^2 - y^2 = 1$

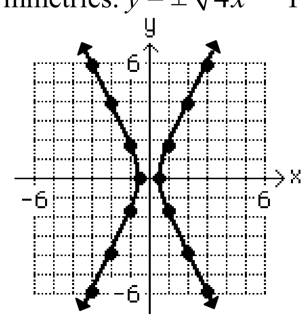
Test y axis
Replace x with $-x$:
$4(-x)^2 - y^2 = 1$
$4x^2 - y^2 = 1$

Test x axis
Replace y with $-y$:
$4x^2 - (-y)^2 = 1$
$4x^2 - y^2 = 1$

Origin symmetry
follows automatically.

The graph has all three symmetries. $y = \pm\sqrt{4x^2 - 1}$.

x	y
$\pm\frac{1}{2}$	0
± 1	$\pm\sqrt{3}$
± 2	$\pm\sqrt{15}$
± 3	$\pm\sqrt{35}$



To obtain the quadrant I portion of the graph, we sketch $y = \sqrt{4x^2 - 1}$, $x \ge 0$. We reflect this graph across the y axis, then reflect everything across the x axis.

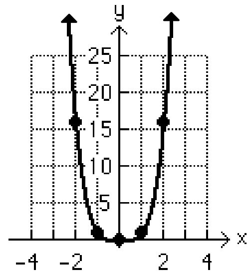
54. $y = x^4$

Test y axis
Replace x with $-x$:
$y = (-x)^4$
$y = x^4$

Test x axis
Replace y with $-y$:
$-y = x^4$
$y = -x^4$

Test origin
Replace x with $-x$ and y with $-y$:
$-y = (-x)^4$
$y = -x^4$

x	y
0	0
± 1	1
± 2	16



The graph has symmetry with respect to the y axis. We reflect the portion of the graph in quadrant I through the y axis, using the y axis symmetry.

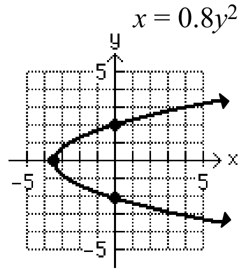
56. $x = 0.8y^2 - 3.5$

Test y axis
Replace x with $-x$:
$-x = 0.8y^2 - 3.5$
$x = -0.8y^2 + 3.5$

Test x axis
Replace y with $-y$:
$x = 0.8(-y)^2 - 3.5$
$x = 0.8y^2 - 3.5$

Test origin
Replace x with $-x$ and y with $-y$:
$-x = 0.8(-y)^2 - 3.5$
$x = -0.8y^2 + 3.5$

x	y
-3.5	0
0	$\pm\sqrt{\frac{35}{8}}$



The graph has symmetry with respect to the x axis. We reflect the portion of the graph for $y \geq 0$ across the x axis, using the x axis symmetry.

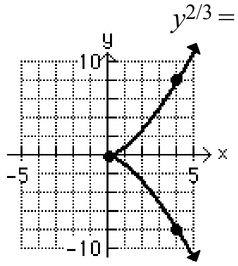
58. $y^{2/3} = x$

Test y axis
Replace x with $-x$:
$y^{2/3} = -x$

Test x axis
Replace y with $-y$:
$(-y)^{2/3} = x$
$y^{2/3} = x$

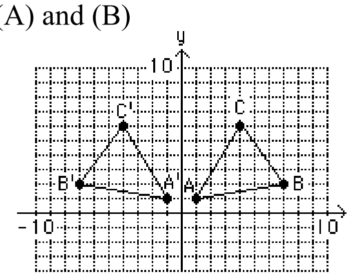
Test origin
Replace x with $-x$ and y with $-y$:
$(-y)^{2/3} = -x$
$y^{2/3} = -x$

x	y
0	0
4	± 8



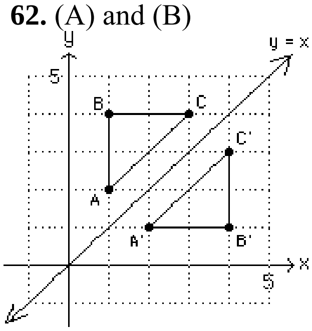
The graph has symmetry with respect to the x axis. We reflect the portion of the graph for $y \geq 0$ across the x axis, using the x axis symmetry.

60. (A) and (B)



(C) The triangles are mirror images of each other, reflected across the y axis. Changing the sign of the x coordinate reflects the graph across the y axis.

62. (A) and (B)

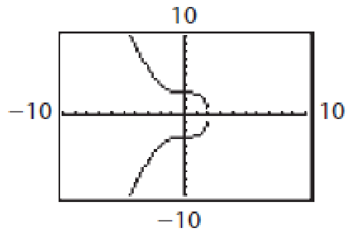


(C) The triangles are mirror images of each other, reflected across the line $y = x$. Reversing the coordinates reflects the graph across the line $y = x$.

64. $x^3 + y^2 = 8$

$y^2 = 8 - x^3$

$y = \pm\sqrt{8 - x^3}$

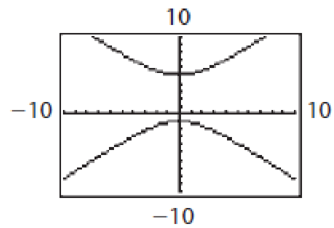


66. $(y-2)^2 - x^2 = 9$

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

$y - 2 = \pm\sqrt{9 + x^2}$

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



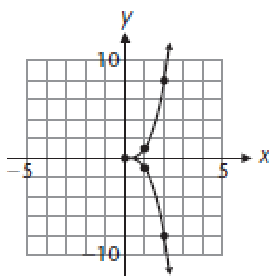
68. $|y| = x^3$

Test y axis
Replace x with $-x$:
$|y| = (-x)^3$
$|y| = -x^3$

Test x axis
Replace y with $-y$:
$|-y| = x^3$
$|y| = x^3$

Test origin
Replace x with $-x$ and y with $-y$:
$|-y| = (-x)^3$
$|y| = -x^3$

x	y
0	0
1	± 1
2	± 8



The graph has symmetry with respect to the x axis. We reflect the portion of the graph for $y \geq 0$ across the x axis, using the x axis symmetry.

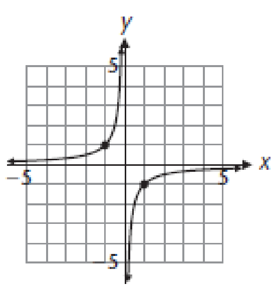
70. $xy = -1$

Test y axis
Replace x with $-x$:
$(-x)y = -1$
$xy = 1$

Test x axis
Replace y with $-y$:
$x(-y) = -1$
$xy = 1$

Test origin
Replace x with $-x$ and y with $-y$:
$(-x)(-y) = -1$
$xy = -1$

x	y
1	-1
-1	1



The graph has symmetry with respect to the origin. We reflect the portion of the graph in quadrant II through the origin, using the origin symmetry.

72. $y = x^2 - 6x$

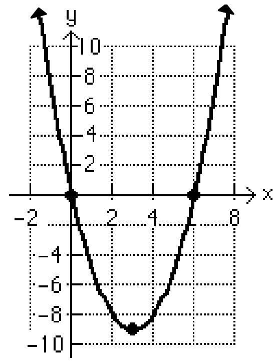
Test y axis
Replace x with $-x$:
$y = (-x)^2 - 6(-x)$
$y = x^2 + 6x$

Test x axis
Replace y with $-y$:
$-y = x^2 - 6x$
$y = -x^2 + 6x$

Test origin
Replace x with $-x$ and y with $-y$:
$-y = (-x)^2 - 6(-x)$
$y = -x^2 - 6x$

The graph has none of these three symmetries.

x	y
0	0
3	–9
6	0



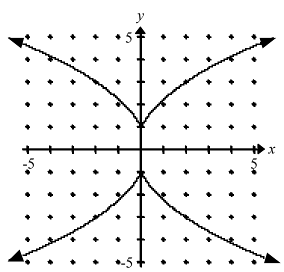
74. $y^2 = 4|x| + 1$

Test y axis
Replace x with $-x$:
$y^2 = 4|-x| + 1$
$y^2 = 4|x| + 1$

Test x axis
Replace y with $-y$:
$(-y)^2 = 4|x| + 1$
$y^2 = 4|x| + 1$

Origin symmetry follows automatically.

x	y
0	1
±1	$\sqrt{5} \approx 2.2$
±2	3



The graph has symmetry with respect to the x axis, the y axis, and the origin.

$y = \pm\sqrt{4|x|+1}$

To obtain the quadrant I portion of this graph, we sketch $y = \sqrt{4|x|+1}$, $x \geq 0$. We reflect this graph across the y axis, then reflect everything across the x axis.

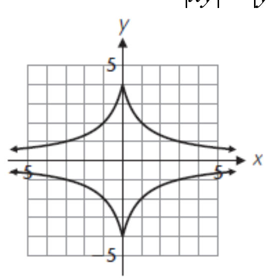
76. $|xy| + |y| = 4$

Test y axis
Replace x with $-x$:
$|(-x)y| + |y| = 4$
$|xy| + |y| = 4$

Test x axis
Replace y with $-y$:
$|x(-y)| + |-y| = 4$
$|xy| + |y| = 4$

Origin symmetry follows automatically.

x	y
0	±4
±1	±2
±3	±1



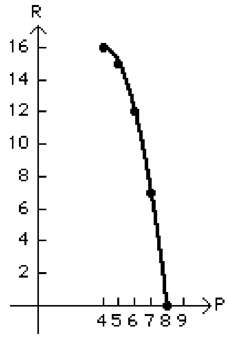
The graph has symmetry with respect to the x axis, the y axis, and the origin.
We reflect the portion of the graph in quadrant I across the y axis, then reflect everything across the x axis.

78. Reflecting a point (x, y) across the y axis yields the point $(-x, y)$. Reflecting this point through the origin yields the point $(x, -y)$. This point is the same point that would result from reflecting the original point across the x axis. Therefore, if the graph is unchanged by reflecting across the y axis and through the origin, it will be unchanged by reflecting across the x axis and will necessarily have symmetry with respect to the x axis.

80. No. For example, the graph of $xy = 1$ is symmetric with respect to the origin, and the equation is unchanged when x is replaced by $-x$ and y is replaced by $-y$ to obtain $(-x)(-y) = 1$ or $xy = 1$. However, it is not symmetric with respect to the y axis, as is seen when only x is replaced by $-x$ to obtain $(-x)y = 1$ or $-xy = 1$.

82.

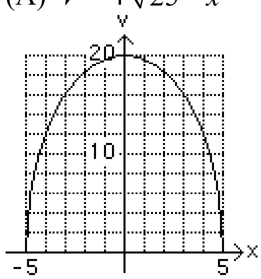
p	$R=(8-p)p$
4	16
5	15
6	12
7	7
8	0



84. (A) The supply is 3000 cases when the price is \$5.60.
(B) As the price increases from \$5.60 to \$5.80 the supply increases by about 300 cases.
(C) As the price decreases from \$5.60 to \$5.40 the supply decreases by about 400 cases.
(D) As price increases so does supply. As price decreases so does supply.

86. (A) The temperature at 7 p.m. is about 60°. (B) The lowest temperature is 44° at 5 a.m. (C) The temperature is 52° at about 9 a.m. and 10 p.m.

88. (A) $V=4\sqrt{25-x^2}$



(B) The speed of the ball is zero at the top and bottom of the oscillation and the ball has a maximum speed of 4 at the rest position.

Section 2-2

2. If the coordinates are given by (x_1 , y_1) and (x_2 , y_2) then the distance between the points is given by the distance formula $d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

4. Use the standard form of the equation of a circle $(x-h)^2+(y-k)^2=r^2$ and substitute (h, k) = (1, 5) and r = $\sqrt{2}$ to obtain $(x-1)^2+(y-5)^2=\left(\sqrt{2}\right)^2$ or $(x-1)^2+(y-5)^2=2$.

6. $d=\sqrt{(3-0)^2+(5-1)^2}=\sqrt{25}=5$

Midpoint = $\left(\frac{0+3}{2},\frac{1+5}{2}\right)=\left(\frac{3}{2},3\right)$

8. $d=\sqrt{(-2-3)^2+(3-0)^2}=\sqrt{34}$

Midpoint = $\left(\frac{3+(-2)}{2},\frac{0+(-3)}{2}\right)=\left(\frac{1}{2},-\frac{3}{2}\right)$

10. $d = \sqrt{(6-(-5))^2 + (-1-4)^2} = \sqrt{146}$

$\text{Midpoint} = \left(\frac{(-5)+6}{2}, \frac{4+(-1)}{2}\right) = \left(\frac{1}{2}, \frac{3}{2}\right)$

12. $d = \sqrt{(-5-(-1))^2 + (-2-2)^2} = \sqrt{32} = 4\sqrt{2}$

$\text{Midpoint} = \left(\frac{(-5)+(-1)}{2}, \frac{-2+2}{2}\right) = (-3, 0)$

14. $C(0, 0)$, $r = 5$

$(x-h)^2 + (y-k)^2 = r^2$

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

$x^2 + y^2 = 25$

16. $C(5, 6)$, $r = 2$

$(x-h)^2 + (y-k)^2 = r^2$

$(x-5)^2 + (y-6)^2 = 4$

18. $C(-5, 6)$, $r = \sqrt{11}$

$(x-h)^2 + (y-k)^2 = r^2$

$(x-(-5))^2 + (y-6)^2 = (\sqrt{11})^2$

$(x+5)^2 + (y-6)^2 = 11$

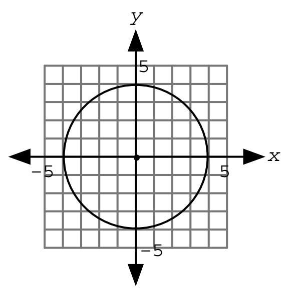
20. $C(4, -1)$, $r = \sqrt{5}$

$(x-h)^2 + (y-k)^2 = r^2$

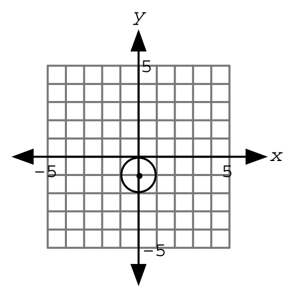
$(x-4)^2 + (y-(-1))^2 = (\sqrt{5})^2$

$(x-4)^2 + (y+1)^2 = 5$

22. This is a circle with center (0, 0) and radius 4. $x^2 + y^2 = 16$

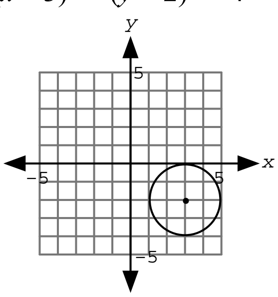


24. This is a circle with center (0, –1) and radius 1. $x^2 + (y+1)^2 = 1$



26. This is a circle with center (3, –2) and radius 2.

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



28.

(A) $\frac{-3+b_1}{2} = 4 \Rightarrow -3 + b_1 = 8 \Rightarrow b_1 = 11$

(B) $\frac{5+b_2}{2} = -2 \Rightarrow 5 + b_2 = -4 \Rightarrow b_2 = -9$

(C) $d(A, M) = \sqrt{(4-(-3))^2 + (-2-5)^2} = \sqrt{98}$

$d(M, b) = \sqrt{(11-4)^2 + (-9-(-2))^2} = \sqrt{98}$

30.

$(x, 2)$ is 4 units from $(3, -3)$:

$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

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

$16 = (x-3)^2 + 25$

$-9 = (x-3)^2$

There is no solution.

32. (3, y) is 13 units from (–9, 2):

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$13 = \sqrt{(3-(-9))^2 + (y-2)^2}$$

$$169 = 144 + (y-2)^2$$

$$25 = (y-2)^2$$

$$\pm 5 = y - 2$$

$$y = 2 + 5 = 7$$

$$y = 2 - 5 = -3$$

34. This is a circle with center (–1, 0) and radius 1. That is, the set of all points that are one unit away from (–1, 0).

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

36. This is a circle with center (2, –1) and radius 3. That is, the set of all points that are three units away from (2, –1).

$$(x-2)^2 + (y+1)^2 = 9$$

38. $M = \left(\dfrac{2.8-4.1}{2}, \dfrac{-3.5+7.6}{2}\right) = (-0.65, 2.05)$

$$d(A, M) = \sqrt{(-0.65-2.8)^2 + (2.05-(-3.5))^2} = 6.53$$

$$d(M, B) = \sqrt{(-4.1-(-0.65))^2 + (7.6-2.05)^2} = 6.53$$

$$\frac{1}{2} d(A, B) = \frac{1}{2}\sqrt{(-4.1-2.8)^2 + (7.6-(-3.5))^2} = 6.53$$

40. Let $A = (a_1, a_2)$

$$\frac{a_1 + 12}{2} = 2.5 \Rightarrow a_1 = -7$$

$$\frac{a_2 + 10}{2} = 3.5 \Rightarrow a_2 = -3$$

$$d(A, M) = \sqrt{(2.5-(-7))^2 + (3.5-(-3))^2} = 11.5$$

$$d(M, B) = \sqrt{(12-2.5)^2 + (10-3.5)^2} = 11.5$$

$$\frac{1}{2} d(A, B) = \frac{1}{2}\sqrt{(12-(-7))^2 + (10-(-3))^2} = 11.5$$

42. Let $B = (b_1, b_2)$

$$\frac{-4 + b_1}{2} = -1.5 \Rightarrow b_1 = 1 \qquad \frac{-2 + b_2}{2} = -4.5 \Rightarrow b_2 = -7$$

$$d(A, M) = \sqrt{(-1.5-(-4))^2 + (-4.5-(-2))^2} = 3.54$$

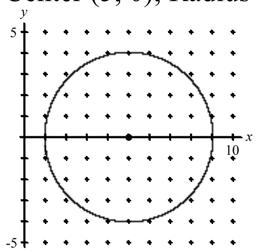
$$d(M, B) = \sqrt{(1-(-1.5))^2 + (-7-(-4.5))^2} = 3.54$$

$$\frac{1}{2} d(A, B) = \frac{1}{2}\sqrt{(1-(-4))^2 + (-7-(-2))^2} = 3.5$$

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

$(x-5)^2+(y-0)^2=4^2$

Center (5, 0); Radius = 4

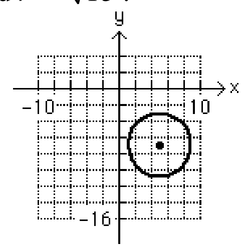


46. $(x-5)^2+(y+7)^2=15$

$(x-5)^2+(y-(-7))^2=(\sqrt{15})^2$

from which $(h, k) = (5, -7)$

and $r=\sqrt{15}$.

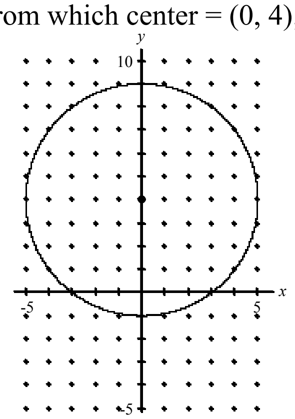


48. $x^2+y^2-8y=9$

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

$x^2+(y-4)^2=25=5^2$

from which center = (0, 4); radius = 5

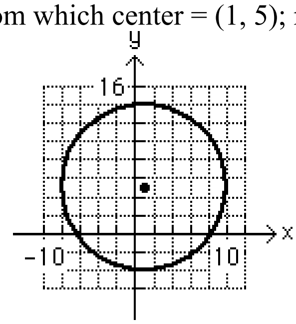


50. $x^2+y^2-2x-10y=55$

$x^2-2x+1+y^2-10y+25=55+26$

$(x-1)^2+(y-5)^2=81=9^2$

from which center = (1, 5); radius = 9



52. $2x^2+2y^2+8x+20y+30=0$

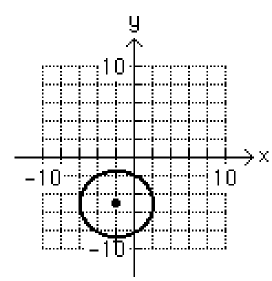
$x^2+y^2+4x+10y+15=0$

$x^2+4x+4+y^2+10y+25=-15+4+25$

$(x+2)^2+(y+5)^2=14$

$(x-(-2))^2+(y-(-5))^2=(\sqrt{14})^2$

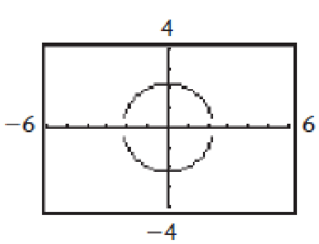
from which center = (–2, –5); radius = $\sqrt{14}$



54. $x^2+y^2=5$

$y^2=5-x^2$

$y=\pm\sqrt{5-x^2}$

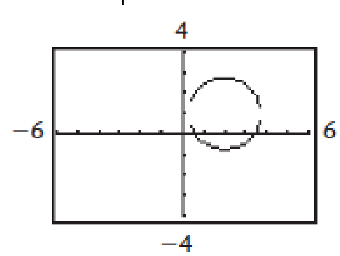


56. $(x-2)^2+(y-1)^2=3$

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

$y-1=\pm\sqrt{3-(x-2)^2}$

$y=1\pm\sqrt{3-(x-2)^2}$



58. Let $A = (-1, 3)$, $B = (3,5)$, $C = (5, 1)$

$d(A, B) = \sqrt{(3-(-1))^2 + (5-3)^2} = \sqrt{20}$

$d(B, C) = \sqrt{(5-3)^2 + (1-5)^2} = \sqrt{20}$

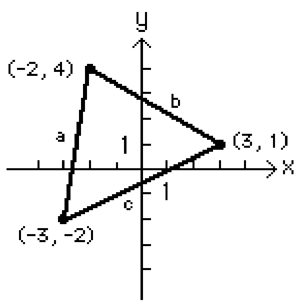
$d(A, C) = \sqrt{(5-(-1))^2 + (1-3)^2} = \sqrt{40}$

$d(A, B)^2 + d(B, C)^2 = d(A, C)^2$, so the points are vertices of a right triangle.

Midpoint of $AC = \left(\frac{-1+5}{2}, \frac{3+1}{2}\right) = (2, 2)$

$d(M, B) = \sqrt{(3-2)^2 + (5-2)^2} = \sqrt{10}$

60.



$a = \sqrt{(-2-(-3))^2 + (4-(-2))^2} = \sqrt{37}$

$b = \sqrt{(-2-3)^2 + (4-1)^2} = \sqrt{34}$

$c = \sqrt{(3-(-3))^2 + (1-(-2))^2} = \sqrt{45}$

$p = a + b + c$

$= \sqrt{37} + \sqrt{34} + \sqrt{45}$

≈ 18.62

62. (A) Midpoint of $AC = \left(\frac{0+a+c}{2}, \frac{0+b}{2}\right) = \left(\frac{a+c}{2}, \frac{b}{2}\right)$.

(B) Midpoint of $BD = \left(\frac{a+c}{2}, \frac{b+0}{2}\right) = \left(\frac{a+c}{2}, \frac{b}{2}\right)$.

(C) They intersect at their midpoints.

64. (5,–1), (5, 7)

Center: $\left(\frac{5+5}{2}, \frac{-1+7}{2}\right) = (5, 3)$

Diameter: $d = \sqrt{(5-5)^2 + [7-(-1)]^2} = \sqrt{64} = 8$

Radius $= \frac{d}{2} = \frac{8}{2} = 4$

$(x - h)^2 + (y - k)^2 = r^2$

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

66. (–6, 0), (0, –8)

Center: $\left(\frac{(-6)+0}{2}, \frac{0+(-8)}{2}\right) = (-3, -4)$

Diameter: $d = \sqrt{[0-(-6)]^2 + [(-8)-0]^2}$

$= \sqrt{100} = 10$

Radius $= \frac{d}{2} = \frac{10}{2} = 5$

$(x - h)^2 + (y - k)^2 = r^2$

$(x + 3)^2 + (y + 4)^2 = 25$

68. (–8, 9), (12, 15)

Center: $\left(\frac{(-8)+12}{2}, \frac{9+15}{2}\right) = (2, 12)$

Diameter: $d = \sqrt{[12-(-8)]^2 + (15-9)^2}$

$= \sqrt{436} = 2\sqrt{109}$

Radius $= \frac{d}{2} = \frac{2\sqrt{109}}{2} = \sqrt{109}$

$(x - h)^2 + (y - k)^2 = r^2$

$(x - 2)^2 + (y - 12)^2 = \left(\sqrt{109}\right)^2$

$(x - 2)^2 + (y - 12)^2 = 109$

70. The radius of a circle is the distance from the center to any point on the circle. Since the center of this circle is (–3, 0) and (6, 1) is a point on the circle, the radius is given by

$$r = \sqrt{[6-(-3)]^2 + (1-0)^2} = \sqrt{81+1} = \sqrt{82}$$

Hence the equation of the circle is given by

$$(x - (-3))^2 + (y - 0)^2 = \left(\sqrt{82}\right)^2$$

$$(x + 3)^2 + y^2 = 82$$

72. The radius of a circle is the distance from the center to any point on the circle. Since the center of this circle is (7,–12) and (13, 8) is a point on the circle, the radius is given by

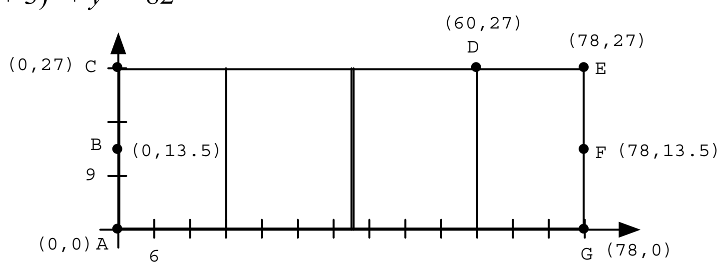
$$r = \sqrt{(13-7)^2 + [8-(-12)]^2} = \sqrt{36+400} = \sqrt{436}$$

Hence the equation of the circle is given by

$$(x - 7)^2 + (y - (-12))^2 = (\sqrt{436})^2$$

$$(x - 7)^2 + (y + 12)^2 = 436$$

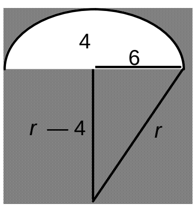
74.



$$d(A, D) = \sqrt{60^2 + 27^2} = 66 \text{ feet}$$

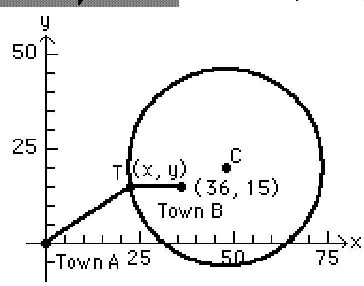
$$d(C, G) = \sqrt{78^2 + 27^2} = 83 \text{ feet}$$

76.



$$r^2 = (r - 4)^2 + 6^2$$
$$r^2 = r^2 - 8r + 16 + 36$$
$$8r = 52$$
$$r = 6.5 \text{ mm}$$

78. (A)



$$AT = 2TB$$

$$\sqrt{(x-0)^2 + (y-0)^2} = 2\sqrt{(x-36)^2 + (y-15)^2}$$

$$x^2 + y^2 = 4(x^2 - 72x + 36^2) + 4(y^2 - 30y + 15^2)$$
$$x^2 + y^2 = 4x^2 - 288x + 5184 + 4y^2 - 120y + 900$$
$$3x^2 - 288x + 3y^2 - 120y = -6084$$
$$x^2 - 96x + y^2 - 40y = -2028$$
$$x^2 - 96x + 2304 + y^2 - 40y + 400 = -2028 + 2304 + 400$$
$$(x - 48)^2 + (y - 20)^2 = 676 = 26^2\text{: circle}$$

center = (48, 20); radius = 26

(B) On the circle, find y when $x = 0$:

$$(x - 48)^2 + (0 - 20)^2 = 676$$
$$(x - 48)^2 = 276$$
$$x - 48 = \pm 16.613$$
$$x = 64.6 \text{ miles or } x = 31.4 \text{ miles}$$

Section 2-3

2. If, as one moves from left to right along the line, the y coordinates of points on the line decrease, the slope of the line is negative.

4. m represents the slope and (x_1, y_1) represent the coordinates of a point on the line.

6. Assume the two equations are $A_1x + B_1y = C_1$ and $A_2x + B_2y = C_2$. Then if one line is horizontal while the other is vertical, ($A_1 = 0$ and $B_2 = 0$ or $A_2 = 0$ and $B_1 = 0$), the lines are perpendicular. If no left-side coefficient is zero, then the slope of the lines are given by $-A_1/B_1$ and $-A_2/B_2$.

If $\left(-A_1/B_1\right)\left(-A_2/B_2\right) = -1$, the lines are perpendicular.

8. Using the points (–3, –3) and (1, 3),

Rise = 3 – (–3) = 6; Run = 1 – (–3) = 4; Slope = $\frac{6}{4} = \frac{3}{2}$

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

10. Using the points (0, –3) and (5, 3),

Rise = 3 – (–3) = 6; Run = 5 – 0 = 5; Slope = $\frac{6}{5}$

$$y - 3 = \frac{6}{5}(x - 5)$$
$$y - 3 = \frac{6}{5}x - 6$$
$$y = \frac{6}{5}x - 3$$
$$6x - 5y = 15$$

12. Using the points (–5, 3) and (–1, –2),

Rise = –2 – 3 = –5; Run = –1 – (–5) = 4; Slope = $-\frac{5}{4}$

$$y - (-2) = -\frac{5}{4}(x - (-1))$$
$$y + 2 = -\frac{5}{4}x - \frac{5}{4}$$
$$y = -\frac{5}{4}x - \frac{13}{4}$$
$$5x + 4y = -13$$

14. The x intercept is 1. The y intercept is 1. From the point (0, 1) to the point (1, 0) the value of y decreases by 1 unit as the value of x increases by 1 unit. Thus slope = $\frac{\text{rise}}{\text{run}} = \frac{-1}{1} = -1$.

Equation: $y = mx + b$

$y = -1x + 1$ or $y = -x + 1$

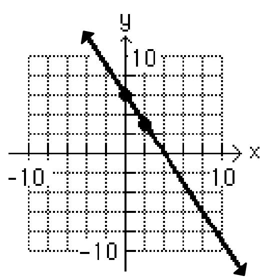
16. There is no x intercept. The y intercept is 3. The slope of this horizontal line is 0. The equation of this horizontal line is $y = 3$.

18. The x intercept is –2. There is no y intercept. The slope of this vertical line is undefined. The equation of this vertical line is $x = -2$.

20. $y = -\frac{3}{2}x + 6$

x	y
0	6
2	3

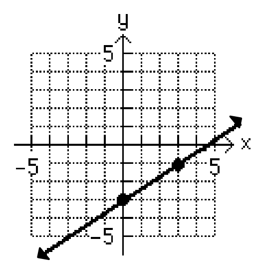
slope = $-\frac{3}{2}$



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

x	y
0	–3
3	–1

slope = $\frac{2}{3}$



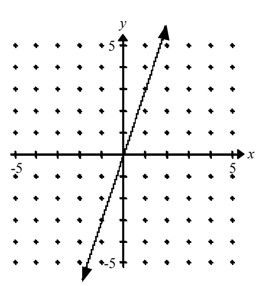
24. $6x - 2y = 0$

$-2y = -6x$

$y = 3x$

x	y
0	0
1	3
2	6

slope 3



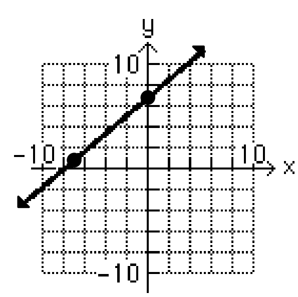
26. $6x - 7y = -49$

$7y = 6x + 49$

$y = \frac{6}{7}x + 7$

x	y
0	7
–7	1

slope = $\frac{6}{7}$



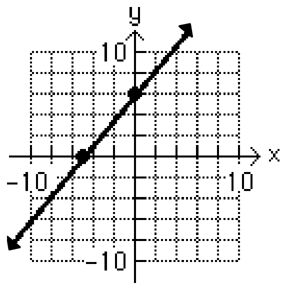
28. $\frac{y}{6} - \frac{x}{5} = 1$

$\frac{y}{6} = \frac{x}{5} + 1$

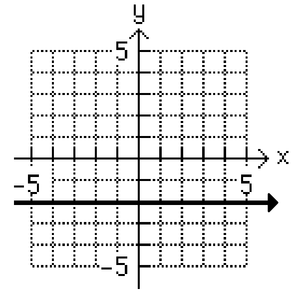
$y = \frac{6}{5}x + 6$

x	y
0	6
–5	0

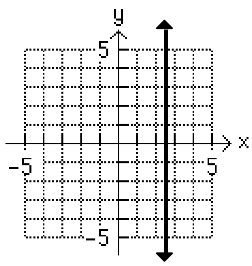
slope = $\frac{6}{5}$



30. $y = -2$,
horizontal line
slope = 0



32. $x = 2.5$,
vertical line
undefined slope



34. $m = 4$, $b = -10$:
$y = mx + b$
$y = 4x - 10$
$4x - y = 10$

36. $m = -\frac{5}{4}$, $b = \frac{11}{5}$:
$y = mx + b$
$y = -\frac{5}{4}x + \frac{11}{5}$
$20y = -25x + 44$
$25x + 20y = 44$

38. The equation of this horizontal line (the x axis) is $y = 0$.

40. A point and the slope are given; we use point-slope form.
$y - 0 = 3\,(x - 4)$
$y = 3x - 12$

42. A point and the slope are given; we use point-slope form.

$y - (-3) = -\frac{4}{5}(x - 2)$

$y + 3 = -\frac{4}{5}x + \frac{8}{5}$

$y = -\frac{4}{5}x - \frac{7}{5}$

44. A point and the slope are given; we use point-slope form.

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

$y - 1 = \frac{4}{3}x - \frac{8}{3}$

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

46. From the given information.
(2, 0); $m = 2$:
$y - y_1 = m(x - x_1)$
$y - 0 = 2(x - 2)$
$y = 2x - 4$

48. From the given information.
(–4, –2); $m = \frac{1}{2}$:

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

$y - (-2) = \frac{1}{2}\,(x - (-4))$

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

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

50. From the given information.

(–3, 4), (6, 1):

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$; $\quad y - y_1 = m(x - x_1)$

$m = \dfrac{1-4}{6-(-3)}$ $\quad y - 4 = -\dfrac{1}{3}(x - (-3))$

$m = -\dfrac{1}{3}$ $\quad y - 4 = -\dfrac{1}{3}x - 1$

$y = -\dfrac{1}{3}x + 3$

52. From the given information.

(2, –1), (10, 5):

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$; $\quad y - y_1 = m(x - x_1)$

$m = \dfrac{5-(-1)}{10-2}$ $\quad y - (-1) = \dfrac{3}{4}(x - 2)$

$m = \dfrac{3}{4}$ $\quad y + 1 = \dfrac{3}{4}x - \dfrac{3}{2}$

$y = \dfrac{3}{4}x - \dfrac{5}{2}$

54. From the given information.

(0, –2), (4, –2):

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-2-(-2)}{4-0}$

$m = 0$, horizontal line

$y = -2$

56. From the given information.

(–3, 1), (–3, –4):

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$m = \dfrac{-4-1}{-3-(-3)}$

$m = \dfrac{-5}{0}$, vertical line

$x = -3$

58. From the given information.

(–4, 0), (0, –5):

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-5-0}{0-(-4)} = -\dfrac{5}{4}$

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

$y - 0 = -\dfrac{5}{4}(x - (-4))$

$y = -\dfrac{5}{4}x - 5$

60. (–4, 0); | | to $y = -2x + 1$:

$y = -2x + 1$

$m = -2$, | | $m = -2$

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

$y - 0 = -2(x - (-4))$

$y = -2x - 8$

$2x + y = -8$

62. (–2, –4); $\perp$ to $y = \dfrac{2}{3}x - 5$

$y = \dfrac{2}{3}x - 5$; $m = \dfrac{2}{3}$

$\perp m = -\dfrac{3}{2}$

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

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

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

$2y + 8 = -3x - 6$

$3x + 2y = -14$

64. $3x + 4y = 8$

$4y = -3x + 8$

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

$m = -\dfrac{3}{4}$

| | $m = -\dfrac{3}{4}$

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

$y - 5 = -\dfrac{3}{4}(x - 3)$

$4y - 20 = -3x + 9$

$3x + 4y = 29$

66. $4x + 5y = 0$

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

$m = -\frac{4}{5}$

$\perp m = \frac{5}{4}$

$m = \frac{5}{4}$; $(-2, 4)$

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

$y - 4 = \frac{5}{4}(x - (-2))$

$4y - 16 = 5x + 10$

$5x - 4y = -26$

68. $m_{DA} = \frac{2-(-2)}{0-(-3)} = \frac{4}{3}$;

$m_{CB} = \frac{-5-(-1)}{1-4} = \frac{4}{3}$

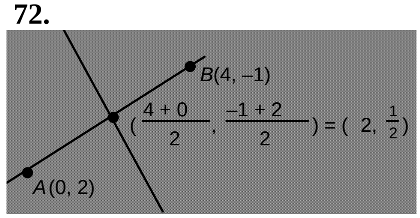
Since $m_{DA} = m_{CB} = \frac{4}{3}$, $DA \parallel CB$.

70. $m_{AD} = \frac{4}{3}$ from problem 68

$m_{DC} = \frac{-5-(-2)}{1-(-3)} = -\frac{3}{4}$ from which

$m_{AD} \cdot m_{DC} = -1$ which shows $AD \perp DC$.

72.



$m_{AB} = \frac{-1-2}{4-0} = -\frac{3}{4}$

$\perp m = \frac{4}{3}$

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

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

$6y - 3 = 8(x - 2)$

$6y - 3 = 8x - 16$

$8x - 6y = 13$

74. Two points are given; we first find the slope, then use the point-slope form.

$m = \frac{y_2 - y_1}{x_2 - x_1}$

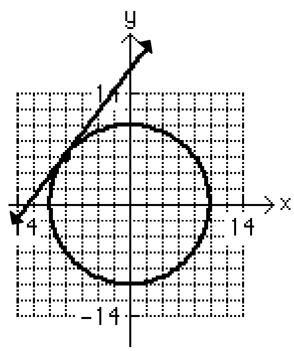
$y - y_1 = m(x - x_1)$

$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

Multiply both sides by $x_2 - x_1$ $(x_2 \neq x_1)$, then

$(y - y_1)(x_2 - x_1) = (y_2 - y_1)(x - x_1)$

76.



$x^2 + y^2 = 100$; $(-8, 6)$

Find m from the center, (0, 0), to (–8, 6):

$m = \frac{6-0}{-8-0} = -\frac{3}{4}$ $\perp m = \frac{4}{3}$

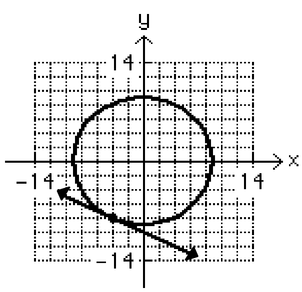
$y - y_1 = m(x - x_1)$

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

$3y - 18 = 4x + 32$

$4x - 3y = -50$

78.



$x^2 + y^2 = 80$; $(-4, -8)$

Find m from the center, (0, 0), to (–4, –8):

$m = \frac{-8-0}{-4-0} = 2$

$\perp m = -\frac{1}{2}$

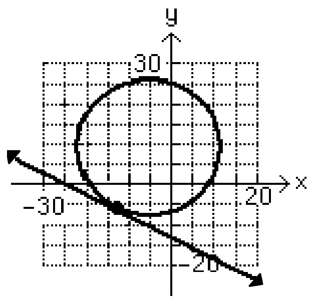
$y - y_1 = m(x - x_1)$

$y - (-8) = -\frac{1}{2}(x - (-4))$

$2y + 16 = -x - 4$

$x + 2y = -20$

80.



$(x + 5)^2 + (y - 9)^2 = 289$; $(-13, -6)$
center = $(-5, 9)$
radius = 17

Find m from the center $(-5, 9)$ to $(-13, -6)$:

$$m = \frac{9-(-6)}{-5-(-13)} = \frac{15}{8}$$

$$\perp m = -\frac{8}{15}$$

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

$$y - (-6) = -\frac{8}{15}(x - (-13))$$

$$15y + 90 = -8x - 104$$

$$8x + 15y = -194$$

82. (A)

x	0	1	2	3	4	5
A	25	16	7	–2	–11	–20

$A = 25 - 9x$

(B) For every kilometer increase in altitude the air temperature decreases 9°C.

84.

$$C = 1{,}200 + 45x$$
$$4{,}800 = 1{,}200 + 45x$$
$$3{,}600 = 45x$$
$$80 = x$$

80 tables can be produced.

86. (A) We write $d = mw + b$. Since $d_1 = 18$ when $w_1 = 3$ and $d_2 = 10$ when $w_2 = 5$, the slope is given by

$$m = \frac{d_2 - d_1}{w_2 - w_1} = \frac{10-18}{5-3} = -4$$

Then $d = -4w + b$.
Substituting $d_1 = 18$ when $w_1 = 3$, we obtain

$$18 = -4(3) + b$$
$$b = 30$$

Hence $d = -4w + 30$

(B) If $w = 0$, $d = 30$ inches.
(C) If $d = 0$, solve $0 = -4w + 30$ to obtain $w = 7.5$ pounds.

88. We write $R = mK + b$. Since $R_1 = 492$ when $K_1 = 273$ and $R_2 = 672$ when $K_2 = 373$, the slope is given by

$$m = \frac{R_2 - R_1}{K_2 - K_1} = \frac{672-492}{373-273} = 1.8$$

Then $R = 1.8K + b$.
Substituting $R_1 = 492$ when $K_1 = 273$, we obtain

$$492 = 1.8(273) + b$$
$$b = 0.6$$

Hence $R = 1.8K + 0.6$

90. (A) We write $h = mt + b$. Since $h_1 = 7$ when $t_1 = 9$ and $h_2 = 11$ when $t_2 = 25$, the slope is given by

$$m = \frac{h_2 - h_1}{t_2 - t_1} = \frac{11-7}{25-9} = \frac{1}{4} = 0.25$$

Then $h = 0.25t + b$.
Substituting $h_1 = 7$ when $t_1 = 9$, we obtain

$$7 = 0.25(9) + b$$
$$b = 4.75$$

Hence $h = 0.25t + 4.75$.

(B) Solve $20 = 0.25t + 4.75$

$$15.25 = 0.25t$$
$$t = 61 \text{ hours}$$

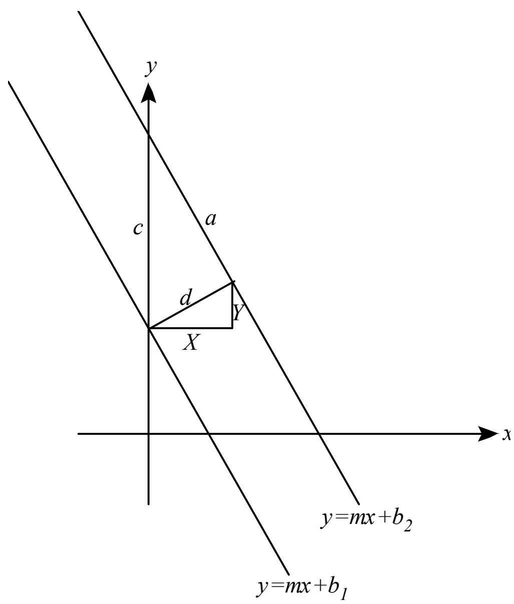
92. (A) We write $N = mt + b$. Since $N_1 = 4.76$ when $t_1 = 0$ and $N_2 = 2.59$ when $t_2 = 100$, the slope is given by

$$m = \frac{N_2 - N_1}{t_2 - t_1} = \frac{2.59 - 4.76}{100 - 0} \approx -0.0217$$

Then $N = -0.0217t + b$.
Substituting $N_1 = 4.76$ when $t_1 = 0$, we obtain $4.76 = b$.
Hence $N = -0.0217t + 4.76$.

(B) We are asked for N when $t = 125$.
$N = -0.0217(125) + 4.76$
$N = 2.05$ persons per household

94.



In general, we can show that $d = \frac{c}{\sqrt{1+m^2}}$ as follows:
The Pythagorean Theorem gives:
$d^2 + a^2 = c^2$
The two triangles shown are similar, hence corresponding sides are proportional. Thus

$$\frac{a}{d} = \frac{X}{Y}$$

The slope of the line segment labeled d is the negative reciprocal of m.

Thus $\frac{Y}{X} = -\frac{1}{m}$

$$\frac{X}{Y} = -m$$

It follows that $a = \frac{X}{Y}d = -md$.

Hence $d^2 + (-md)^2 = c^2$

$$d^2(1 + m^2) = c^2$$

$$d^2 = \frac{c^2}{1+m^2}$$

$$d = \frac{c}{\sqrt{1+m^2}}$$

In particular, avenue A is shown to have a rise of –5000 and a run of 4000, hence $m = -\frac{5000}{4000} = -1.25$. The equation of avenue A is then (using the slope-intercept form $y = mx + b$) $y = -1.25x + 4000$. Avenue B has the same slope, and y intercept 4000. Avenue C has the same slope, and y intercept 2000. Substituting in the above formula, with $c = 4000 - 2000 = 2000$, yields

$$d_2 = \frac{2000}{\sqrt{1+(-1.25)^2}} = 1{,}249 \text{ ft.}$$

Section 2-4

2. Given the values y_1 and y_2 associated with x_1 and x_2 respectively, then

$$\text{rate of change} = \text{slope of line} = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}.$$

4. If x_1 and x_2 are, respectively, the lowest and highest values for the independent variable data, then interpolation represents analyzing values of the variables for x between x_1 and x_2, while extrapolation represents analyzing values of the variables for $x < x_1$ or $x > x_2$.

6. (A) If cost y is linearly related to the number of tennis rackets x_1 then we are looking for an equation whose graph passes through $(x_1, y_1) = (50, 4{,}174)$ and $(x_2, y_2) = (60, 4{,}634)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4{,}634 - 4{,}174}{60 - 50} = 46$$

$$y - y_1 = m(x - x_1)$$
$$y - 4{,}174 = 46(x - 50)$$
$$y - 4{,}174 = 46x - 2300$$
$$y = 46x + 1{,}874$$

(B) The slope of 46 is the rate of change of cost with respect to production, $46 per tennis racket.
(C) Increasing production by 1 unit increases cost by $46.

8. (A) The rate of change of height with respect to DBH is 2.27 feet per inch.

(B) Increasing DBH by 1 inch increases height by 2.27 feet.

(C) Substitute $d = 12$ into $h = 2.27d + 33.1$ to obtain

$$h = 2.27(12) + 33.1$$
$$h = 60 \text{ feet}$$

(D) Substitute $h = 100$ into $h = 2.27d + 33.1$ and solve.

$$100 = 2.27d + 33.1$$
$$66.9 = 2.27d$$
$$d = 29 \text{ inches}$$

10. (A) Robinson: The rate of change of weight with respect to height is 4.2 pounds per inch.
Miller: The rate of change of weight with respect to height is 3.1 pounds per inch.

(B) 5'10" = 10 inches over 5 feet
Substitute $h = 10$ into each model.
Robinson: $w = 115 + 4.2(10) = 157$ pounds
Miller: $w = 124 + 3.1(10) = 155$ pounds

(C) Substitute $w = 160$ into each model and solve.
Robinson: $160 = 115 + 4.2h$
$45 = 4.2h$
$h = 11$ inches, predicting 5'11".
Miller: $160 = 124 + 3.1h$
$36 = 3.1h$
$h = 12$ inches, predicting 6'.

12. If speed s is linearly related to temperature t, then we are looking for an equation whose graph passes through $(t_1, s_1) = (10, 337)$ and $(t_2, s_2) = (20, 343)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{s_2 - s_1}{t_2 - t_1} = \frac{343 - 337}{20 - 10} = 0.6$$

$$s - s_1 = m(t - t_1)$$
$$s - 337 = 0.6(t - 10)$$
$$s - 337 = 0.6t - 6$$
$$s = 0.6t + 331$$

The speed of sound at sea level increases by 0.6 mph for each 1˚C change in temperature.

14. If percentage f is linearly related to time t, then we are looking for an equation whose graph passes through $(t_1, f_1) = (0, 21.0)$ and $(t_2, f_2) = (6, 18.0)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{f_2 - f_1}{t_2 - t_1} = \frac{18.0 - 21.0}{6 - 0} = -0.5$$

$$f - f_1 = m(t - t_1)$$
$$f - 21.0 = -0.5(t - 0)$$
$$f = -0.5t + 21.0$$

To find t when $f = 10$, substitute $f = 10$ and solve.

$$10 = -0.5t + 21.0$$
$$-11 = -0.5t$$
$$t = 22$$

22 years after 2000 will be 2022.

16. (A) If value V is linearly related to time t, then we are looking for an equation whose graph passes through $(t_1, V_1) = (0, 154{,}900)$ and $(t_2, V_2) = (16, 46{,}100)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{V_2 - V_1}{t_2 - t_1} = \frac{46{,}100 - 154{,}900}{16 - 0} = -6{,}800$$

$$V - V_1 = m(t - t_1)$$
$$V - 154{,}900 = -6{,}800(t - 0)$$
$$V = -6{,}800t + 154{,}900$$

(B) The boat's value decreases at the rate of \$6,800 per year.

(C) To find t when $V = 100{,}000$ substitute $V = 100{,}000$ and solve.

$$100{,}000 = -6{,}800t + 154{,}900$$
$$-54{,}900 = -6{,}800t$$
$t = 8.07$, that is, during the ninth year

18. (A) If price R is linearly related to cost C, then we are looking for an equation whose graph passes through $(C_1, R_1) = (20, 33)$ and $(C_2, R_2) = (60, 93)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{R_2 - R_1}{C_2 - C_1} = \frac{93 - 33}{60 - 20} = 1.5$$

$$R - R_1 = m(C - C_1)$$
$$R - 33 = 1.5(C - 20)$$
$$R - 33 = 1.5C - 30$$
$$R = 1.5C + 3$$

(B) The slope is 1.5. This is the rate of change of retail price with respect to cost.

(C) To find C when $R = 240$, substitute $R = 240$ and solve.

$$240 = 1.5C + 3$$
$$237 = 1.5C$$
$$C = \$158$$

20. (A) Since the true airspeed is 2% more than the indicated airspeed for each 1000 feet of altitude, an indicated airspeed of 200 mph must be adjusted by 2% (200) = 4 mph for each 1000 feet of altitude. Thus T is linearly related to A with a slope of $4 = m$. Then $T = 4A + b$. Since $T = 200$ (true airspeed = indicated airspeed) when $A = 0$, the y intercept $b = 200$. Thus $T = 4A + 200$.

(B) Substitute $A = 6.5$ to obtain $T = 4(6.5) + 200 = 226$ mph.

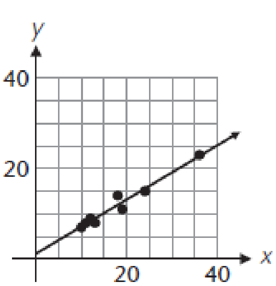
22. (A) If altitude a is linearly related to time t, then we are looking for an equation whose graph passes through $(t_1, a_1) = (0, 2{,}880)$ and $(t_2, a_2) = (180, 0)$. We find the slope and then use the point-slope form to find the equation.

$$m = \frac{a_2 - a_1}{t_2 - t_1} = \frac{0 - 2{,}880}{180 - 0} = -16$$

$$a - a_1 = m(t - t_1)$$
$$a - 2{,}880 = -16(t - 0)$$
$$a = -16t + 2{,}880$$

(B) Since altitude is decreasing at the rate of 16 feet per second, this is the rate of descent.

24. (A)



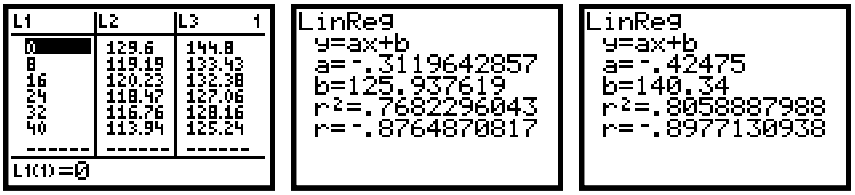
(B) Substitute $x = 9.4$ into $y = 0.6x + 1.15$ to obtain

$y = 0.6(9.4) + 1.15 \approx 6.8$ million

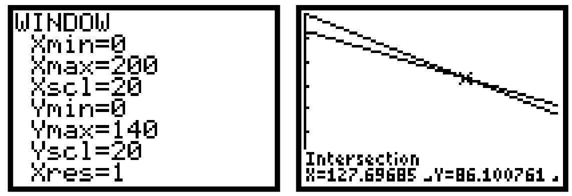
(C) Substitute $x = 8.7$ into $y = 0.6x + 1.15$ to obtain

$y = 0.6(8.7) + 1.15 \approx 6.4$ million

26. The entered data is shown here along with the results of the linear regression calculations.

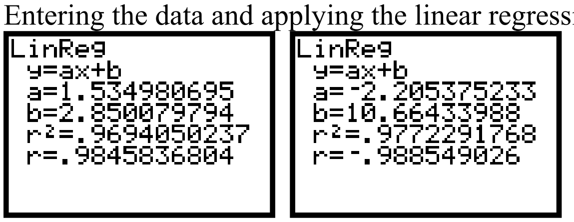


The linear regression model for men's 200-meter backstroke data is seen to be $y = -0.3120x + 125.94$. The linear regression model for women's 200-meter backstroke data is seen to be $y = -0.4248x + 140.34$. A plausible window is shown here, along with the results of an intersection calculation.

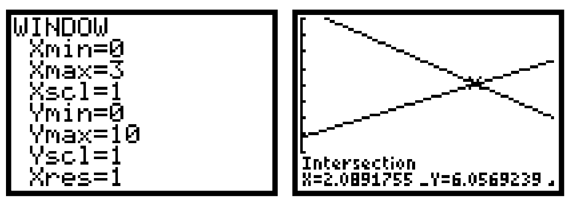


The fact that the lines intersect indicates that, according to this model, the women will eventually catch up with the men.

28. Entering the data and applying the linear regression routine yields the following:



The linear regression model for the price-supply data is seen to be $y = 1.53x + 2.85$. The linear regression model for the price-demand data is seen to be $y = -2.21x + 10.7$. A plausible window is shown here, along with the results of the intersection calculation.



The intersection for $y = 6.06$ implies an equilibrium price of \$6.06.

Chapter 2 Group Activity

1. (A) Total distance = 15 + 20 + 30 = 65 miles

$$\text{Total time} = \frac{15\text{ miles}}{21\text{ mph}} + \frac{20\text{ miles}}{18\text{ mph}} + \frac{30\text{ miles}}{12\text{ mph}} = \frac{545}{126}\text{ hours}$$

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}} = 65 \div \frac{545}{126} = \frac{1638}{109} \approx 15.03\text{ mph}$$

(B) Total distance = (18 mph) × (2 hr) + (12 mph) × (2 hr) = 60 miles

Total time = 2 + 2 = 4 hr

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{60\text{ miles}}{4\text{ hr}} = 15\text{ mph}$$

(C) Average pace = $\dfrac{\text{total time (in minutes)}}{\text{total distance}}$

In the first part of the race the distance covered = 60 minutes ÷ 8 minutes per mile = 7.5 miles.

In the second part of the race the time elapsed = (10 – 7.5 miles) × 9 minutes per mile = 22.5 minutes.

Then the total time in minutes = 60 + 22.5 = 82.5 minutes.

Total distance = 10 miles

Average pace = $\dfrac{\text{total time}}{\text{total distance}} = \dfrac{\text{82.5 minutes}}{\text{10 miles}}$ = 8.25 minutes per mile or 8 minutes, 15 seconds per mile.

Average speed = $\dfrac{\text{total distance in miles}}{\text{total time in hours}}$

Average speed × Average pace = number of minutes in 1 hour = 60.