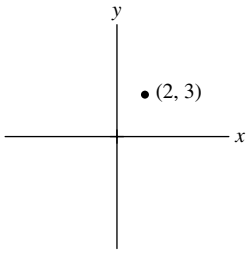
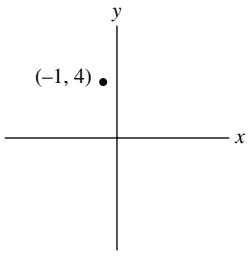
# Chapter 1

**Exercises 1.1**

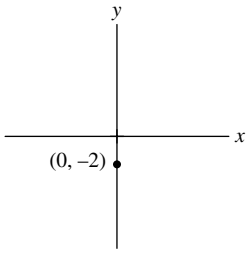
**1.** Right 2, up 3



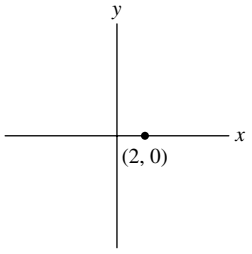

**2.** Left 1, up 4



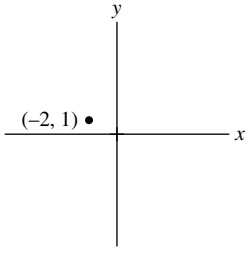

**3.** Down 2



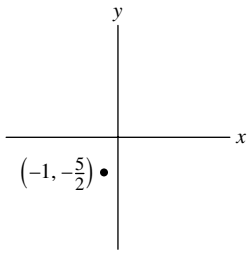

**4.** Right 2



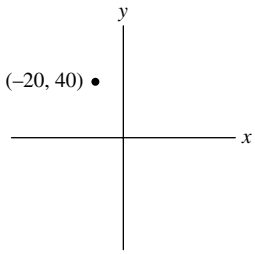

**5.** Left 2, up 1



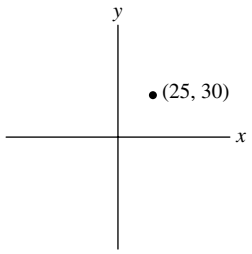

**6.** Left 1, down $\frac{5}{2}$




**7.** Left 20, up 40




**8.** Right 25, up 30




**9.** e

**10.** d

**11.** $-2(1)+\frac{1}{3}(3)=-2+1=-1$ so the point is on the line.

**12.** $-2(2)+\frac{1}{3}(6)=-1$ is false, so the point is not on the line

**13.** $-2x+\frac{1}{3}y=-1$ Substitute the x and y coordinates of the point into the equation:
$\left(\frac{1}{2},3\right)\rightarrow -2\left(\frac{1}{2}\right)+\frac{1}{3}(3)=-1\rightarrow -1+1=-1$
is a false statement. So the point is not on the line.

**14.** $-2\left(\frac{1}{3}\right)+\left(\frac{1}{3}\right)(-1)=-1$ is true so the point is on the line.

**15.** $m = 5$, $b = 8$

**16.** m = –2 and b = –6

**17.** $y = 0x + 3$; $m = 0$, $b = 3$

**18.** $y=\frac{2}{3}x+0;\ m=\frac{2}{3},\ b=0$

**19.** $14x+7y=21$

$7y=-14x+21$

$y=-2x+3$

**20.** $x-y=3$

$-y=-x+3$

$y=x-3$

**21.** $3x=5$

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

**22.** $-\frac{1}{2}x+\frac{2}{3}y=10$

$\frac{2}{3}y=\frac{1}{2}x+10$

$y=\frac{3}{4}x+15$

**23.** $0=-4x+8$

$4x=8$

$x=2$

$x$-intercept: (2, 0)

$y = –4(0) + 8$

$y = 8$

$y$-intercept: (0, 8)

**24.** 0 = 5

no solution

$x$-intercept: none

When $x = 0$, $y = 5$

$y$-intercept: (0, 5)

**25.** When $y = 0$, $x = 7$

$x$-intercept: (7, 0)

0 = 7

no solution

$y$-intercept: none

**26.** $0 = –8x$

$x = 0$

$x$-intercept: (0, 0)

$y = –8(0)$

$y = 0$

$y$-intercept: (0, 0)

**27.** $0=\frac{1}{3}x-1$

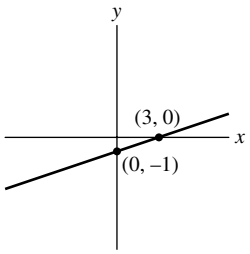
$x = 3$

$x$-intercept: (3, 0)

$y=\frac{1}{3}(0)-1$

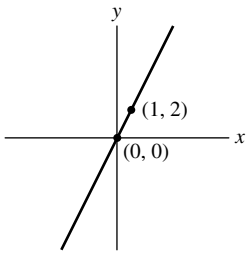
$y = –1$

$y$-intercept: (0, –1)




**28.** When $x = 0$, $y = 0$.

When $x = 1$, $y = 2$.



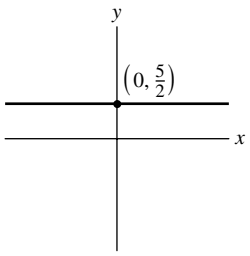
**29.** $0 = \frac{5}{2}$

no solution

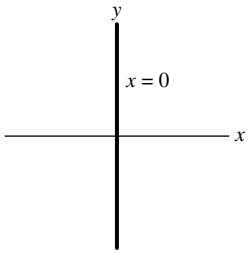
*x*-intercept: none

When $x = 0$, $y = \frac{5}{2}$

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




**30.** The line coincides with the *y*-axis.




**31.** $3x + 4(0) = 24$

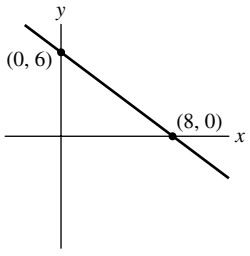
$x = 8$

*x*-intercept: (8, 0)

$3(0) + 4y = 24$

$y = 6$

*y*-intercept: (0, 6)




**32.** $x + 0 = 3$

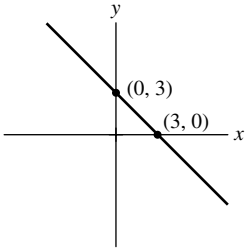
$x = 3$

*x*-intercept: (3, 0)

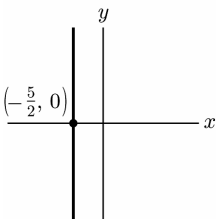
$0 + y = 3$

$y = 3$

*y*-intercept: (0, 3)




**33.** $x = -\frac{5}{2}$




**34.** $\frac{1}{2}x - \frac{1}{3}(0) = -1$

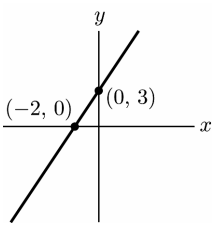
$x = -2$

x intercept (–2, 0)

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

$y = 3$

*y* intercept (0, 3)



**35.** $2x+3y=6$

$3y=-2x+6$

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

**a.** $4x+6y=12$

$6y=-4x+12$

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

Yes

**b.** Yes

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

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

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

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

Yes

**d.** $6-2x-y=0$

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

No

**e.** $y=2-\frac{2}{3}x=-\frac{2}{3}x+2$

Yes

**f.** $x+y=1$

$y=-x+1$

No

**36.** $\frac{1}{2}x-5y=1$

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

$y=\frac{1}{10}x-\frac{1}{5}$

**a.** $2x-\frac{1}{5}y=1$

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

$y=10x-5$

No

**b.** $x=5y+2$

$5y=x-2$

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

No

**c.** $2-5x+10y=0$

$-10y=-5x+2$

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

No

**d.** $y=0.1(x-2)$

$y=0.1x-0.2$

$y=\frac{1}{10}x-\frac{1}{5}$

Yes

**e.** $10y-x=-2$

$10y=x-2$

$y=\frac{1}{10}x-\frac{1}{5}$

Yes

**f.** $1+0.5x=2+5y$

$5y=0.5x-1$

$y=\frac{1}{10}x-\frac{1}{5}$

Yes

**37. a.** $x + y = 3$

$y = -x + 3$

$m = -1, b = 3$

$L_3$

**b.** $2x - y = -2$

$-y = -2x - 2$

$y = 2x + 2$

$m = 2, b = 2$

$L_1$

**c.** $x = 3y + 3$

$3y = x - 3$

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

$m = \frac{1}{3}, \ b = -1$

$L_2$

**38. a.** No; $5 + 4 \neq 3$

**b.** No; $2 \neq 1 - 1$

**c.** Yes; $2(2) = 1 + 3$ and $2(4) = 5 + 3$

**39.** $y = 30x + 72$

**a.** When x = 0, y = 72. This is the temperature of the water at time = 0 before the kettle is turned on.

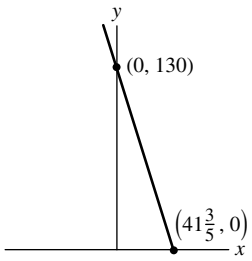
**b.** $y = 30(3) + 72$

$y = 162^{\circ} F$

**c.** Water boils when y = 212 so we have $212 = 30x + 72$. Solving for x gives x = 4.67 minutes or 4 minutes 40 seconds.

**40. a.** *x*-intercept: $\left(41\frac{3}{5}, 0\right)$

*y*-intercept: (0, 130)




**b.** In 1969 there were 130,000 square miles of rain forest.

**c.** $80 = \left(-\frac{25}{8}\right)x + 130$

$x = 16$

1969 + 16 = 1985

**d.** $2007 - 1969 = 38$

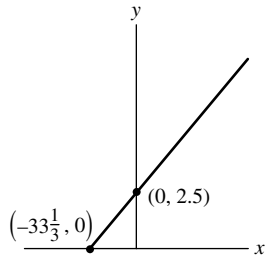
$y = \left(-\frac{25}{8}\right)(38) + 130$

$y = 11.25$

There will be 11,250 square miles of rain forest remaining in 2007.

**41. a.** *x*-intercept: $\left(-33\frac{1}{3}, 0\right)$

*y*-intercept: (0, 2.5)




**b.** In 1960, 2.5 trillion cigarettes were sold.

**c.** $4 = .075x + 2.5$

$x = 20$

1960 + 20 = 1980

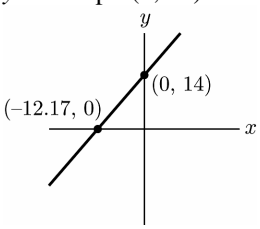
**d.** 2020 – 1960 = 60

$y = .075(60) + 2.5$

$y = 7$

7 trillion

**42. a.** *x*-intercept: (–12.17, 0)
*y*-intercept: (0, 14)

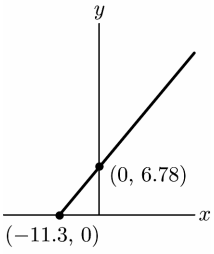



**b.** In 2000 the income from ecotourism was \$14,000.

**c.** $20 = 1.15x + 14$
$x \approx 5.22$
$2000 + 5.22 = 2005.22$
The year 2005.

**d.** $2016 - 2000 = 16$
$y = 1.15(16) + 14$
$y = 32.4$
\$32,400

**43. a.** *x*-intercept: (–11.3, 0)
*y*-intercept: (0, 678)




**b.** In 1997 the car insurance rate for a small car was \$678.

**c.** $2000 - 1997 = 3$
$y = 60(3) + 678$
$y = 858$
\$858

**d.** $1578 = 60x + 678$
$x = 15$
$1997 + 15 = 2012$
The year 2012

**44. a.** In 2000, 3.85% of entering college freshmen intended to major in biology.

**b.** $2005 - 2000 = 5$
$y = 0.15(5) + 3.85$
$y = 4.6$
4.6% of college freshmen in 2005 intended to major in biology

**c.** $4.9 = 0.15x + 3.85$
$x = 7$
$2000 + 7 = 2007$
In 2007, the percent of college freshmen that intended to major in biology was 4.9.

**45. a.** In 2000, 10% of college freshmen smoked.

**b.** $2005 - 2000 = 5$
$y = \left(-\frac{26}{35}\right)(5) + 10$
$y \approx 6.3$
6.3% of college freshmen smoked in 2005.

**c.** $4.8 = -\frac{26}{35}x + 10$
$x = 7$
$2000 + 7 = 2007$
In 2007, the percent of college freshmen that smoked was 4.8.

**46.** $y = mx + b$
$8 = m(0) + b$
$b = 8$
$0 = m(16) + 8$
$m = -\frac{1}{2}$
$y = -\frac{1}{2}x + 8$

**47.** $y = mx + b$
$0.9 = m(0) + b$
$b = 0.9$
$0 = m(0.6) + 0.9$
$m = -1.5$
$y = -1.5x + 0.9$

**48.** $y = mx + b$
$5 = m(0) + b$
$b = 5$
$0 = m(4) + 5$
$m = -\frac{5}{4}$
$y = -\frac{5}{4}x + 5$

**49.** On the $x$-axis, $y = 0$.

**50.** No, because two straight lines (the graphed line and the $x$-axis) cannot intersect more than once.

**51.** y = b is an equation of a line parallel to the x-axis.

**52.** $\frac{x}{a} + \frac{y}{b} = 1$
$x$-intercept:
$\frac{x}{a} + \frac{0}{b} = 1$
$x = a$
(a, 0)
$y$-intercept:
$\frac{0}{a} + \frac{y}{b} = 1$
$y = b$
(0, b)

**53.** $2x - y = -3$

**54.** $1 \cdot x + 0 \cdot y = 5$

**55.** $1 \cdot x + 0 \cdot y = -3$

**56.** $-3x + y = -4$

**57.** $\frac{2}{3}x + y = -5$
$2x + 3y = -15$

**58.** $4x - y = \frac{5}{6}$
$24x - 6y = 5$

**59.** Since (a,0) and (0,b) are points on the line the slope of the line is (b-0)/(0-a) = -b/a. Since the y intercept is (0,b), the equation of the line is $y = -(b/a)x + b$ or $ay = -bx + ab$. In general form, the equation is bx + ay = ab.

**60.** If (5, 0) and (0, 6) are on the line, then a = 5 and b = 6. Substituting these values into the equation bx + ay = ab gives 6x + 5y = 30.

**61.** One possible equation is $y = x - 9$.

**62.** One possible equation is $y = x + 10$.

**63.** One possible equation is $y = x + 7$.

**64.** One possible equation is $y = x - 6$.

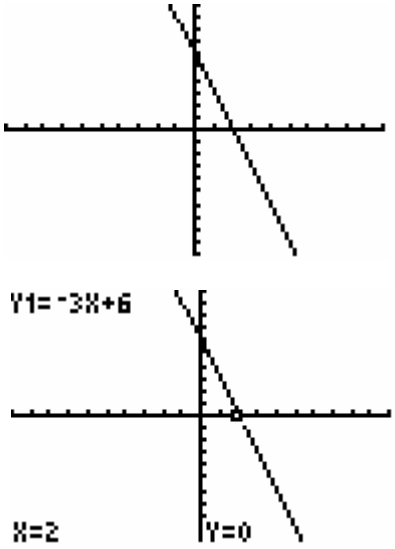
**65.** One possible equation is $y = x + 2$.

**66.** One possible equation is $y = x$.

**67.** One possible equation is $y = x + 9$.

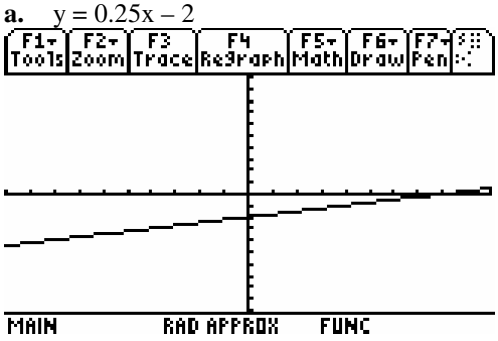
**68.** One possible equation is $y = x - 5$.

**69**. **a.** y = –3x + 6




**b**. When $x = 2$, $y = 0$
**c**. The intercepts are at the points (2, 0) and (0, 6)

**70**. **a.** y = 0.25x – 2

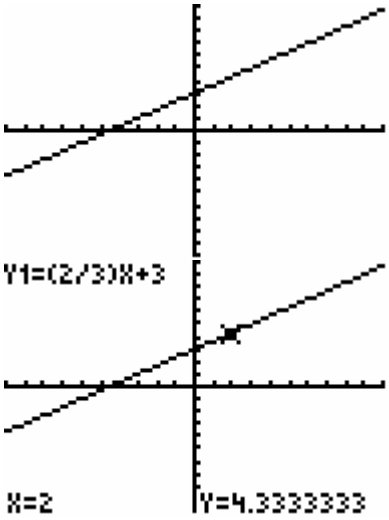



**b.** When x = 2, y = –1.5.
**c.** (0, –2) and ( 8,0) are intercepts

**71. a.** $3y - 2x = 9$

$3y = 2x + 9$

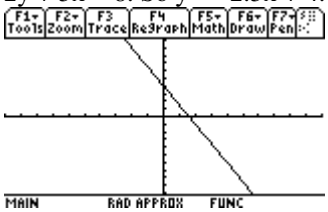
$y = \frac{2}{3}x + 3$




**b.** When $x = 2$, $y = 4.33$ or $13 / 3$.

**c.** The intercepts are at the points (–4.5, 0) and (0, 3).

**72. a.** $2y + 5x = 8$. So $y = –2.5x + 4$.




**b.** When x = 2 then y = –1.

**c.** The intercepts are (0, 4) and (1.6, 0)

**73.** 2y + x = 100. When y = 0, x = 100. and when x = 0, y = 50. An appropriate window might be [-10, 110] and [-10,60]. Other answers are possible.

**74.** x – 3y = 60. When x = 0, then y = - 20 and when y = 0 x = 60. An appropriate window might be [ -30, 70] and [-30 , 30] but other answers are equally correct.

**Exercises 1.2**

**1.** False

**2.** True

**3.** True

**4.** False

**5.** $2x - 5 \geq 3$

$2x \geq 8$

$x \geq 4$

**6.** $3x - 7 \leq 2$

$3x \leq 9$

$x \leq 3$

**7.** $–5x + 13 \leq –2$

$–5x \leq –15$

$x \geq 3$

**8.** $–x + 1 \leq 3$

$–x \leq 2$

$x \geq –2$

(d)

**9.** $2x + y \leq 5$

$y \leq –2x + 5$

**10.** $–3x + y \geq 1$

$y \geq 3x + 1$

**11.** $5x - \frac{1}{3}y \leq 6$

$-\frac{1}{3}y \leq -5x + 6$

$y \geq 15x - 18$

**12.** $\frac{1}{2}x - y \leq -1$

$-y \leq -\frac{1}{2}x - 1$

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

**13.** $4x \geq -3$

$x \geq -\frac{3}{4}$

**14.** $–2x \leq 4$

$x \geq –2$

**15.** $3(2) + 5(1) \leq 12$

$6 + 5 \leq 12$

$11 \leq 12$

Yes

**16.** $-2(3) + 15 \geq 9$
$-6 + 15 \geq 9$
$9 \geq 9$
Yes

**17.** $0 \geq -2(3) + 7$
$0 \geq -6 + 7$
$0 \geq 1$
No

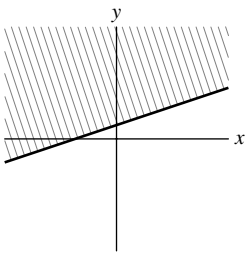
**18.** $6 \leq \frac{1}{2}(4) + 3$
$6 \leq 2 + 3$
$6 \leq 5$
No

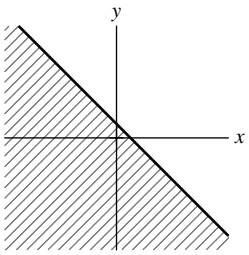
**19.** $5 \leq 3(3) - 4$
$5 \leq 9 - 4$
$5 \leq 5$
Yes

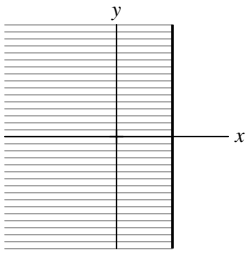
**20.** $-2 \geq -3$
Yes

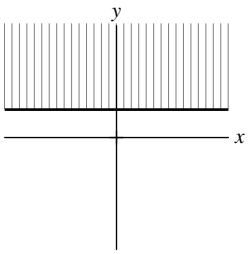
**21.** $7 \geq 5$
Yes

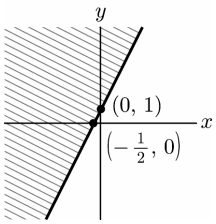
**22.** $0 \leq 7$
Yes

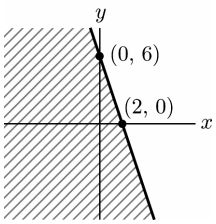
**23.**


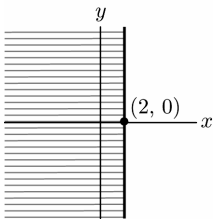

**24.**


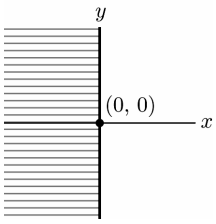

**25.**



**26.**



**27.**


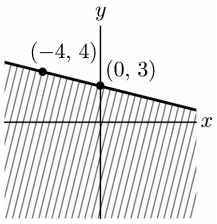

**28.**



**29.**



**30.**


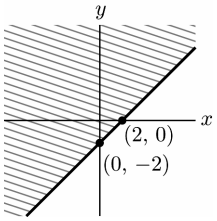
**31.** $x + 4y \geq 12$

$$y \geq -\frac{1}{4}x + 3$$



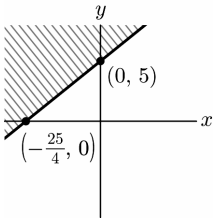

**32.** $4x - 4y \geq 8$

$$y \leq x - 2$$



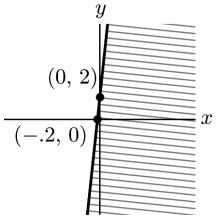

**33.** $4x - 5y + 25 \geq 0$

$$y \leq \frac{4}{5}x + 5$$



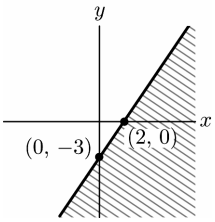

**34.** $0.1y - x = 0.2$

$$y \geq 10x + 2$$



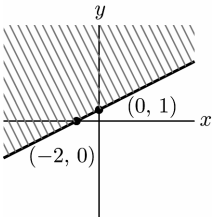

**35.** $\frac{1}{2}x - \frac{1}{3}y \leq 1$

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



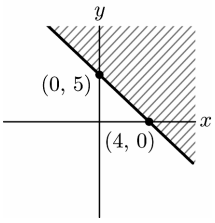

**36.** $3y + \frac{1}{2}x \leq 2y + x + 1$

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



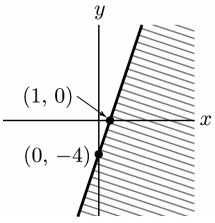

**37.** $0.5x + 0.4y \leq 2$

$$y \leq -1.25x + 5$$

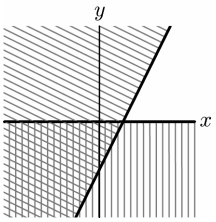



**38.** $y - 2x \geq \frac{1}{2}y - 2$

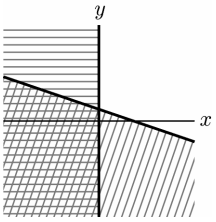
$$y \geq 4x - 4$$



**39.** $\begin{cases} y \le 2x - 4 \\ y \ge 0 \end{cases}$

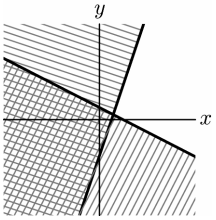



**40.** $\begin{cases} y \ge -\frac{1}{3}x + 1 \\ x \ge 0 \end{cases}$



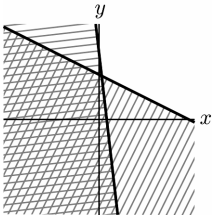

**41.** $\begin{cases} x + 2y \ge 2 \\ 3x - y \ge 3 \end{cases}$

$\begin{cases} y \ge -\frac{1}{2}x + 1 \\ y \le 3x - 3 \end{cases}$



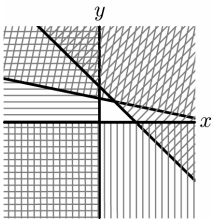

**42.** $\begin{cases} 3x + 6y \ge 24 \\ 3x + y \ge 6 \end{cases}$

$\begin{cases} y \ge -\frac{1}{2}x + 4 \\ y \ge -3x + 6 \end{cases}$



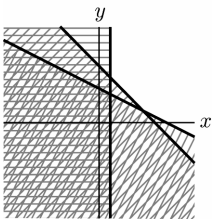

**43.** $\begin{cases} x + 5y \le 10 \\ x + y \le 3 \\ x \ge 0,\ y \ge 0 \end{cases}$

$\begin{cases} y \le -\frac{1}{5}x + 2 \\ y \le -x + 3 \\ x \ge 0,\ y \ge 0 \end{cases}$




**44.** $\begin{cases} x + 2y \ge 6 \\ x + y \ge 5 \\ x \ge 1 \end{cases}$

$\begin{cases} y \ge -\frac{1}{2}x + 3 \\ y \ge -x + 5 \\ x \ge 1 \end{cases}$




**45.** $\begin{cases} 6(8) + 3(7) \le 96 \\ 8 + 7 \le 18 \\ 2(8) + 6(7) \le 72 \\ 8 \ge 0,\ 7 \ge 0 \end{cases}$

$\begin{cases} 69 \le 96 \\ 15 \le 18 \\ 58 \le 72 \\ 8 \ge 0,\ 7 \ge 0 \end{cases}$

Yes

**46.** $\begin{cases} 6(14)+3(3) \le 96 \\ 14+3 \le 18 \\ 2(14)+6(3) \le 72 \\ 14 \ge 0,\ 3 \ge 0 \end{cases}$

$\begin{cases} 93 \le 96 \\ 17 \le 18 \\ 46 \le 72 \\ 14 \ge 0,\ 3 \ge 0 \end{cases}$

Yes

**47.** $\begin{cases} 6(9)+3(10) \le 96 \\ 9+10 \le 18 \\ 2(9)+6(10) \le 72 \\ 9 \ge 0,\ 10 \ge 0 \end{cases}$

$\begin{cases} 84 \le 96 \\ 19 \le 18 \\ 78 \le 72 \\ 9 \ge 0,\ 10 \ge 0 \end{cases}$

No

**48.** $\begin{cases} 6(16)+3(0) \le 96 \\ 16+0 \le 18 \\ 2(16)+6(0) \le 72 \\ 16 \ge 0,\ 0 \ge 0 \end{cases}$

$\begin{cases} 96 \le 96 \\ 16 \le 18 \\ 32 \le 72 \\ 16 \ge 0,\ 0 \ge 0 \end{cases}$

Yes

**49.** For $x = 3$, $y = 2(3) + 5 = 11$.
So (3, 9) is below.

**50.** $3x - y = 4$
$y = 3x - 4$
For $x = 2$, $y = 3(2) - 4 = 2$.
So (2, 3) is above.

**51.** $7 - 4x + 5y = 0$

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

For $x = 0$, $y = \frac{4}{5}(0) - \frac{7}{5} = -\frac{7}{5}$.
So (0, 0) is above.

**52.** $x = 2y + 5$

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

For $x = 6$, $y = \frac{1}{2}(6) - \frac{5}{2} = \frac{1}{2}$.
So (6, 1) is above.

**53.** $8x - 4y = 4$
$y = 2x - 1$
$8x - 4y = 0$
$y = 2x$

$\begin{cases} y \ge 2x - 1 \\ y \le 2x \end{cases}$

**54.** e

**55.** d

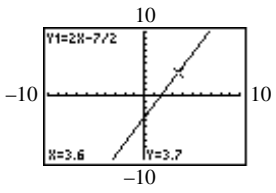
**56.** d

**57.** e

**58.** $4x - 2y = 7$

$$y = 2x - \frac{7}{2}$$

**a.**



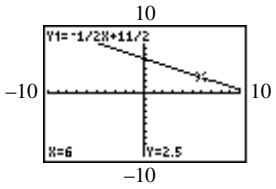

(3.6, 3.7)

**b.** Below, because (3.6, 3.7) is on the line.

**59.** $x + 2y = 11$

$$y = -\frac{1}{2}x + \frac{11}{2}$$

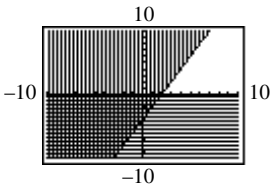
**a.**




(6, 2.5)

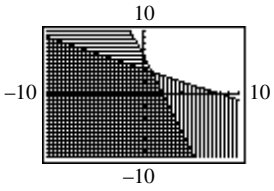
**b.** Above, because (6, 2.5) is on the line.

**60.**




**61.** $\begin{cases} 3x + 6y \geq 24 \\ 3x + y \geq 6 \end{cases}$

$$\begin{cases} y \geq -\frac{1}{2}x + 4 \\ y \geq -3x + 6 \end{cases}$$




**Exercises 1.3**

**1.** $4x - 5 = -2x + 7$
$6x = 12$
$x = 2$
$y = 4(2) - 5 = 3$
(2, 3)

**2.** $3x - 15 = -2x + 10$
$5x = 25$
$x = 5$
$y = 3(5) - 15 = 0$
(5, 0)

**3.** $x = 4y - 2$
$x = -2y + 4$
$4y - 2 = -2y + 4$
$6y = 6$
$y = 1$
$x = 4(1) - 2 = 2$
(2, 1)

**4.** $\begin{cases} 2x - 3y = 3 \\ y = 3 \end{cases}$

$$x = \frac{3}{2}y + \frac{3}{2} = \frac{3}{2}(3) + \frac{3}{2} = 6$$

(6, 3)

**5.** $y = \frac{1}{3}(12) - 1 = 3$
(12, 3)

**6.** $\begin{cases} 2x - 3y = 3 \\ x = 6 \end{cases}$

$$y = \frac{2}{3}x - 1 = \frac{2}{3}(6) - 1 = 3$$

(6, 3)

**7.** $\begin{cases} 6 - 3(4) = -6 \\ 3(6) - 2(4) = 10 \end{cases}$

$\begin{cases} -6 = -6 \\ 10 = 10 \end{cases}$

Yes

**8.** $\begin{cases} 4 = \frac{1}{3}(12) - 1 \\ 12 = 12 \end{cases}$

$\begin{cases} 4 = 3 \\ 12 = 12 \end{cases}$

No

**9.** $\begin{cases} y = -2x + 7 \\ y = x - 3 \end{cases}$

$-2x + 7 = x - 3$

$-3x = -10$

$x = \frac{10}{3}$

$y = \frac{10}{3} - 3 = \frac{1}{3}$

$x = \frac{10}{3},\ y = \frac{1}{3}$

**10.** $\begin{cases} y = -\frac{1}{2}x + 2 \\ y = -x + 6 \end{cases}$

$-\frac{1}{2}x + 2 = -x + 6$

$\frac{1}{2}x = 4$

$x = 8$

$y = -(8) + 6 = -2$

$x = 8,\ y = -2$

**11.** $\begin{cases} y = \frac{5}{2}x - \frac{1}{2} \\ y = -2x - 4 \end{cases}$

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

$\frac{9}{2}x = -\frac{7}{2}$

$x = -\frac{7}{9}$

$y = -2\left(-\frac{7}{9}\right) - 4 = -\frac{22}{9}$

$x = -\frac{7}{9},\ y = -\frac{22}{9}$

**12.** $\begin{cases} y = -\frac{1}{2}x + 3 \\ y = 3x - 12 \end{cases}$

$-\frac{1}{2}x + 3 = 3x - 12$

$-\frac{7}{2}x = -15$

$x = \frac{30}{7}$

$y = -\frac{1}{2}\left(\frac{30}{7}\right) + 3 = \frac{6}{7}$

$x = \frac{30}{7},\ y = \frac{6}{7}$

**13.** $\begin{cases} x = 3 \\ 2x + 3y = 18 \end{cases}$

$y = -\frac{2}{3}x + 6 = -\frac{2}{3}(3) + 6 = 4$

$A = (3, 4)$

$\begin{cases} y = 2 \\ 2x + 3y = 18 \end{cases}$

$x = -\frac{3}{2}y + 9 = -\frac{3}{2}(2) + 9 = 6$

$B = (6, 2)$

**14.** $\begin{cases} y = -\frac{1}{3}x + 7 \\ x = 0 \end{cases}$

$y = -\frac{1}{3}(0) + 7 = 7$

$A = (0, 7)$

$\begin{cases} y = -\frac{1}{3}x + 7 \\ y = -x + 9 \end{cases}$

$-\frac{1}{3}x + 7 = -x + 9$

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

$x = 3$

$y = -(3) + 9 = 6$

$B = (3, 6)$

$$\begin{cases} y = -x + 9 \\ y = -3x + 19 \end{cases}$$

$-x + 9 = -3x + 19$

$2x = 10$

$x = 5$

$y = -(5) + 9 = 4$

$C = (5, 4)$

$$\begin{cases} y = -3x + 19 \\ y = 0 \end{cases}$$

$-3x + 19 = 0$

$-3x = -19$

$$x = \frac{19}{3}$$

$$D = \left( \frac{19}{3}, 0 \right)$$

**15.** $A = (0, 0)$

$$\begin{cases} y = 2x \\ y = \frac{1}{2}x + 3 \end{cases}$$

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

$x = 2$

$y = 2(2) = 4$

$B = (2, 4)$

$$\begin{cases} y = \frac{1}{2}x + 3 \\ x = 5 \end{cases}$$

$$y = \frac{1}{2}(5) + 3 = \frac{11}{2}$$

$$C = \left( 5, \frac{11}{2} \right)$$

$D = (5, 0)$

**16.** $$\begin{cases} x = 0 \\ 2x + y = 14 \end{cases}$$

$y = -2x + 14 = -2(0) + 14 = 14$

$A = (0, 14)$

$$\begin{cases} 2x + y = 14 \\ 3x + 2y = 24 \end{cases}$$

$$\begin{cases} y = -2x + 14 \\ y = -\frac{3}{2}x + 12 \end{cases}$$

$$-2x + 14 = -\frac{3}{2}x + 12$$

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

$x = 4$

$y = -2(4) + 14 = 6$

$B = (4, 6)$

$$\begin{cases} 3x + 2y = 24 \\ x + 2y = 12 \end{cases}$$

$$\begin{cases} y = -\frac{3}{2}x + 12 \\ y = -\frac{1}{2}x + 6 \end{cases}$$

$$-\frac{3}{2}x + 12 = -\frac{1}{2}x + 6$$

$-x = -6$

$x = 6$

$$y = -\frac{1}{2}(6) + 6 = 3$$

$C = (6, 3)$

$$\begin{cases} x + 2y = 12 \\ y = 0 \end{cases}$$

$x = -2y + 12 = -2(0) + 12 = 12$

$D = (12, 0)$

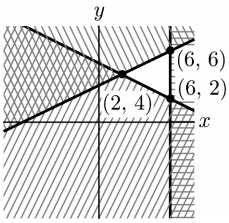
**17.** $$\begin{cases} 2y - x \le 6 \\ x + 2y \ge 10 \\ x \le 6 \end{cases}$$

$$\begin{cases} y \le \frac{1}{2}x + 3 \\ y \ge -\frac{1}{2}x + 5 \\ x \le 6 \end{cases}$$

$$\begin{cases} y = \frac{1}{2}x + 3 \\ y = -\frac{1}{2}x + 5 \end{cases} \Rightarrow (2, 4)$$

$$\begin{cases} y = -\frac{1}{2}x + 5 \\ x = 6 \end{cases} \Rightarrow (6, 2)$$

$$\begin{cases} y = \dfrac{1}{2}x + 3 \\ x = 6 \end{cases} \Rightarrow (6, 6)$$

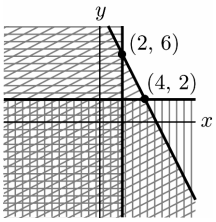



**18.** $\begin{cases} 2x + y \geq 10 \\ x \geq 2 \\ y \geq 2 \end{cases}$

$$\begin{cases} y \geq -2x + 10 \\ x \geq 2 \\ y \geq 2 \end{cases}$$

$$\begin{cases} y = -2x + 10 \\ x = 2 \end{cases} \Rightarrow (2, 6)$$

$$\begin{cases} y = -2x + 10 \\ y = 2 \end{cases} \Rightarrow (4, 2)$$




**19.** $\begin{cases} x + 3y \leq 18 \\ 2x + y \leq 16 \\ x \geq 0,\ y \geq 0 \end{cases}$

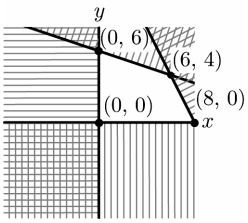
$$\begin{cases} y \leq -\dfrac{1}{3}x + 6 \\ y \leq -2x + 16 \\ x \geq 0,\ y \geq 0 \end{cases}$$

$$\begin{cases} y = -\dfrac{1}{3}x + 6 \\ y = -2x + 16 \end{cases} \Rightarrow (6, 4)$$

$$\begin{cases} y = -\dfrac{1}{3}x + 6 \\ x = 0 \end{cases} \Rightarrow (0, 6)$$

$$\begin{cases} y = -2x + 16 \\ y = 0 \end{cases} \Rightarrow (8,0)$$

$$\begin{cases} x = 0 \\ y = 0 \end{cases} \Rightarrow (0, 0)$$



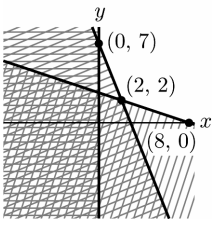

**20.** $\begin{cases} 5x + 2y \geq 14 \\ x + 3y \geq 8 \\ x \geq 0,\ y \geq 0 \end{cases}$

$$\begin{cases} y \geq -\dfrac{5}{2}x + 7 \\ y \geq -\dfrac{1}{3}x + \dfrac{8}{3} \\ x \geq 0,\ y \geq 0 \end{cases}$$

$$\begin{cases} y = -\dfrac{5}{2}x + 7 \\ y = -\dfrac{1}{3}x + \dfrac{8}{3} \end{cases} \Rightarrow (2, 2)$$

$$\begin{cases} y = -\dfrac{5}{2}x + 7 \\ x = 0 \end{cases} \Rightarrow (0, 7)$$

$$\begin{cases} y = -\dfrac{1}{3}x + \dfrac{8}{3} \\ y = 0 \end{cases} \Rightarrow (8, 0)$$



**21.** $\begin{cases} 4x + y \ge 8 \\ x + y \ge 5 \\ x + 3y \ge 9 \\ x \ge 0,\ y \ge 0 \end{cases}$

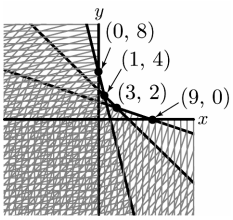
$\begin{cases} y \ge -4x + 8 \\ y \ge -x + 5 \\ y \ge -\frac{1}{3}x + 3 \\ x \ge 0,\ y \ge 0 \end{cases}$

$\begin{cases} y = -4x + 8 \\ y = -x + 5 \end{cases} \Rightarrow (1, 4)$

$\begin{cases} y = -x + 5 \\ y = -\frac{1}{3}x + 3 \end{cases} \Rightarrow (3, 2)$

$\begin{cases} y = -\frac{1}{3}x + 3 \\ y = 0 \end{cases} \Rightarrow (9, 0)$

$\begin{cases} y = -4x + 8 \\ x = 0 \end{cases} \Rightarrow (0, 8)$




**22.** $\begin{cases} x + 4y \le 28 \\ x + y \le 10 \\ 3x + y \le 24 \\ x \ge 0,\ y \ge 0 \end{cases}$

$\begin{cases} y \le -\frac{1}{4}x + 7 \\ y \le -x + 10 \\ y \le -3x + 24 \\ x \ge 0,\ y \ge 0 \end{cases}$

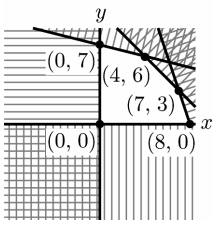
$\begin{cases} y = -\frac{1}{4}x + 7 \\ x = 0 \end{cases} \Rightarrow (0, 7)$

$\begin{cases} y = -\frac{1}{4}x + 7 \\ y = -x + 10 \end{cases} \Rightarrow (4, 6)$

$\begin{cases} y = -x + 10 \\ y = -3x + 24 \end{cases} \Rightarrow (7, 3)$

$\begin{cases} y = -3x + 24 \\ y = 0 \end{cases} \Rightarrow (8, 0)$

$\begin{cases} x = 0 \\ y = 0 \end{cases} \Rightarrow (0, 0)$




**23. a.** $p = .0001(19{,}500) + .05$
$= \$2.00$

**b.** $p = .0001(0) + .05$
$= \$.05$
No units will be supplied for $.05 or less.

**24. a.** $p = -.001(31{,}500) + 32.5$
$= \$1.00$

**b.** $-.001q + 32.5 < 0$
$q > 32{,}500$ units

**25.** $\begin{cases} p = .0001q + .05 \\ p = -.001q + 32.5 \end{cases}$

$0.0001q + 0.05 = -0.001q + 32.5$
$.0011q = 32.45$
$q = 29{,}500$ units
$p = .0001(29{,}500) + .05$
$p = \$3.00$

**26. a.** $F = \frac{9}{5}(5) + 32$
$F = 41$
$F = 2(5) + 30$
$F = 40$
The two temperatures differ by 1 degree.

**b.** $F = \frac{9}{5}(20) + 32$

$F = 68$

$F = 2(20) + 30$

$F = 70$

The two temperatures differ by 2 degrees.

**c.** $2C + 30 = \frac{9}{5}C + 32$

$\frac{1}{5}C = 2$

$C = 10$

When the temperature is 10 degrees Celsius, the two formulas will give the same Fahrenheit temperature.

**27.** $p = \frac{1}{300}q + 13$

$p = -.03q + 19$

$\frac{1}{300}q + 13 = -.03q + 19$

$\frac{1}{30}q = 6$

$q = 180$ books

$p = -.03(180) + 19$

$p = \$13.60$

**28.** Let $x$ = hours working and
$y$ = hours supervising.

$\begin{cases} x + y = 40 \\ 12x + 15y = 504 \end{cases}$

$\begin{cases} y = -x + 40 \\ y = -\frac{4}{5}x + \frac{168}{5} \end{cases}$

$-x + 40 = -\frac{4}{5}x + \frac{168}{5}$

$-\frac{1}{5}x = -\frac{32}{5}$

$x = 32$

$y = -32 + 40 = 8$

Working: 32; supervising: 8

**29.** Method A: $y = 0.45 + 0.01x$

Method B: $y = 0.035x$

Intersection point:

$0.45 + 0.01x = 0.035x$

$0.45 = 0.025x$

$18 = x$

For a call lasting 18 minutes, the costs for either method will be the same, $y = 0.035(18) = 63$.

The cost will be 63cents.

**30.** Let $x$ = weight of first contestant
$y$ = weight of second contestant

$\begin{cases} x + y = 700 \\ 2x = 275 + y \end{cases}$

$\begin{cases} y = 700 - x \\ y = 2x - 275 \end{cases}$

$700 - x = 2x - 275$

$975 = 3x$

$x = 325$ pounds

Answer (c) is correct.

**31.** Let $x$ = number of 15" TVs sold
$y$ = number of 19" TVs sold

$\begin{cases} y = x + 5 \\ 280x + 400y = 15600 \end{cases}$

$\begin{cases} y = x + 5 \\ y = -\frac{7}{10}x + 39 \end{cases}$

$x + 5 = -\frac{7}{10}x + 39$

$\frac{17}{10}x = 34$

$x = 20$ TV sets

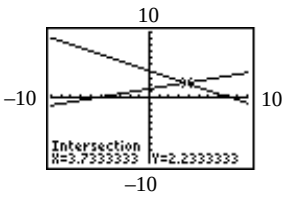
$y = 20 + 5$

$= 25$ TV sets

Total = 20 + 25 = 45 TV sets

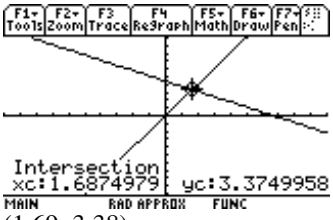
Answer (d) is correct.

**32.**




(3.73, 2.23)

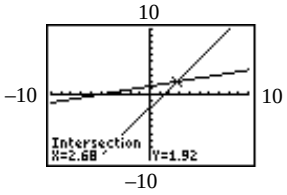
**33.**




(1.69, 3.38)

**34.** $\begin{cases} x-4y=-5 \\ 3x-2y=4.2 \end{cases}$

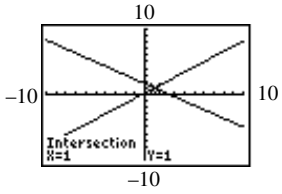
$\begin{cases} y=\frac{1}{4}x+\frac{5}{4} \\ y=\frac{3}{2}x-2.1 \end{cases}$




(2.68, 1.92)

**35.** $\begin{cases} 2x+3y=5 \\ -4x+5y=1 \end{cases}$

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

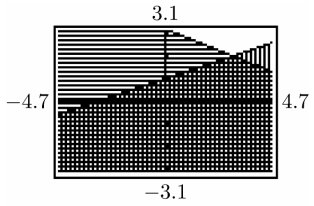



(1, 1)

**36.** $\begin{cases} -x+3y \ge 3 \\ .4x+y \ge 3.2 \end{cases}$

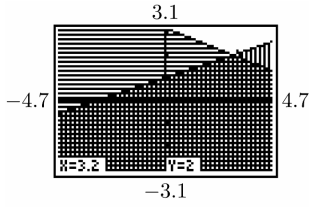
$\begin{cases} y \ge \frac{1}{3}x+1 \\ y \ge -.4x+3.2 \end{cases}$

**a.**




**b.** (3, 2)

**c.**




**d.** $\begin{cases} -(3.2)+3(2) \ge 3 \\ .4(3.2)+2 \ge 3.2 \end{cases}$

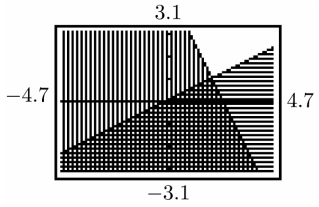
$\begin{cases} 2.8 \ge 3 \\ 3.28 \ge 3.2 \end{cases}$

No

**37.** $\begin{cases} 2x+y \ge 5 \\ x-2y \le 0 \end{cases}$

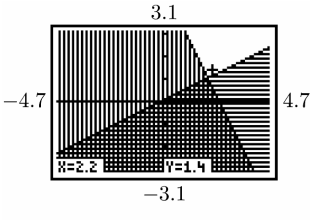
$\begin{cases} y \ge -2x+5 \\ y \ge \frac{1}{2}x \end{cases}$

**a.**




**b.** (2, 1)

**c.**




**d.** Yes

**Exercises 1.4**

**1.** $m = \frac{2}{3}$

**2.** $y = 0x - 4$
$m = 0$

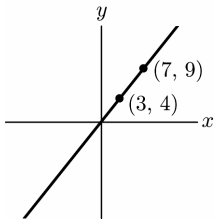
**3.** $y - 3 = 5(x + 4)$
$y = 5x + 23$
$m = 5$

**4.** $7x + 5y = 10$

$$y = -\frac{7}{5}x + 2$$

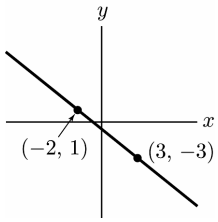
$$m = -\frac{7}{5}$$

**5.**



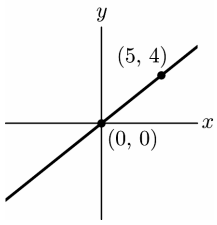

$$m = \frac{9-4}{7-3} = \frac{5}{4}$$

**6.**



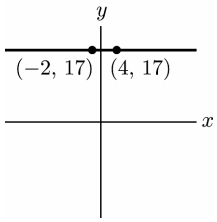

$$m = \frac{-3-1}{3-(-2)} = -\frac{4}{5}$$

**7.**




$$m = \frac{4-0}{5-0} = \frac{4}{5}$$

**8.**

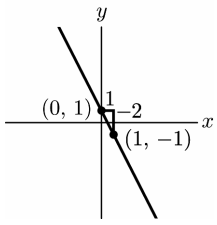



$$m = \frac{17-17}{-2-4} = 0$$

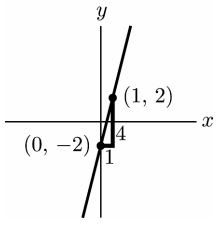
**9.** The slope of a vertical line is undefined.

**10.** The slope of a vertical line is undefined.

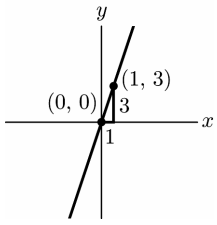
**11.**



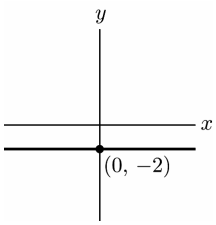

**12.**




**13.**



**14.**




**15.** $m = \dfrac{-2}{1} = -2$

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

$y = -2x + 7$

**16.** $m = \dfrac{\frac{1}{2}}{1} = \dfrac{1}{2}$

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

$y = \dfrac{1}{2}x - \dfrac{1}{2}$

**17.** $m = \dfrac{0-2}{2-1} = -2$

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

$y = -2x + 4$

**18.** $m = \dfrac{2 - \frac{1}{2}}{1-(-1)} = \dfrac{3}{4}$

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

$y = \dfrac{3}{4}x + \dfrac{5}{4}$

**19.** $m = -\dfrac{1}{-4} = \dfrac{1}{4}$

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

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

**20.** $m = \dfrac{1}{3}$

$y - 3 = \dfrac{1}{3}(x - 5)$

$y = \dfrac{1}{3}x + \dfrac{4}{3}$

**21.** $m = -1$

$y - 0 = -1(x - 0)$

$y = -x$

**22.** $m = -\dfrac{1}{-\frac{1}{2}} = 2$

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

$y = 2x - 5$

**23.** $m = 0$

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

$y = 3$

**24.** $m = 1.5$

$y - 0 = 1.5(x - 0)$

$y = 1.5x$

**25.** $y - 6 = \dfrac{3}{5}(x - 5)$

$y = \dfrac{3}{5}x + 3$

$y$-intercept: (0, 3)

**26.** $m = \dfrac{4-4}{0-1} = 0$

**27.** Each unit sold yields a commission of \$5. In addition, she receives \$60 per week base pay.

**28.** Let $y$ = cost in dollars.

$y = 4x + 2000$

**29.** **a.** $p$-intercept: (0, 1200); at \$1200 no one will buy the item.

**b.** $0 = -3q + 1200$

$q = 400$ units

$q$-intercept: (400, 0); even if the item is given away, only 400 will be taken.

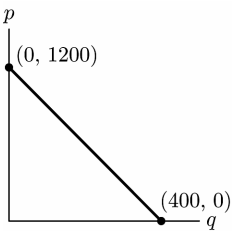
**c.** –3; to sell an additional item, the price must be reduced by \$3.

**d.** $p = -3(350) + 1200 = \$150$

**e.** $300 = -3q + 1200$

$q = 300$ items

**f.**




**30. a.** $m = \dfrac{172-124}{80-68} = 4$

$c - 124 = 4(F - 68)$

$c = 4F - 148$

**b.** $F = \dfrac{1}{4}c + 37,$ so add 37 to the number of chirps counted in 15 seconds $\left(\dfrac{1}{4} \text{ of a minute}\right)$.

**31. a.** Let $x$ = quantity and $y$ = cost.

$m = \dfrac{9500-6800}{50-20} = 90$

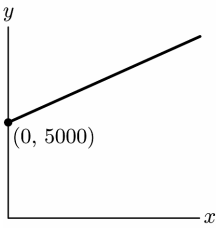
$y - 6800 = 90(x - 20)$

$y = 90x + 5000$

**b.** \$5000

**c.** \$90

**d.**




**32. a.** $y = 40(100) + 2400 = \$6400$

**b.** $3600 = 40x + 2400$

$x = 30$ coats

**c.** $y = 40(0) + 2400 = \$2400$
(0, 2400); even if no coats are made there is a cost for having the ability to make them.

**d.** 40; each additional coat costs \$40 to make.

**33. a.** $100(300) = \$30{,}000$

**b.** $6000 = 100x$

$x = 60$ coats

**c.** $y = 100(0) = 0$
(0, 0); if no coats are sold, there is no revenue.

**d.** 100; each additional coat yields an additional \$100 in revenue.

**34. a.** Profit = revenue – cost
$y = 100x - (40x + 2400)$
$y = 60x - 2400$

**b.** (0, –2400); if no coats are sold, \$2400 will be lost.

**c.** $0 = 60x - 2400$
$x = 40$
(40, 0); the break-even point is 40 coats. Less than 40 coats sold yields a loss, more than 40 yields a profit.

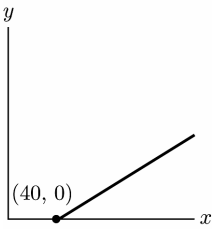
**d.** 60; each additional coat sold yields an additional \$60 profit.

**e.** $y = 60(80) - 2400 = \$2400$

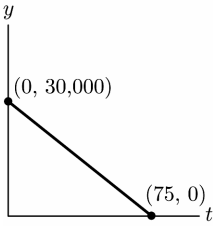
**f.** $6000 = 60x - 2400$

$x = 140$ coats

**g.**




**35. a.**



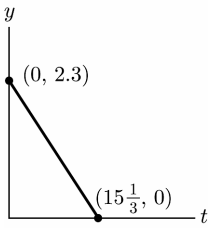

**b.** On February 1, 31 days have elapsed since January 1. The amount of oil y = 30,000 – 400(31) = 17,600 gallons.

**c.** On February 15, 45 days have elapsed since January 1. Therefore, the amount of oil would be y = 30,000- 400(45) = 12,000 gallons.

**d.** The significance of the y-intercept is that amount of oil present initially on January 1. This amount is 30,000 gallons.

**e.** The t-intercept is (75,0) and corresponds to the number of days at which the oil will be depleted.

**36. a.**




**b.** $y = 2.3 - .15(15) = \$.05$ million
\$50,000

**c.** (0, 2.3); \$2.3 million is the amount of cash reserves on July 1.

**d.** $0 = 2.3 - .15t$

$t = 15\frac{1}{3}$

$\left(15\frac{1}{3}, 0\right)$; the cash reserves will be depleted after $15\frac{1}{3}$ days.

**e.** $y = 2.3 - .15(3) = \$1.85$ million

**f.** $.8 = 2.3 - .15t$
$t = 10$
After 10 days, on July 11

**37. a.** $y = 0.10x + 220$

**b.** $y = 0.10(2000) + 220$

$y = 420$

**c.** $540 = 0.10x + 220$

$x = \$3200$

**38.** $m = -\frac{1}{2},\ b = 0$

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

**39.** $m = 3,\ b = -1$

$y = 3x - 1$

**40.** $m = -\frac{1}{3}$

$y - (-2) = -\frac{1}{3}(x - 6)$

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

**41.** $m = 1$

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

$y = x + 1$

**42.** $m = \frac{1}{2}$

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

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

**43.** $m = -7$

$y - 0 = -7(x - 5)$

$y = -7x + 35$

**44.** $m = -\frac{2}{5}$

$y - 5 = -\frac{2}{5}(x - 0)$

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

**45.** $m = 0$

$y - 4 = 0(x - 7)$

$y = 4$

**46.** $m = \frac{3 - (-3)}{-1 - 5} = -1$

$y - 3 = -1[x - (-1)]$

$y = -x + 2$

**47.** $m = \dfrac{2-1}{4-2} = \dfrac{1}{2}$

$y - 1 = \dfrac{1}{2}(x-2)$

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

**48.** $m = \dfrac{-1-(-1)}{3-2} = 0$

$y - (-1) = 0(x-2)$

$y = -1$

**49.** $m = \dfrac{-2-0}{1-0} = -2$

$y = -2x$

**50.** m = $\dfrac{1-(-1)}{3-3} = \dfrac{2}{0}$ (undefined slope). Line is vertical. Equation is x = 3.

**51.** Changes in *x*-coordinate: 1, –1, –2
Changes in *y*-coordinate are *m* times that or 2, –2, –4: new y values are 5, 1, –1

**52.** Change in x coordinates are 1, 2, –1.
Change in y coordinates are *m* times that or –3, –6, 3. New y values are –1, –4, 5.

**53.** The slope is $\dfrac{-1}{4}$ Changes in x coordinates are 1, 2, –1. Changes in y coordinates are m times the x coordinate changes. New y coordinates are

$\dfrac{-5}{4}, \dfrac{-3}{2}, \dfrac{-3}{4}$

**54.** Changes in *x*-coordinate: 1, 2, 3
Changes in *y*-coordinate are *m* times that:

$\dfrac{1}{3}, \dfrac{2}{3}, 1$

*y*-coordinates:

$2 + \dfrac{1}{3} = \dfrac{7}{3},\ 2 + \dfrac{2}{3} = \dfrac{8}{3},\ 2 + 1 = 3$

$\dfrac{7}{3}; \dfrac{8}{3}; 3$

**55.** **a.** $x + y = 1$
$y = -x + 1$
(C)

**b.** $x - y = 1$
$y = x - 1$
(B)

**c.** $x + y = -1$
$y = -x - 1$
(D)

**d.** $x - y = -1$
$y = x + 1$
(A)

**56.** $m = \dfrac{4.8-3.6}{4.9-4.8} = 12;$

$y - 6 = 12(x-5)$

$y = 12x - 54$

$b = -54$

**57.** One possible equation is $y = x + 1.$

**58.** One possible equation is $y = -x + 1.$

**59.** One possible equation is $y = 5.$

**60.** One possible equation is $x = 2.$

**61.** One possible equation is $y = -\dfrac{2}{3}x.$

**62.** One possible equation is $y = \dfrac{6}{5}x.$

**63.** $m = \dfrac{212-32}{100-0} = \dfrac{9}{5}$

$F - 32 = \dfrac{9}{5}(C-0)$

$F = \dfrac{9}{5}C + 32$

**64.** Let $x$ = years B.C. and $y$ = feet.

$m = \dfrac{8-4}{2100-1500} = \dfrac{1}{150}$

$y - 4 = \dfrac{1}{150}(x - 1500)$

$y = \dfrac{1}{150}x - 6$

$y = \dfrac{1}{150}(3000) - 6 = 14\,ft$

**65**. Let 1995 correspond to x = 0. So in 2006, x = 11. When x = 0 , tuition is 2848. When x = 11, tuition is 5685. Using (0,2848) and (11,5685) as ordered pairs, find the slope of the line containing these points:
$\frac{5685-2848}{11-0} = 257.91$. Since the y-intercept is 2848, the equation becomes y = 257.91x + 2848. Therefore, in 2000 when x =5, the tuition should approximately be
$y = 257.91(5) + 2848 = 4137.55.$

**66**. Let 1990 correspond to x = 0. So in 2005, x = 15. When x = 0 , enrollment is 5.2 million. When x = 15, enrollment is 6.5million. Using (0,5.2) and (15,6.5) as ordered pairs, find the slope of the line containing these points:
$\frac{6.5-5.2}{15-0} = 0.087$ . Since the y-intercept is 5.2, the equation becomes y = 0.087x + 5.2. Therefore, the enrollment was at 6 million:
$y = 0.087x + 5.2$
$6 = 0.087x + 5.2$
$9.2 = x$
Since *x* is the number of years after 1990, the enrollment was 6 million around 1999.

**67**. Let x = number of pounds tires are under inflated. When x = 0, the miles per gallon (y) is 25. When x = 1, mpg decreases to 24.5. The equation is $y = -\frac{1}{2}x + 25$ . Thus, when x = 8 pounds the miles per gallon will be
$y = -\frac{1}{2}(8) + 25 = 21 \text{ mpg.}$

**68.** The slope is $\frac{1{,}171{,}000 - 787{,}000}{10} = 38400$ .
The equation is y = 38400x + 787,000. When x = 6 (2012), y = 38400(6) + 787,000 =1,017,400.

**69**. Let 1991 correspond to x = 0 and 2006 correspond to x = 15. Then, the two ordered pairs are on the line: (0, 249,165) and (15,318,042). The slope of the line is
$\frac{318{,}042 - 249{,}165}{15-0} = 4591.8$ The equation of the line is therefore $y = 4591.8x + 249{,}165.$ In the year 2011, x = 20, so the number of Bachelor's degrees awarded can be estimated as
$y = 4591.8(20) + 249{,}165 = 341{,}001.$

**70.** The slope is $\frac{5143-4818}{5} = 65$ . The equation is y = 65x+ 4818 Find x when y = 6000. We have 6000 = 65x+4818. Solving for x gives x about 18.2 years or in the year 2019.

**71.** Let 2005 correspond to x = 5 and 2008 correspond to x = 8. Then, the two ordered pairs are on the line: (5, 2.4) and (8,2.7). The slope of the line is $\frac{2.7-2.4}{8-5} = 0.1.$ The equation of the line is therefore $y = 0.1x + 1.9.$ In the year 2007, x = 7, so the cost of a 30-second advertising slot (in millions) can be estimated as
$y = 0.1(7) + 1.9 = \$2.6 \text{ million.}$

**72.** $m = \frac{9-5}{4-2} = 2$
$y - 5 \le 2(x-2)$
$y \le 2x + 1$

**73.** $y \ge 4x + 3$

**74.** $m_1 = \frac{8-5}{2-(-2)} = \frac{3}{4}$
$y - 8 = \frac{3}{4}(x-2)$
$y = \frac{3}{4}x + \frac{13}{2}$
$m_2 = \frac{1-8}{5-2} = -\frac{7}{3}$
$y - 1 = -\frac{7}{3}(x-5)$
$y = -\frac{7}{3}x + \frac{38}{3}$
$m_3 = \frac{1-5}{5-(-2)} = -\frac{4}{7}$

$$y-1=-\frac{4}{7}(x-5)$$
$$y=-\frac{4}{7}x+\frac{27}{7}$$
$$\begin{cases} y\le\frac{3}{4}x+\frac{13}{2} \\ y\le-\frac{7}{3}x+\frac{38}{3} \\ y\ge-\frac{4}{7}x+\frac{27}{7} \end{cases}$$

**75.** $m_1=\frac{3-4}{2-0}=-\frac{1}{2}$

$$y=-\frac{1}{2}x+4$$
$$m_2=\frac{1-3}{4-2}=-1$$
$$y-1=-(x-4)$$
$$y=-x+5$$
$$m_3=\frac{1-0}{4-3}=1$$
$$y=x-3$$
$$\begin{cases} y\le-\frac{1}{2}x+4 \\ y\le-x+5 \\ y\ge x-3 \\ x\ge 0,\ y\ge 0 \end{cases}$$

**76.** $m_1=\frac{4-3}{2-1}=1$

$$m_2=\frac{-1-4}{3-2}=-5$$
$$m_1\ne m_2$$

**77.** Set two slopes equal:

$$\frac{7-5}{2-1}=\frac{k-7}{3-2}$$
$$2=k-7$$
$$k=9$$

**78.** Set slopes equal:

$$\frac{-3.1-1}{2-a}=\frac{2.4-0}{3.8-(-1)}$$
$$\frac{-4.1}{2-a}=\frac{1}{2}$$
$$-8.2=2-a$$
$$a=10.2$$

**79.** Make slopes negative inverses of each other:

$$\frac{-3.1-1}{2-a}=-\frac{1}{\frac{2.4-0}{3.8-(-1)}}$$
$$\frac{-4.1}{2-a}=-2$$
$$4.1=4-2a$$
$$a=-0.05$$

**80.** Solve $mx+b=m'x+b'$, where $b\ne b'$.

$$(m-m')x=b'-b$$
$$x=\frac{b'-b}{m-m'},$$

which is defined if and only if $m\ne m'$.

**81.** $l_1: y=m_1x$

$l_2: y=m_2x$

So the vertical segment lies on $x = 1$.

Then

$$1^2+m_1^2=a^2$$
$$1^2+m_2^2=b^2$$

Add equations and rearrange:

$$a^2+b^2-(m_1^2+m_2^2)=2$$

$l_1$ and $l_2$ are perpendicular if and only if

$$a^2+b^2=(m_1-m_2)^2=m_1^2+m_2^2-2m_1m_2$$

or $a^2+b^2-(m_1^2+m_2^2)=-2m_1m_2$

Substitute: $2=-2m_1m_2$

Therefore, the product of the slopes are –1.

**82.** Let $x$ = Centigrade temperature
$y$ = Fahrenheit temperature

$$m=\frac{212-32}{100-0}=1.8$$
$$y=1.8x+32$$
$$y=1.8(30)+32=86°\text{F}$$

Answer (b) is correct.

**83.** Let $x$ = weight
$y$ = cost

$$m = \frac{38-5}{60-0} = \frac{11}{20}$$

$$y = \frac{11}{20}x + 5$$

$$y = \frac{11}{20}(20) + 5 = \$16$$

The answer is (c).

**84.** Let $x$ = number of T-shirts
profit = revenue – cost

$$65{,}000 = 12.50x - (8x + 25{,}000)$$

$$90{,}000 = 4.50x$$

$$x = 20{,}000$$

So 20,000 T-shirts must be produced and sold.
Answer (d) is correct.

**85.** Let $x$ = number of units
profit = revenue – cost

$$2{,}000{,}000 = 130x - (100x + 1{,}000{,}000)$$

$$3{,}000{,}000 = 30x$$

$$x = 100{,}000 \text{ units}$$

Answer (e) is correct.

**86.** $q = 800 - 4(150)$

$= 200$ bikes

revenue = 150(200) = \$30,000
Answer (d) is correct.

**87.** $n = 2200 - 25(8)$

$= 2000$ cameras

revenue = 8(2000) = \$16,000
Answer (c) is correct.

**88.** Let $x$ = variable costs
For 2008: profit = revenue – cost

$$400{,}000 = 100(50{,}000) - (50{,}000x + 600{,}000)$$

$$50{,}000x = 4{,}000{,}000$$

$$x = \$80 \text{ per unit}$$

For 2009:
Let $y$ = 2009 price
profit = revenue – cost

$$400{,}000 = 50{,}000y - [80(50{,}000) + 600{,}000 + 200{,}000]$$

$$5{,}200{,}000 = 50{,}000y$$

$$y = \$104$$

Answer (d) is correct.

**89.** Let $x$ = variable costs
For 2008: profit = revenue – costs

$$300{,}000 = 100(50{,}000) - (50{,}000x + 800{,}000)$$

$$50{,}000x = 3{,}900{,}000$$

$$x = \$78 \text{ per unit}$$

For 2009:
Let $y$ = 2009 price
profit = revenue – cost

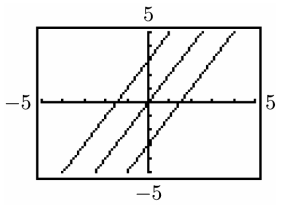
$$300{,}000 = 50{,}000y - [78(50{,}000) + 800{,}000 + 200{,}000]$$

$$5{,}200{,}000 = 50{,}000y$$

$$y = \$104$$

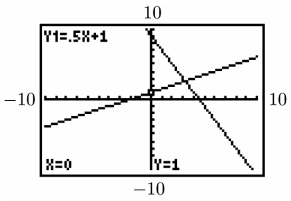
Answer (d) is correct.

**90**

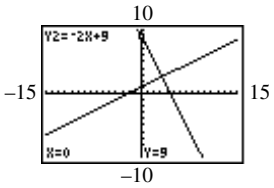



From left to right the lines are $y = 2x + 3$, $y = 2x$, and $y = 2x - 3$.
The lines are distinguished by their $y$-intercepts, which appear as $b$ in the form $y = mx + b$.

**91.**

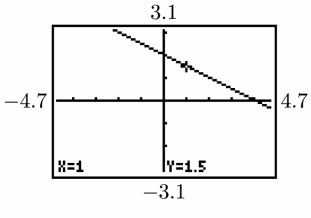



No, do not appear perpendicular



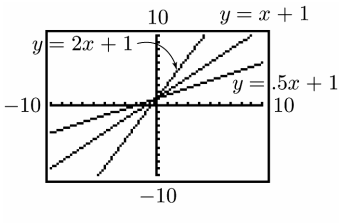

Do appear perpendicular

**92**



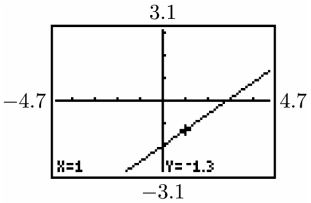

Since the slope equals $-\frac{1}{2}$, moving 2 units to the right requires moving $2\cdot\left(-\frac{1}{2}\right)=-1$ unit up, or 1 unit down.

**93.**




The steeper the line, the greater the slope *m* in *y* = *mx* + *b* form.

**94.**




Since the slope equals 0.7, moving 2 units to the right requires moving $2\cdot 0.7=1.4$ units up.

**Exercises 1.5**

**1.**

| Data Point | Point on Line | Vertical Distance |
|---|---|---|
| (1, 3) | (1, 4) | 1 |
| (2, 6) | (2, 7) | 1 |
| (3, 11) | (3, 10) | 1 |
| (4, 12) | (4, 13) | 1 |

$1^2+1^2+1^2+1^2=4$

**2.**

| Data Point | Point on Line | Vertical Distance |
|---|---|---|
| (1, 11) | (1, 10) | 1 |
| (2, 7) | (2, 8) | 1 |
| (3, 5) | (3, 6) | 1 |
| (4, 5) | (4, 4) | 1 |

$E=1^2+1^2+1^2+1^2=4$

**3.** $E_1^2=[1.1(1)+3-3]^2=1.21$

$E_2^2=[1.1(2)+3-6]^2=0.64$

$E_3^2=[1.1(3)+3-8]^2=2.89$

$E_4^2=[1.1(4)+3-6]^2=1.96$

$E = 1.21 + 0.64 + 2.89 + 1.96 = 6.70$

**4.** $E_1^2 = [-1.3(1) + 8.3 - 8]^2 = 1.00$

$E_2^2 = [-1.3(2) + 8.3 - 5]^2 = 0.49$

$E_3^2 = [-1.3(3) + 8.3 - 3]^2 = 1.96$

$E_4^2 = [-1.3(4) + 8.3 - 4]^2 = 0.81$

$E_5^2 = [-1.3(5) + 8.3 - 2]^2 = 0.04$

$E = 1.00 + 0.49 + 1.96 + 0.81 + 0.04 = 4.30$

**5.**

| $x$ | $y$ | $xy$ | $x^2$ |
|---|---|---|---|
| 1 | 7 | 7 | 1 |
| 2 | 6 | 12 | 4 |
| 3 | 4 | 12 | 9 |
| 4 | 3 | 12 | 16 |
| $\sum x = 10$ | $\sum y = 20$ | $\sum xy = 43$ | $\sum x^2 = 30$ |

$$m = \frac{4 \cdot 43 - 10 \cdot 20}{4 \cdot 30 - 10^2} = -1.4$$

$$b = \frac{20 - (-1.4)(10)}{4} = 8.5$$

**6.**

| $x$ | $y$ | $xy$ | $x^2$ |
|---|---|---|---|
| 1 | 2 | 2 | 1 |
| 2 | 4 | 8 | 4 |
| 3 | 7 | 21 | 9 |
| 4 | 9 | 36 | 16 |
| 5 | 12 | 60 | 25 |
| $\sum x = 15$ | $\sum y = 34$ | $\sum xy = 127$ | $\sum x^2 = 55$ |

$$m = \frac{5 \cdot 127 - 15 \cdot 34}{5 \cdot 55 - 15^2} = 2.5$$

$$b = \frac{34 - (2.5)(15)}{5} = -0.7$$

**7.** $\sum x = 6, \sum y = 18, \sum xy = 45, \sum x^2 = 14$

$$m = \frac{3 \cdot 45 - 6 \cdot 18}{3 \cdot 14 - 6^2} = 4.5$$

$$b = \frac{18 - (4.5)(6)}{3} = -3$$

$y = 4.5x - 3$

**8.** $\sum x = 7, \sum y = 15, \sum xy = 28, \sum x^2 = 21$

$$m = \frac{3 \cdot 28 - 7 \cdot 15}{3 \cdot 21 - 7^2} = -1.5$$

$$b = \frac{15 - (-1.5)(7)}{3} = 8.5$$

$y = -1.5x + 8.5$

**9.** $\sum x = 10, \sum y = 26, \sum xy = 55,$
$\sum x^2 = 30$

$$m = \frac{4 \cdot 55 - 10 \cdot 26}{4 \cdot 30 - 10^2} = -2$$

$$b = \frac{26 - (-2)(10)}{4} = 11.5$$

$y = -2x + 11.5$

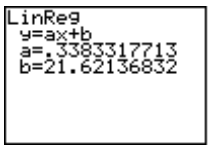
**10.** $\sum x = 10, \sum y = 28, \sum xy = 77,$
$\sum x^2 = 30$

$$m = \frac{4 \cdot 77 - 10 \cdot 28}{4 \cdot 30 - 10^2} = 1.4$$

$$b = \frac{28 - (1.4)(10)}{4} = 3.5$$

$y = 1.4x + 3.5$

**11. a.**




$y = .338x + 21.6$

**b.** .338(1100) + 21.6 = 393.4
About 393 deaths per million males

**12. a.** $y = 2648.1x - 2436.8$

**b.** 2648.1(2.04) – 2436.8 = 2965.324
About 2965 average miles per automobile

**c.** $11{,}868 = 2648.1x - 2436.8$

$x \approx 5.40$
About \$5.40

**13. a.** Let x be the number of years after 1980, then
y = .419$x$ + 17.1

**b.** .419(23) + 17.1 = 26.73
About 26.7%

**c.** $30 = .419x + 17.1$

$x \approx 30.78$
The year 2011 or late 2010

**14. a.** Let x be the number of years after 1995, then
y = 0.208$x$ + 11.1

**b.** .0.208(3) + 11.1 ≈ 11.724
About 11.7 million

**c.** $15 = 0.208x + 11.1$

$x = 18.75$
The year 2014

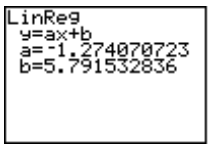
**15. a.** $y = 0.153x + 73.5$

**b.** 0.153(30) +73.5 =78.09
About 78.09 years

**c.** 0.153(50) +73.5 =81.15
About 81.15 years

d. 0.153(90) +73.5 =87.27
About 87.27 years.(This is an example of a fit that is not capable of extrapolating beyond the given data)

**16. a.**




$y = -1.274x + 5.792$

**b.** The higher the independence, the lower the inflation rate.

**c.** $-1.274(.6) + 5.792 = 5.0276$
About 5.0%

**d.** $6.8 = -1.274x + 5.792$
$x \approx -0.791$
About –0.8

**17. a.** Let x be the number of years after 1993, then $y = 0.048x + 2.89$

**b.** $0.048(6) + 2.89 \approx 3.178$
About \$3.18

**c.** $3.85 = 0.048x + 2.89$
$x = 20$
The year 2013

**18. a.** $y = 1.38x + 312.5$

**b.** The year 2000 is 42 years after the base year of 1958, therefore:
$1.38(42) + 312.5 \approx 370.46$
About 370.5

**c.** $398 = 1.38x + 312.5$
$x \approx 61.96$
The year is 62 years after 1958 or 2020.

**19.** $\sum x = 12, \sum y = 7, \sum xy = 41, \sum x^2 = 74$

$$m = \frac{2 \cdot 41 - 12 \cdot 7}{2 \cdot 74 - 12^2} = -0.5$$

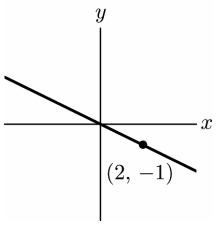
$$b = \frac{7 - (-0.5)(12)}{2} = 6.5$$

$y = -0.5x + 6.5$
$4 = -0.5(5) + 6.5$
$3 = -0.5(7) + 6.5$

## Chapter 1 Supplementary Exercises

**1.** $x = 0$

**2.**




**3.** $\begin{cases} x - 5y = 6 \\ 3x = 6 \end{cases}$

$\begin{cases} x = 5y + 6 \\ x = 2 \end{cases}$

$5y + 6 = 2$

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

$$\left(2, -\frac{4}{5}\right)$$

**4.** $3x - 4y = 8$

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

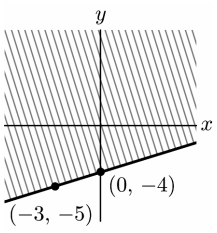
$$m = \frac{3}{4}$$

**5.** $m = \dfrac{0-5}{10-0} = -\dfrac{1}{2}, \ b = 5$

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

**6.** $x - 3y \geq 12$

$$y \leq \frac{1}{3}x - 4$$



**7.** $3(1) + 4(2) \geq 11$
$3 + 8 \geq 11$
$11 \geq 11$
Yes

**8.** $\begin{cases} 2x - y = 1 \\ x + 2y = 13 \end{cases}$

$\begin{cases} y = 2x - 1 \\ y = -\frac{1}{2}x + \frac{13}{2} \end{cases}$

$2x - 1 = -\frac{1}{2}x + \frac{13}{2}$

$\frac{5}{2}x = \frac{15}{2}$

$x = 3$

$y = 2(3) - 1 = 5$
(3, 5)

**9.** $2x - 10y = 7$

$y = \frac{1}{5}x - \frac{7}{10}$

$m = \frac{1}{5}$

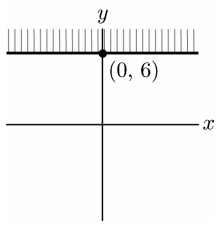
$y - 16 = \frac{1}{5}(x - 15)$

$y = \frac{1}{5}x + 13$

**10.** $y = 3(1) + 7 = 10$

**11.** (5, 0)

**12.**




**13.** $\begin{cases} 3x - 2y = 1 \\ 2x + y = 24 \end{cases}$

$\begin{cases} y = \frac{3}{2}x - \frac{1}{2} \\ y = -2x + 24 \end{cases}$

$\frac{3}{2}x - \frac{1}{2} = -2x + 24$

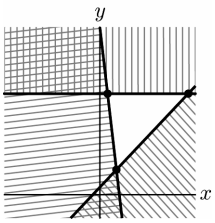
$\frac{7}{2}x = \frac{49}{2}$

$x = 7$

$y = -2(7) + 24 = 10$
(7, 10)

**14.** $\begin{cases} 2y + 7x \geq 28 \\ 2y - x \geq 0 \\ y \leq 8 \end{cases}$

$\begin{cases} y \geq -\frac{7}{2}x + 14 \\ y \geq \frac{1}{2}x \\ y \leq 8 \end{cases}$




**15.** $y - 9 = \frac{1}{2}(x - 4)$

$y = \frac{1}{2}x + 7$

$b = 7$
(0, 7)

**16.** The rate is \$35 per hour plus a flat fee of \$20.

**17.** $m_1 = \frac{0 - 2}{2 - 1} = -2$

$m_2 = \frac{1 - 0}{3 - 2} = 1$

$m_1 \neq m_2$
No

**18.** $m = \frac{-2 - 0}{0 - 3} = \frac{2}{3}$, $b = -2$

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

**19.** $x + 7y = 30$
$-2y + 7y = 30$
$5y = 30$
$y = 6$
Answer (d) is correct.

**20.** $y \le \frac{2}{3}x + \frac{3}{2}$

**21.** $m = \frac{8.6 - (-1)}{6 - 2} = 2.4$
$y + 1 \ge 2.4(x - 2)$
$y \ge 2.4x - 5.8$

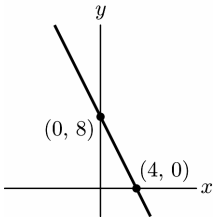
**22.** $\begin{cases} 1.2x + 2.4y = .6 \\ 4.8y - 1.6x = 2.4 \end{cases}$
$\begin{cases} y = -.5x + .25 \\ y = \frac{1}{3}x + .5 \end{cases}$
$-.5x + .25 = \frac{1}{3}x + .5$
$-\frac{5}{6}x = 0.25$
$x = -0.3$
$y = \frac{1}{3}(-.3) + .5 = 0.4$

**23.** $\begin{cases} y = -x + 1 \\ y = 2x + 3 \end{cases}$
$-x + 1 = 2x + 3$
$-3x = 2$
$x = -\frac{2}{3}$
$y = -\left(-\frac{2}{3}\right) + 1 = \frac{5}{3}$
$\left(-\frac{2}{3}, \frac{5}{3}\right)$

$m = \frac{\frac{5}{3} - 1}{-\frac{2}{3} - 1} = -\frac{2}{5}$
$y - 1 = -\frac{2}{5}(x - 1)$
$y = -\frac{2}{5}x + \frac{7}{5}$

**24.** $2x + 3(x - 2) \ge 0$
$5x \ge 6$
$x \ge \frac{6}{5}$

**25.** $x + \frac{1}{2}y = 4$
$y = -2x + 8$
$m = -2$
$y$-intercept: (0, 8)
$0 = -2x + 8$
$x = 4$
$x$-intercept: (4, 0)



**26.** $\begin{cases} 5x+2y=0 \\ x+y=1 \end{cases}$

$\begin{cases} y=-\frac{5}{2}x \\ y=-x+1 \end{cases}$

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

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

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

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

Substitute $x=-\frac{2}{3}$ and $y=\frac{5}{3}$ in

$2x-3y=1$

$2\left(-\frac{2}{3}\right)-3\left(\frac{5}{3}\right)=1$

$-\frac{19}{3}=1$

No

**27.** $\begin{cases} 2x-3y=1 \\ 3x+2y=4 \end{cases}$

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

$m_1=-\frac{1}{m_2}$

**28.** **a.** $x+y\geq 1$

$y\geq -x+1$

(C)

**b.** $x+y\leq 1$

$y\leq -x+1$

(A)

**c.** $x-y\leq 1$

$y\geq x-1$

(B)

**d.** $y-x\leq -1$

$y\leq x-1$

(D)

**29.** **a.** $4x+y=17$

$y=-4x+17$

$L_3$

**b.** $y=x+2$

$L_1$

**c.** $2x+3y=11$

$y=-\frac{2}{3}x+\frac{11}{3}$

$L_2$

**30.** $m_1=\frac{\frac{3}{2}-5}{4-0}=-\frac{7}{8}, b_1=5$

$y=-\frac{7}{8}x+5$

$m_2=-\frac{1}{m_1}=\frac{8}{7}$

$y-\frac{3}{2}=\frac{8}{7}(x-4)$

$y=\frac{8}{7}x-\frac{43}{14}$

$\begin{cases} y\leq -\frac{7}{8}x+5 \\ y\geq \frac{8}{7}x-\frac{43}{14} \\ x\geq 0,\ y\geq 0 \end{cases}$

$0=\frac{8}{7}x-\frac{43}{14}$

$x=\frac{43}{16}$

$\left(\frac{43}{16},0\right)$

**31.** Supply curve is $p = .005q + .5$
Demand curve is $p = -.01q + 5$

$$\begin{cases} p = .005q + .5 \\ p = -.01q + 5 \end{cases}$$

$$.005q + .5 = -.01q + 5$$

$$.015q = 4.5$$

$$q = 300 \text{ units}$$

$p = .005(300) + .5 = \$2$

**32.** $$\begin{cases} x \ge 0 \\ y \ge 0 \end{cases}$$

(0, 0)

$$\begin{cases} y \ge 0 \\ 5x + y \le 50 \end{cases}$$

$$\begin{cases} y \ge 0 \\ y \le -5x + 50 \end{cases}$$

$0 = -5x + 50$
$x = 10$
(10, 0)

$$\begin{cases} 5x + y \le 50 \\ 2x + 3y \le 33 \end{cases}$$

$$\begin{cases} y \le -5x + 50 \\ y \le -\frac{2}{3}x + 11 \end{cases}$$

$$-5x + 50 = -\frac{2}{3}x + 11$$

$$-\frac{13}{3}x = -39$$

$$x = 9$$

$y = -5(9) + 50 = 5$
(9, 5)

$$\begin{cases} 2x + 3y \le 33 \\ x - 2y \ge -8 \end{cases}$$

$$\begin{cases} y \le -\frac{2}{3}x + 11 \\ y \le \frac{1}{2}x + 4 \end{cases}$$

$$-\frac{2}{3}x + 11 = \frac{1}{2}x + 4$$

$$-\frac{7}{6}x = -7$$

$$x = 6$$

$$x = \frac{1}{2}(6) + 4 = 7$$

(6, 7)

$$\begin{cases} x - 2y \ge -8 \\ x \ge 0 \end{cases}$$

$$\begin{cases} x \ge 2y - 8 \\ x \ge 0 \end{cases}$$

$2y - 8 = 0$
$y = 4$
(0, 4)

**33. a.** In 2000, 8.8% of college freshmen intended to obtain a medical degree.

**b.** $2008 - 2000 = 8$

$$y = 0.1(8) + 8.8$$

$$y = 9.6$$

9.6% of college freshmen in 2008 intended to obtain a medical degree

**c.** $$9.2 = 0.1x + 8.8$$

$$x = 4$$

$$2000 + 4 = 2004$$

In 2004, the percent of college freshmen that intended to obtain a medical degree was 9.2.

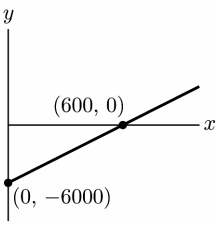
**34. a.** $m = 10$

$$y - 4000 = 10(x - 1000)$$

$$y = 10x - 6000$$

**b.** $0 = 10x - 6000$
$x = 600$
$x$-intercept: (600, 0)
$y$-intercept: (0, –6000)

**c.**




**35. a.** A: $y = .1x + 50$
B: $y = .2x + 40$

**b.** A: $.1(80) + 50 = 58$
B: $.2(80) + 40 = 56$
Company B

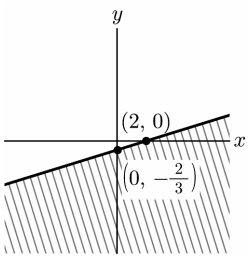
**c.** A: .1(160) + 50 = 66
B: .2(160) + 40 = 72
Company A

**d.** $.1x + 50 = .2x + 40$
$-.1x = -10$
$x = 100$ miles

**36. a.** $m = \dfrac{1.21 - 0.69}{17 - 0} = 0.031$
$y - 0.69 = 0.031(x - 0)$
$y = 0.031x + 0.69$

**b.** $1.00 = 0.031x + 0.69$
$x = 10$
The year 1990 + 10 = 2000

**37.** $x \le 3y + 2$
$y \ge \dfrac{1}{3}x - \dfrac{2}{3}$




**38.** $0.03x + 200 = 0.05x + 100$
$-0.02x = -100$
$x = \$5000$

**39.** $m_1 = \dfrac{5 - 0}{0 - (-4)} = \dfrac{5}{4}, b_1 = 5$
$y = \dfrac{5}{4}x + 5$
$m_2 = \dfrac{0 - 2}{5 - 0} = -\dfrac{2}{5}, b_2 = 2$
$y = -\dfrac{2}{5}x + 2$
$m_3 = \dfrac{0 - (-3)}{5 - 0} = \dfrac{3}{5}, b_3 = -3$
$y = \dfrac{3}{5}x - 3$
$m_4 = \dfrac{-5 - 0}{0 - (-2)} = -\dfrac{5}{2}, b_4 = -5$
$y = -\dfrac{5}{2}x - 5$

$$\begin{cases} y \le \dfrac{5}{4}x + 5 \\ y \le -\dfrac{2}{5}x + 2 \\ y \ge \dfrac{3}{5}x - 3 \\ y \ge -\dfrac{5}{2} - 5 \end{cases}$$

**40.** $m_1 = \dfrac{2 - 0}{0 - 3} = -\dfrac{2}{3}, b_1 = 2$
$y = -\dfrac{2}{3}x + 2$
The other lines are $x = -2$, $x = 4$, and $y = -3$.

$$\begin{cases} y \le -\dfrac{2}{3}x + 2 \\ x \ge -2 \\ x \le 4 \\ y \ge -3 \end{cases}$$

**41**. (0, 417,000) ; in 2016: (10, 565,000)
m = $m = \dfrac{565{,}000 - 417{,}000}{10 - 0} = 14800$
$y - 417{,}000 = 14800(x - 0)$
$y = 14800x + 417{,}000$
For the year 2012, $x$=6:
$y = 14800(6) + 417{,}000 = 505{,}800.$

**42.** Slope of line is –237.93. Equation of line is: y = –237.93x + 110,807. In 2010, x = 19 so y = 106,286.

**43**. Let x = 0 correspond to year 2000. Then y = 20.4. When x = 7, y = 17.2. The rate of change (slope) = (17.2 – 20.4)/(7 – 0) = –0.46. The equation of the line that predicts the percentage of market is y = –0.46x + 20.4. When x = 5, y = 18.1%.

**44. a.** $y = 1.06x + 1.71$

**b.** 1.06(77.2) +1.71 =83.54
About 83.5 years

**c.** $84.2 = 1.06x + 1.71$

$x \approx 77.82$
About 77.8 years

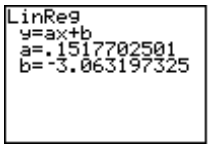
**45. a.** $y = 0.18x + 3.06$

**b.** 0.18(9) +3.06 =4.68
About 4.68%

**c.** $5.4 = 0.18x + 3.06$

$x = 13$
13 years after 2000 or 2013

**46. a.**




$y = .152x - 3.063$

**b.** .152(160) – 3.063 = 21.257
About 21 deaths per 100,000

**c.** 22 = .152$x$ – 3.063
$x \approx 164.888$
About 165 grams

**47.** Up; the value of $b$ is the y-intercept

**48.** Counter - Clockwise

**49.** When the line passes through the origin.

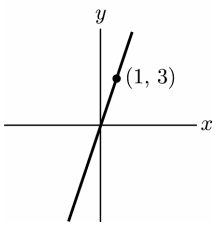
**50.** A line with undefined sloe is a vertical line and a line with zero slope is a horizontal line.

**51. a.** No; A line that is parallel to the x axis will not have an x intercept.

**b.** No; A line that is parallel to the y axis will not have a y intercept

**Chapter 1 Chapter Test**

**1.**




**2.** $y = -2\left(\frac{1}{2}\right) + 6$

$y = 5$

**3.** $m = -2$

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

$y = -2x + 1$

**4.** $\begin{cases} 2x - 3y = 9 \\ -3x + 7y = -11 \end{cases}$

$\begin{cases} y = \frac{2}{3}x - 3 \\ y = \frac{3}{7}x - \frac{11}{7} \end{cases}$

$\frac{2}{3}x - 3 = \frac{3}{7}x - \frac{11}{7}$

$\frac{5}{21}x = \frac{10}{7}$

$x = 6$

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

(6, 1)

**5.** $3x - y = 1$

$y = 3x - 1$

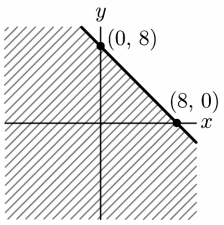
$m = 3$

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

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

The lines are perpendicular.

**6.**




**7.** $\begin{cases} 4x+5y=11 \\ 2x-3y=7 \end{cases}$

$\begin{cases} y=-\frac{4}{5}x+\frac{11}{5} \\ y=\frac{2}{3}x-\frac{7}{3} \end{cases}$

$-\frac{4}{5}x+\frac{11}{5}=\frac{2}{3}x-\frac{7}{3}$

$\frac{68}{15}=\frac{22}{15}x$

$x=\frac{68}{22}$

$=\frac{34}{11}$

$y=-\frac{4}{5}\left(\frac{34}{11}\right)+\frac{11}{5}$

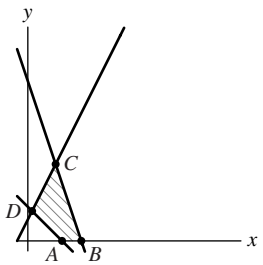
$y=-\frac{3}{11}$

$\left(\frac{34}{11},-\frac{3}{11}\right)$

$y-\left(-\frac{3}{11}\right)=2\left(x-\frac{34}{11}\right)$

$y=2x-\frac{71}{11}$

**8.**




$\begin{cases} x+y=16 \\ y=0 \end{cases}$

$x=16$

**A:**(16, 0)

$\begin{cases} 3x+y=75 \\ y=0 \end{cases}$

$3x=75$

$x=25$

**B:**(25, 0)

$\begin{cases} 3x+y=75 \\ -2x+y=10 \end{cases}$

$\begin{cases} y=75-3x \\ y=2x+10 \end{cases}$

$75-3x=2x+10$

$65=5x$

$x=13$

$y = 2(13) + 10 = 36$

**C:**(13, 36)

$\begin{cases} x+y=16 \\ -2x+y=10 \end{cases}$

$\begin{cases} y=16-x \\ y=2x+10 \end{cases}$

$16-x=2x+10$

$6=3x$

$x=2$

$y = 2(2) + 10 = 14$

**D:**(2, 14)

**9.** Let $x$ = volume of sales

$250+.03x>200+.05x$

$50>.02x$

$2500>x$

Fred's sister is correct for sales less than \$2500. She is incorrect for sales greater than \$2500.

**10.** **a.** Let x be the number of years after 1999, then $y = 0.033x + 0.819$

**b.** $0.033(5) + 0.819 \approx 0.984$
About \$0.98

**c.** $1.25 = 0.033x + 0.819$
$x \approx 13.06$
In the year 2012

**Chapter 1 Project**

**1.** $p = -0.4q + 400$

**2.** $p = -0.4(350) + 400 = \$260$
Revenue = $260(350{,}000) = \$91{,}000{,}000$

**3.** $300 = -0.4q + 400$

$q = 250$ thousand cameras
Revenue = $300(250{,}000) = \$75{,}000{,}000$

**4.** $1000q(-0.4q + 400) = -400q^2 + 400{,}000q$

**5.** Cost = $100{,}000q + 8{,}000{,}000$

**6.** On your graphing calculator, set the window values to: $x : [0, 1000]$ and $y : [0, 100{,}000{,}000]$ and graph both equations. The graph intersects at $x \approx 27.69$, $y \approx 10{,}768{,}890$, and $x \approx 722.31$, $y \approx 80{,}231{,}110$.

**7.** The break-even point is $q \approx 27.69$. That is, when 27,690 cameras are sold.

**8.** The company will make a profit when $27.69 < q < 722.31$.