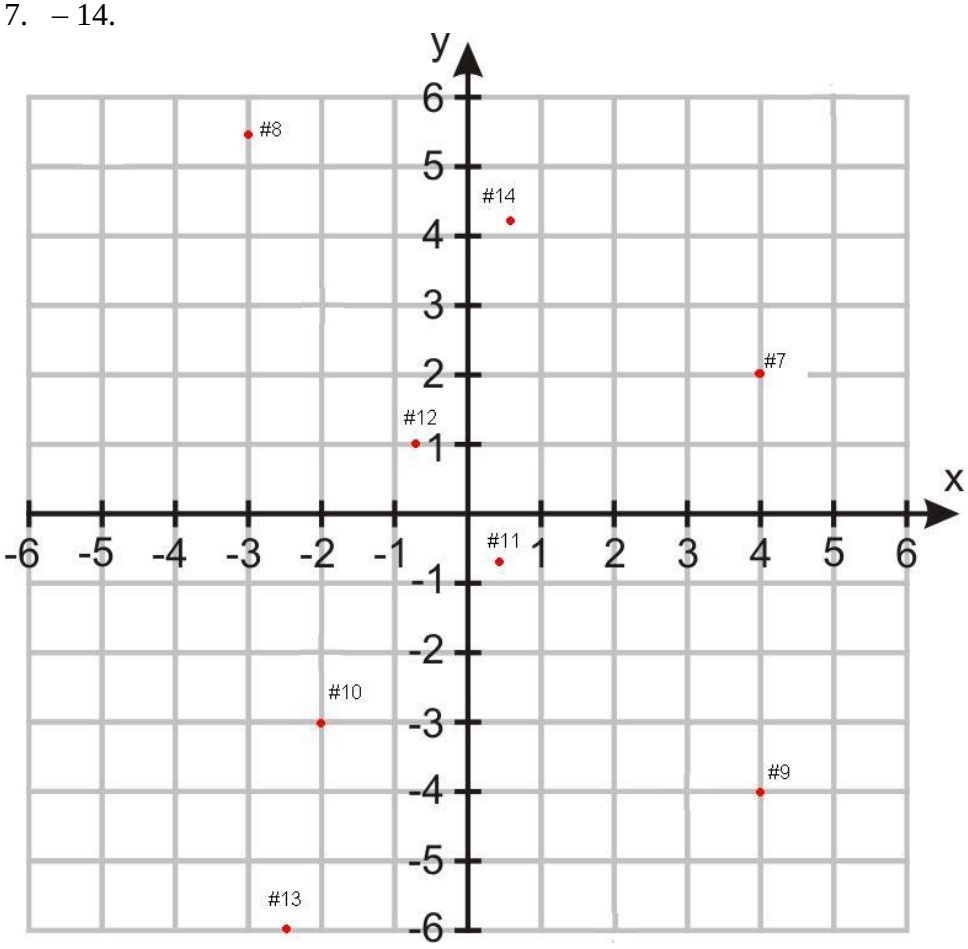
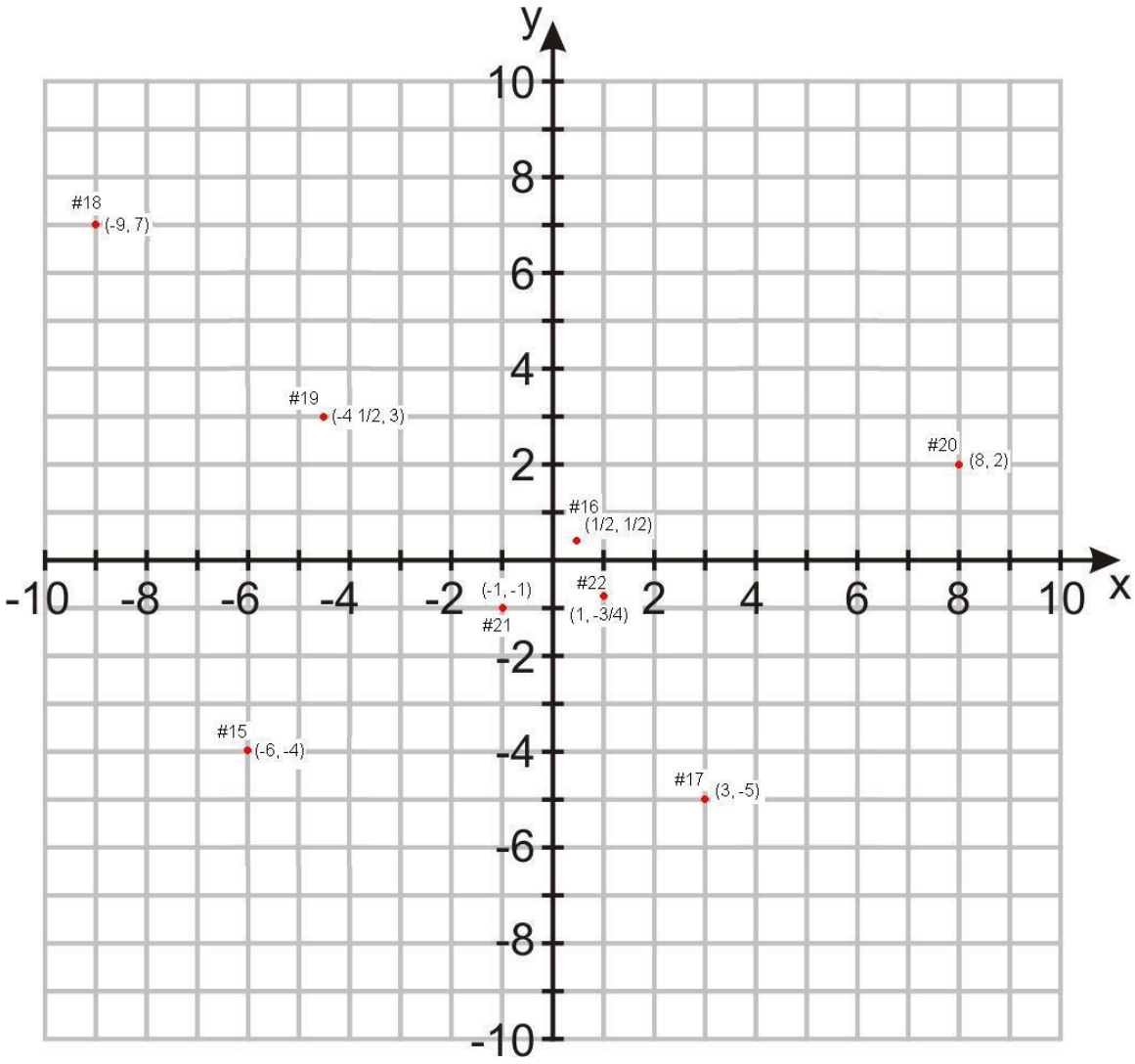
Chapter 4 Graphing Linear Equations and Functions

Lesson 4.1

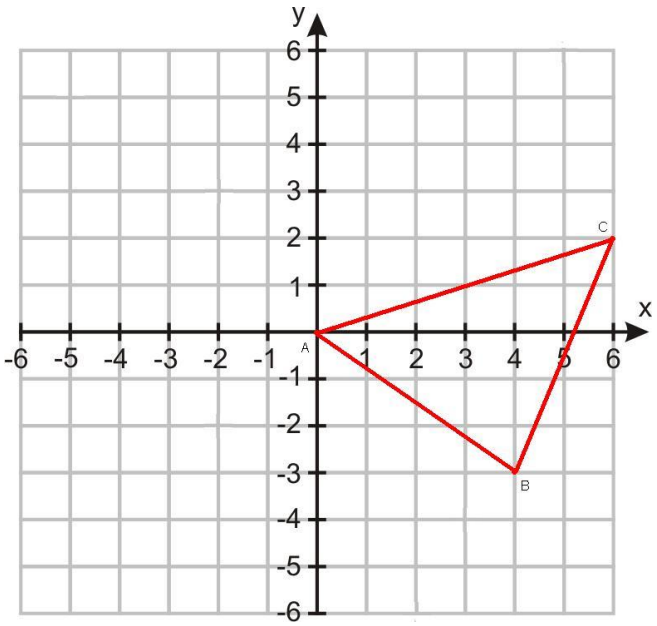
1. (–2, –2)
2. (5, 6)
3. (2, –6)
4. (3, –4)
5. (–5, 5)
6. (–2, 3)
7. – 14.



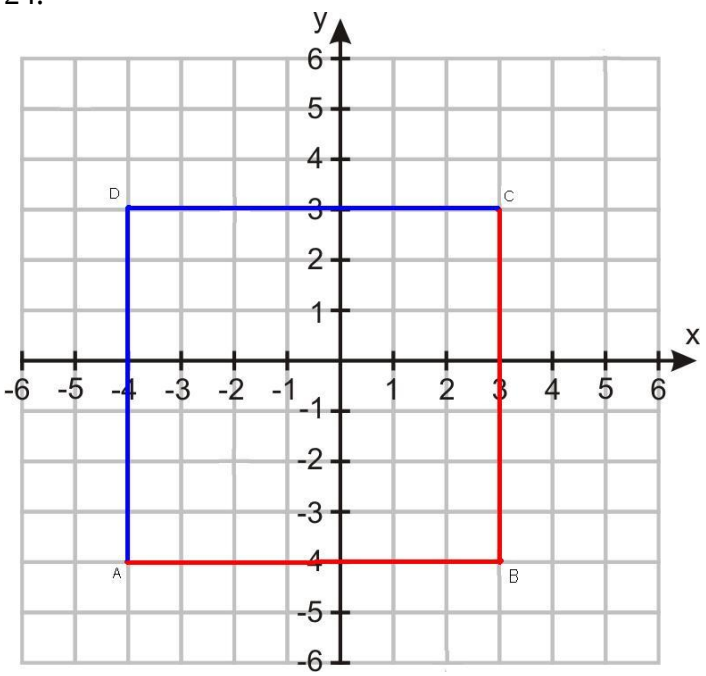
15. – 22.



23.



24.



25. The point (2, 0) does not lie in a quadrant. Since the *y*-coordinate is 0, then the point lies on the *x*-axis.

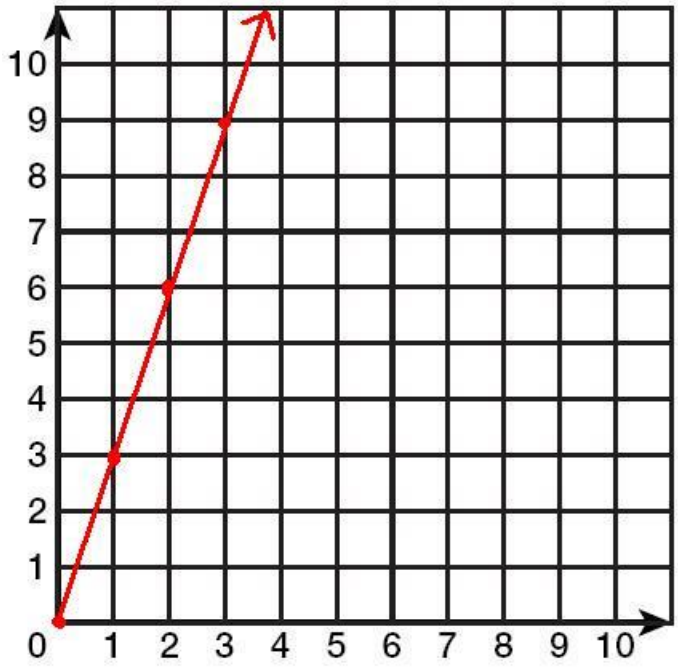
26. The point (0, 0) is called the origin because it is the beginning location for counting the distance right or left and the distance up or down.

27. (a) $y = 3x$

(b)

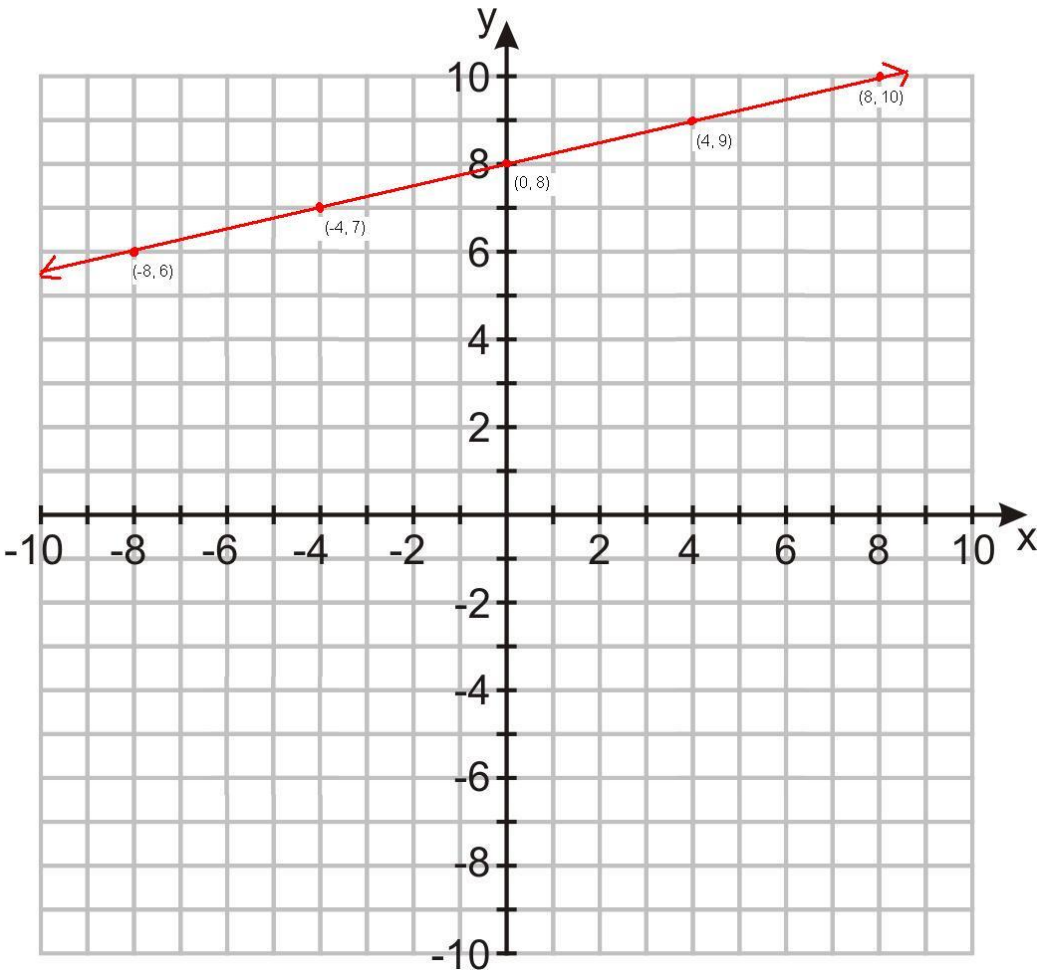
x	$y = 3x$	y
0	$y = 3(0) = 0$	0
1	$y = 3(1) = 3$	3
2	$y = 3(2) = 6$	6
3	$y = 3(3) = 9$	9
4	$y = 3(4) = 12$	12
5	$y = 3(5) = 15$	15

(c)

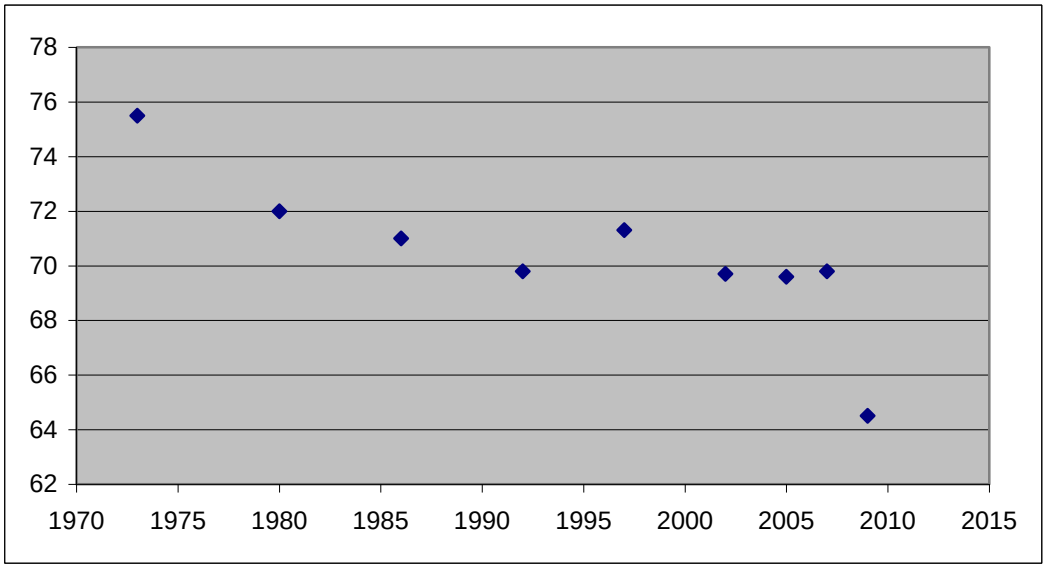


28.

x	$y=\frac{1}{4}x+8$	y
–8	$y=\frac{1}{4}(-8)+8=-2+8=6$	6
–4	$y=\frac{1}{4}(-4)+8=-1+8=7$	7
0	$y=\frac{1}{4}(0)+8=0+8=8$	8
4	$y=\frac{1}{4}(4)+8=1+8=9$	9
8	$y=\frac{1}{4}(8)+8=2+8=10$	10



29.



The percent of the men employed in the U.S. will continue to decline in the near future.

30. $\frac{3}{8}+\frac{1}{5}-\frac{5}{9}=\frac{3(45)+1(72)-5(40)}{360}=\frac{135+72-200}{360}=\frac{7}{360}$

31. $0.05m + 0.025(6000 - m) = 512$
$0.05m + 150 - 0.025m = 512$
$0.025m + 150 = 512$
$0.025m = 362$
$m=\frac{362}{0.025}=14,480$

32. $\frac{16}{u-8}=\frac{36}{u}$
$16u = 36(u - 8)$
$16u = 36u - 288$
$-20u = -288$
$u=\frac{-288}{-20}=14\frac{2}{5}$

33. The Additive Identity Property allows one to add 0 to an equation and not change to value of the variable.

34. $\frac{28}{4}-3=7-3=4$ apples

35. $P = a + b + c$. We know $P = 34$, $a = 12$, and $b = 7$.
$34 = 12 + 7 + c$
$34 = 19 + c$
$c = 34 - 19 = 15$

36. $\frac{y^2 - 16 + 10y + 2x}{2}$ when $x = 2$ and $y = -2$

$$\frac{(-2)^2 - 16 + 10(-2) + 2(2)}{2} = \frac{4 - 16 - 20 + 4}{2} = \frac{-28}{2} = -14$$

Lesson 4.2

1. The solutions to an equation with two variables are ordered pairs that can be graphed on a Cartesian plane. Solutions to an equation with one variable can be graphed on a number line.

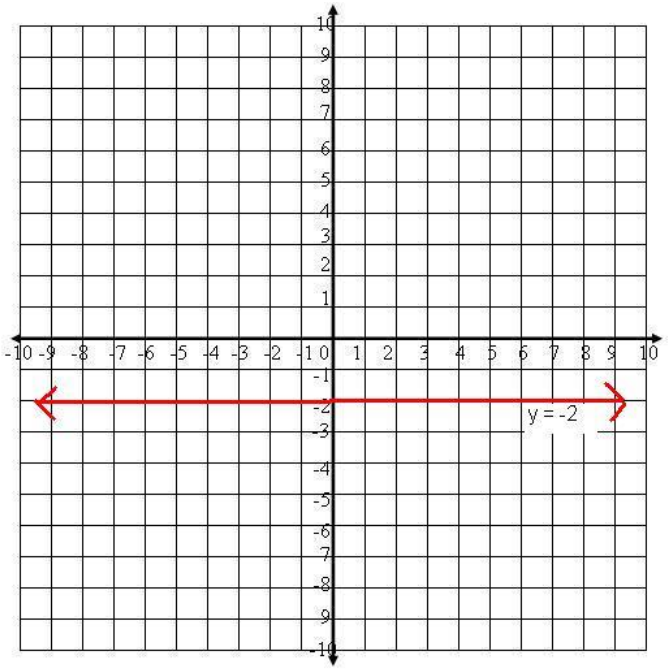
2. The equation for the *x*-axis is $y = 0$.

3. The equation for the *y*-axis is $x = 0$.

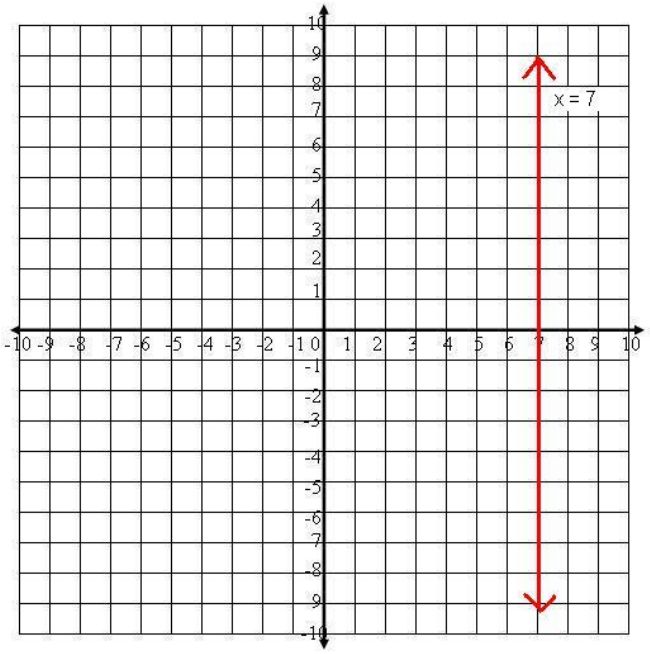
4. Based on the tax graph, and item that costs $8.00 before taxes will cost a total of $9.00 after taxes.

5. Based on the temperature graph:
   a. 32°F
   b. About 85°F
   c. –17°C
   d. Students cannot answer this question based on what they have been taught so far. They cannot extrapolate until Chapter 5.

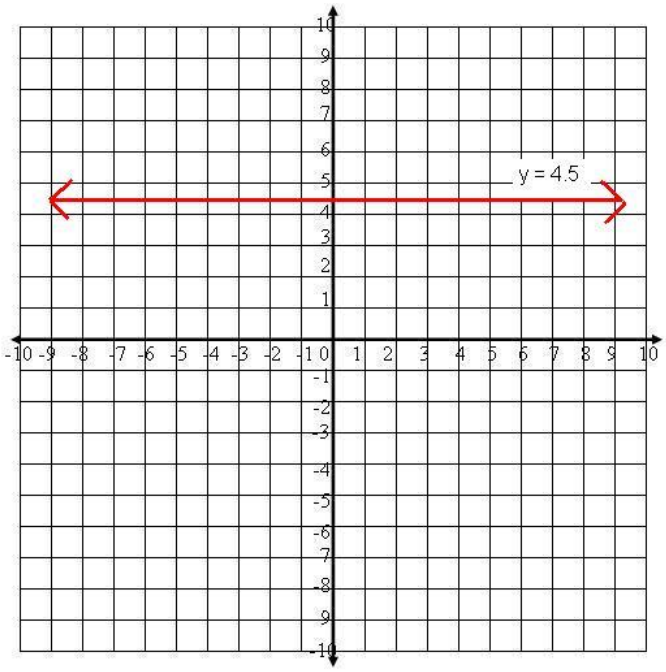
6. a.



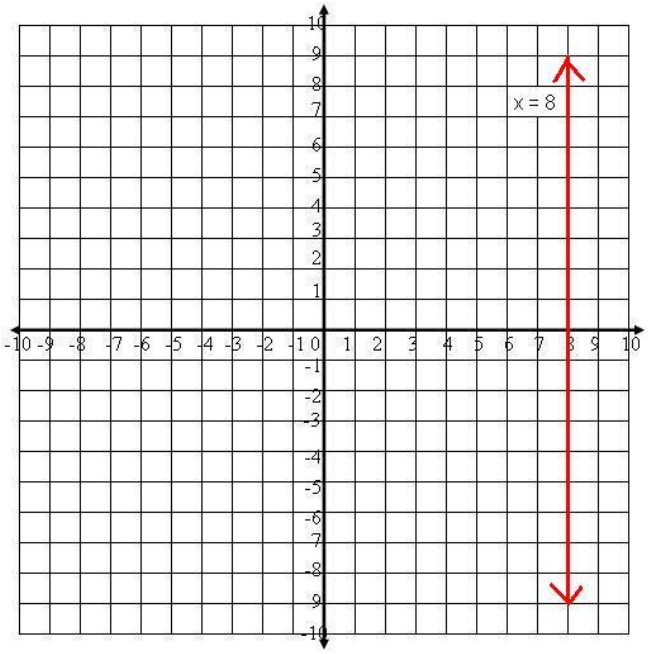
b.



c.



d.



7. Four kilograms is approximately nine pounds.

8. Nine kilograms is approximately twenty pounds.

9. Twelve pounds is approximately 5.4 kilograms.

10. Seventeen pounds is approximately 7.5 kilograms.

11. The equation for line *E* is $x = 6$.

12. The equation for line *B* is $y = -2$.

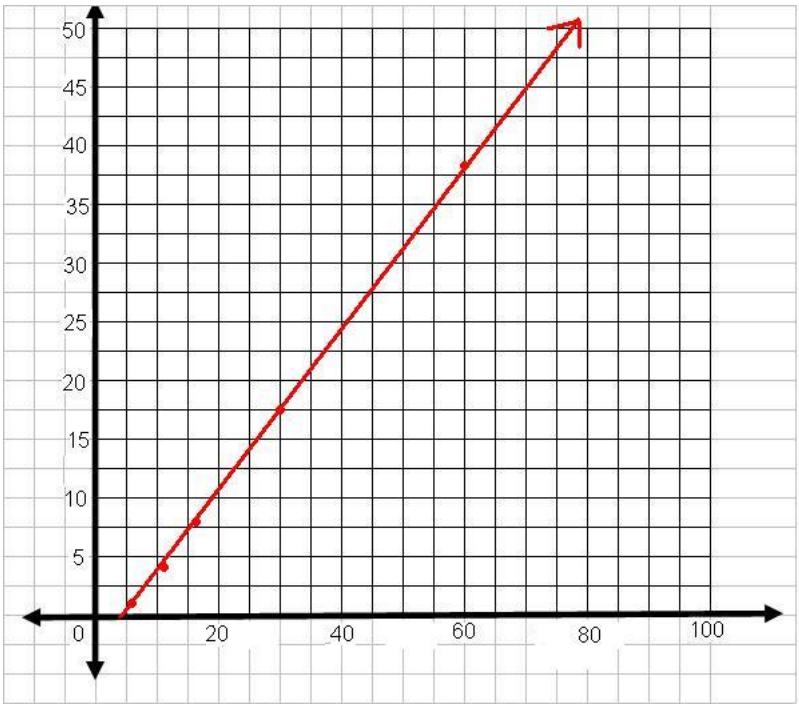
13. The equation for line *C* is $y = -7$.

14. The equation for line *A* is $y = 5$.

15. The equation for line *D* is $x = -4$.

16. Let x = the amount of dollars. Then $f(x)$ = the amount of Euros.

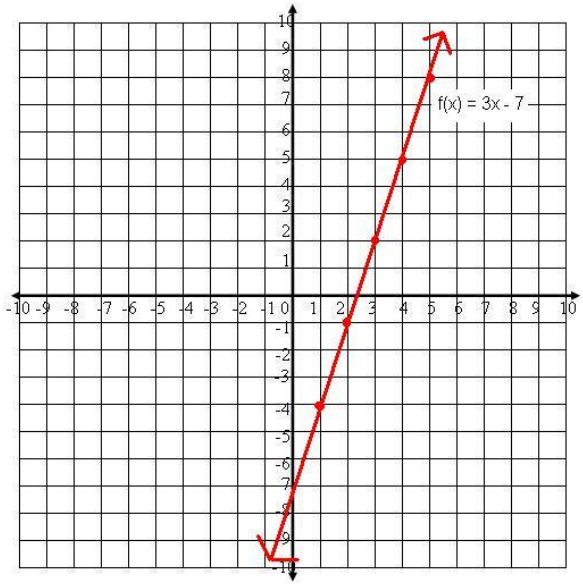
x	$f(x)$
6	0.7
11	4.2
16	7.7
30	17.5
60	38.5



The number of Euros one would receive for $50 is about 31.5 Euros.

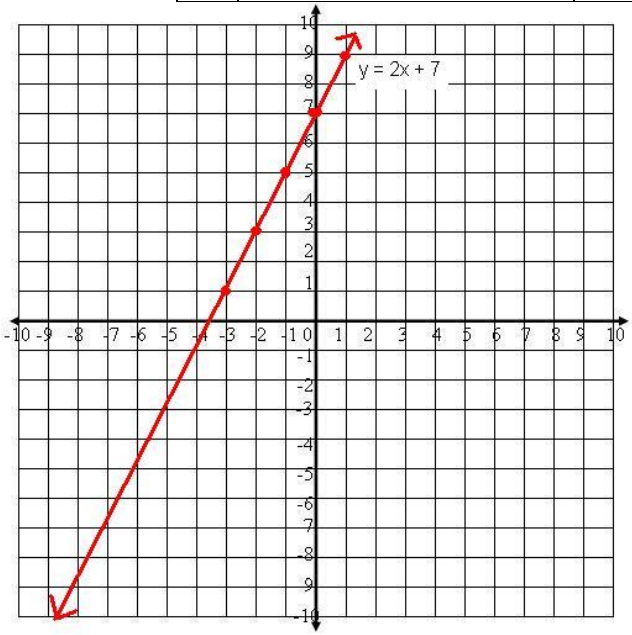
17. Let x = the number.

x	$f(x) = 3x - 7$	$f(x)$
1	$f(1) = 3(1) - 7 = -4$	–4
2	$f(2) = 3(2) - 7 = -1$	–1
3	$f(3) = 3(3) - 7 = 2$	2
4	$f(4) = 3(4) - 7 = 5$	5
5	$f(5) = 3(5) - 7 = 8$	8



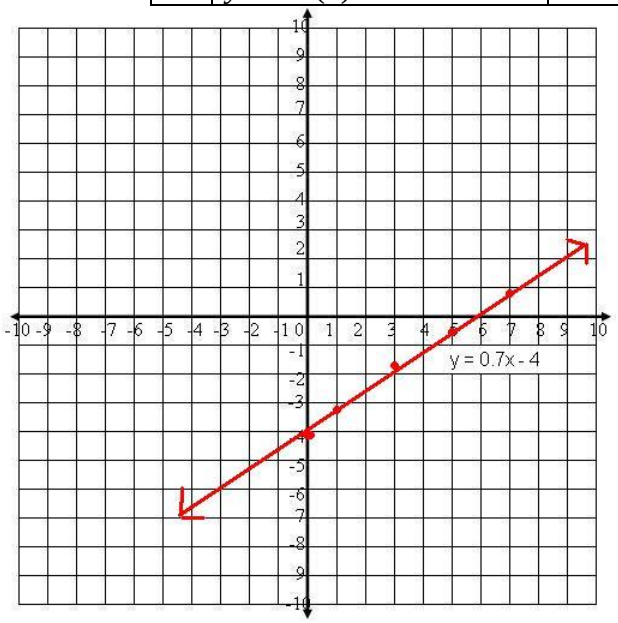
18.

x	$y = 2x + 7$	y
–3	$y = 2(–3) + 7 = 1$	1
–2	$y = 2(–2) + 7 = 3$	3
–1	$y = 2(–1) + 7 = 5$	5
0	$y = 2(0) + 7 = 7$	7
1	$y = 2(1) + 7 = 9$	9



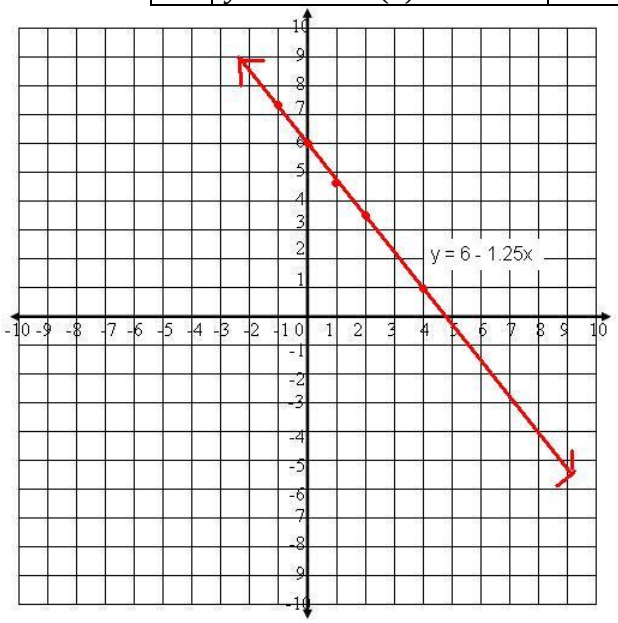
19.

x	$y = 0.7x - 4$	y
0	$y = 0.7(0) - 4 = -4$	–4
1	$y = 0.7(1) - 4 = -3.3$	–3.3
3	$y = 0.7(3) - 4 = -1.9$	–1.9
5	$y = 0.7(5) - 4 = -0.5$	–0.5
7	$y = 0.7(7) - 4 = 0.9$	0.9



20.

x	$y = 6 - 1.25x$	y
–1	$y = 6 - 1.25(-1) = 7.25$	7.25
0	$y = 6 - 1.25(0) = 6$	6
1	$y = 6 - 1.25(1) = 4.75$	4.75
2	$y = 6 - 1.25(2) = 3.5$	3.5
4	$y = 6 - 1.25(4) = 1$	1



21. The amount of change = 19.50 – 17 = 2.50.

$$\text{percent change} = \frac{\text{amount of change}}{\text{original amount}} = \frac{2.50}{17} = 14.7\% \text{ increase}$$

22. One ordered pair in Quadrant III is (–7, –2).

23. $\frac{1}{3}\left(\frac{1}{2}\right) = \frac{1}{6}$

24. $b + 16 = 3b - 2$
$16 - 2 = 3b - b$
$14 = 2b$
$b = 7$

25. What is 16% of 97?
$x = 0.16(97) = 15.52$

26. $0.73(80) = 58.4$
Cheyenne got 58 questions correct.

27. Four math verbs any of the following – divide, subtract, add, multiply, square root, exponent – there are many others

Lesson 4.3

1. intercept – the point at which a graphed line crosses an axis

2. The coordinates for an x-intercept is $(x, 0)$, where x is any real number on the x-axis.

3. One can "Cover Up" one of the terms, which symbolizes eliminating one of the variables using the multiplication property of zero. Then one can solve the remaining equation for the other variable. This will provide the intercept. After, one can repeat the process with the other variable.

4. $y = 3x - 6$ | $y = 3(0) - 6$
   $0 = 3x - 6$ | $y = 0 - 6$
   $6 = 3x$ | $y = -6$
   $x = 2$ | $(0, -6)$
   $(2, 0)$

5. $y = -2x + 4$ | $y = -2(0) + 4$
   $0 = -2x + 4$ | $y = 0 + 4$
   $-4 = -2x$ | $y = 4$
   $x = 2$ | $(0, 4)$
   $(2, 0)$

6. $y = 14x - 21$ | $y = -2(0) - 21$
   $0 = 14x - 21$ | $y = 0 - 21$
   $21 = 14x$ | $y = -21$
   $x = \frac{3}{2}$ | $(0, -21)$
   $(\frac{3}{2}, 0)$

7. $y = 7 - 3x$ | $y = 7 - 3x$
   $0 = 7 - 3x$ | $y = 7 - 0$
   $-7 = -3x$ | $y = 7$
   $x = \frac{7}{3}$ | $(0, 7)$
   $(\frac{7}{3}, 0)$

8. $5x - 6y = 15$ | $5x - 6y = 15$
   $5x = 15$ | $-6y = 15$
   $x = 3$ | $y = \frac{15}{-6} = -\frac{5}{2}$
   $(3, 0)$ | $(0, -\frac{5}{2})$

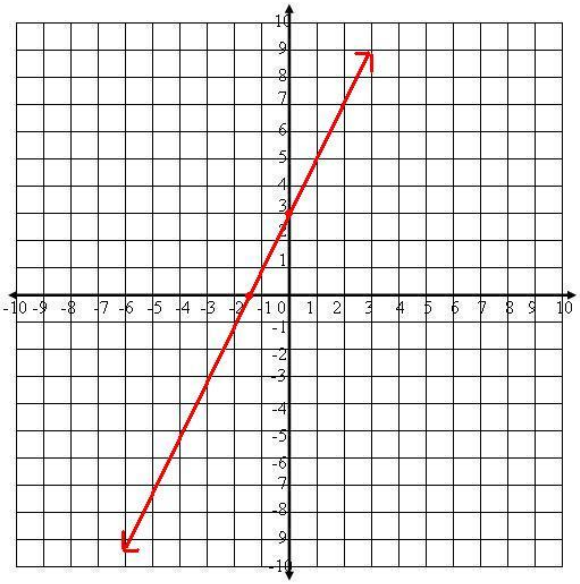
9. $3x - 4y = -5$ $\quad$ $3x - 4y = -5$
$3x = -5$ $\quad$ $-4y = -5$
$x = -\frac{5}{3}$ $\quad$ $y = \frac{5}{4}$
$(-\frac{5}{3}, 0)$ $\quad$ $(0, \frac{5}{4})$

10. $2x + 7y = -11$ $\quad$ $2x + 7y = -11$
$2x = -11$ $\quad$ $7y = -11$
$x = -\frac{11}{2}$ $\quad$ $y = -\frac{11}{7}$
$(-\frac{11}{2}, 0)$ $\quad$ $(0, -\frac{11}{7})$

11. $5x + 10y = 25$ $\quad$ $5x + 10y = 25$
$5x = 25$ $\quad$ $10y = 25$
$x = 5$ $\quad$ $y = \frac{5}{2}$
$(5, 0)$ $\quad$ $(0, \frac{5}{2})$

12. I prefer the cover-up method because is saves a step. **(OR other valid answer)**

13. $y = 2x + 3$ $\quad$ $y = 2x + 3$
$0 = 2x + 3$ $\quad$ $y = 3$
$-3 = 2x$ $\quad$ $(0, 3)$
$x = -\frac{3}{2}$
$(-\frac{3}{2}, 0)$



14. $6(x - 1) = 2(y + 3)$

$6x - 6 = 2y + 6$

$6x - 6 = 6$

$6x = 12$

$(2, 0)$

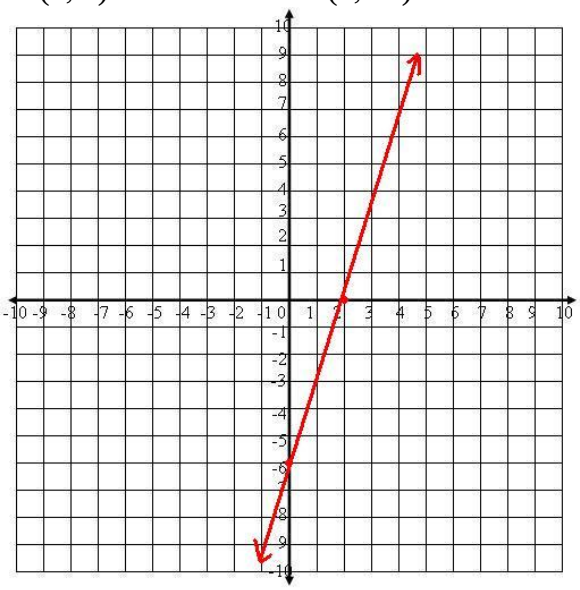
$6(x - 1) = 2(y + 3)$

$6x - 6 = 2y + 6$

$-6 = 2y + 6$

$-12 = 2y$

$(0, -6)$



15. $x - y = 5$

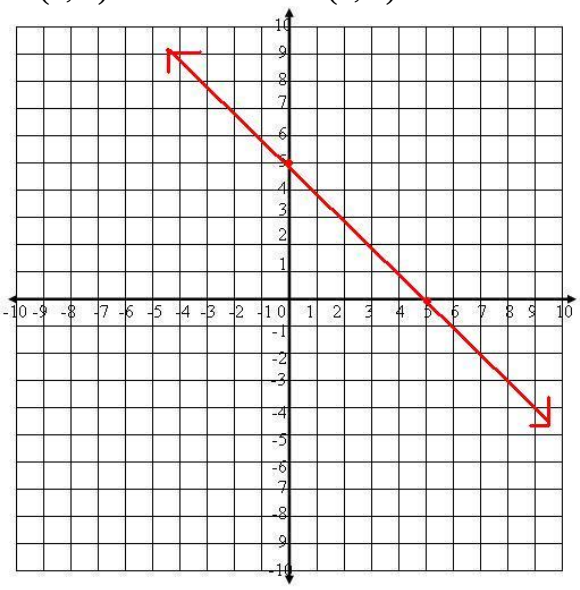
$x = 5$

$(5, 0)$

$x - y = 5$

$-y = -5$

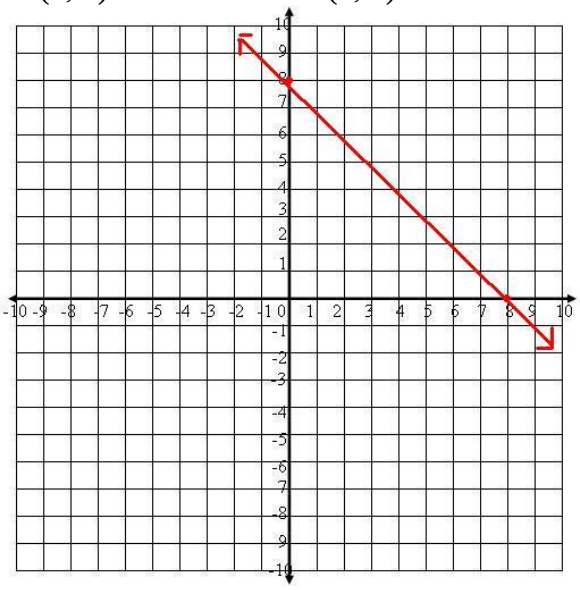
$(0, 5)$



16. $x + y = 8$ $\quad\quad$ $x + y = 8$

$x = 8$ $\quad\quad$ $y = 8$

(8, 0) $\quad\quad$ (0, 8)



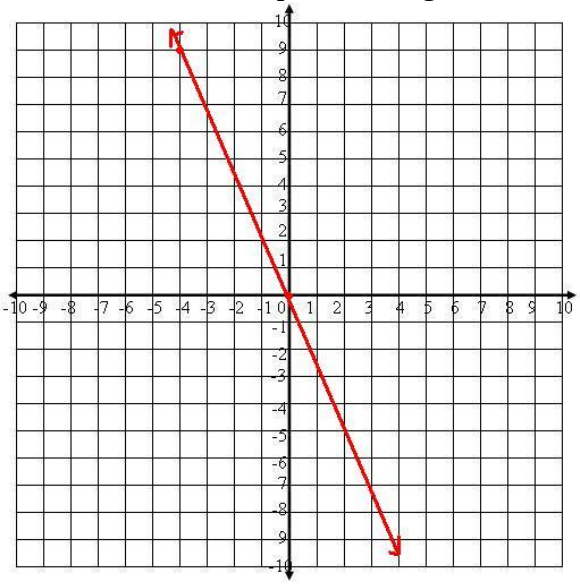
17. $4x + 9y = 0$

$4x = 0$

$x = 0$

(0, 0)

Since the x-intercept is the origin, there is no need to find the y-intercept.

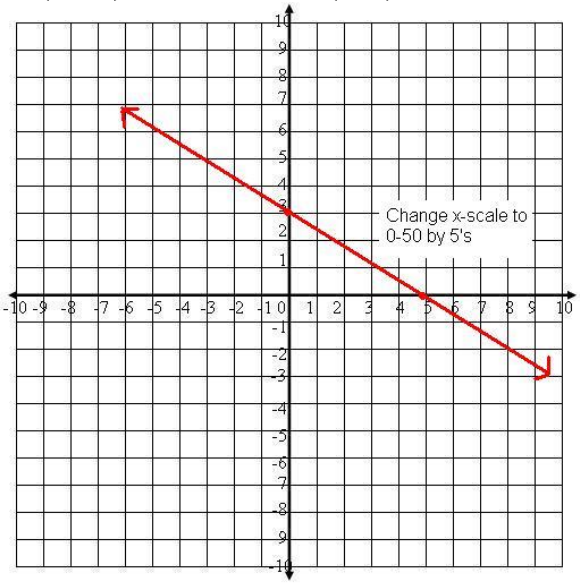


18. $\frac{1}{2}x + 4y = 12$ $\frac{1}{2}x + 4y = 12$

$\frac{1}{2}x = 12$ $4y = 12$

$x = 24$ $y = 3$

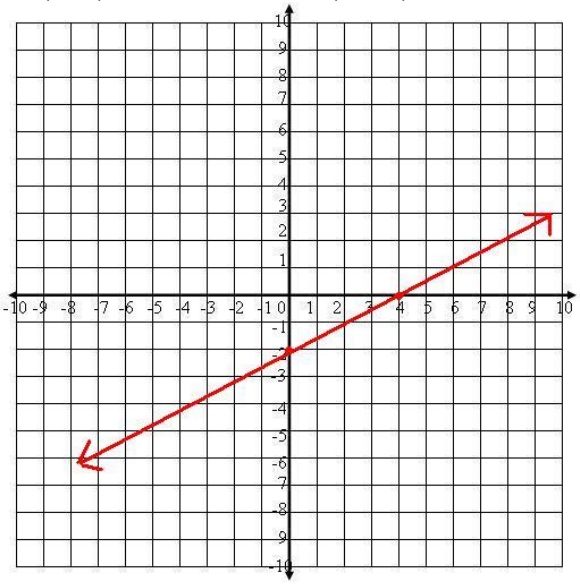
(24, 0) (0, 3)



19. $x - 2y = 4$ $x - 2y = 4$

$x = 4$ $-2y = 4$

(4, 0) (0, –2)



20. $7x - 5y = 10$

$7x = 10$

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

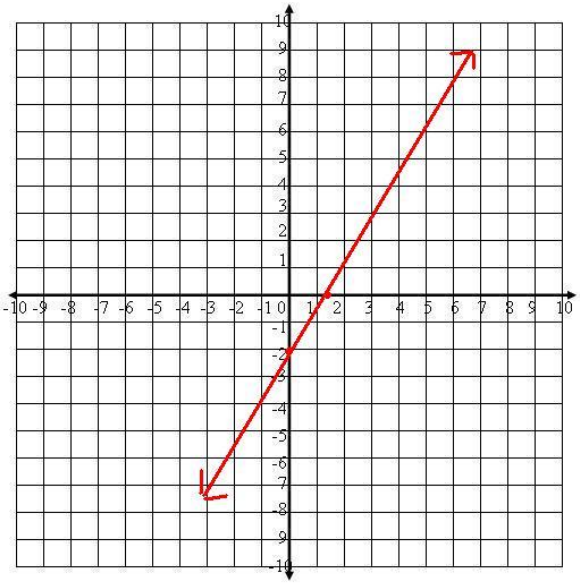
$(\frac{10}{7}, 0)$

$7x - 5y = 10$

$-5y = 10$

$y = -2$

$(0, -2)$



21. $4x - y = -3$

$4x = -3$

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

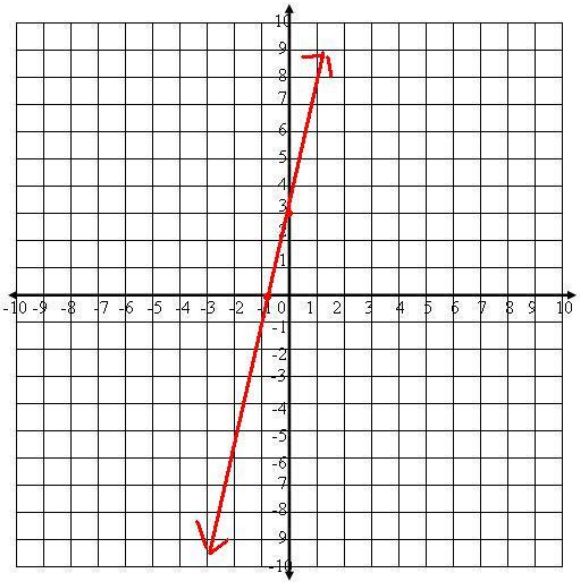
$(-\frac{3}{4}, 0)$

$4x - y = -3$

$-y = -3$

$y = 3$

$(0, 3)$

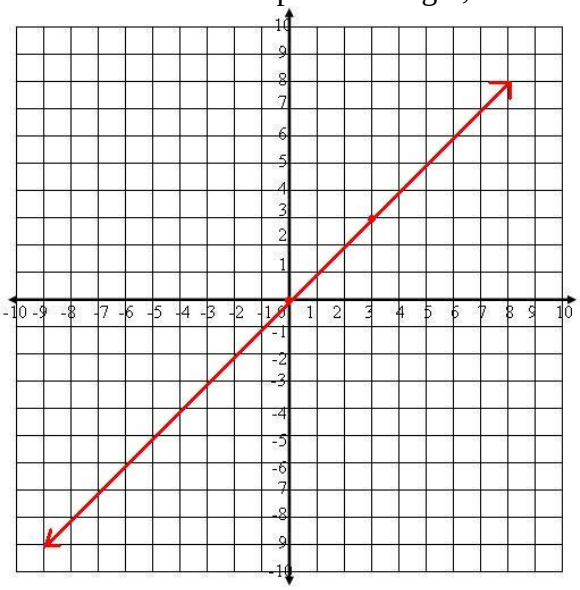


22. $x - y = 0$

$x = 0$

(0, 0)

Since the x-intercept is the origin, there is no need to find the y-intercept.



23. $5x + y = 5$

$5x = 5$

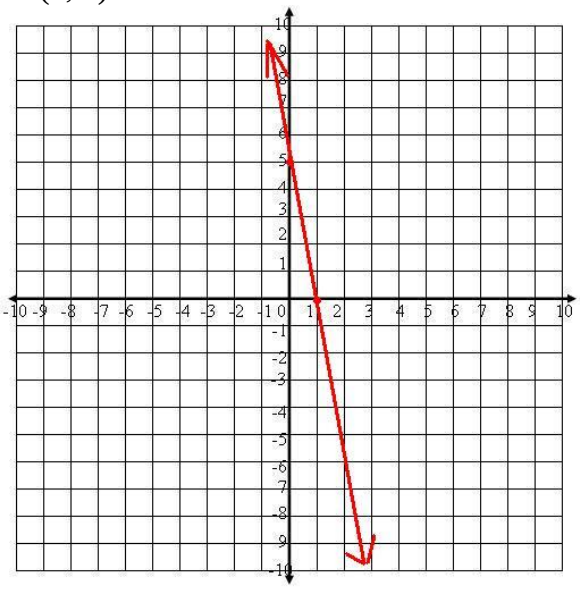
$x = 1$

(1, 0)

$5x + y = 5$

$y = 5$

(0, 5)

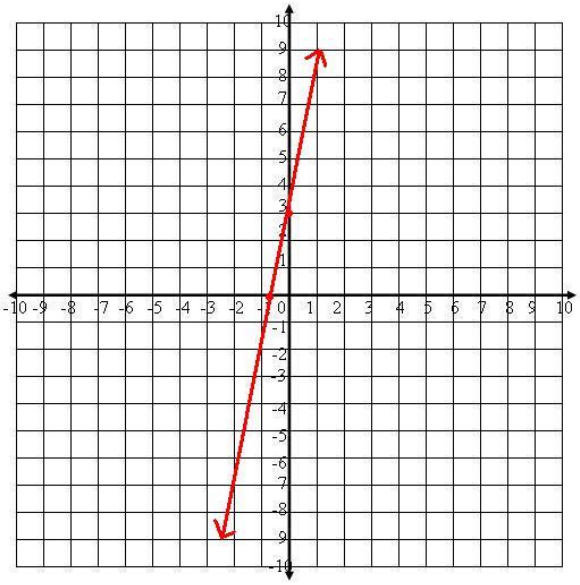


24. $7x - 2y = -6$ $\qquad$ $7x - 2y = -6$

$7x = -6$ $\qquad$ $-2y = -6$

$x = -\frac{6}{7}$ $\qquad$ $y = 3$

$(-\frac{6}{7}, 0)$ $\qquad$ $(0, 3)$



25. Vertical lines have *x*-intercepts only.

26. The line represented by $y = 5$ is a horizontal line. Therefore, it only has a *y*-intercept.

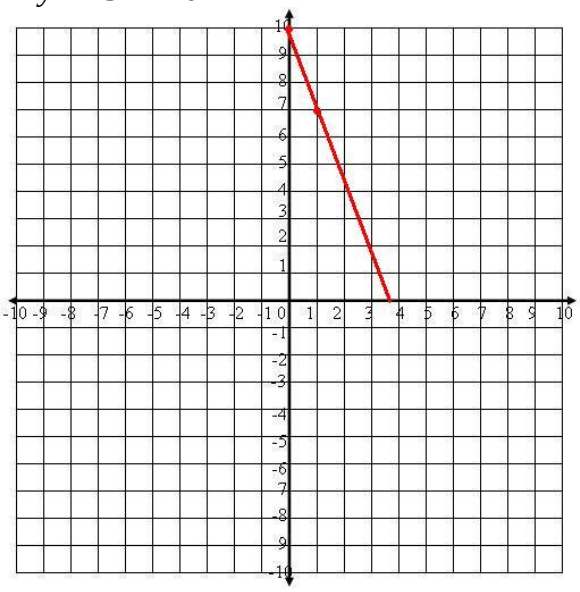
27. $x = -4$

28. There are an infinite number of lines that can be drawn with only (0, 0) as the intercept. The slope is the only thing that will change.

29. One must distribute the 3 on the left side of the equation and distribute the 2 on the right side of the equation.

30. Let x = the number of pounds of strawberries and y = the number of pounds of bananas. Then we can write $3x + 1y = 10$ or $3x + y = 10$.

$y = -3x + 10$

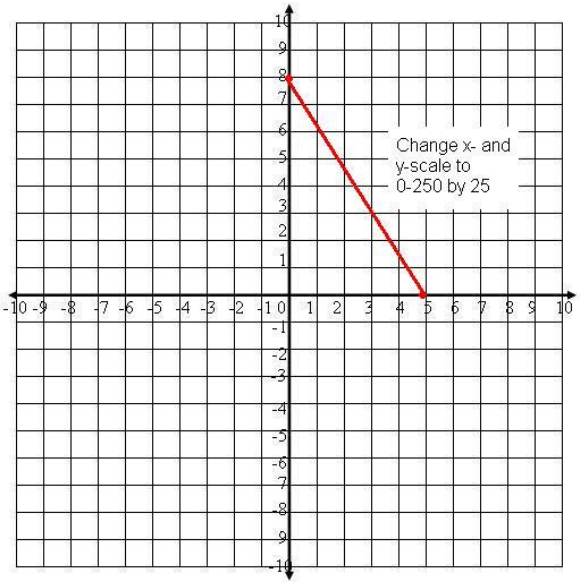


31. Let x = the number of adult tickets and y = the number of children's tickets. Then we can write $7.50x + 4.50y = 900$.

$4.50y = -7.50x + 900$

$$y = -\frac{7.50}{4.50}x + \frac{900}{4.50}$$

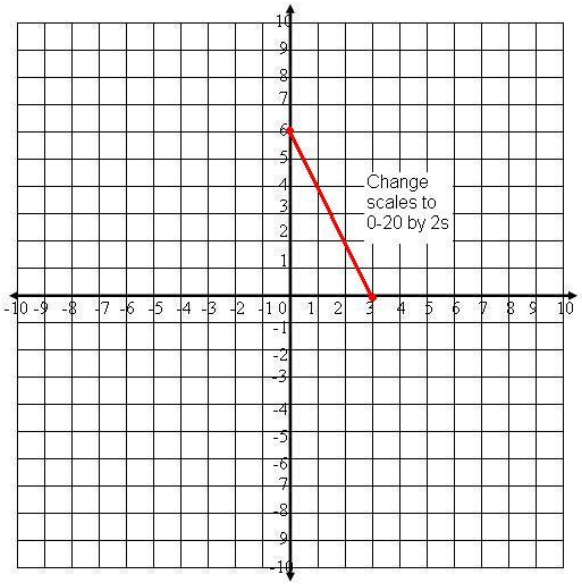
$$y = -\frac{5}{3}x + 200$$



32. Let x = the number of touchdowns and y = the number of field goals. Then we can write $6x + 3y = 36$.

$3y = -6x + 36$

$y = -2x + 12$



33. $5x + 2y = 23$; (7, –6) and (3, 4)

$5(7) + 2(-6) = 23$

$35 + (-12) = 23$

$23 = 23$

(7, –6) is a solution

$5(3) + 2(4) = 23$

$15 + 8 = 23$

$23 = 23$

(3, 4) is a solution

34. $3a - 2b = 6$; (0, 3) and $\left(\frac{5}{3}, \frac{-1}{2}\right)$

$3(0) - 2(3) = 6$

$0 - 6 = 6$

$-6 \neq 6$

(0, 3) is not a solution

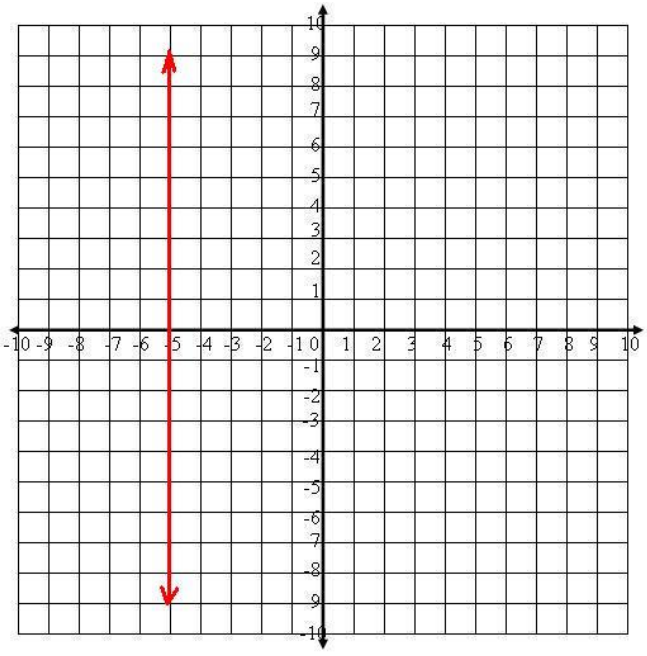
$3(\frac{5}{3}) - 2(-\frac{1}{2}) = 6$

$5 + 1 = 6$

$6 = 6$

$\left(\frac{5}{3}, \frac{-1}{2}\right)$ is a solution

35.



36. $\frac{4}{5}k - 16 = -\frac{1}{4}$

$20\left(\frac{4}{5}k - 16\right) = 20\left(-\frac{1}{4}\right)$

$16k - 320 = 5$

$16k = 325$

$k = \frac{325}{16} = 20\frac{5}{16}$

37. The relation is not a function because one value in the domain (0) is matched to two values in the range (0 and 6).

38. The domain would be whole numbers.

39. amount of change = 1299 – 1145 = 154

$\text{percent change} = \frac{\text{amount of change}}{\text{original amount}} = \frac{154}{1299} \approx 11.9\%$

Lesson 4.4

1. Slope is the measure of steepness of a line. (page 137)

2. The rate of change of a real-life situation is the same as the slope. Slope can refer to hypothetical or non-real life scenarios.

3. You can use the slope formula or the slope triangle method. I prefer the slope formula because one can always calculate the slope of a line in he/she knows two points on the line. **(or other valid answer)**

4. All vertical lines have an undefined slope because the denominator results in 0. Division by 0 is undefined.

5. All horizontal lines have zero slope because the numerator results in 0.

6. (a) Two points on the line are (3, 6) and (–1, –6)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-(-6)}{3-(-1)} = \frac{12}{4} = 3$$

(b) Two points on the line are (0, 1) and (–6, –2)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-1}{-6-0} = \frac{-3}{-6} = \frac{1}{2}$$

7. (c) Two points on the line are (–1, 6) and (–5, –6)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-6}{-5-(-1)} = \frac{-12}{-4} = 3$$

(d) Two points on the line are (4, 2) and (–2, –4)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-2}{-2-4} = \frac{-6}{-6} = 1$$

8. (d) Two points on the line are (4, 2) and (4, –6)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-2}{4-4} = \frac{-8}{0} = \text{undefined}$$

Vertical lines have undefined slope.

(f) Two points on the line are (3, 1) and (–6, –2)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-1}{-6-3} = \frac{-3}{-9} = \frac{1}{3}$$

9. $$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0-7}{0-(-5)} = \frac{-7}{5} = -\frac{7}{5}$$

10. $$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-(-5)}{3-(-3)} = \frac{16}{6} = \frac{8}{3}$$

11. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9-(-5)}{-2-3} = \frac{14}{-5} = -\frac{14}{5}$

12. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-7}{-5-(-5)} = \frac{4}{0} = \text{undefined}$

13. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-9-9}{-9-9} = \frac{-18}{-18} = 1$

14. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-5}{-2-3} = \frac{3}{-5} = -\frac{3}{5}$

15. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-\frac{3}{4}}{-2-\frac{1}{2}} = \frac{\frac{21}{4}}{-\frac{5}{2}} = \left(\frac{21}{4}\right)\left(-\frac{5}{2}\right) = -\frac{105}{8}$

16. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8-3}{4-(-2)} = \frac{5}{6}$

17. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-11}{4-(-17)} = \frac{0}{21} = 0$

18. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-19-2}{31-31} = \frac{-21}{0} = \text{undefined}$

19. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-(-3)}{3-0} = \frac{2}{3}$

20. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2-7}{7-2} = \frac{-5}{5} = -1$

21. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\frac{1}{4}-0}{\frac{2}{3}-0} = \frac{\frac{1}{4}}{\frac{2}{3}} = \left(\frac{1}{4}\right)\left(\frac{3}{2}\right) = \frac{3}{8}$

22. Since $y = 16$ is a horizontal line, it has a slope of zero.

23. Since $x = -99$ is a vertical line, it has an undefined slope.

24.

Section A: The interval is (5, 0.5) and (0, 0).

$$\text{rate of change} = \frac{0-0.5}{0-5} = \frac{-0.5}{-5} = 0.1 \text{ mile per minute}$$

Section B: The interval is (7, 0.5) and (5, 0.5).

Since the line is horizontal, we can determine he was stopped. Therefore, his speed was 0 mile per minute.

Section C: The interval is (7, 0.5) to (14, 1.2).

$$\text{rate of change} = \frac{1.2-0.5}{14-7} = \frac{0.7}{7} = 0.1 \text{ mile per minute}$$

Section D: The interval is (14, 1.2) to (20, 3).

$$\text{rate of change} = \frac{3-1.2}{20-14} = \frac{1.8}{6} = 0.3 \text{ mile per minute}$$

Section E: The interval is (20, 3) to (25, 3).

Since the line is horizontal, we can determine he was stopped. Therefore, his speed was 0 mile per minute.

Section F: The interval is (25, 3) to (30, 3.5).

$$\text{rate of change} = \frac{3.5-3}{35-30} = \frac{0.5}{5} = 0.1 \text{ mile per minute}$$

25. The interval is (4, 145) to (7, 300).

$$\text{rate of speed} = \frac{300-145}{7-4} = \frac{155}{3} \approx 51.7 \text{ miles per hour}$$

26. $\dfrac{60}{2\frac{1}{2}} = \dfrac{60}{\frac{5}{2}} = 60\left(\dfrac{2}{5}\right) = \$24$ each week

27. Geoffrey is riding on a ride at a fair. The first part of the ride climbs quickly. After 1 second on the ride, he is 10 feet in the air. After 3 seconds, he is 30 feet in the air.

28. The intercepts of $3x - 5y = 10$ are:

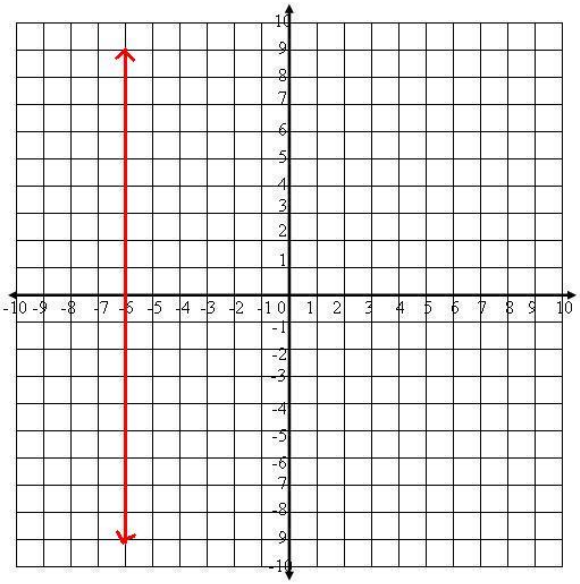
$3x = 10$

$x = \dfrac{10}{3} \rightarrow (\dfrac{10}{3}, 0)$

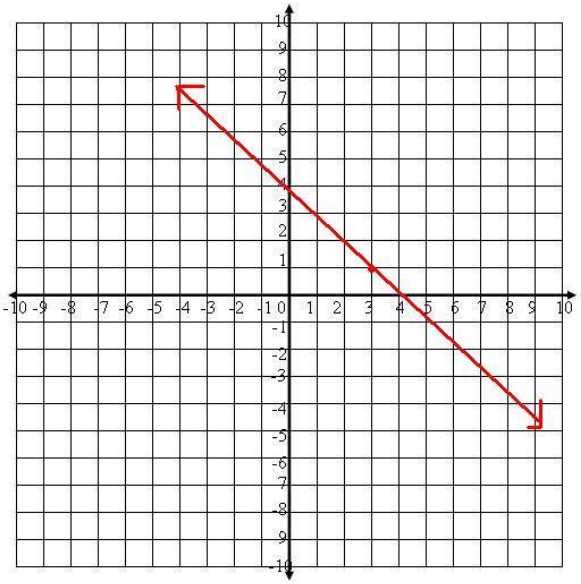
$-5y = 10$

$y = \dfrac{10}{-5} = -2 \rightarrow (0, -2)$

29.



30.



31. Let x = the number of quarters and y = the number of dines. Then we can write $0.25x + 0.10y = 4$

$0.10y = 4$

$0.10y = 4$

$y = \frac{4}{0.1} = 40 \rightarrow (0, 40)$

$0.25x = 4$

$x = \frac{4}{0.25} = 16 \rightarrow (16, 0)$

32. Domain {–2, –1, 0, 1, 2} Range {0, 1, 2}

33. $16y - 72 = 36$
$16y = 108$
$y = 6.75$

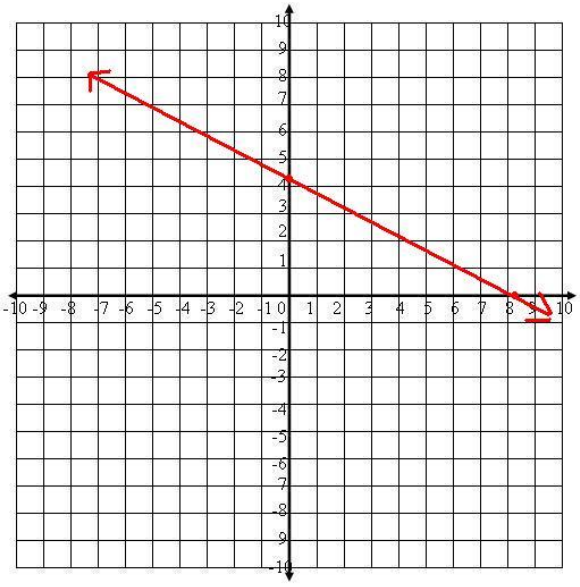
34. $3x + 1 = 2x - 35$
$3x - 2x = -35 - 1$ (combine like terms)
$x = -36$ (simplify the left and right sides)

35. $\frac{6}{a} = \frac{14}{2a+1}$
$6(2a + 1) = 14a$
$12a + 6 = 14a$
$6 = 2a$
$a = 3$

Quick Quiz

1. $3x + 6y = 25$

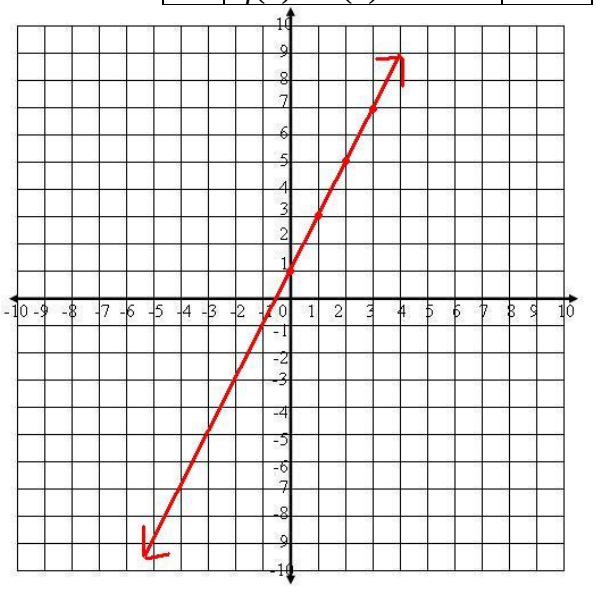
$3x = 25$	$6y = 25$
$x = 8\frac{1}{3}$	$y = 4\frac{1}{6}$
$(8\frac{1}{3}, 0)$	$(0, 4\frac{1}{6})$



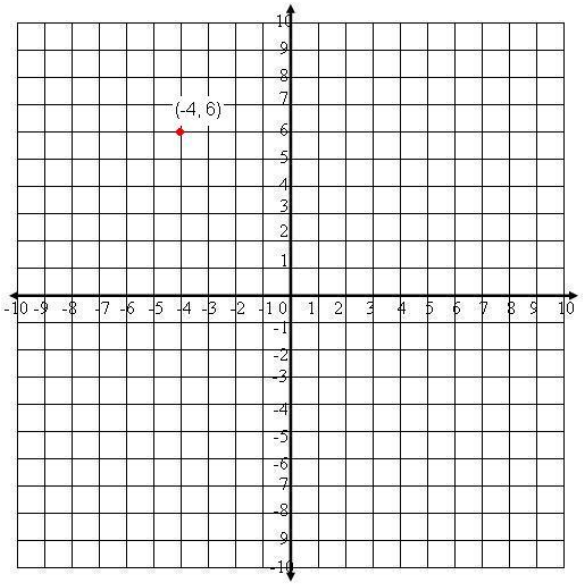
2. (8, 5) and (–5, 6)
$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-5}{-5-8} = \frac{1}{-13} = -\frac{1}{13}$

3. $f(x) = 2x + 1$

x	$f(x) = 2x + 1$	$f(x)$
0	$f(0) = 2(0) + 1 = 1$	1
1	$f(1) = 2(1) + 1 = 3$	3
2	$f(2) = 2(2) + 1 = 5$	5
3	$f(3) = 2(3) + 1 = 7$	7



4.



5. There are many possible solutions. Two trends are listed here:
   a. The number of students in public school increased every year from 1990 to 2000.
   b. The rate of increase for the number of students was slower towards the end of the decade than the beginning of the decade.

Lesson 4.5

1. Slope (m) = 2; y-intercept (b) = 5

2. $m = -0.2$; $b = 7$

3. $m = 1$; $b = 0$

4. $m = 0$; $b = 3.75$

5. $m = \frac{2}{3}$; $b = -9$

6. $m = -0.01$; $b = 10{,}000$

7. $m = \frac{3}{5}$; $b = 7$

8. The slope of line F is down 2, and right 4, so $\frac{-2}{4} = -\frac{1}{2}$.

9. The slope of line C is 0.

10. The slope of line A is down 2, and right 1, so $\frac{-2}{1} = -2$.

11. The slope of line G is up 4, and right 1, so $\frac{4}{1} = 4$.

12. The slope of line B is down 4, and right 3, so $\frac{-4}{3} = -\frac{4}{3}$.

13. The slope of line D is up 2, and right 5, so $\frac{2}{5}$.

14. The slope of line E is down 2, and right 8, so $\frac{-2}{8} = -\frac{1}{4}$.

15. The slope of line D is –1, and the y-intercept is 0.

16. The slope of line A is $-\frac{2}{3}$, and the y-intercept is about $1\frac{1}{3}$.

17. The slope of line F is $-\frac{1}{5}$, and the y-intercept is –2.

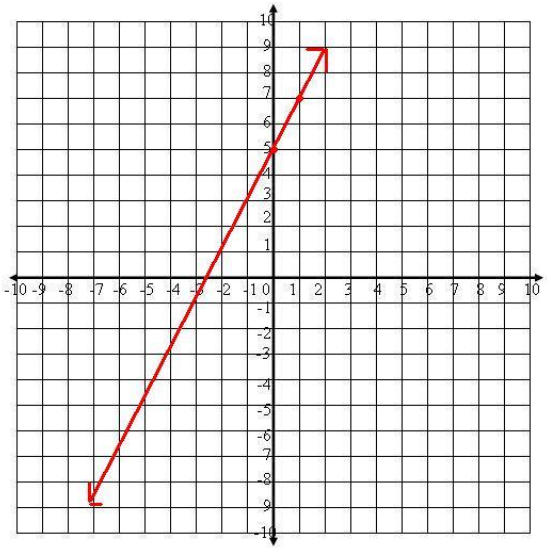
18. The slope of line *B* is 3, and the *y*-intercept is 1.

19. The slope of line *E* is 0, and the *y*-intercept is 3.

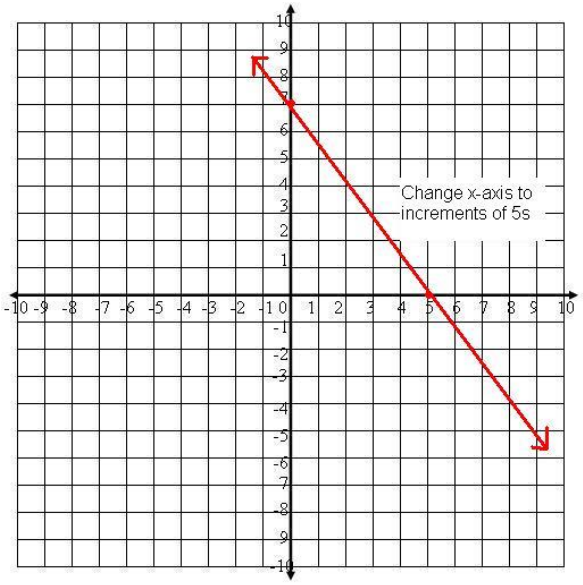
20. The slope of line *C* is $\frac{1}{2}$, and the *y*-intercept is –2.

21. $-5x + 12 = 20$
    Since there is no *y*, then we know the line is vertical. Therefore, the line has undefined slope. It does not have a *y*-intercept.

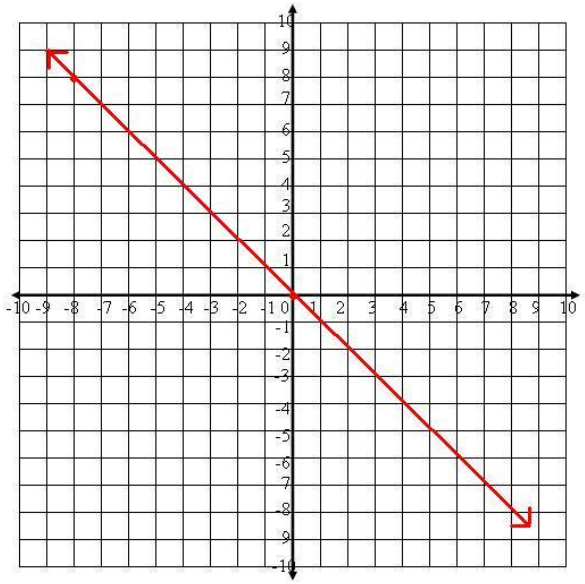
22.



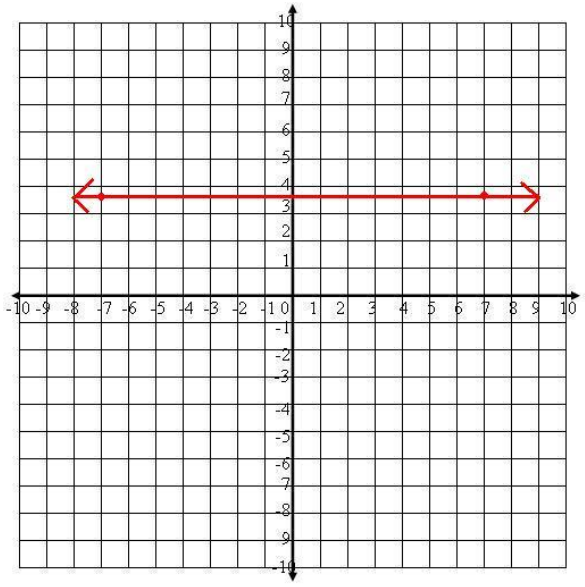
23.



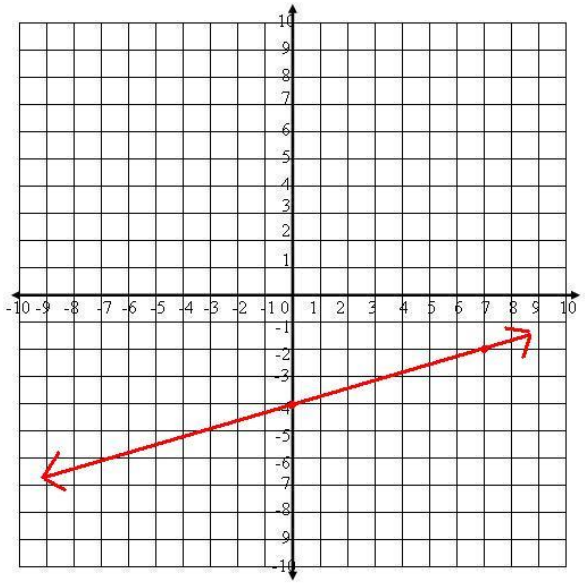
24.



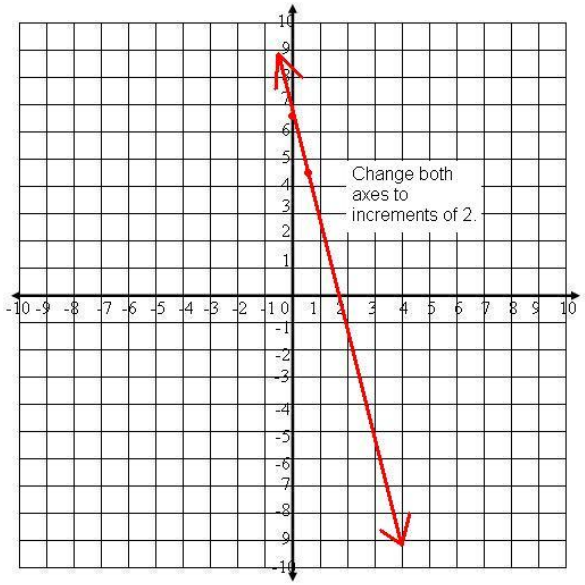
25.



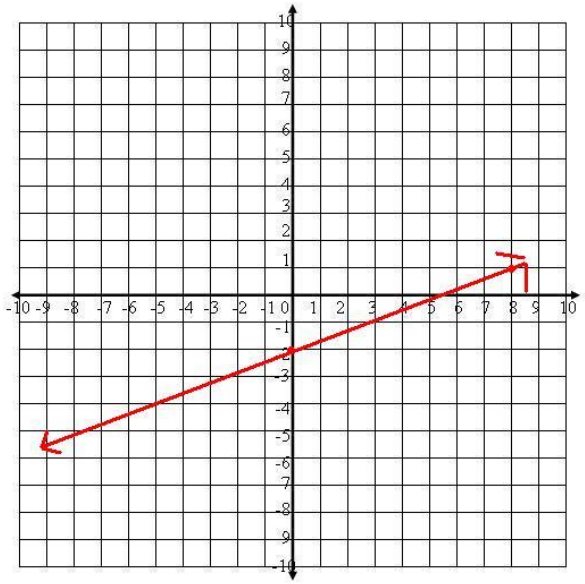
26.



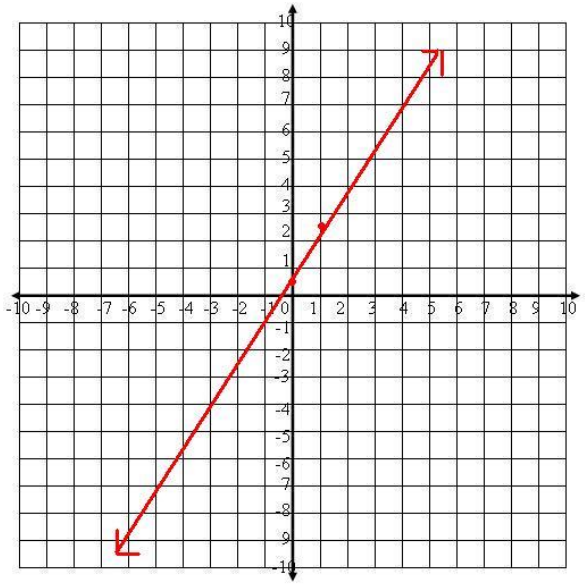
27.



28.



29.



30. The slope of the given line is 2, so the slope of any line parallel to it will have a slope of 2.

31. The slope of the given line is –0.2, so the slope of any line parallel to it will have a slope of –0.2.

32. The slope of the given line is –1, so the slope of any line parallel to it will have a slope of –1.

33. The slope of the given line is 0, so the slope of any line parallel to it will have a slope of 0.

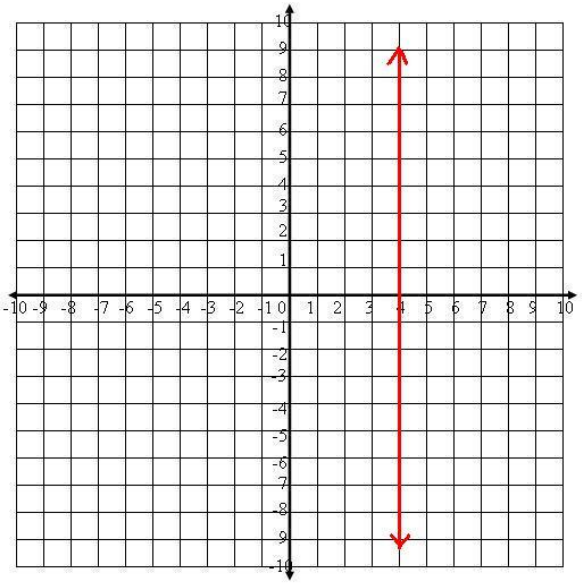
34. The slope of the given line is $-\frac{1}{5}$, so the slope of any line parallel to it will have a slope of $-\frac{1}{5}$.

35. The slope of the given line is –5, so the slope of any line parallel to it will have a slope of –5.

36. The slope of the given line is –3, so the slope of any line parallel to it will have a slope of –3.

37. The slope of the given line is 3, so the slope of any line parallel to it will have a slope of 3.

38.



39. $|8 - 11| + 4g = 99$
    $|-3| + 4g = 99$
    $3 + 4g = 99$
    $4g = 96$
    $g = 24$

40. The order of operations:
    "Whatever is found inside **PARENTHESES** must be done first. **EXPONENTS** are to be simplified next. **MULTIPLICATION** and **DIVISION** are equally important and must be performed moving left to right. **ADDITION** and **SUBTRACTION** are also equally important and must be performed moving left to right." (page 6)

    The order of operations are used for simplifying algebraic or numeric expressions.

41. One example of a negative irrational number is $-e$.

42. One example of a positive rational number $\frac{1}{2}$.

43. An integer is always a rational number because it can be written as the ratio of two integers.

Lesson 4.6

1. **Direct Variation** can be expressed as the equation $y = (k)x$, where k is called the constant of variation.
   Direct variation occurs when:
   • The fraction $\frac{\text{rise}}{\text{run}}$ or $\frac{\text{change in } y}{\text{change in } x}$ is always the same, and
   • The ordered pair (0, 0) is a solution to the situation.

2. The equation for direct variation is $y = k(x)$, where k is the constant of variation.

3. The two methods that can be used to solve a direct variation equation are:
   a. graphing
   b. Cross Products Theorem of proportions

4. It is **FALSE** that all linear equations are direct variation situations.

5. Let m = the amount of money earned, and h = the number of hours worked.
   Then $m = kh$, where k is the constant of proportionality.

6. Let m = the weight on the moon, and w = the weight on Earth.
   Then $m = kw$, where k is the constant of proportionality.

7. Let v = the volume of the gas, and t = the temperature of the gas in Kelvin.
   Then $v = kt$, where k is the constant of proportionality.

8. Let p = the number of people served, and m = the amount of ground meat.
   Then $p = km$, where k is the constant of proportionality.

9. Let c = the cost of purchase, and p = the number of pounds.
   Then $c = kp$, where k is the constant of proportionality.

10. This is not direct variation because the x is in the denominator.

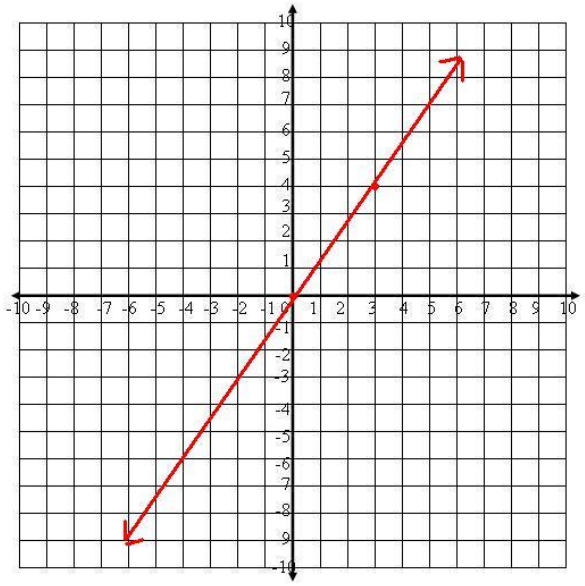
11. This is not direct variation because there is no x value.

12. This is not direct variation because there is no y value.

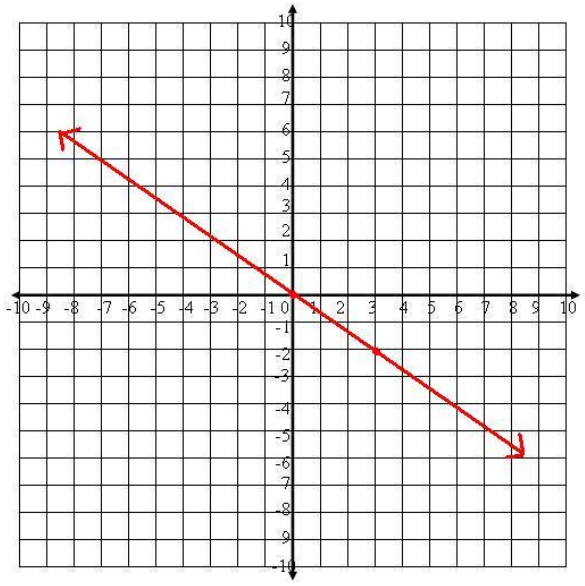
13. This is not direct variation because the graph does not pass through (0, 0).

14. This is not direct variation because the graph does not pass through (0, 0).

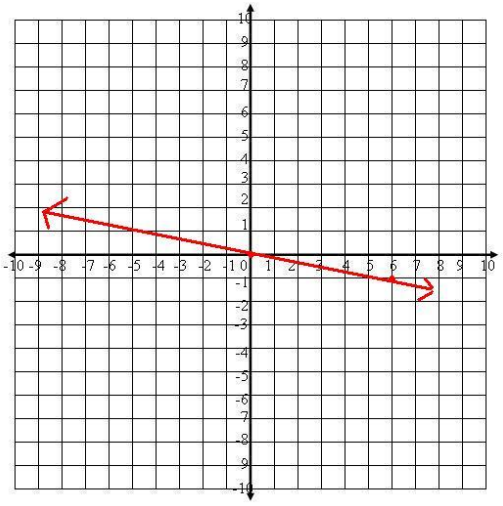
15.



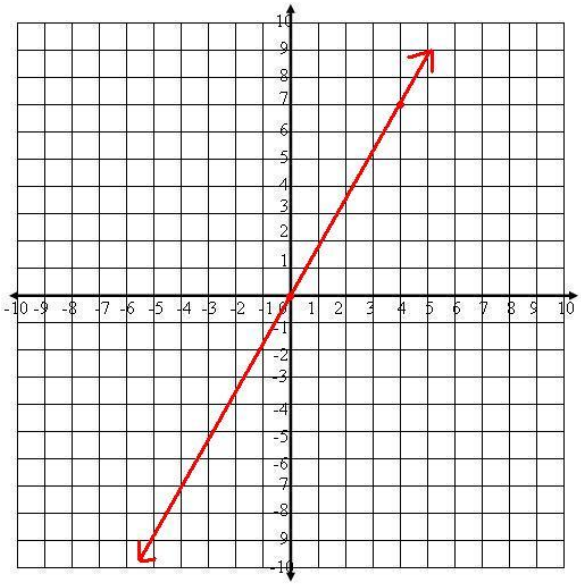
16.



17.



18.



19. This is not direct variation because the graph does not pass through (0, 0).

20. $y = kx$

$48 = k(4)$

$$k = \frac{48}{4} = 12$$

21. $d = kt$

$329 = k(7)$

$$k = \frac{329}{7} = 47$$

22. $l = kh$

$48 = k(4)$

$k = \frac{112}{-16} = -7$

23. $m = kh$

$461.50 = k(89.6)$

$k = \frac{461.50}{89.6} \approx 5.15$

24. $z = kr$

$48 = k(4)$

$k = \frac{51.5}{412} = 0.125$

25. Let c = the cost of the strawberries, and p = the number of pounds.

Then $c = kp$

$12.50 = k(5)$

$k = \frac{12.50}{5} = 2.50$

The equation for the cost of the strawberries is $c = 2.50p$.

26. Let s = the amount spent, and m = the number of minutes.

Then $s = km$

$3.50 = k(10)$

$k = \frac{3.50}{10} = 0.35$

The equation for the cost of the strawberries is $s = 0.35m$.

$20.00 = 0.35\text{m}$

$m = \frac{20.00}{0.35} \approx 57.14$

He can play games for about 57 minutes.

27. It would take $m = \frac{30}{2.5} = 12$ minutes.

28. Ohm's Law uses the equation $V = IR$. $V = 288$ and I = 32.

a. Therefore $k = \frac{288}{32} = 9$.

b. $\frac{288 \text{ volts}}{32 \text{ amps}} = \frac{V \text{ volts}}{65 \text{ amps}}$

$32V = 18{,}720$

$V = 585$ volts

29. Let d = diameter, and c = circumference.

$$\frac{6.28}{2} = \frac{c}{15}$$

$2c = 94.2$

$c = 47.1$ inches

30. The amount of time from 10 pm to 6 am is 8 hours. If d = the depth of the pool and t = time (in hours), then $d = kt$.

$$\frac{\frac{8}{4}}{7} = \frac{t}{1}$$

$t = 14$ hours until full

The pool will be full at 12 pm (10 pm to 10 am is 12 hours, so 14 hours is at 12 pm.)

31. $$\frac{200,500}{232} = \frac{p}{60}$$

$232p = 120,300,000$

$p = \$51,853.45$

32. $F = kx$

a. $12 = k(10)$

$k = 1.2$ N/cm

b. $F = kx$

$F = 1.2(7) = 8.4$ N

c. $F = kx$

$23 = 1.2(x) \approx 19.7$ cm

33.

a. The slope is $\frac{3}{1} = 3$, so the equation is $y = 3x$.

b. The slope is $\frac{-2}{1} = -2$, so the equation is $y = -2x$.

c. The slope is $\frac{-1}{5} = -\frac{1}{5}$, so the equation is $y = -\frac{1}{5}x$.

d. The slope is $\frac{2}{9}$, so the equation is $y = \frac{2}{9}x$.

34. $3x = 48$

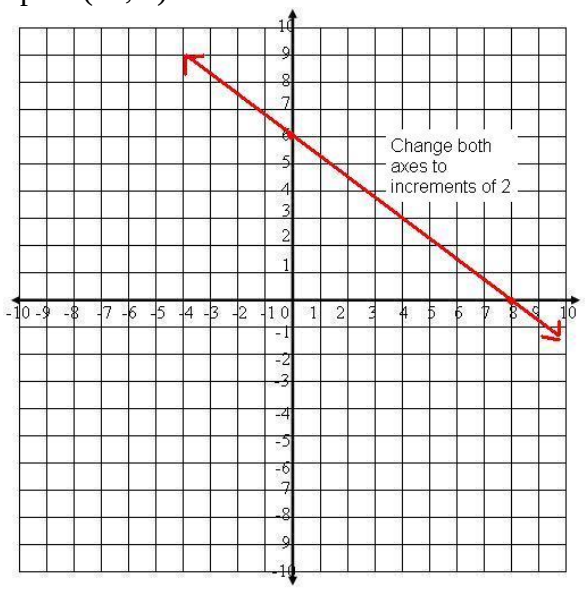
$x = \frac{48}{3} = 16$

The x-intercept is (16, 0).

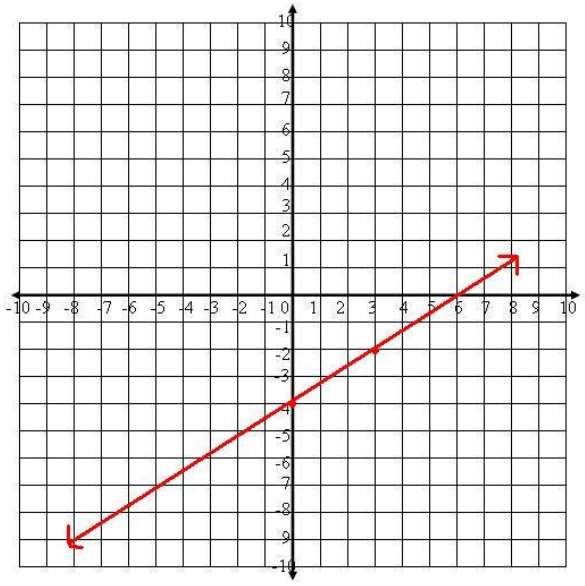
$4y = 48$

$y = \frac{48}{4} = 12$

The y-intercept is (12, 0).



35.



36. $4(u + 3) = 3(3u - 7)$

$4u + 12 = 9u - 21$

$5u = 33$

$u = \frac{33}{5} = 6\frac{3}{5}$

37. The slope of the first line is $\frac{1}{2}$.

$2y = x + 2$

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

The slope of the second line is $\frac{1}{2}$, so the lines are parallel.

38. The point (-99, 100) lies in the second quadrant (QII).

39. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-0}{3-2} = \frac{7}{1} = 7$

40. When $a = -3$ and $b = 4$, then $\frac{1+4b}{2a-5b} = \frac{1+4(4)}{2(-3)-5(4)} = \frac{17}{-6-20} = \frac{17}{-26} = -\frac{17}{26}$.

Lesson 4.7

1. $f(x)$ reads f of x

2. Function notation allows you to easily see the input value for the independent variable inside the parentheses (p. 155). This is helpful because it will allow you to easily plot the graph of a function.

3. A **function** is a relationship between two variables such that the input value has ONLY one unique output value.

4. This graph is a function because is passes the Vertical Line Test.

5. This graph is not a function because is fails the Vertical Line Test. A vertical line will touch the graph in more than one place at one time.

6. This graph is not a function because is fails the Vertical Line Test. A vertical line will touch the graph in more than one place at one time.

7. This graph is a function because is passes the Vertical Line Test.

8. $f(x) = 7x - 21$

9. $6x + 8y = 36$
   $8y = -6x + 36$
   $y = -\frac{3}{4}x + \frac{9}{2}$
   $f(x) = -\frac{3}{4}x + \frac{9}{2}$

10. $x = 9y + 3$
    $9y = x - 3$
    $y = \frac{1}{9}x - \frac{1}{3}$
    $f(x) = \frac{1}{9}x - \frac{1}{3}$

11. $f(x) = 6$

12. $f(t) = 65t + 100$

13. $f(C) = 1.8C + 32$

14. $f(m) = 0.10m + 25{,}000$

15. $f(-3) = -2(-3) + 3 = 6 + 3 = 9$
$f(7) = -2(7) + 3 = -14 + 3 = -11$
$f(0) = -2(0) + 3 = 0 + 3 = 3$
$f(z) = -2(z) + 3 = -2z + 3$

16. $f(-3) = -0.7(-3) + 3.2 = 2.1 + 3.2 = 5.3$
$f(7) = -0.7(7) + 3.2 = -4.9 + 3.2 = -1.7$
$f(0) = -0.7(0) + 3.2 = 0 + 3.2 = 3.2$
$f(z) = -0.7(z) + 3.2 = -0.7z + 3.2$

17. $f(-3) = \dfrac{5(2-(-3))}{11} = \dfrac{5(5)}{11} = \dfrac{25}{11}$
$f(7) = \dfrac{5(2-7)}{11} = \dfrac{5(-5)}{11} = \dfrac{-25}{11}$
$f(0) = \dfrac{5(2-0)}{11} = \dfrac{5(2)}{11} = \dfrac{10}{11}$
$f(z) = \dfrac{5(2-z)}{11} = \dfrac{10-5z}{11}$

18. $f(-3) = \dfrac{1}{2}(-3)^2 + 4 = \dfrac{1}{2}(9) + 4 = \dfrac{9}{2} + 4 = \dfrac{9+8}{2} = \dfrac{17}{2}$
$f(7) = \dfrac{1}{2}(7)^2 + 4 = \dfrac{1}{2}(49) + 4 = \dfrac{49}{2} + 4 = \dfrac{49+8}{2} = \dfrac{57}{2}$
$f(0) = \dfrac{1}{2}(0)^2 + 4 = 0 + 4 = 4$
$f(z) = \dfrac{1}{2}(z)^2 + 4 = \dfrac{1}{2}z^2 + 4$

19. $f(-3) = 3 - \dfrac{1}{2}(-3) = 3 + \dfrac{3}{2} = \dfrac{6+3}{2} = \dfrac{9}{2}$
$f(7) = 3 - \dfrac{1}{2}(7) = 3 - \dfrac{7}{2} = \dfrac{6-7}{2} = \dfrac{-1}{2}$
$f(0) = 3 - \dfrac{1}{2}(0) = 3$
$f(z) = 3 - \dfrac{1}{2}(z) = 3 - \dfrac{1}{2}z$

20.
a. Since x = the number of pounds, the function would be $f(x) = 8x + 100$.
b. $f(10) = 8(10) + 100 = 80 + 100 = 180$ minutes
c. $f(27) = 8(27) + 216 = 80 + 100 = 316$ minutes
d. 4.5 hours = 60(4.5) = 270 minutes
$270 = 8x + 100$
$170 = 8x$
$x = 21.25$ pounds

21. $F(C) = 1.8C + 32 \rightarrow F(100) = 1.8(100) + 32 = 212$
The temperature equivalent of 100°C is 212°F.

22. Let m = the number of minutes. Then the function is $f(m) = 20 – 0.16m$.
$0 = 20 – 0.16m$
$–20 = –0.16m$
$m = 125$
One can talk for 125 minutes.

23. We know that $b(1) = 330$, so our function is $b(h) = 330h$.
$b(0.75) = 330(0.75) = 247.5$ calories

24. Let w = the number of weeks.
a. The function is $f(w) = 650 – 55w$.
b. $f(10) = 650 – 55(10) = 650 – 550 = 100$
Sadie has $100 left in her account.

25. $-120\left(\frac{1}{2}\right)\left(\frac{3}{5}\right) = \frac{-360}{10} = -36$

26. $7\frac{1}{4} + 3\frac{2}{3} + 5\frac{3}{4} = \frac{29}{4} + \frac{11}{3} + \frac{23}{4} = \frac{29(3) + 11(4) + 23(3)}{12} = \frac{87 + 44 + 69}{12} = \frac{200}{12} = 16\frac{2}{3}$

27. $–3(4m + 11) = –12m – 33$

28. Because we are not given specifics, we have to go by what is given. The amount of income taxes is dependent on the amount of one's salary. However, y = taxes paid, which could be sales tax. In addition, some places do not collect state income tax. So, with the given information, we cannot determine if this situation is a function or not.

29. $y = kz$
$450 = k(6)$
$k = 75$

30. 30 minutes = 0.5 hours
$\frac{15 \text{ gallons}}{2.5 \text{ hours}} = \frac{x \text{ gallons}}{0.5 \text{ hours}}$
$7.5 = 2.5x$
$x = 3$ gallons

Lesson 4.8

1.

a. $\frac{30}{250} = \frac{40}{\text{Earnings}}$

Earnings = 250(40) ÷ 30 = $333.33

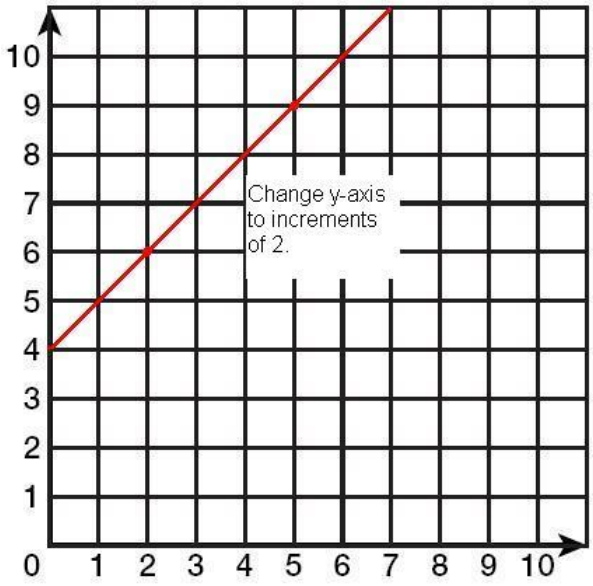
c. It took 30 hours to earn $250.

d. Two points on the graph are (0, 50) and (30, 250).

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{250 - 50}{30 - 0} = \frac{200}{30} = 6.67$$

The slope represents the amount the amount Aatif makes per hour.

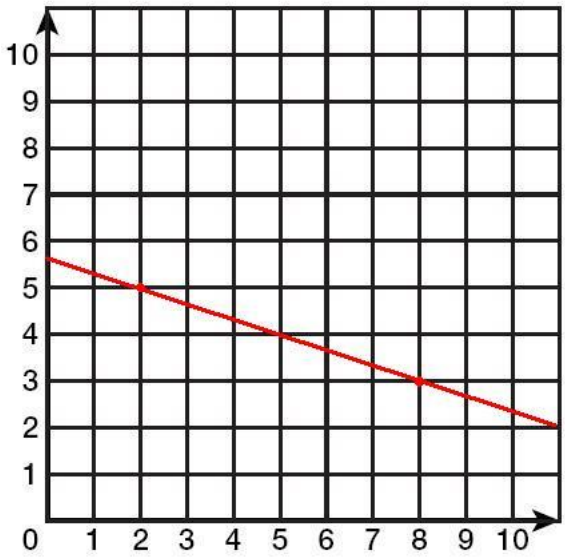
2. Two points along the linear function are (2, 12) and (5, 18), where x = the amount of weight and y = the number of inches stretched. We can graph these points on a graph.



Based on the graph, the length of the spring is 4 inches when no weight is added.

3. Let c = the cost and m = the number of months.
Our equation will be $c = 200 + 39m$. The cost for 12 months will be
200 + 39(12) = $668.

4. Two points along the linear function are (2, 5) and (8, 3), where x = the number of minutes and y = the length of the candle. We can graph these points on a graph.



According to the graph, the original length of the graph was about 5.5 inches.

5. $\dfrac{1.25 \text{ inches}}{550 \text{ pages}} \approx 0.002$ inches per page

6. Let g = the number of glasses of lemonade. Then the equation will be
$0.45g = 25$.
$g = 55.56 \approx 56$ glasses

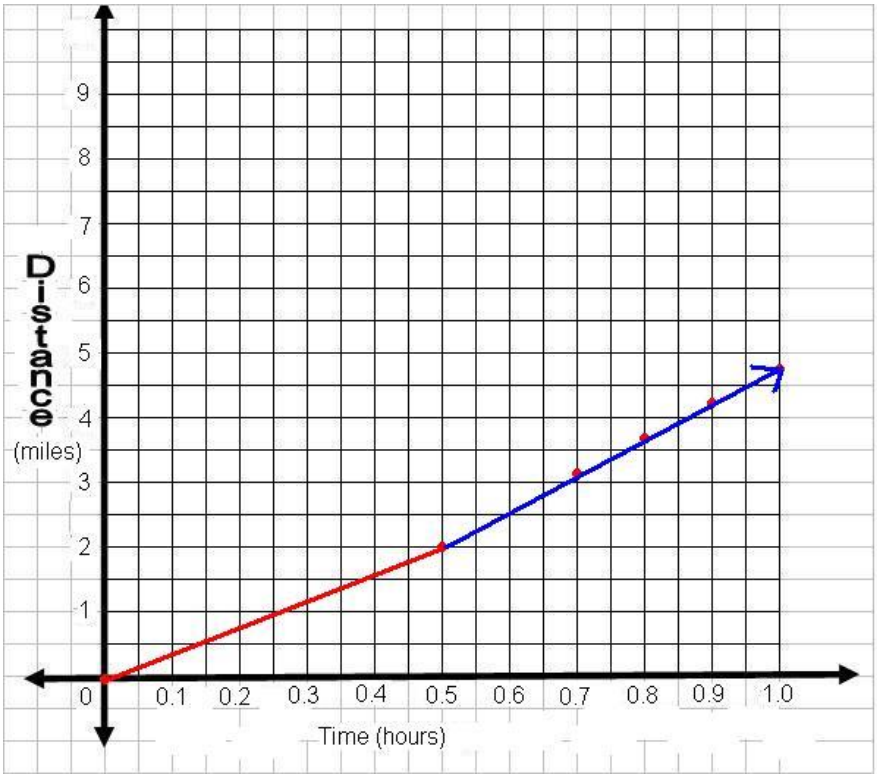
7. $\dfrac{78.00}{9.20} = \dfrac{21.50}{\text{tip}}$
tip = 21.50(9.20) ÷ 78.00 = \$2.54

8. First, it is important to notice that the rate (speed) is in miles per hour, while the time is given in minutes. It is easier to convert the minutes to hours rather than the speed.

$$30 \text{ minutes}\left(\frac{1 \text{ hour}}{60 \text{ minutes}}\right) = 0.5 \text{ hours}$$

$$25 \text{ minutes}\left(\frac{1 \text{ hour}}{60 \text{ minutes}}\right) \approx 0.417 \text{ hours}$$

$$45 \text{ minutes}\left(\frac{1 \text{ hour}}{60 \text{ minutes}}\right) \approx 0.75 \text{ hours}$$



According to the graph, after 45 minutes, Karen is approximately 3.4 miles from her home.

9. $-4|-21 - 11| + 16 = -4|-31| + 16 = -4(31) + 16 = -124 + 16 = -108$

10. $y = 3.5x$, where 3.5 is the constant of variation.

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

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

$m = \frac{5}{3}; b = 4$

12. A rule to move point A to Quadrant III would be $(-x, -y)$.

13. $0.04x = 18$ $\quad$ $0.06y = 18$
$x = 450$ $\quad$ $y = 300$
$(450, 0)$ $\quad$ $(0, 300)$

14. $f(4) = \dfrac{3(4)^2}{8} = \dfrac{3(16)}{8} = \dfrac{48}{8} = 6$

Lesson 4.9 Chapter 4 Review

1. *x*-intercept – the location where a graph crosses the *x*-axis

2. *y*-intercept – the location where a graph crosses the *y*-axis

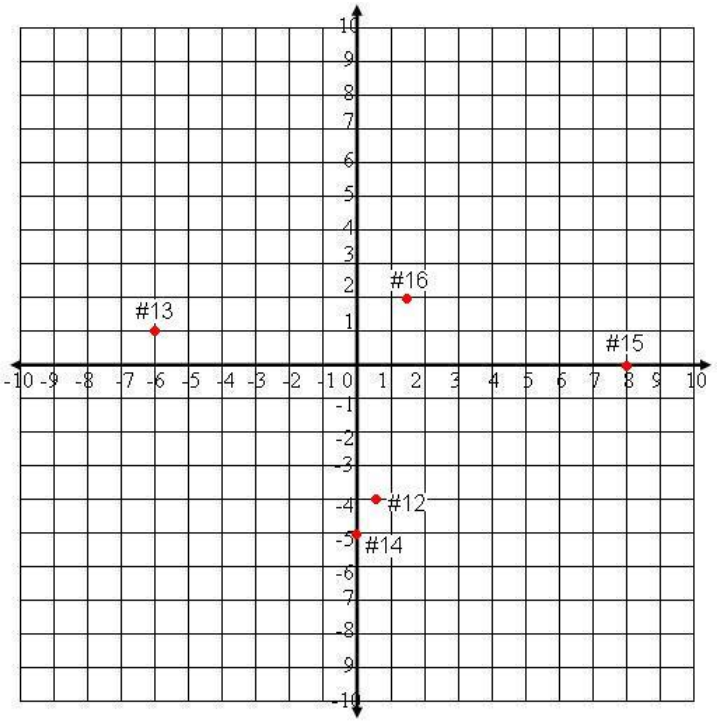
3. **Direct Variation** can be expressed as the equation $y = (k)x$, where k is called the constant of variation.
   Direct variation occurs when:
   • The fraction $\frac{\text{rise}}{\text{run}}$ or $\frac{\text{change in } y}{\text{change in } x}$ is always the same, and
   • The ordered pair (0, 0) is a solution to the situation.

4. Parallel lines are lines that will never intersect.

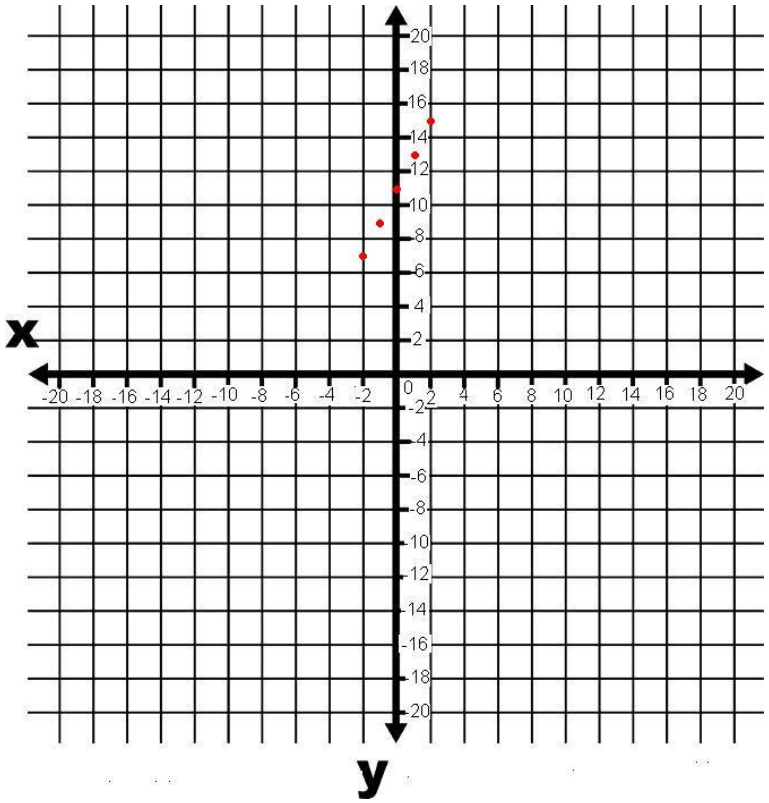
5. rate of change – When finding the slope of real-world situations, it is often referred to as **rate of change**. "Rate of change" means the same as "slope."

6. (5, 1)
7. (–5, –5)
8. (0, 7)
9. (–8, 9)
10. (–4, 0)
11. (6, –2)

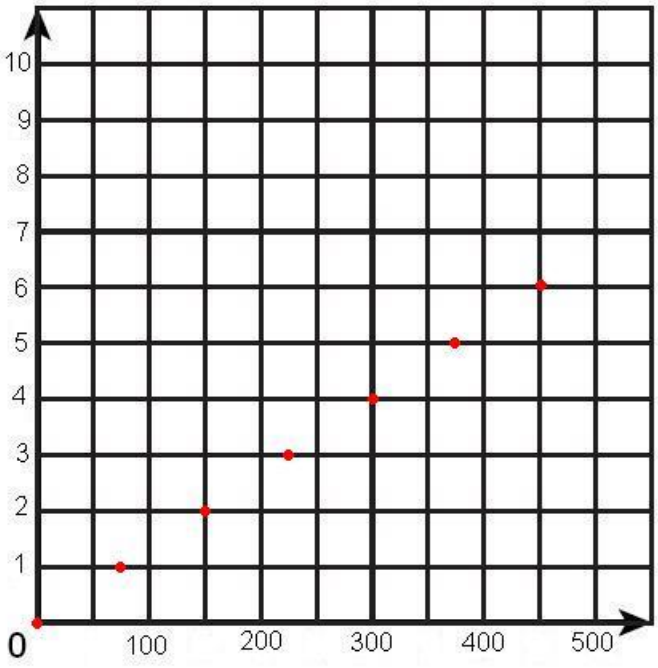
12. – 16.



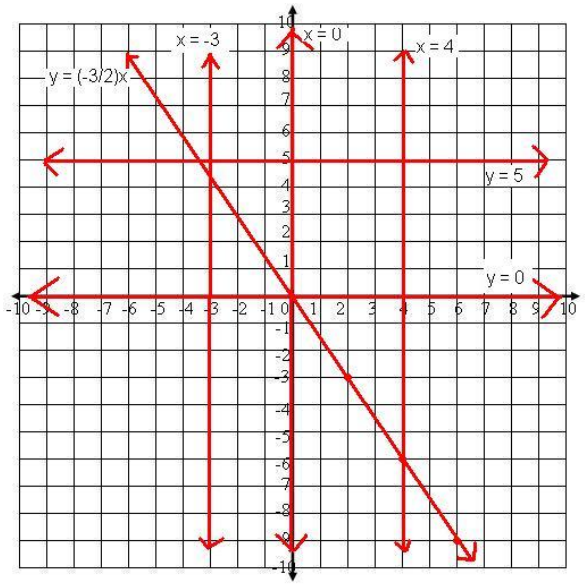
17.


x
y
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20
20 18 16 14 12 10 8 6 4 2 -2 -4 -6 -8 -10 -12 -14 -16 -18 -20

18.


10 9 8 7 6 5 4 3 2 1 0
100 200 300 400 500

19. – 24.



25. $y = 4x - 5$
$y = -5$, so y-intercept is $(0, 5)$

$0 = 4x - 5$
$5 = 4x$
$x = \frac{5}{4}$, so x-intercept is $(\frac{5}{4}, 0)$

26. $5x = 20$
$x = 4$
x-intercept $(4, 0)$

$5y = 20$
$y = 4$
y-intercept $(0, 4)$

27. $x = 7$
x-intercept $(7, 0)$

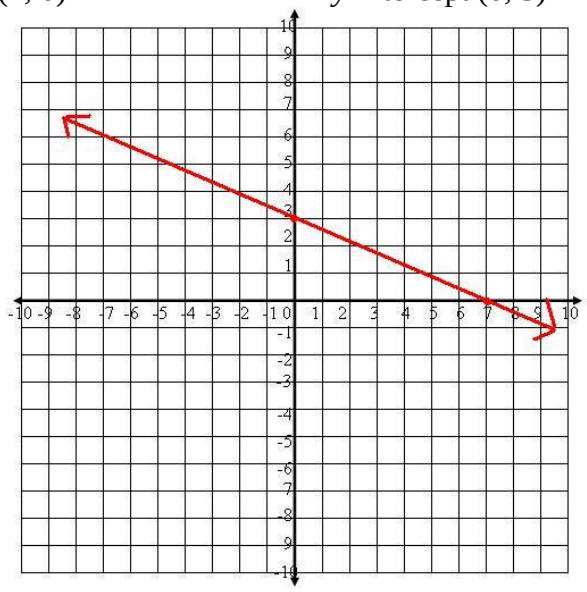
$y = 7$
y-intercept $(0, 7)$

28. $-16x = 48$
$x = -3$
x-intercept $(-3, 0)$

$8y = 48$
$y = 6$
y-intercept $(0, 6)$

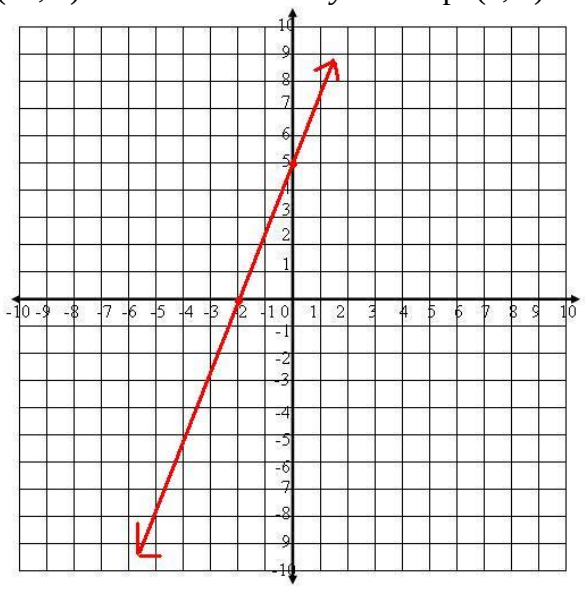
29. $3x = 21$
$x = 7$
x-intercept (7, 0)

$7y = 21$
$y = 3$
y-intercept (0, 3)



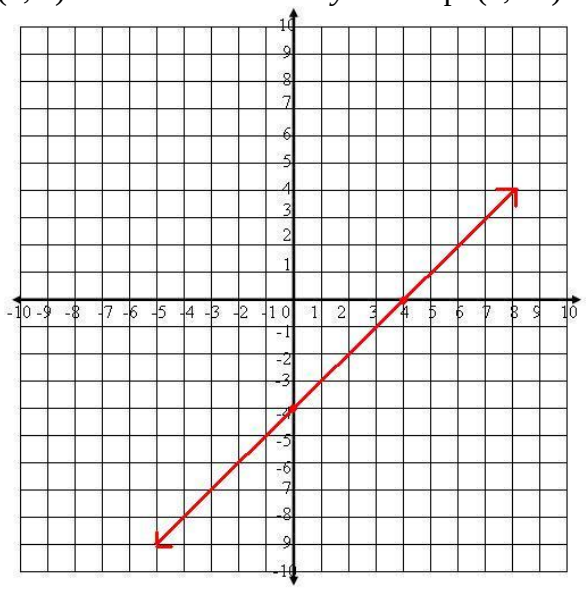
30. $-5x = 10$
$x = -2$
x-intercept (–2, 0)

$2y = 10$
$y = 5$
y-intercept (0, 5)



31. $x = 4$ $-y = 4$

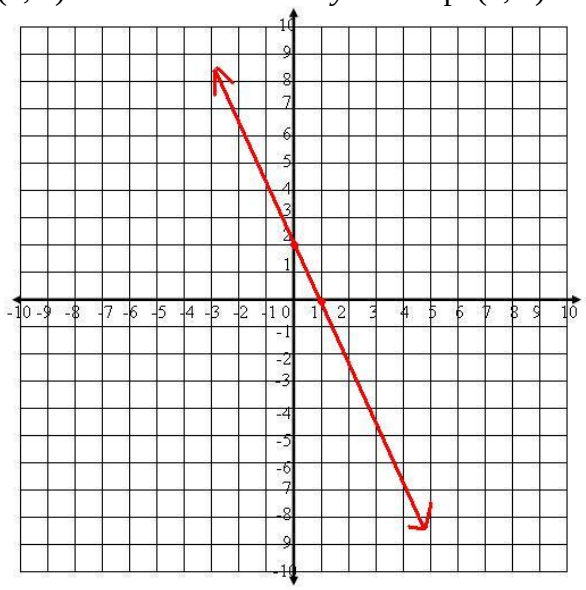
x-intercept (4, 0) y-intercept (0, –4)



32. $16x = 16$ $8y = 16$

$x = 1$ $y = 2$

x-intercept (1, 0) y-intercept (0, 2)



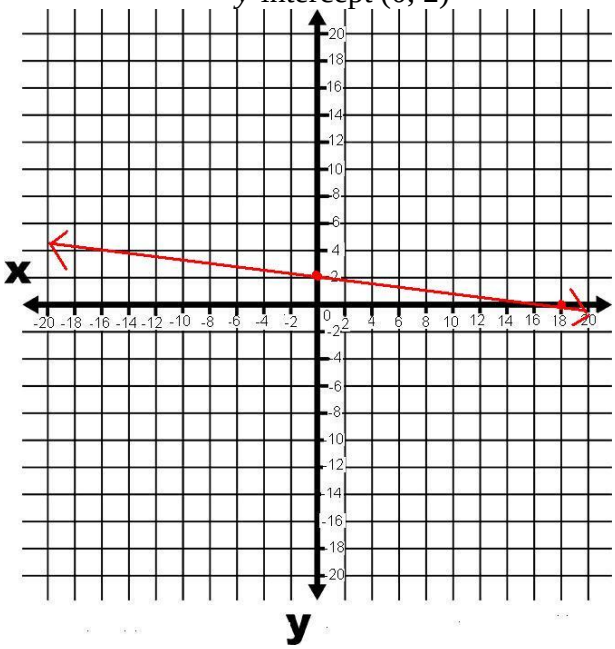
33. $x = 18$

x-intercept (18, 0)

$9y = 18$

$y = 2$

y-intercept (0, 2)



34. $\frac{1}{7}x = 7$

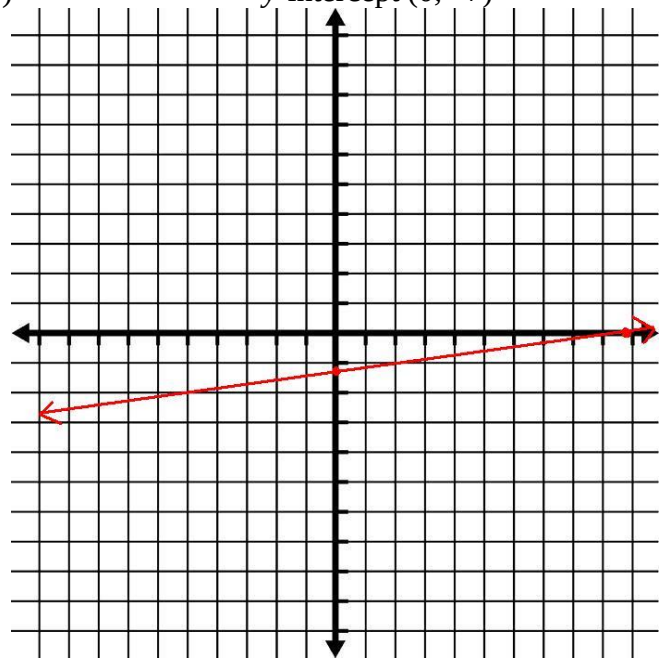
$x = 49$

x-intercept (49, 0)

$7 + y = 0$

$y = -7$

y-intercept (0, –7)



35. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 20}{19 - 3} = \frac{-12}{16} = -\frac{3}{4}$

36. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0-5}{12-12} = \frac{-5}{0} = \text{undefined}$

37. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-5}{\frac{3}{2} - \left(\frac{-1}{2}\right)} = \frac{-2}{\frac{4}{2}} = \frac{-2}{2} = -1$

38. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-3}{12-8} = \frac{0}{4} = 0$

39. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-22-17}{-14-14} = \frac{-39}{-28} = \frac{39}{28}$

40. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-4}{18-1} = \frac{2}{17}$

41. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-6}{10-10} = \frac{-12}{0} = \text{undefined}$

42. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-2}{19-(-3)} = \frac{3}{22}$

43. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9-9}{13-2} = \frac{0}{11} = 0$

44. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-(-1)}{-10-10} = \frac{7}{-20} = -\frac{7}{20}$

45. $\frac{150 \text{ pages}}{3 \text{ hours}} = 50 \text{ pages/hour}$

46. $\frac{65 \text{ onions}}{1.5 \text{ hours}} = 43\frac{1}{3} \text{ onions/hour}$

47. $\frac{215 \text{ miles}}{3.9 \text{ hours}} \approx 55.13 \text{ miles/hour}$

48. $\frac{65 \text{ jumping jacks}}{1 \text{ minute}} = 65 \text{ jumping jacks/minute}$

49. $\frac{\$48.60}{2{,}430 \text{ texts}} = \$0.02/\text{text}$

50. $\frac{65 \text{ hotdogs}}{22 \text{ minutes}} \approx$ 2.95 hotdogs/minute

51. $x + y = 3$
$y = -x + 3$
slope = –1; y-intercept = 3

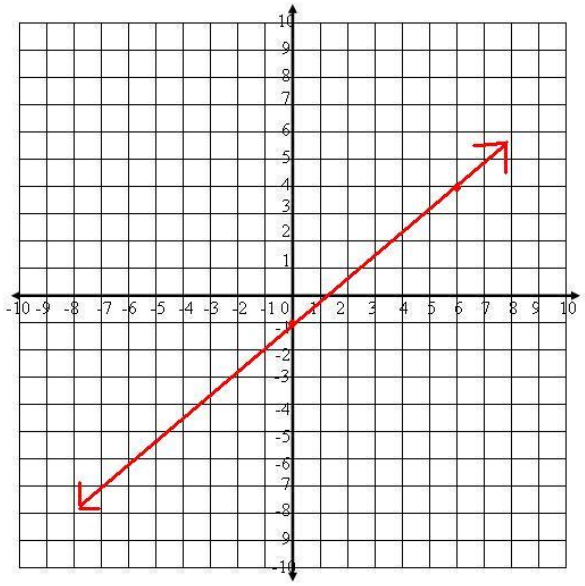
52. $\frac{1}{3}x = 7 + y$
$y = \frac{1}{3}x - 7$
slope = $\frac{1}{3}$; y-intercept = –7

53. $y = \frac{2}{5}x + 3$
slope = $\frac{2}{5}$; y-intercept = 3

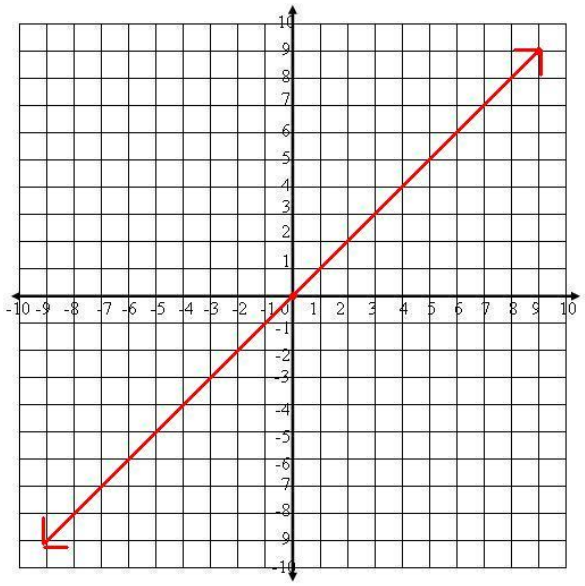
54. $x = 4$
slope = undefined, no y-intercept

55. $y = \frac{1}{4}$
slope = 0, y-intercept = $\frac{1}{4}$

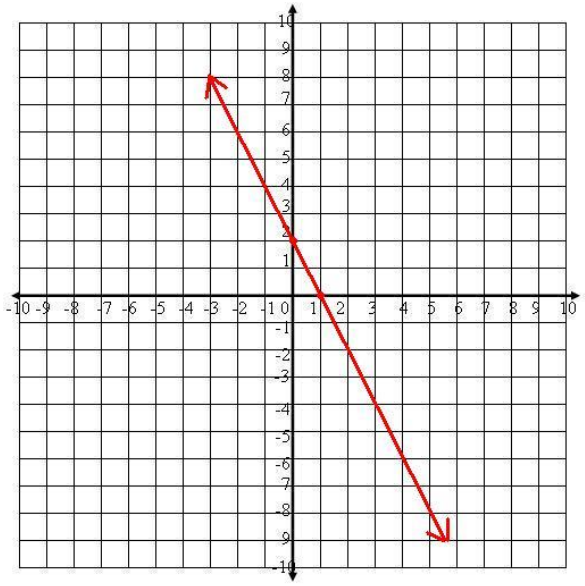
56.



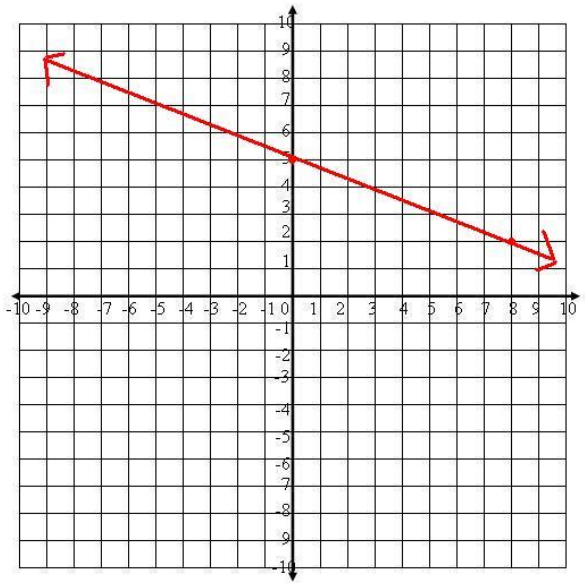
57.



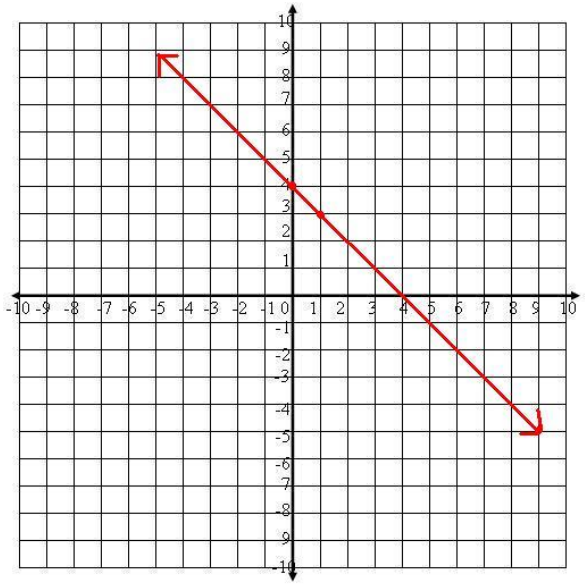
58.



59.



60.



61. $3x + 6y = 8$

$6y = -3x + 8$

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

The slope of the first line is $-\frac{1}{2}$. The slope of the second line is 2. Therefore the lines are not parallel.

62. The slope of the first line is 1. The slope of the second line is –1. Therefore the lines are not parallel.

63. $2x + 4y = 16$
$4y = -2x + 16$
$y = -\frac{1}{2}x + 4$
The slope of the first line is $-\frac{1}{2}$. The slope of the second line is $-\frac{1}{2}$. Therefore the lines are parallel.

64. $g(7) = -2|7 - 3| = -2(4) = -8$

65. $h(8) = 8^2 - 4(8) = 64 - 32 = 32$

66. $p(\frac{1}{6}) = 3(\frac{1}{6}) + 1 = \frac{1}{2} + 1 = \frac{3}{2}$

67. $g(-3) = 4|-3| = 4(3) = 12$

68. $h(24) = \frac{1}{3}(24) - 4 = 8 - 4 = 4$

69. $f(20) = \frac{20+8}{6} = \frac{28}{6} = \frac{14}{3}$

70. $r(26.99) = 0.06(26.99) = 1.6194$

71. $\frac{168}{4} = \frac{m}{7}$
$4m = 1176$
$m = 294$ miles

72. $C(84) = \frac{84-32}{1.8} \approx 28.9^\circ\text{C}$

73. Let h = the number of hours. Since the rate of cookie baking is 12/30 minutes, that translates to 24 cookies/hour. We can write an equation to model this.
$176 = 24h + 32$
$144 = 24h$
$h = 6$
It will take 6 hours to have 176 cookies.

74. Let the amount of 12% concentration mixture = a
Therefore the amount of 8% concentration mixture = 60 - a.
Therefore sum of acid in each mixture is equal to acid in solution
$0.12a + 0.08(60 - a) = 6$
$a = 30$ Mixture A = 30 ounces, Mixture B = 30 ounces

75. $\dfrac{5 \text{ units}}{5{,}000 \text{ gallons}} = \dfrac{x \text{ units}}{7{,}500 \text{ gallons}}$

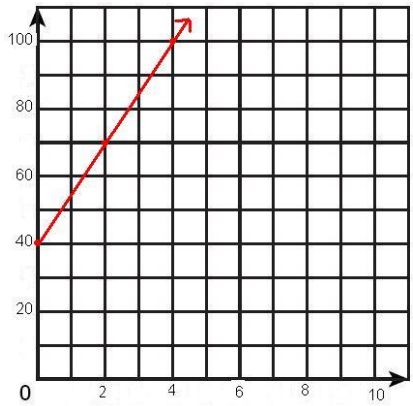
$5{,}000x = 37{,}500$

$x = 7.5$ units of chlorine

76.

(i) Let $T(c) = 15c + 40$

(ii)



(iii) $67 = 15c + 40$

$27 = 15c$

$c = 1.8 \approx 2$

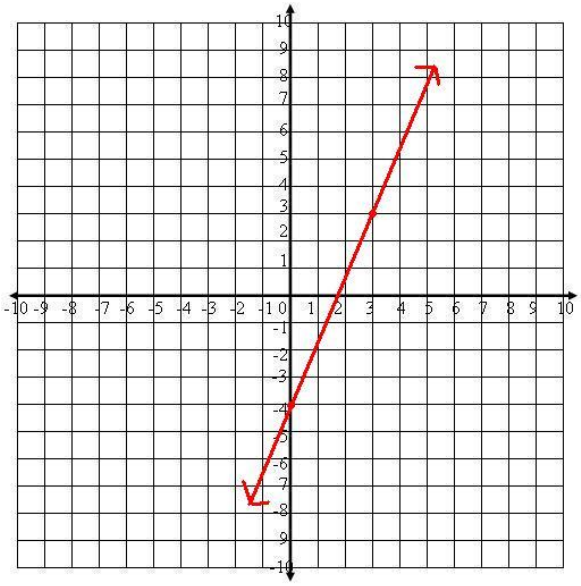
(iv) The y-intercept means there are no cricket chirps.

(v) The graph cannot interpret temperatures below 40 degrees because there cannot be a negative number of cricket chirps.

Lesson 4.10 Chapter 4 Test

1. A (–4, 5)
2. B (0, –2)
3. C (3, 6)

4.



5. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-2.25 - 5}{-1.25 - (-3)} = \dfrac{-7.25}{1.75} \approx -4.14$

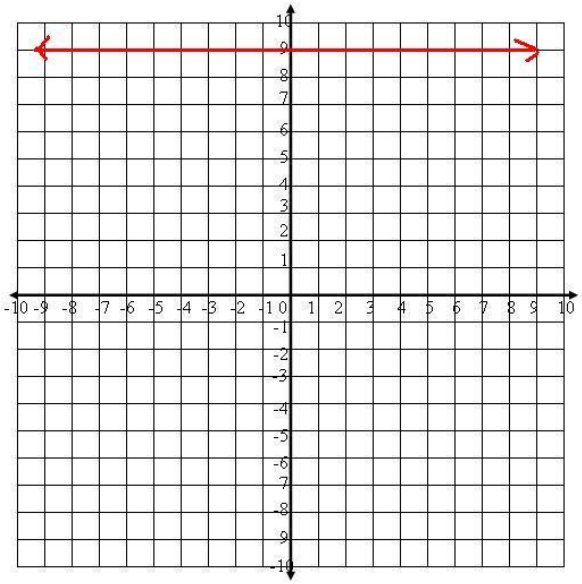
6. $6x = 54$ $\qquad$ $9y = 54$
   $x = 9$ $\qquad$ $y = 6$
   (9, 0) $\qquad$ (0, 6)

7. $\dfrac{84.6 - 86.3}{2008 - 2004} = \dfrac{-1.7}{4} \approx 0.425$
   The graduation rate will continue to decrease over the next 4 years.

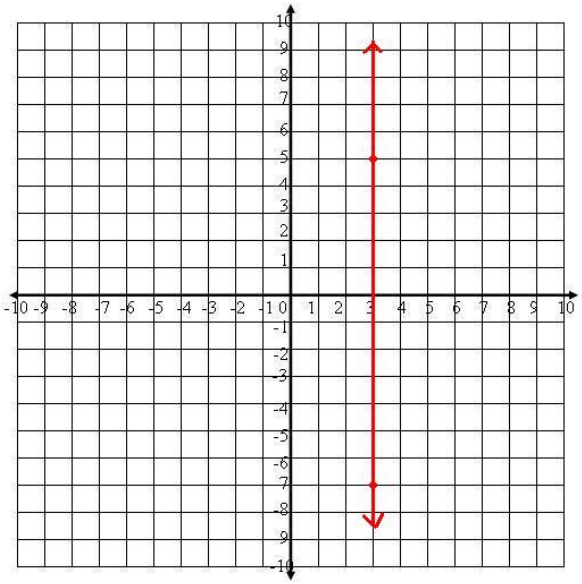
8. $4x + 7y = 28$
   $7y = -4x + 28$
   $y = -\dfrac{4}{7}x + 4$
   Slope = $-\dfrac{4}{7}$; y-intercept = 4

9. Slope = $-\dfrac{3}{5}$; y-intercept = –8

10.



11.

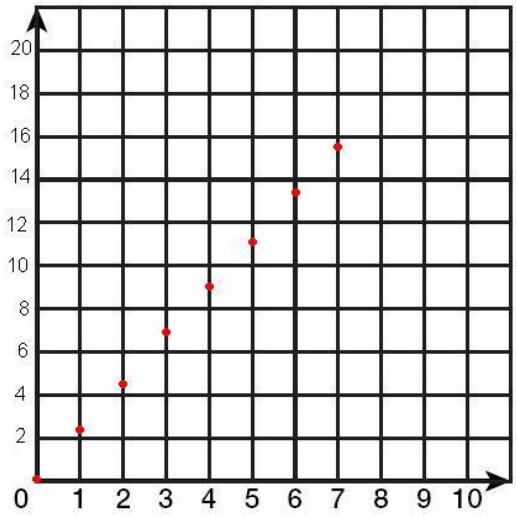


12. $\frac{26 \text{ quarts}}{104 \text{ cups}} = \frac{2.75 \text{ quarts}}{x \text{ cups}}$

$26x = 286$

$x = 11$ cups

13.



14. $\frac{27}{4} = \frac{h}{-5.5}$

$4h = -148.5$

$h = -37.125$

15. $h(25) = \frac{1}{2}|6 - 25| + 11 = \frac{1}{2}(21) + 11 = 21.5$

16. The two lines are not parallel because the slopes of the lines are different.

17. $0.02A + 0.015B$ = total

When $A = 6$, total = 0.51

$0.02(6) + 0.015B = 0.51$

$0.12 + 0.015B = 0.51$

$0.015B = 0.39$

$B = 26$ ounces