2-2 Linear Relations and Functions

State whether each function is a linear function. Write *yes* or *no*. Explain.

1. $f(x)=\frac{x+12}{5}$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

The function $f(x)=\frac{x+12}{5}$ is linear as it can be written as $f(x)=\frac{x}{5}+\frac{12}{5}$.

2. $g(x)=\frac{7-x}{x}$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

$g(x)=\frac{7-x}{x}$ cannot be written in the form $f(x) = mx + b$.

So the function is not linear.

3. $p(x)=3x^2-4$

SOLUTION:

$p(x)=3x^2-4$ is not a linear function as x has an exponent that is not 1.

4. $q(x)=-8x-21$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.
$q(x)$ can be written in the form $f(x) = mx + b$.
So the function is linear.

5. **RECREATION** You want to make sure that you have enough music for a car trip. If each CD is an average of 45 minutes long, the linear function $m(x) = 0.75x$ could be used to find out how many CDs you need to bring.

a. If you have 4 CDs, how many hours of music is that?

b. If the trip you are taking is 6 hours, how many CDs should you bring?

SOLUTION:

a. $m(x) = 0.75x$
Replace x with 4.
$m(4) = 0.75(4) = 3$
Therefore, 4 CDs have 3 hours of music.

b. Replace m with 6.
$6 = 0.75x$

This implies:

$$x=\frac{6}{0.75}$$
$$=8$$

The number of CDs needed for a 6 hour trip is 8.

CCSS STRUCTURE Write each equation in standard form. Identify *A*, *B*, and *C*.

6. $y=-4x-7$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$y=-4x-7$$
$$4x+y=-7$$

$A = 4$, $B = 1$, and $C = -7$.

7. $y = 6x + 5$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} y &= 6x + 5 \\ -6x + y &= 5 \\ 6x - y &= -5 \end{aligned}$$

$A = 6$, $B = –1$, and $C = –5$.

8. $3x = -2y - 1$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 3x &= -2y - 1 \\ 3x + 2y &= -1 \end{aligned}$$

$A = 3$, $B = 2$, and $C = –1$.

9. $-8x = 9y - 6$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} -8x &= 9y - 6 \\ -8x - 9y &= -6 \\ 8x + 9y &= 6 \end{aligned}$$

$A = 8$, $B = 9$, and $C = 6$.

10. $12y = 4x + 8$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 12y &= 4x + 8 \\ -4x + 12y &= 8 \\ 4x - 12y &= -8 \\ x - 3y &= -2 \end{aligned}$$

$A = 1$, $B = –3$, and $C = –2$.

11. $4x - 6y = 24$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 4x - 6y &= 24 \\ 2x - 3y &= 12 \end{aligned}$$

$A = 2$, $B = –3$, and $C = 12$.

Find the x-intercept and the y-intercept of the graph of each equation. Then graph the equation using the intercepts.

12. $y = 5x + 12$

SOLUTION:

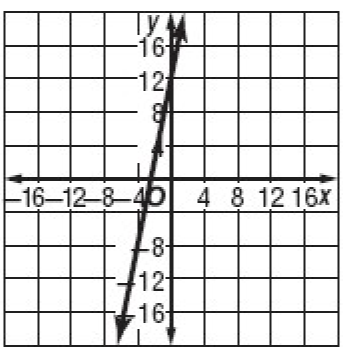
The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.
The x-intercept is the value of x when $y = 0$.

Substitute $y = 0$ in the equation.

$0 = 5x + 12$
$x = -\frac{12}{5}$

The x-intercept is $-\frac{12}{5}$.
The y-intercept is the value of y when $x = 0$.

Therefore, the y-intercept is 12
.



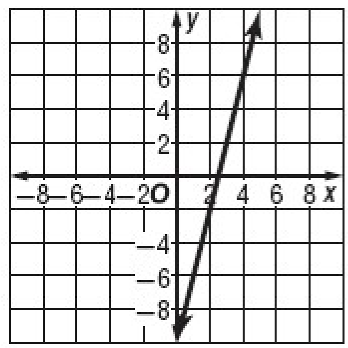
13. $y = 4x - 10$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.
The x-intercept is the value of x when $y = 0$.

So, the x-intercept is $\frac{5}{2}$.
The y-intercept is the value of y when $x = 0$.

So, the y-intercept is –10.



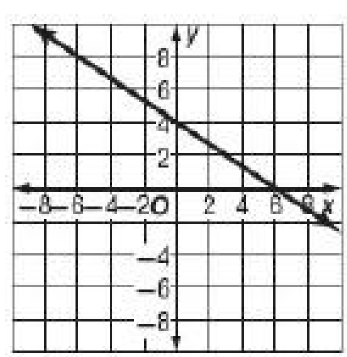
14. $2x + 3y = 12$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is 6.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is 4.



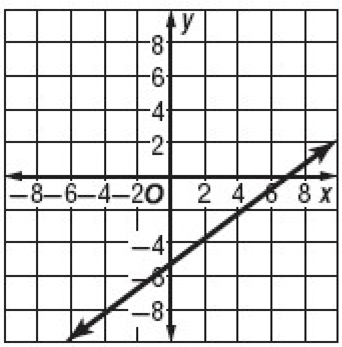
15. $3x - 4y - 6 = 15$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the ***y*-intercept**. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is 7.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is $-\frac{21}{4}$.



State whether each equation or function is a linear function. Write *yes* or *no*. Explain.

16. $3y - 4x = 20$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

Yes; it can be written in $f(x) = mx + b$ form, where $m = \frac{4}{3}$ and $b = \frac{20}{3}$.

17. $y = x^2 - 6$

SOLUTION:

In a linear function, the exponent of the independent variable is less than or equal to 1.

No; x has an exponent other than 1.

18. $h(x) = 6$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

Yes; it can be written in $f(x) = mx + b$ form, where $m = 0$ and $b = 6$.

19. $j(x) = 2x^2 + 4x + 1$

SOLUTION:

In a linear function, the exponent of the independent variable is less than or equal to 1.

No; x has an exponent other than 1.

20. $g(x) = 5 + \frac{6}{x}$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

No; it cannot be written in $f(x) = mx + b$ form.

21. $f(x) = \sqrt{7 - x}$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

No; it cannot be written in $f(x) = mx + b$ form.

22. $4x + \sqrt{y} = 12$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

No; it cannot be written in $f(x) = mx + b$ form.

23. $\frac{1}{x} + \frac{1}{y} = 1$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

No; it cannot be written in $f(x) = mx + b$ form; There is an xy term.

24. $f(x) = \frac{4x}{5} + \frac{8}{3}$

SOLUTION:

A linear function is a function with ordered pairs that satisfy a linear equation of the form $y = mx + b$.

Yes; it can be written in $f(x) = mx + b$ form, where $m = \frac{4}{5}$ and $b = \frac{8}{3}$.

25. **ROLLER COASTERS** The speed of the Steel Dragon 2000 roller coaster in Mie Prefecture, Japan, can be modeled by $y = 10.4x$, where y is the distance traveled in meters in x seconds.

a. How far does the coaster travel in 25 seconds?

b. The speed of Kingda Ka in Jackson, New Jersey, can be described by $y = 33.9x$. Which coaster travels faster? Explain your reasoning.

SOLUTION:

a. $y = 10.4x$

Replace x with 25.

$$\begin{aligned} y &= 10.4(25) \\ &= 260 \end{aligned}$$

The roller coaster travels 260 meters in 25 seconds.

b. Kingda Ka; Sample answer: The Kingda Ka travels 847.5 meters in 25 seconds, so it travels a greater distance in the same amount of time.

Write each equation in standard form. Identify *A*, *B*, and *C*.

26. $-7x - 5y = 35$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} -7x - 5y &= 35 \\ 7x + 5y &= -35 \end{aligned}$$

$A = 7$, $B = 5$, and $C = –35$.

27. $8x + 3y + 6 = 0$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 8x + 3y + 6 &= 0 \\ 8x + 3y &= -6 \end{aligned}$$

$A = 8$, $B = 3$, and $C = –6$.

28. $10y - 3x + 6 = 11$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 10y - 3x + 6 &= 11 \\ 3x - 10y - 6 &= -11 \\ 3x - 10y &= -5 \end{aligned}$$

$A = 3$, $B = –10$, and $C = –5$.

29. $-6x - 3y - 12 = 21$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} -6x - 3y - 12 &= 21 \\ -6x - 3y &= 33 \\ 6x + 3y &= -33 \\ 2x + y &= -11 \end{aligned}$$

A= 2, B = 1, and C = –11.

30. $3y = 9x - 12$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 3y &= 9x - 12 \\ -9x + 3y &= -12 \\ 9x - 3y &= 12 \\ 3x - y &= 4 \end{aligned}$$

A = 3, B = –1, and C = 4.

31. $2.4y = -14.4x$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 2.4y &= -14.4x \\ 14.4x + 2.4y &= 0 \\ 6x + y &= 0 \end{aligned}$$

A = 6, B = 1, and C = 0.

32. $\frac{2}{3}y - \frac{3}{4}x + \frac{1}{6} = 0$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} 2.4y &= -14.4x \\ 14.4x + 2.4y &= 0 \\ 6x + y &= 0 \end{aligned}$$

$$\begin{aligned} \frac{2}{3}y - \frac{3}{4}x + \frac{1}{6} &= 0 \\ 8y - 9x + 2 &= 0 \\ 9x - 8y - 2 &= 0 \\ 9x - 8y &= 2 \end{aligned}$$

A = 9, B = –8, and C = 2.

33. $\frac{4}{5}y + \frac{1}{8}x = 4$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\begin{aligned} \frac{4}{5}y + \frac{1}{8}x &= 4 \\ 32y + 5x &= 160 \\ 5x + 32y &= 160 \end{aligned}$$

A = 5, B = 32, and C = 160.

34. $-0.08x = 1.24y - 3.12$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \ge 0$, and A and B are not both zero.

$$-0.08x = 1.24y - 3.12$$
$$0.08x - 1.24y = -3.12$$
$$\frac{0.08}{4}x - \frac{1.24}{4}y = -\frac{3.12}{4}$$
$$0.02x - 0.31y = 0.78$$
$$2x - 31y = 78$$

$A = 2$, $B = 31$, and $C = 78$.

Find the x-intercept and the y-intercept of the graph of each equation. Then graph the equation using the intercepts.

35. $y = -8x - 4$

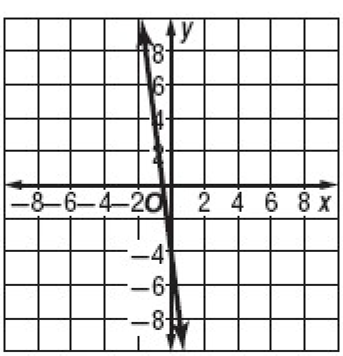
SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The equation is $y = -8x - 4$.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is –0.5.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is –4.



36. $5y = 15x - 90$

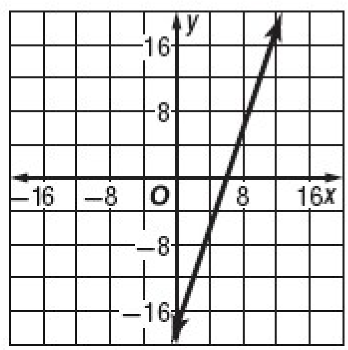
SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The equation is $5y = 15x - 90$.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is 6.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is –18.



37. $-4y + 6x = -42$

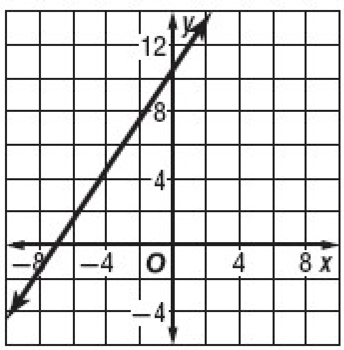
SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The equation is $-4y + 6x = -42$.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is –7.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is 10.5.



38. $-9x - 7y = -30$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

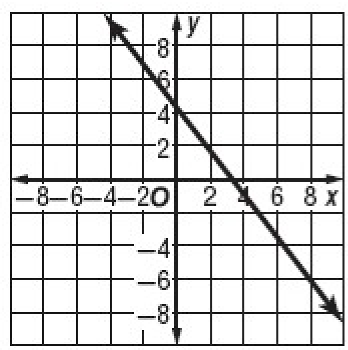
The equation is $-9x - 7y = -30$.

The x-intercept is the value of x when $y = 0$.

So, the x-intercept is $\frac{10}{3}$.

The y-intercept is the value of y when $x = 0$.

So, the y-intercept is $\frac{30}{7}$.



39. $\frac{1}{3}x - \frac{2}{9}y = 4$

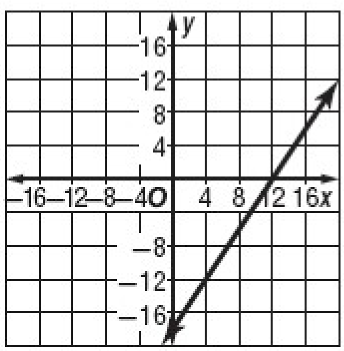
SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The equation is $\frac{1}{3}x - \frac{2}{9}y = 4$.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is 12.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is –18.



40. $\frac{3}{4}y - \frac{2}{3}x = 12$

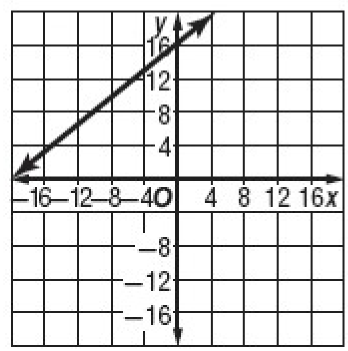
SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

The equation is $\frac{3}{4}y - \frac{2}{3}x = 12$.

The x-intercept is the value of x when $y = 0$.
So, the x-intercept is –18.

The y-intercept is the value of y when $x = 0$.
So, the y-intercept is 16.



41. **CCSS MODELING** Latonya earns a commission of $1.75 for each magazine subscription she sells and $1.50 for each newspaper subscription she sells. Her goal is to earn a total of $525 in commissions in the next two weeks.

a. Write an equation that is a model for the different numbers of magazine and newspaper subscriptions that can be sold to meet the goal.

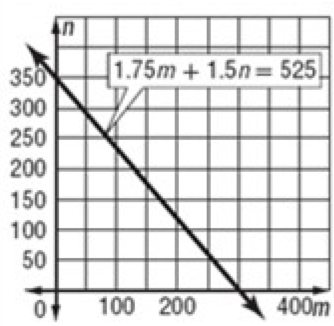
b. Graph the equation. Does this equation represent a function? Explain.

c. If Latonya sells 100 magazine subscriptions and 200 newspaper subscriptions, will she meet her goal? Explain.

SOLUTION:

a. Let *m* and *n* represent the number of magazines and newspapers respectively.
Commission for *m* magazines = 1.75*m*
Commission for *n* newspapers = 1.5*n*
The goal is $525.
So:
$1.75m + 1.5n = 525$

b.



The graph passes the vertical line test. So, the equation represents a function.

c. Replace *m* with 100 and *n* with 200.

$$1.75(100) + 1.5(200)$$
$$= 175 + 300$$
$$= 475$$

The amount that Latonya will earn is $475. So, she could not meet her goal.

42. **SNAKES** Suppose the body length *L* in inches of a baby snake is given by *L*(*m*) = 1.5 + 2*m*, where *m* is the age of the snake in months until it becomes 12 months old.

a. Find the length of an 8-month-old snake.

b. Find the snake's age if the length of the snake is 25.5 inches.

SOLUTION:

a.
L(*m*) = 1.5 + 2*m*
Replace *m* with 8.

$$L(8) = 1.5 + 2(8)$$
$$= 1.5 + 16$$
$$= 17.5$$

The length of an 8-month-old snake is 17.5 inches.

b. Replace *L* with 25.5 inches.

$$25.5 = 1.5 + 2m$$
$$24 = 2m$$
$$12 = m$$

Therefore, the snake is 12 months.

43. **STATE FAIR** The Ohio State Fair charges $8 for admission and $5 for parking. After Joey pays for admission and parking, he plans to spend all of his remaining money at the ring game, which costs $3 per game.

a. Write an equation representing the situation.

b. How much did Joey spend at the fair if he paid $6 for food and drinks and played the ring game 4 times?

SOLUTION:

a. Let x be the number of games that Joey plays. The amount spend by Joey is given by:

$$y = 3x + 13$$

b. The amount that Joey spent on admission, parking, and food is $19.
The amount spent on 4 games = 3(4) = $12.

So, the total amount = $19 + $12 = $31.

Write each equation in standard form. Identify *A*, *B*, and *C*.

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

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\frac{x+5}{3} = -2y + 4$$
$$x + 5 = -6y + 12$$
$$x + 6y = 7$$

$A = 1$, $B = 6$, and $C = 7$.

45. $\frac{4x-1}{5} = 8y - 12$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\frac{4x-1}{5} = 8y - 12$$
$$4x - 1 = 40y - 60$$
$$4x - 40y = -59$$

$A = 4$, $B = -40$, and $C = -59$.

46. $\frac{-2x-8}{3} = -12y + 18$

SOLUTION:

The standard form of a linear equation is $Ax + By = C$, where A, B, and C are integers with a greatest common factor of 1, $A \geq 0$, and A and B are not both zero.

$$\frac{-2x-8}{3} = -12y + 18$$
$$-2x - 8 = -36y + 54$$
$$-2x + 36y = 62$$
$$x - 18y = -31$$

Find the x-intercept and the y-intercept of the graph of each equation.

47. $\frac{6x+15}{4}=3y-12$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

$$\frac{6x+15}{4}=3y-12$$

The x-intercept is the value of x when y = 0. Replace y with 0.

$$\begin{aligned}\frac{6x+15}{4}&=-12\\ 6x+15&=-48\\ x&=-10.5\end{aligned}$$

So, the x-intercept is –10.5
.
The y-intercept is the value of y when x = 0. Replace x with 0.

$$\begin{aligned}\frac{6(0)+15}{4}&=3y-12\\ \frac{15}{4}&=3y-12\\ 3y&=\frac{63}{4}\\ y&=5.25\end{aligned}$$

So, the y-intercept is 5.25.

48. $\frac{-8x+12}{3}=16y+24$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

$$\frac{-8x+12}{3}=16y+24$$

The x-intercept is the value of x when y = 0.

Replace y with 0.

$$\begin{aligned}\frac{-8x+12}{3}&=24\\ -8x+12&=72\\ -8x&=60\\ x&=-7.5\end{aligned}$$

So, the x-intercept is –7.5.

The y-intercept is the value of y when x = 0.

Replace x with 0.

$$\begin{aligned}\frac{-8(0)+12}{3}&=16y+24\\ 4&=16y+24\\ y&=-1.25\end{aligned}$$

So, the y-intercept is –1.25.

49. $\frac{15x+20}{4}=\frac{3y+6}{5}$

SOLUTION:

The y-coordinate of the point at which a graph crosses the y-axis is called the y-intercept. Likewise, the x-coordinate of the point at which it crosses the x-axis is called the x-intercept.

$$\frac{15x+20}{4}=\frac{3y+6}{5}$$

The x-intercept is the value of x when y = 0.

Replace y with 0.

$$\frac{15x+20}{4}=\frac{6}{5}$$
$$15x+20=\frac{24}{5}$$
$$15x=-\frac{76}{5}$$
$$x=-\frac{76}{75}$$
$$x=-1\frac{1}{75}$$

So, the x-intercept is $-1\frac{1}{75}$.

The y-intercept is the value of y when x = 0.

Replace x with 0.

$$\frac{20}{4}=\frac{3y+6}{5}$$
$$3y=\frac{76}{4}$$
$$y=\frac{19}{3}$$
$$y=6\frac{1}{3}$$

So, the y-intercept is $6\frac{1}{3}$.

50. **FUNDRAISING** The Freshman Class Student Council wanted to raise money by giving car washes. The students spent $10 on supplies and charged $2 per car wash.

a. Write an equation to model the situation.

b. Graph the equation.

c. How much money did they earn after 20 car washes?

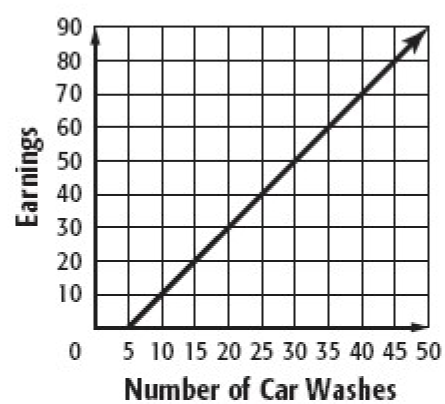
d. How many car washes are needed for them to earn $100?

SOLUTION:

a. Let c be the number of cars and E be the earnings.

So:
$E = 2c - 10$

b.



c. Replace c with 20.

$$E=2(20)-10$$
$$=30$$

They earned $30 by washing 20 cars.

d. Replace E with 100.

$$100=2c-10$$
$$110=2c$$
$$c=55$$

They need to wash 55 cars to earn $100.

51. **MULTIPLE REPRESENTATIONS** Consider the following linear functions.

$f(x) = -2x + 4 \qquad g(x) = 6 \qquad h(x) = \frac{1}{3}x + 5$

a. GRAPHICAL Graph the linear functions on separate graphs.

b. TABULAR Use the graphs to complete the table

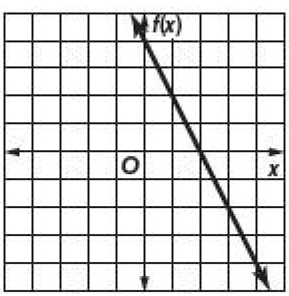
Function	One-to-One	Onto
$f(x) = -2x + 4$		
$g(x) = 6$		
$h(x) = \frac{1}{3}x + 5$		

c. VERBAL Are all linear functions one-to-one and/or onto? Explain your reasoning.

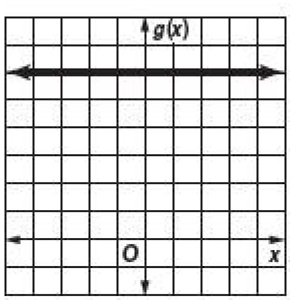
SOLUTION:

a. Use the intercepts to graph each equation.

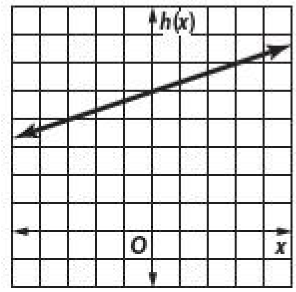
f(*x*) = -2*x* + 4; The *y*-intercept is 4, the *x*-intercept is 2.



g(*x*) = 6; the *y*-intercept is 6, there is no *x*-intercept.



$h(x) = \frac{1}{3}x + 5$; the *y*-intercept is 5, the *x*-intercept is -15.



b. Analyze the graphs of each function to determine whether they are one-to-one or onto.

Function	One-to-One	Onto
$f(x) = -2x + 4$	yes	yes
$g(x) = 6$	no	no
$h(x) = \frac{1}{3}x + 5$	yes	yes

c. No; horizontal lines are neither one-to-one nor onto because only one *y*-value is used and it is repeated fo every *x*-value. Every other linear function is one-to-one and onto because every *x*-value has one unique *y* value that is not used by any other *x*-element and every possible *y*-value is used.

52. **CHALLENGE** Write a function with an *x*-intercept of (*a*, 0) and a *y*-intercept of (0, *b*).

SOLUTION:

Sample answer: Use the *x*- and *y*-intercepts to determine the slope of the function. Since the *y*-intercept is (0, *b*), the function will be in the form $f(x) = mx + b$. Find *m* using the *x*-intercept. Let *f*(*x*) = 0 and *x* = *a*. Solve for *m*.

$$f(x) = mx + b$$
$$0 = ma + b$$
$$-b = ma$$
$$\frac{-b}{a} = m$$

The function is $f(x) = -\frac{bx}{a} + b$.

53. **OPEN ENDED** Write an equation of a line with an x-intercept of 3.

SOLUTION:

Sample answer:An x-intercept of 3 means that when 3 is substituted into the equation, $y = 0$. To write an equation, one factor should be $(x - 3)$.

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

54. **REASONING** Determine whether an equation of the form $x = a$, where a is a constant, is *sometimes, always,* or *never* a function. Explain your reasoning.

SOLUTION:

Sample answer: Never; the graph of $x = a$ is a vertical line. Therefore it will always fail the vertical line test, for any value of a.

55. **CCSS ARGUMENTS** Of the four equations shown, identify the one that does not belong. Explain your reasoning.

$y = 2x + 3$

$2x + y = 5$

$y = 5$

$y = 2xy$

SOLUTION:

$y = 2xy$; since it cannot be written in the form $f(x) = mx + b$, $y = 2xy$ is not a linear function.

56. **WRITING IN MATH** Consider the graph of the relationship between hours worked and earnings.

a. When would this graph represent a linear relationship? Explain your reasoning.

b. Provide another example of a linear relationship in a real-world situation.

SOLUTION:

a. Sample answer: When the earnings are determined by a constant hourly wage, the total earnings can be represented by $y = mx$ where m is the hourly wage.

b. Sample answer: The relationship between the cost and the number of gallons of gasoline purchased. Within a transaction, the cost of gasoline is constant so the total cost and the number of gallons purchased are a linear relationship.

57. Tom bought n DVDs for a total cost of $15n - 2$ dollars. Which expression represents the cost of each DVD?

A $n(15n - 2)$
B $n + (15n - 2)$
C $(15n - 2) \div n;\ n \neq 0$
D $(15n - 2) - n$

SOLUTION:

The cost of n DVDs is $15n - 2$.

The cost of 1 DVD is $15n - 2 \div n$.

The correct choice is **C.**

58. **SHORT RESPONSE** What is the complete solution of the equation?

$$|9-3x|=18$$

SOLUTION:

$$|9-3x|=18$$
$$9-3x=-18 \quad \text{or} \quad 9-3x=18$$
$$3x=27 \quad \text{or} \quad 3x=-9$$
$$x=9 \quad \text{or} \quad x=-3$$

The solution set is {–3, 9}.

59. **NUMBER THEORY** If a, b, c, and d are consecutive odd integers and $a < b < c < d$, how much greater is $c + d$ than $a + b$?

F 2
H 4
G 6
J 8

SOLUTION:

Let $a = 2n + 1$.

So:

$$b=2n+3$$
$$c=2n+5$$
$$d=2n+7$$

Therefore:

$$c+d=4n+12$$
$$a+b=4n+4$$
$$c+d-(a+b)=4n+12-4n-4$$
$$=8$$

The correct choice is **J.**

60. **ACT/SAT** Which function is linear?

A $f(x)=x^2$

B $g(x)=\sqrt{x-1}$

C $f(x)=\sqrt{9-x^2}$

D $g(x)=\frac{2.7}{x}$

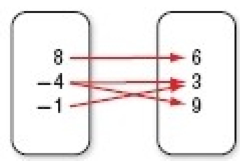
E $f(x)=2x$

SOLUTION:

In a linear function, the exponent of the independent variable is less than or equal to 1, and the variable is not in the denominator of a fraction.

The correct choice is **E.**

State the domain and range of each relation. Then determine whether each relation is a *function* . If it is a function, determine if it is *one-to-one, onto, both,* or *neither*.

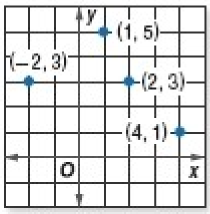
61. 

SOLUTION:

The left side of the mapping is the domain and the right side is the range.

D = {–4, –1, 8}, R = {3, 6, 9};

The relation is not a function because –4 is mapped to both 3 and 9.

62. 

SOLUTION:
The members of the domain are the x-values of the relation while the members of the range are the y-values.

D = {–2, 1, 2, 4}, R = {1, 3, 5};

Each element of the domain is paired with exactly one element of the range. So, the relation is a function.

The function is *onto* because each element of the range corresponds to an element of the domain.

63.

x	y
–4	–2
–3	–1
–3	–1
7	9

SOLUTION:
The members of the domain are the x-values of the relation while the members of the range are the y-values.

D = {–4, –3, 7}, R = {–2, –1, 9};

Each element of the domain is paired with exactly one element of the range. So, the relation is a function.

The function is both *one-to-one* and *onto* because each element of the domain is paired with a unique element of the range and each element of the range corresponds to an element of the domain.

64. **SHOPPING** Claudio is shopping for a new television. The average price of the televisions he likes is \$800, and the actual prices differ from the average by up to \$350. Write and solve an absolute value inequality to determine the price range of the televisions.

SOLUTION:
Let x be the actual price of the television.

So:

$$|x - 800| \le 350$$

This implies:

$$\begin{aligned} -350 &\le x - 800 \le 350 \\ -350 + 800 &\le x - 800 + 800 \le 350 + 800 \\ 450 &\le x \le 1150 \end{aligned}$$

The price of the televisions ranges from \$450 to \$1150.

Evaluate each expression if a = –6, b = 5, and c = 3.6.

65. $\frac{6a - 3c}{2ab}$

SOLUTION:

$$\frac{6a - 3c}{2ab}$$

Replace a with –6, b with 5, and c with 3.6.

$$\begin{aligned} &\frac{6(-6) - 3(3.6)}{2(-6)(5)} \\ &= \frac{-36 - 10.8}{-60} \\ &= 0.78 \end{aligned}$$

66. $\frac{a+7b}{4bc}$

SOLUTION:

$\frac{a+7b}{4bc}$

Replace *a* with –6, *b* with 5, and *c* with 3.6.

$$\frac{-6+7(5)}{4(5)(3.6)} = \frac{29}{72}$$

67. $\frac{b-c}{a+c}$

SOLUTION:

$\frac{b-c}{a+c}$

Replace *a* with –6, *b* with 5, and *c* with 3.6.

$$\frac{5-3.6}{-6+3.6} = \frac{1.4}{-2.4}$$
$$= -\frac{7}{12}$$

68. **FOOD** Brandi can order a small, medium, or large pizza with pepperoni, mushrooms, or sausage. How many different one-topping pizzas can she order?

SOLUTION:

The number of small pizzas with different one-topping = 3.

The number of medium pizzas with different one-topping = 3.

The number of large pizzas with different one-topping = 3.

Total = 9

Evaluate each expression.

69. $\frac{12-8}{4-(-2)}$

SOLUTION:

$$\frac{12-8}{4-(-2)} = \frac{12-8}{4+2}$$
$$= \frac{4}{6}$$
$$= \frac{2}{3}$$

70. $\frac{5-9}{-3-(-6)}$

SOLUTION:

$$\frac{5-9}{-3-(-6)} = \frac{5-9}{-3+6}$$
$$= -\frac{4}{3}$$

71. $\frac{-2-8}{3-(-5)}$

SOLUTION:

$$\frac{-2-8}{3-(-5)} = \frac{-2-8}{3+5}$$
$$= -\frac{10}{8}$$
$$= -\frac{5}{4}$$

72. $\frac{-2-(-6)}{-1-(-8)}$

SOLUTION:

$$\frac{-2-(-6)}{-1-(-8)} = \frac{-2+6}{-1+8}$$
$$= \frac{4}{7}$$

73. $\frac{-7-(-11)}{-3-9}$

SOLUTION:

$$\begin{aligned}\frac{-7-(-11)}{-3-9} &= \frac{-7+11}{-3-9} \\ &= -\frac{4}{12} \\ &= -\frac{1}{3}\end{aligned}$$

74. $\frac{-1-8}{7-(-3)}$

SOLUTION:

$$\begin{aligned}\frac{-1-8}{7-(-3)} &= \frac{-1-8}{7+3} \\ &= -\frac{9}{10}\end{aligned}$$

75. $\frac{-12-(-3)}{-6-(-5)}$

SOLUTION:

$$\begin{aligned}\frac{-12-(-3)}{-6-(-5)} &= \frac{-12+3}{-6+5} \\ &= \frac{-9}{-1} \\ &= 9\end{aligned}$$

76. $\frac{4-3}{2-5}$

SOLUTION:

$$\begin{aligned}\frac{4-3}{2-5} &= \frac{1}{-3} \\ &= -\frac{1}{3}\end{aligned}$$