

2-2 Linear Relations and Functions

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

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

ANSWER:

Yes; it can be written as $f(x) = \frac{x}{5} + \frac{12}{5}$.

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

ANSWER:

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

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

ANSWER:

No; x has an exponent that is not 1.

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

ANSWER:

Yes; it is written in $f(x) = mx + b$ form.

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?

ANSWER:

- a. 3 hours
b. 8 CDs

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

6. $y = -4x - 7$

ANSWER:

$4x + y = -7$; $A = 4$, $B = 1$, $C = -7$

7. $y = 6x + 5$

ANSWER:

$6x - y = -5$; $A = 6$, $B = -1$, $C = -5$

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

ANSWER:

$3x + 2y = -1$; $A = 3$, $B = 2$, $C = -1$

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

ANSWER:

$8x + 9y = 6$; $A = 8$, $B = 9$, $C = 6$

10. $12y = 4x + 8$

ANSWER:

$x - 3y = -2$; $A = 1$, $B = -3$, $C = -2$

11. $4x - 6y = 24$

ANSWER:

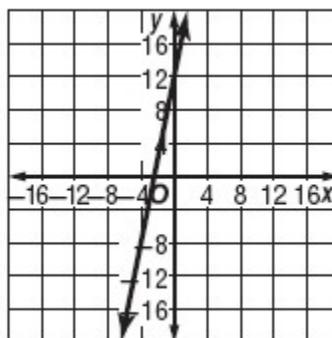
$2x - 3y = 12$; $A = 2$, $B = -3$, $C = 12$

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

12. $y = 5x + 12$

ANSWER:

$-\frac{12}{5}$; 12

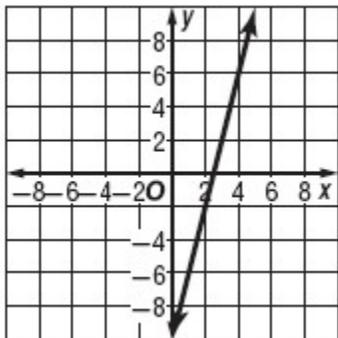


2-2 Linear Relations and Functions

13. $y = 4x - 10$

ANSWER:

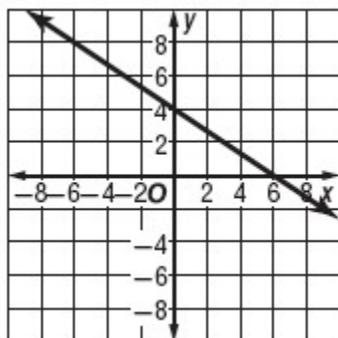
$$\frac{5}{2}; -10$$



14. $2x + 3y = 12$

ANSWER:

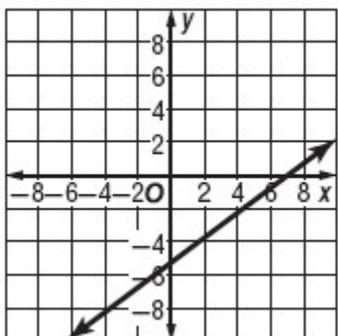
$$6; 4$$



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

ANSWER:

$$7; -\frac{21}{4}$$



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

16. $3y - 4x = 20$

ANSWER:

Yes; it can be written in $f(x) = mx + b$ form, where

$$m = \frac{4}{3} \text{ and } b = \frac{20}{3}.$$

17. $y = x^2 - 6$

ANSWER:

No; x has an exponent other than 1.

18. $h(x) = 6$

ANSWER:

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

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

ANSWER:

No; x has an exponent other than 1.

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

ANSWER:

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

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

ANSWER:

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

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

ANSWER:

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

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

ANSWER:

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

2-2 Linear Relations and Functions

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

ANSWER:

Yes; it can be written in $f(x) = mx + b$ form, where

$$m = \frac{4}{5} \text{ and } b = \frac{8}{3}.$$

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.

ANSWER:

a. 260 m

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. $-7x - 5y = 35$

ANSWER:

$$7x + 5y = -35; A = 7, B = 5, C = -35$$

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

ANSWER:

$$8x + 3y = -6; A = 8, B = 3, C = -6$$

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

ANSWER:

$$3x - 10y = -5; A = 3, B = -10, C = -5$$

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

ANSWER:

$$2x + y = -11; A = 2, B = 1, C = -11$$

30. $3y = 9x - 12$

ANSWER:

$$3x - y = 4; A = 3, B = -1, C = 4$$

31. $2.4y = -14.4x$

ANSWER:

$$6x + y = 0; A = 6, B = 1, C = 0$$

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

ANSWER:

$$9x - 8y = 2; A = 9, B = -8, C = 2$$

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

ANSWER:

$$5x + 32y = 160; A = 5, B = 32, C = 160$$

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

ANSWER:

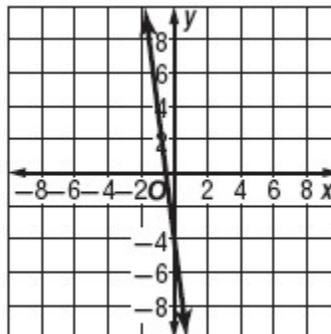
$$2x + 31y = 78; A = 2, B = 31, C = 78$$

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

35. $y = -8x - 4$

ANSWER:

$$-0.5; -4$$

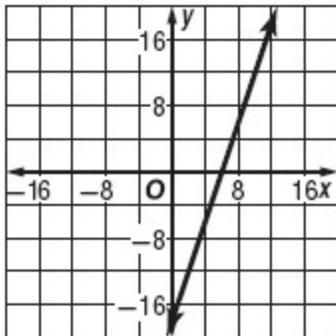


2-2 Linear Relations and Functions

36. $5y = 15x - 90$

ANSWER:

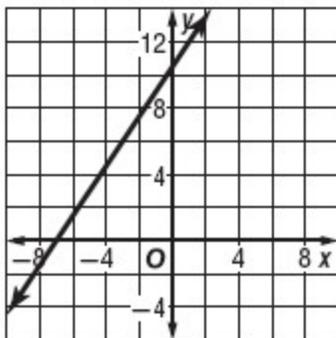
6; -18



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

ANSWER:

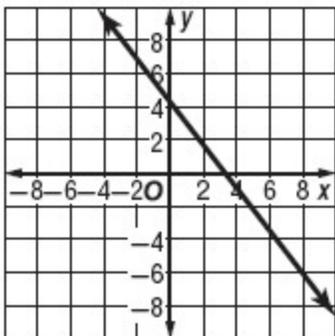
-7; 10.5



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

ANSWER:

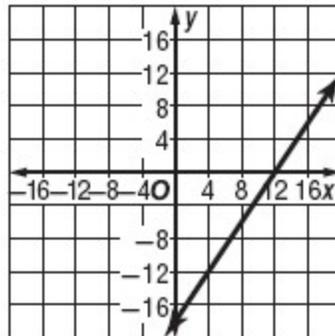
$\frac{10}{3}$; $\frac{30}{7}$



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

ANSWER:

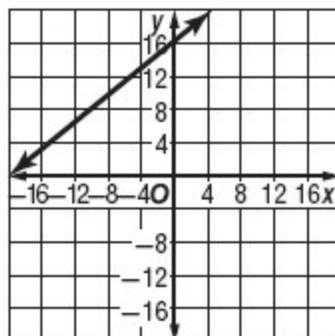
12; -18



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

ANSWER:

-18; 16



2-2 Linear Relations and Functions

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.

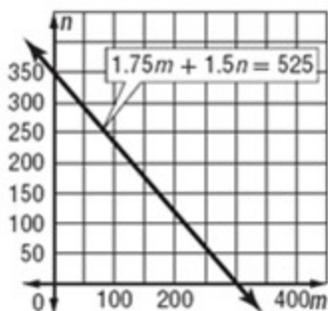
b. Graph the equation. Does this equation represent a function? Explain.

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

ANSWER:

a. $1.75m + 1.5n = 525$

b.



Yes; the graph passes the vertical line test.

c. No; the amount that Latonya will sell is $1.75 \cdot 100 + 1.5 \cdot 200$, which is \$475.

42. **SNAKES** Suppose the body length L in inches of a baby snake is given by $L(m) = 1.5 + 2m$, 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.

ANSWER:

a. 17.5 in.

b. 12 mo

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?

ANSWER:

a. $y = 3x + 13$

b. \$31

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

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

ANSWER:

$x + 6y = 7$; $A=1, B=6, C=7$

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

ANSWER:

$4x - 40y = -59$; $A=4, B=-40, C=-59$

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

ANSWER:

$x - 18y = -31$; $A = 1, B = -18, C = -31$

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

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

ANSWER:

-10.5; 5.25

2-2 Linear Relations and Functions

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

ANSWER:

$-7.5; -1.25$

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

ANSWER:

$-1\frac{1}{75}; 6\frac{1}{3}$

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.

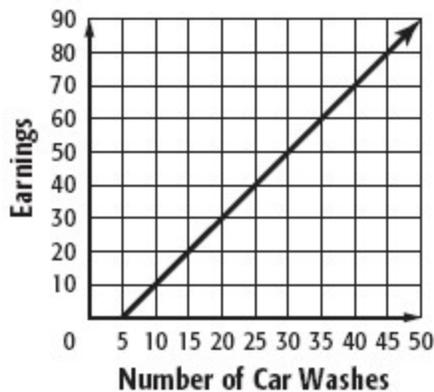
b. Graph the equation.

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

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

ANSWER:

a. $E = 2c - 10$



b.

c. \$30

d. 55

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

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

a. **GRAPHICAL** Graph the linear functions on separate graphs.

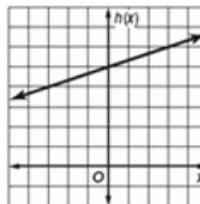
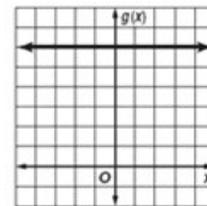
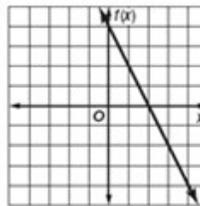
b. **TABULAR** Use the graphs to complete the table

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.

ANSWER:

a.



b.

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 for 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.

2-2 Linear Relations and Functions

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

ANSWER:

Sample answer: $f(x) = -\frac{bx}{a} + b$

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

ANSWER:

Sample answer: $f(x) = 2(x - 3)$

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.

ANSWER:

Sample answer: Never; the graph of $x = a$ is a vertical line.

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

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

ANSWER:

$y = 2xy$; Sample answer: $y = 2xy$ 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.

ANSWER:

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.

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 $(15n - 2) - n$

ANSWER:

C

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

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

ANSWER:

-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

ANSWER:

J

2-2 Linear Relations and Functions

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

A $f(x) = x^2$

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

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

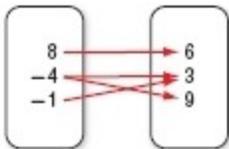
D $g(x) = \frac{2.7}{x}$

E $f(x) = 2x$

ANSWER:

E

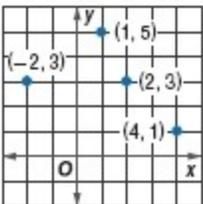
State the domain and range of each relation. Then determine whether each relation is a function. If it is a function, determine if it is *one-to-one*, *onto*, *both*, or *neither*.



61.

ANSWER:

$D = \{-4, -1, 8\}$, $R = \{3, 6, 9\}$; not a function



62.

ANSWER:

$D = \{-2, 1, 2, 4\}$, $R = \{1, 3, 5\}$; function; onto

x	y
-4	-2
-3	-1
-3	-1
7	9

63.

ANSWER:

$D = \{-4, -3, 7\}$, $R = \{-2, -1, 9\}$; function; both

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.

ANSWER:

$$|x - 800| \leq 350; \$450 \leq x \leq \$1150$$

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

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

ANSWER:

0.78

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

ANSWER:

$\frac{29}{72}$

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

ANSWER:

$-\frac{7}{12}$

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?

ANSWER:

9

Evaluate each expression.

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

ANSWER:

$\frac{2}{3}$

2-2 Linear Relations and Functions

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

ANSWER:

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

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

ANSWER:

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

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

ANSWER:

$$\frac{4}{7}$$

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

ANSWER:

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

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

ANSWER:

$$-\frac{9}{10}$$

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

ANSWER:

$$9$$

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

ANSWER:

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