

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

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

ANSWER:

No; x has an exponent that is not 1.

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. How many hours of music are there on 4 CDs?

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 .

7. $y = 6x + 5$

ANSWER:

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

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

ANSWER:

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

11. $4x - 6y = 24$

ANSWER:

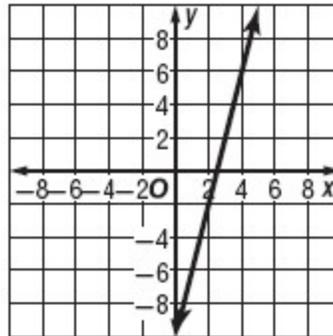
$2x - 3y = 12$; $A = 2$, $B = -3$, $C = 12$

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

13. $y = 4x - 10$

ANSWER:

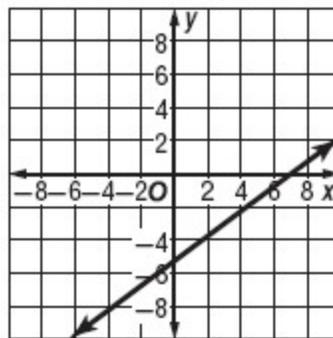
$\frac{5}{2}$; -10



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.

17. $y = x^2 - 6$

ANSWER:

No; x has an exponent other than 1.

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

ANSWER:

No; x has an exponent other than 1.

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

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.

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.

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

ANSWER:

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

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

ANSWER:

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

31. $2.4y = -14.4x$

ANSWER:

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

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

ANSWER:

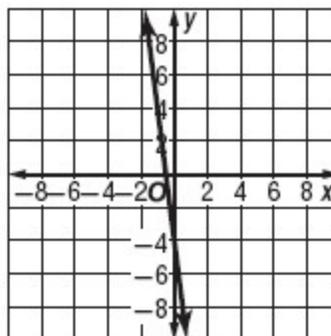
$$5x + 32y = 160; A = 5, B = 32, C = 160$$

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:

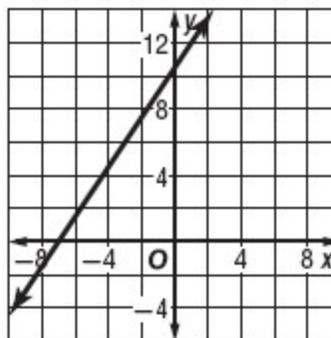
$$-0.5; -4$$



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

ANSWER:

$$-7; 10.5$$

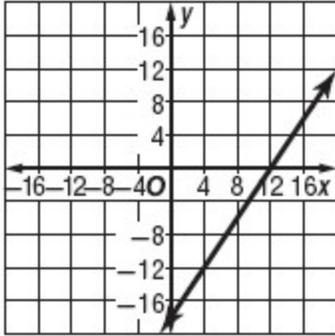


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39. $\frac{1}{3}x - \frac{2}{9}y = 4$

ANSWER:

12; -18



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.

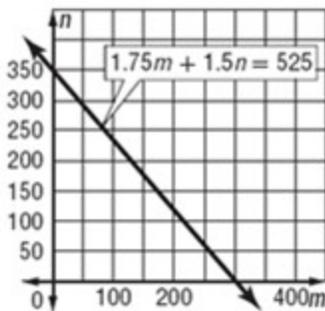
b. Graph the equation. Does this equation represent a function? Explain.

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.

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*.

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

ANSWER:

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

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

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

ANSWER:

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

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

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

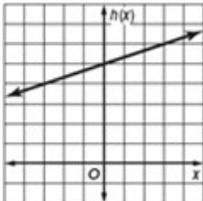
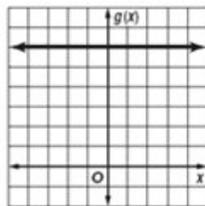
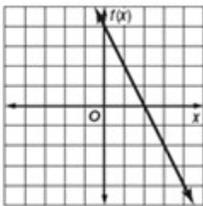
- a. **GRAPHICAL** Graph the linear functions on separate graphs.
- b. **TABULAR** Use the graphs to complete the table

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.

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

ANSWER:

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

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.

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

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 $a + b$?

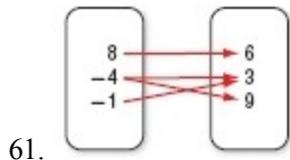
- F 2
 H 4
 G 6
 J 8

ANSWER:

J

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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*.



ANSWER:

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

63.

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

ANSWER:

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

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

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

ANSWER:

0.78

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

ANSWER:

$-\frac{7}{12}$

Evaluate each expression.

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

ANSWER:

$\frac{2}{3}$

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

ANSWER:

$-\frac{5}{4}$

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

ANSWER:

$-\frac{1}{3}$

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

ANSWER:

9