Direct Variation

Warm Up

Problem of the Day

Lesson Presentation

Lesson Quizzes

Direct Variation

Warm Up

1. Regina walked 9 miles in 3 hours. How many miles did she walk per hour?

3 mi per hour

2. To make 3 bowls of trail mix, Sandra needs 15 ounces of nuts. How many ounces of nuts does she need for 1 bowl of trail mix?

5 oz

Direct Variation

Problem of the Day

Paul has earned $60 from his paper route. Each day he earns $3.50 more. How many days will it take for Paul's earnings to top $100?

12 days

Direct Variation

Learn to identify, write, and graph an equation of direct variation.

Vocabulary

direct variation

constant of variation

Direct Variation

Direct variation is a linear relationship between two variable that can be written in the form $y = kx$ or $k = \frac{y}{x}$, where $k \neq 0$. The fixed number k in a direct variation equation is the constant of variation.

Direct Variation

Reading Math

You can read direct variation as "*y varies directly as x*" or "*y is directly proportional to x*" or "*y varies with x.*"

Additional Example 1A: Identifying a Direct Variation from an Equation

Tell whether each equation represents a direct variation. If so, identify the constant of variation.

$y + 8 = x$

Solve the equation for y.
Subtract 8 from both sides.

$$y + 8 = x$$
$$-8 \quad = \quad -8$$
$$y = x - 8$$

The equation is not in the form $y = kx$, so $y + 8 = x$ is not a direct variation.

Additional Example 1B: Identifying a Direct Variation from an Equation

Tell whether each equation represents a direct variation. If so, identify the constant of variation.

$3y = 2x$

$\frac{3y}{3} = \frac{2x}{3}$ *Solve the equation for y. Divide both sides by 3.*

$y = \frac{2}{3}x$ *Write* $\frac{2x}{3}$ *as* $\frac{2}{3}x$.

The equation is in the form $y = kx$, so the original equation $3y = 2x$ is a direct variation.

Direct Variation

Check It Out: Example 1A

Tell whether each equation represents a direct variation. If so, identify the constant of variation.

$y + 3 = 3x$

$y + 3 = 3x$

$-3 \quad -3$

Solve the equation for y.
Subtract 3 from both sides.

$y = 3x - 3$

The equation is not in the form $y = kx$, so $y + 3 = 3x$ is not a direct variation.

Check It Out: Example 1B

Tell whether each equation represents a direct variation. If so, identify the constant of variation.

$4y = 3x$

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

Solve the equation for y. Divide both sides by 4.

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

Write $\frac{3x}{4}$ *as* $\frac{3}{4}x$.

The equation is in the form $y = kx$, so the original equation $4y = 3x$ is a direct variation.

Direct Variation

Additional Example 2A: Identifying a Direct Variation from a Table

Tell whether each set of data represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

Price (c)	69	99	129
Weight (oz)	2	3	4

Find $\frac{y}{x}$ for each ordered pair.

$\frac{y}{x} = \frac{2}{69}$ $\quad \frac{y}{x} = \frac{3}{99} = \frac{1}{33}$ $\quad \frac{y}{x} = \frac{4}{129}$

k is not the same for each ordered pair.

The data does not represent a direct variation.

Direct Variation

Helpful Hint

In a direct variation where k is positive, when x increases, y also increases; when x decreases, y also decreases.

Direct Variation

Additional Example 2B: Identifying a Direct Variation from a Table

Tell whether each set of data represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

Inches	1	2	5
Centimeters	2.54	5.08	12.70

Find $\frac{y}{x}$ for each ordered pair.

$\frac{y}{x} = \frac{2.54}{1} = 2.54$ $\frac{y}{x} = \frac{5.08}{2} = 2.54$ $\frac{y}{x} = \frac{12.7}{5} = 2.54$

$k = 2.54$ for each ordered pair.

The data represent a direct variation where $k = 2.54$.

The equation is $y = 2.54x$

Direct Variation

Check It Out: Example 2A

Tell whether each set of data represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

Price (c)	5	10	15
Weight (lb)	2	3	4

Find $\frac{y}{x}$ for each ordered pair.

$\frac{y}{x} = \frac{2}{5}$ $\frac{y}{x} = \frac{3}{10}$ $\frac{y}{x} = \frac{4}{15}$

k is not the same for each ordered pair.

The data does not represent a direct variation.

Direct Variation

Check It Out: Example 2B

Tell whether each set of data represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

Meters	3	4	5
Miles	9	12	15

Find $\frac{y}{x}$ for each ordered pair.

$\frac{y}{x} = \frac{9}{3} = 3$ $\quad \frac{y}{x} = \frac{12}{4} = 3$ $\quad \frac{y}{x} = \frac{15}{5} = 3$

$k = 3$ for each ordered pair.

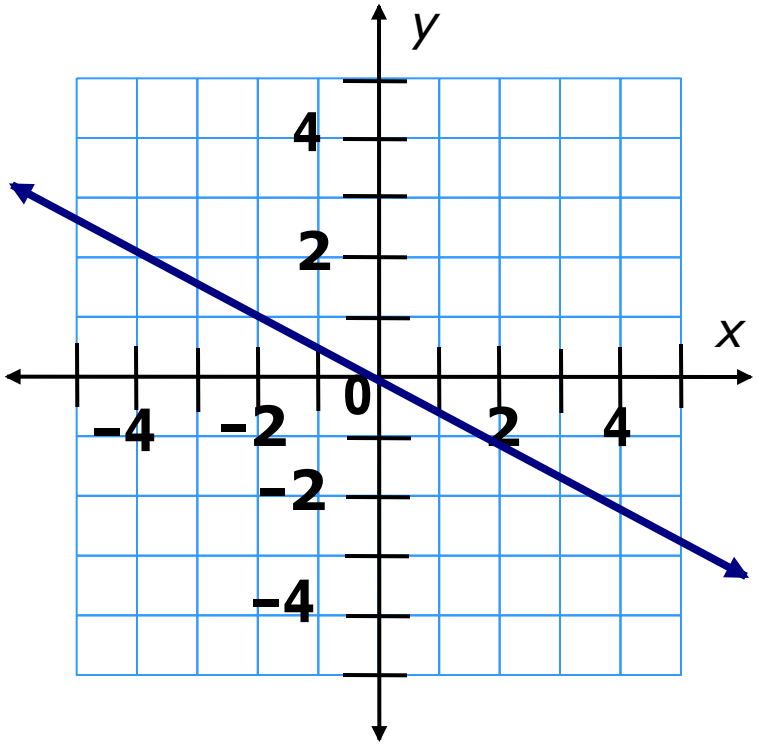
The data represent a direct variation where $k = 3$.

The equation is $y = 3x$

Additional Example 3: Identifying a Direct Variation from a Graph

Tell whether each graph represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

The graph is a line through (0, 0). This is a direct variation. The Slope of the line is ½, so $k = -½$. The equation is $y = -½x$.



Direct Variation

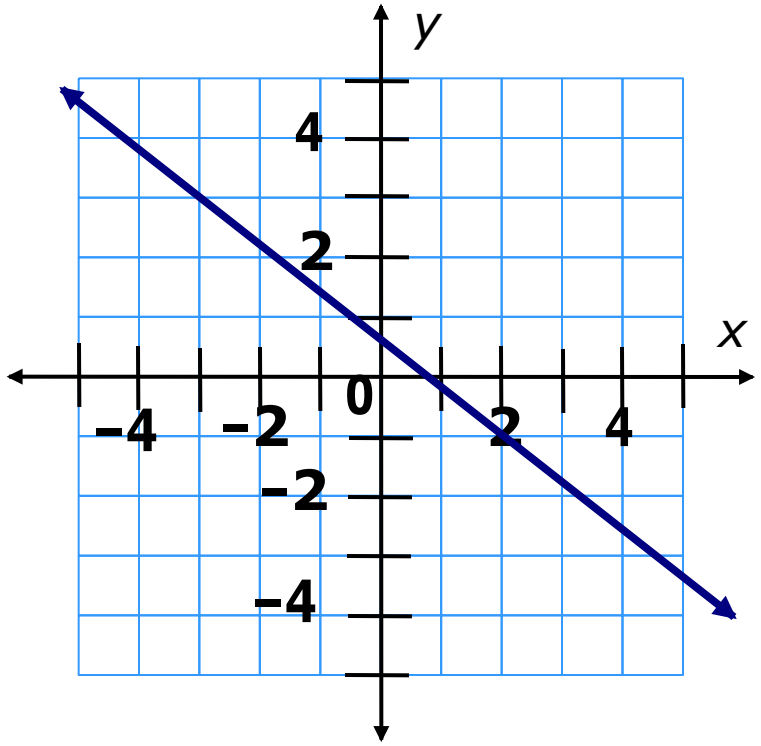
Helpful Hint

In a direct variation, the slope, k, represents a constant rate of change.

Check It Out: Example 3

Tell whether each graph represents a direct variation. If so, identify the constant of variation and then write the direct variation equation.

The line does not pass through (0, 0). This is not a direct variation.



Direct Variation

Additional Example 4A: *Application*

A truck travels at a speed of 55 miles per hour.

Write a direct variation equation for the distance *y* the truck travels in *x* hours.

distance = 55 miles per hour times number of hours

Use the formula $y = kx$. $k = 55$

$$y = 55 \cdot x$$

$$y = 55x$$

Additional Example 4B: *Application*

A truck travels at a speed of 55 miles per hour.

Graph the data.

Make a table. Since time cannot be negative, use nonnegative number for I.

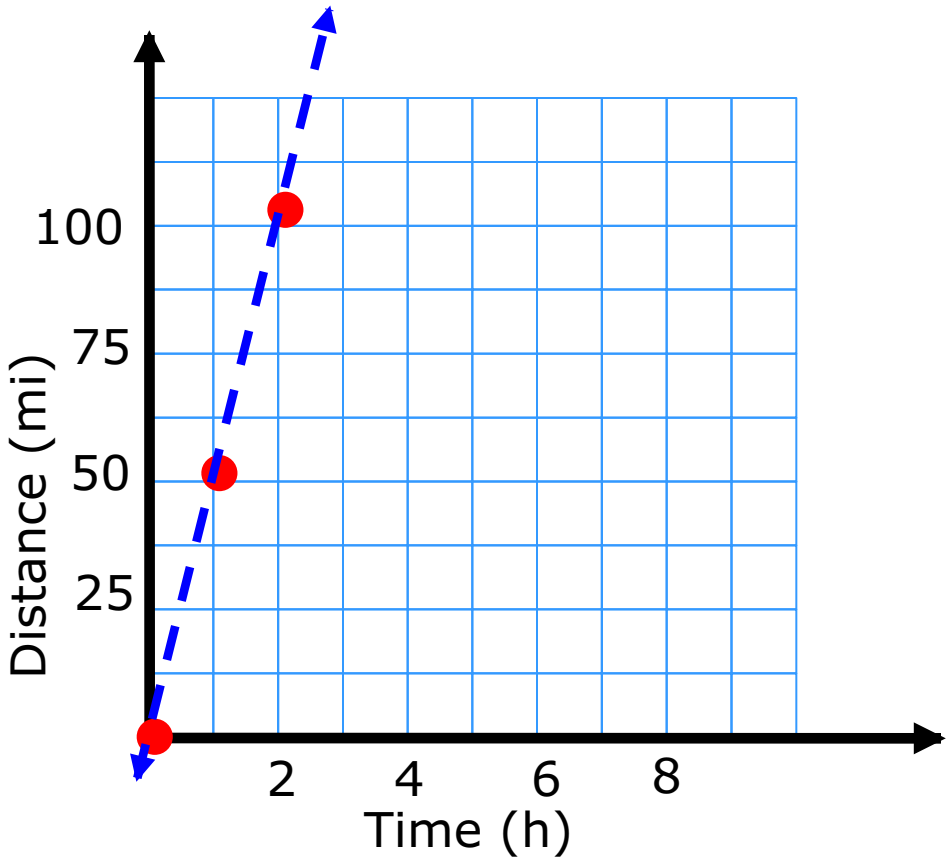
x	$y = 55x$	y	(x, y)
0	$y = 55(0)$	0	(0, 0)
1	$y = 55(1)$	55	(1, 55)
2	$y = 55(2)$	110	(2, 110)

Additional Example 4 Continued

Use the ordered pairs top plot the points on a coordinate plane. Connect the points in a straight line. Label the axes.

Check

$y = 55x$ is in slope-intercept form with $m = 55$ and b = 0. The graph shows a slope of 55 and a y-intercept of 0.



Additional Example 4 Continued

C. How long does it take the truck to travel 660 miles?

Find the value of x when $y = 660$

$y = 55x$ *Write the equation for the direct variation.*

$\frac{660}{55} = \frac{55x}{55}$ *Substitute 660 for y.*

Divide both sides by 660.

$12 = x$

It will take the truck 12 hours to travel 660 miles.

Check It Out: Example 4A

A bicycle travels at a speed of 12 miles per hour.

Write a direct variation equation for the distance *y* the bike travels in *x* hours.

distance = 12 miles per hour times number of hours

Use the formula y = kx. k = 12

$y = 12 \cdot x$

$y = 12x$

Check It Out: Example 4B

A bicycle travels at a speed of 12 miles per hour.

Graph the data.

Make a table. Since time cannot be negative, use nonnegative number for x.

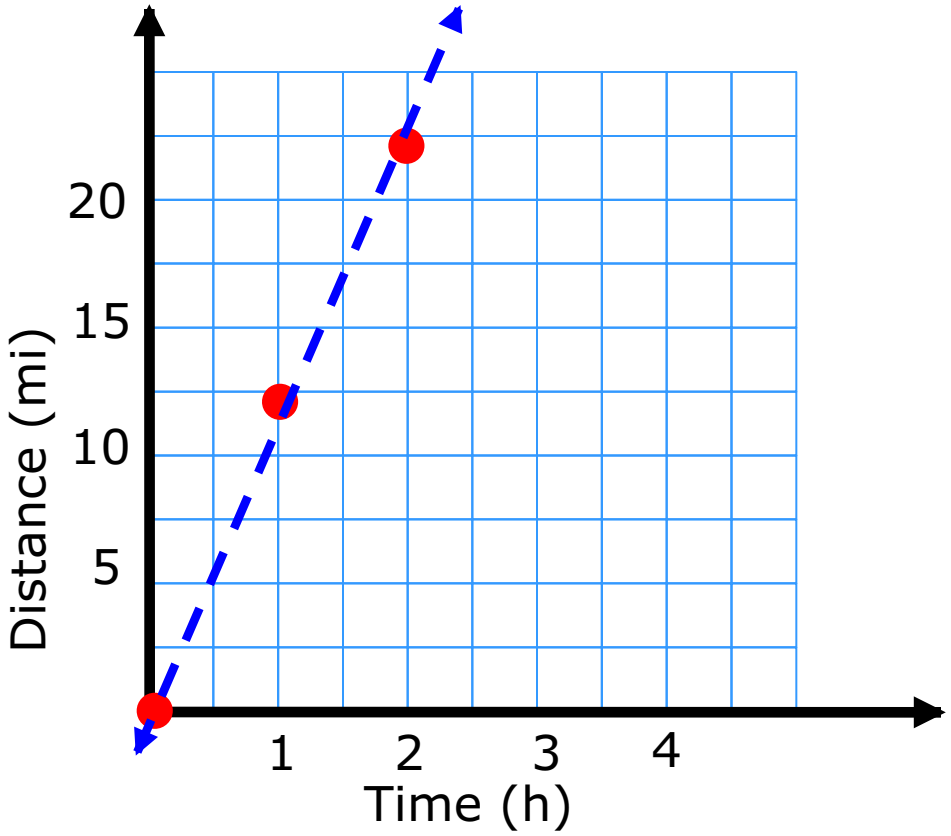
x	$y = 12x$	y	(x, y)
0	$y = 12(0)$	0	(0, 0)
1	$y = 12(1)$	12	(1, 12)
2	$y = 12(2)$	24	(2, 12)

Check It Out: Example 4 Continued

Use the ordered pairs top plot the points on a coordinate plane. Connect the points in a straight line. Label the axes.

Check

$y = 12x$ is in slope-intercept form with $m = 12$ and b = 0. The graph shows a slope of 12 and a y-intercept of 0.



Check It Out: Example 4 Continued

C. How long does it take the bicycle to travel 96 miles?

Find the value of x when $y = 96$

$y = 12x$ *Write the equation for the direct variation.*

$\frac{96}{12} = \frac{12x}{12}$ *Substitute 96 for x.*

Divide both sides by 12.

$8 = x$

It will take the bicycle 8 hours to travel 96 miles.

Lesson Quizzes

Standard Lesson Quiz

Lesson Quiz for Student Response Systems

Direct Variation

Lesson Quiz: Part I

Tell whether each of the following represents a direct variation. If so, identify the constant of variation.

1. $12y = 6x$ *yes; $k = \frac{1}{2}$*

2.

Speed (mi/h)	40	50	60
Time (h)	7.5	6	5

no

Direct Variation

Lesson Quiz: Part II

3. A cheetah runs at a speed of 0.75 miles per minute.

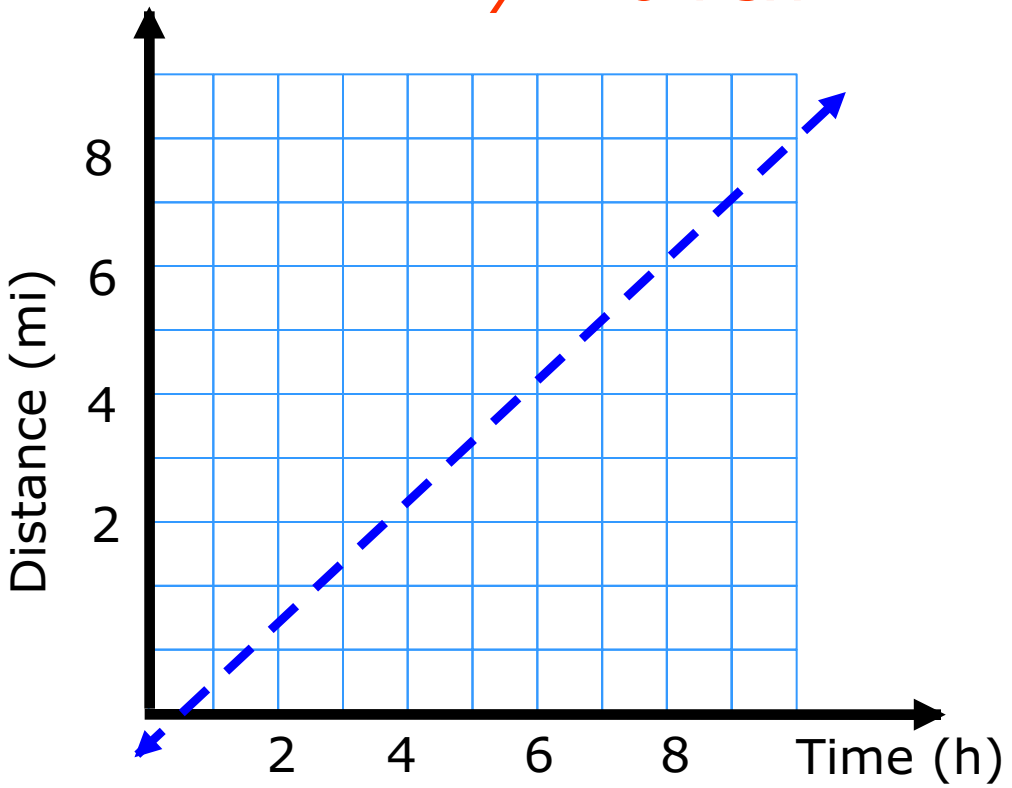
a. Write a direct variation equation for the distance y the cheetah runs in x minutes.

$y = 0.75x$

b. Graph the data.

c. How far does the cheetah run in 5 minutes?

3.75 miles



Direct Variation

Lesson Quiz for Student Response Systems

1. Tell whether the equation represents a direct variation. If so, identify the constant of variation.

$y = 1.5x$

A. yes; $k = 0$

B. yes; $k = 1$

C. yes; $k = 1.5$

D. no

Lesson Quiz for Student Response Systems

2. Tell whether the data set represents a direct variation. If so, identify the constant of variation.

Time (hr)	0	2	3	5
Distance (mi)	0	10	18	40

A. yes; $k = 10$

B. yes; $k = 5$

C. yes; $k = 0$

D. no

Direct Variation

Lesson Quiz for Student Response Systems

3. An employee's pay is $8.50 per number of hours worked. Write a direct variation equation for the amount *y* the employee gets in *x* number of hours. Graph the data. How much does the employee get in 8 hours?

A. $y = 8.5x$; $52 **B.** $y = 8.5x$; $68