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

DAY 1
IDENTIFYING

What is it?

- Variation, in general, will concern two variables: say height and weight of a person
- When one of these changes, the other might be expected to change.

Let’s focus on direct….

MCC7.RP.2b Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships

Fill in your Graphic Organizer with the following information.

Direct variation

What is it?

- When two variables change in the same sense; i.e. if one increases, so does the other.
  - Ex: As students increase, chaperones increase
  - Ex: As schools increase, buses increase

Constant

K = it is constant for all ordered pairs

$$K = \frac{y}{x}$$

Equation

$$y = kx$$

Constant

* y and x are an ordered pair (x,y)

Table

$y = 1/2x$

x	y
-4	-2
-2	-1
0	0
2	1
4	2

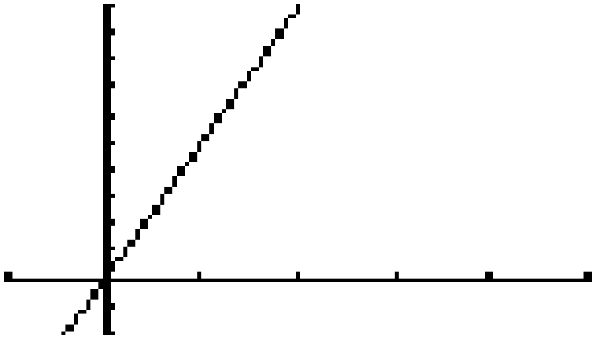
* Plug each x-value in and solve for y.

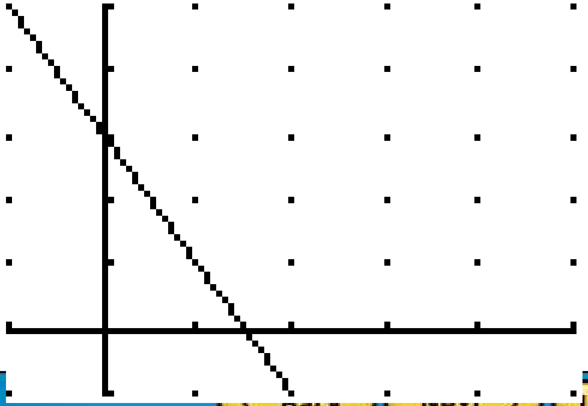
Do not write, just watch

Graph

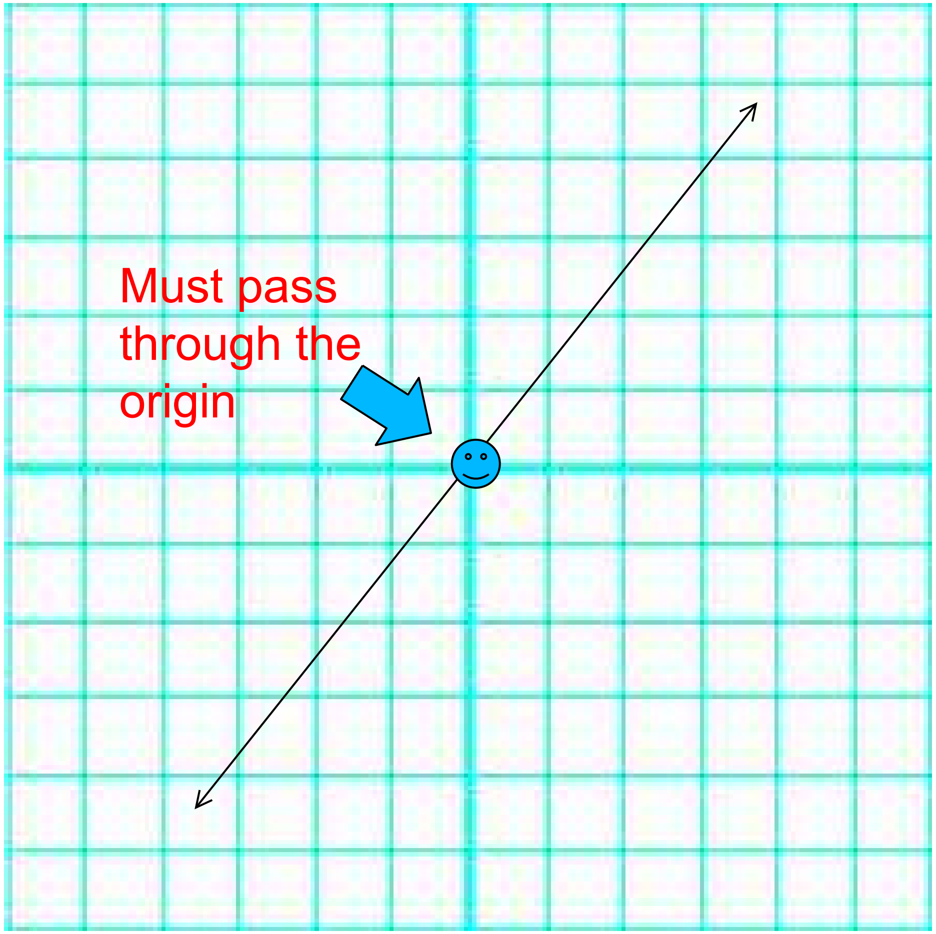
- Always a line
- Must go through the origin

Is **Is Not**





Graph



1 EXPLORE Graphing Proportional Relationships

Most showerheads that were manufactured before 1994 use 5 gallons of water per minute. Is the relationship between the number of gallons of water and the number of minutes a proportional relationship?

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A Complete the table.

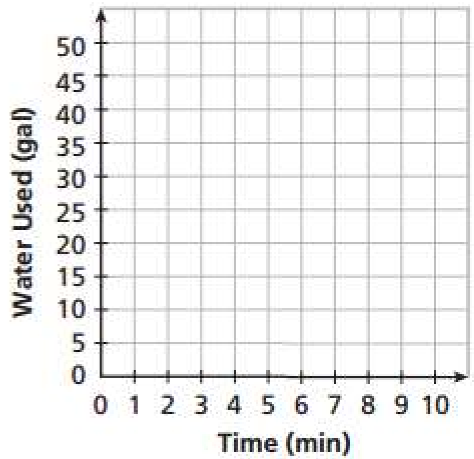
Time (min)	1	2	3		10
Water Used (gal)	5			35	

B Based on the table, is this a proportional relationship? Explain your answer.

____

C Plot the data from the table.

Showerhead Water Use



D **Draw Conclusions** If you continued the table to include 23 minutes, would the point (23, 125) be on this graph? Why or why not?

____

____

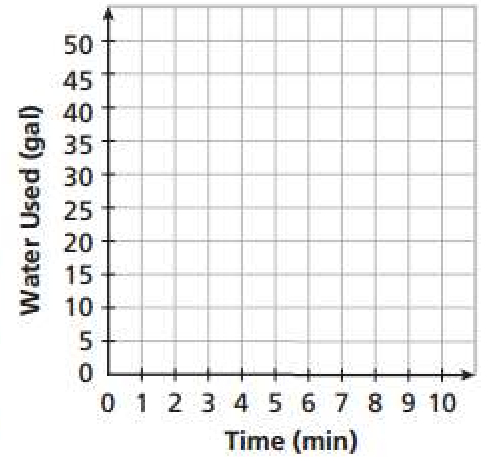
____

REFLECT

B Based on the table, is this a proportional relationship? Explain your answer.

C Plot the data from the table.

Showerhead Water Use



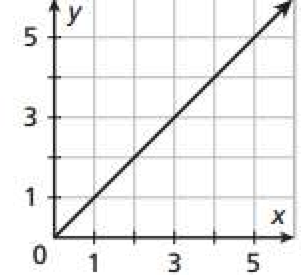
D **Draw Conclusions** If you continued the table to include 23 minutes, would the point (23, 125) be on this graph? Why or why not?

REFLECT

1a. **What If...?** If a line was drawn through the plotted points, does it make sense that it would go through the origin? Explain.

1b. Another showerhead uses less water per minute. How would its graph compare to the one you plotted?

In addition to using a table to determine if a relationship is proportional, you also can use a graph. A relationship is a proportional relationship if its graph is a straight line through the origin.



MCC7.RP.2a

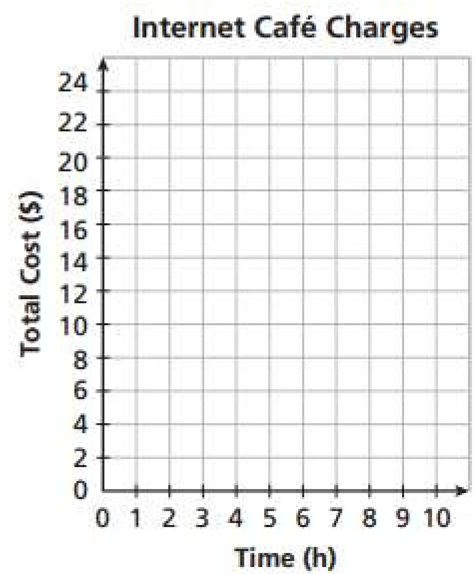
2 EXAMPLE Identifying Proportional Relationships

An Internet café charges a one-time $5 service fee and then $2 for every hour of use. Is this relationship a proportional relationship?

A Complete the table.

Time (h)	1	2	5		8
Total Cost ($)	7			17	

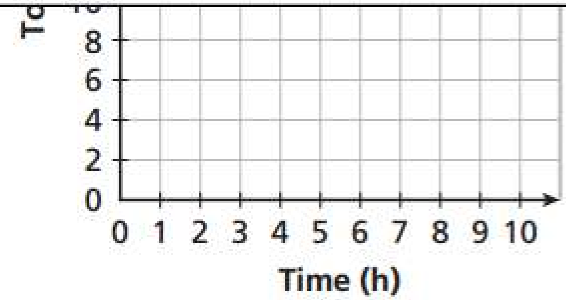
B Plot the data from the table and connect the points with a line.



C The graph of the data is a ______________________________.

The line does/does not go through the origin.

So, the relationship is ______________________________________.



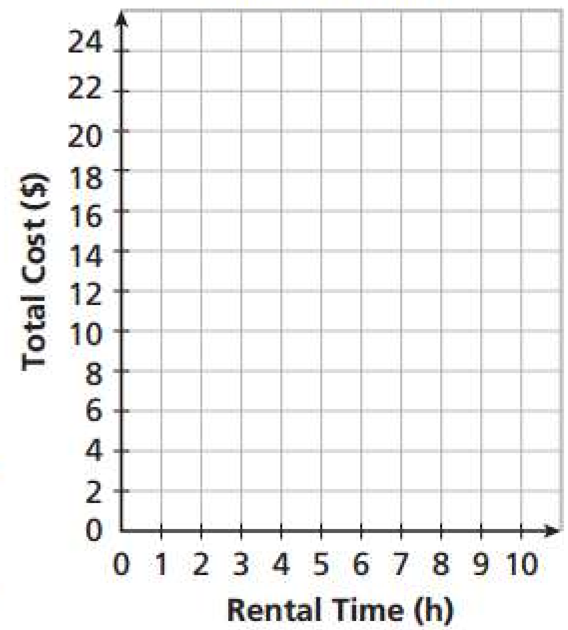
So, the relationship is ______________________.

TRY THIS!

2a. Plot the data from the table and connect the points with a line.

Canoe Rental (h)	2	5	8	10
Total Cost ($)	5	11	17	21

Canoe Rental Fees



2b. Is this a proportional relationship? Explain.

____

____

____

Where do graphs come from…

Equations!!!

Direct Variation

Equation : $y = kx$

where *k* is called the **constant of proportionality** because the ratios of y and x are proportional.

- *Cannot not have anything else*
- *Must be positive*

- *Ex*

y = 3x

Finding K

Equation

$$y = kx$$

Divide both sides by 'x'

Table

$$y \div x = k$$

hrw.com/math14/ga/msm/student/osp/g7/data/unit03/mod09/lesson01/exploration_core_lesson.pdf

EXAMPLE Writing an Equation for a Proportional Relationship

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Two pounds of cashews cost $5, 3 pounds of cashews cost $7.50, and 8 pounds of cashews cost $20. Show that the relationship between the number of pounds of cashews and the cost is a proportional relationship. Then write an equation for the relationship.

Make a table to find the common ratio. Then write an equation with the common ratio as the constant of proportionality.

A Complete the table.

Number of Pounds	2	3	8
Cost ($)	5		

B Complete the ratios. $\frac{\text{Cost}}{\text{Number of Pounds}} = \frac{5}{2} = \frac{\square}{\square} = \frac{\square}{\square} = \square$

The common ratio is ________________.

C To write an equation, first tell what the variables represent.

Let x represent the number of pounds of cashews.

Let y represent the cost in dollars.

Use the common ratio as the constant of proportionality.

So, the equation for the relationship is ________________.

REFLECT

3a. How can you use substitution to check your equation?

____

3b. What is the unit cost (unit rate) for the cashews? How does the unit cost appear in your equation?

____

3c. How can you use your equation to find the cost of 6 pounds of cashews?

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.

$\boldsymbol{y + 8 = x}$

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

$$y + 8 = x$$
$$\underline{-\ 8} = \underline{-\ 8}$$
$$y = x - 8$$

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.

Check It Out: Example 1A

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

$y + 3 = 3x$

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

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

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.

Practice

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

1. $Y = 7x$
2. $3y = 2x + 5$
3. $y = 13x + 0$
4. $4y = 2x$

Direct Variation Video

DAY 2
FIDING K

Warm Up

1. Describe the patterns you notice in the table.
2. Graph the table (Use graph paper if you have it) Graph on a coordinate plane.
3. What do you notice about the graph?

X value	Y value
0	0
1	2
3	4
5	6
7	8

Finding k

Alisa and her parents are going on a vacation. The table shows the number of hours they drive and the miles they travel.

Hours (x)	2	2.5	3	4
Miles (y)	120	150	180	240

Did you get it?

Can you find k? Y = kx Solve for K. Divide both sides by x.

y/x = k

Hours (x)	2	2.5	3	4
Miles (y)	120	150	180	240

120 / 2 = 60
150 / 2.5 = 60
180 / 3 = 60
240/4 = 60

k = 60!!!

k = 60!!!

Can you rewrite an equation y = kx

Hours (x)	2	2.5	3	4
Miles (y)	120	150	180	240

y = 60x

Try it!
Use this table

Hours (x)	0	20	40	60
Wage (y)	0	40	80	120

K = y/x
K = 40/20 = 2
K = 80/40 = 2
K = 120/60 = 2
Rewrite as an equation: y = kx
Y = 2x

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.

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

k is not the same for each ordered pair.

The data does not represent a 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.

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.

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

$k = 3$ for each ordered pair.

The data represent a direct variation where $k = 3$.
The equation is $y = 3x$

Example

- Given that *y* and *x* are directly proportional, and *y* = 2 when *x* = 5. Solve for k.

Formula: y = kx

We first find value of *k*, using inverse operations.

y/x = k

- Substitute in the given values. y = 2 x = 5

y/x = k 2/5 = k

Suppose y varies directly as x, and y = 16 when x = 8. Find y when x = 16.

Step 1: Solve for K.

$y = kx$ Substitute the known values

$16 = k(8)$ Solve the one-step equation

$2 = k$

Step 2: Substitute the known values to solve for y when $x = 16$

$y = kx$

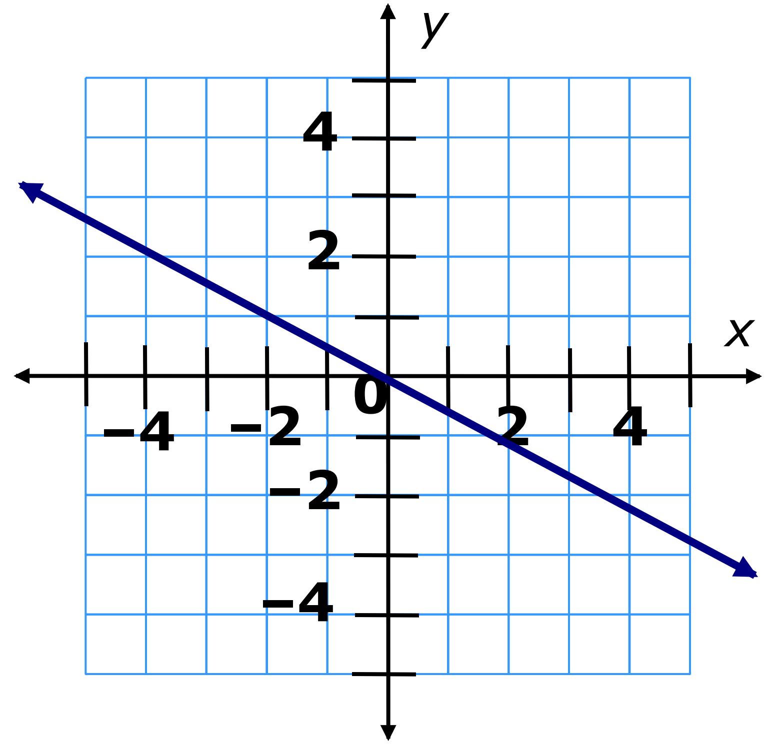
$y = 2(16)$

$y = 32$

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



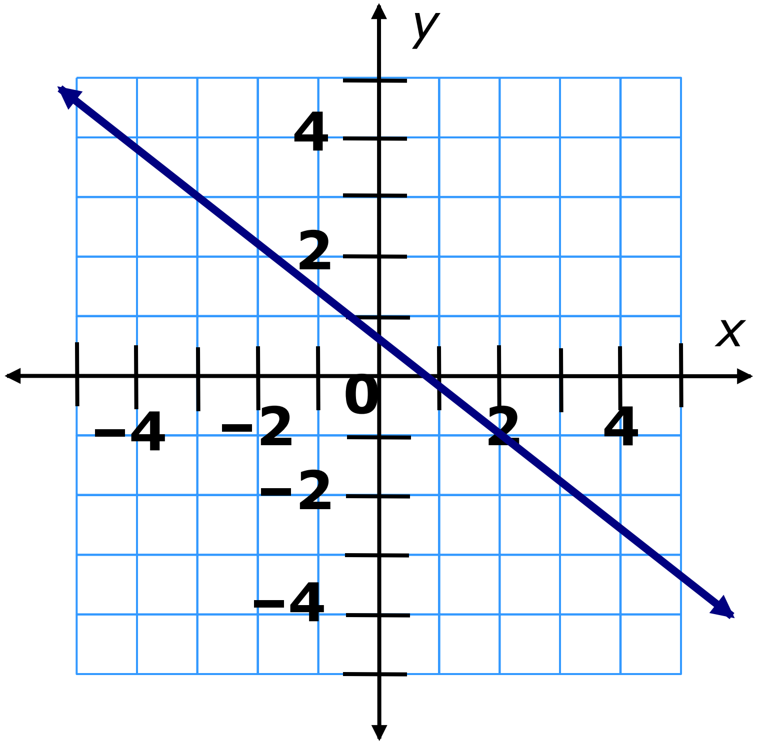
Helpful Hint

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.



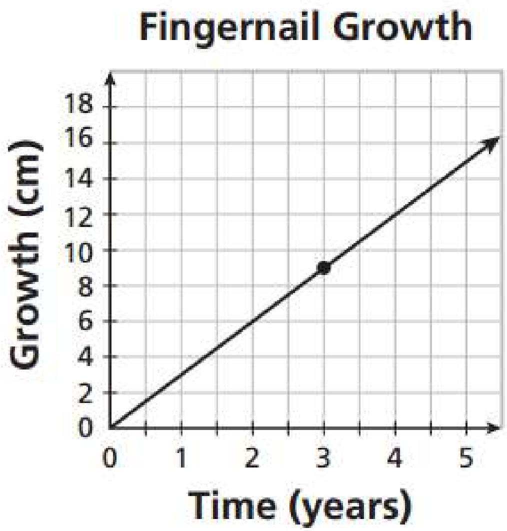
$y = ax$, where a is a positive number. The constant of proportionality, a, tells you how steep the graph of the relationship is. The greater the value of a, the steeper the line.

MCC7.RP.2d

Pg. 214

4 EXAMPLE Analyzing Proportional Graphs

The graph shows the relationship between time in years and the number of centimeters a fingernail grows.



A What does the point (3, 9) represent?

____

____

B What is the constant of proportionality? ____________

C Write an equation for the relationship. ____________

REFLECT

4a. What does the point (0, 0) on the graph represent?

____

4b. What is the rate at which a fingernail grows? How does this relate to the constant of proportionality?

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 $y = kx$. $k = 55$

$y \quad = \quad 55 \quad \bullet \quad x$

$y = 55x$

Additional Example 4B: *Application*

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

Graph the data.

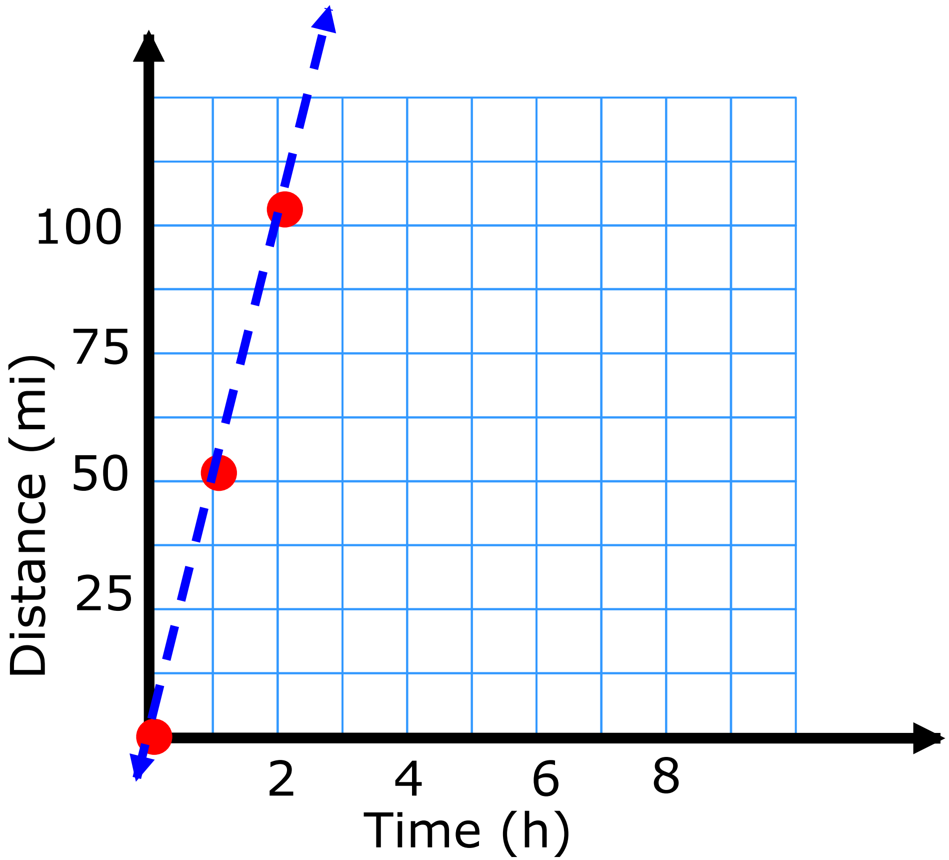
Make a table. Since time cannot be negative, use nonnegative number for I.

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.*

$660 = 55x$ *Substitute 660 for y.*

$\frac{660}{55} = \frac{55x}{55}$ *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
y	=	12	•	x

Use the formula $y = kx$. $k = 12$

$y = 12x$

Direct Variation

Check It Out: Example 4B

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

Graph the data.

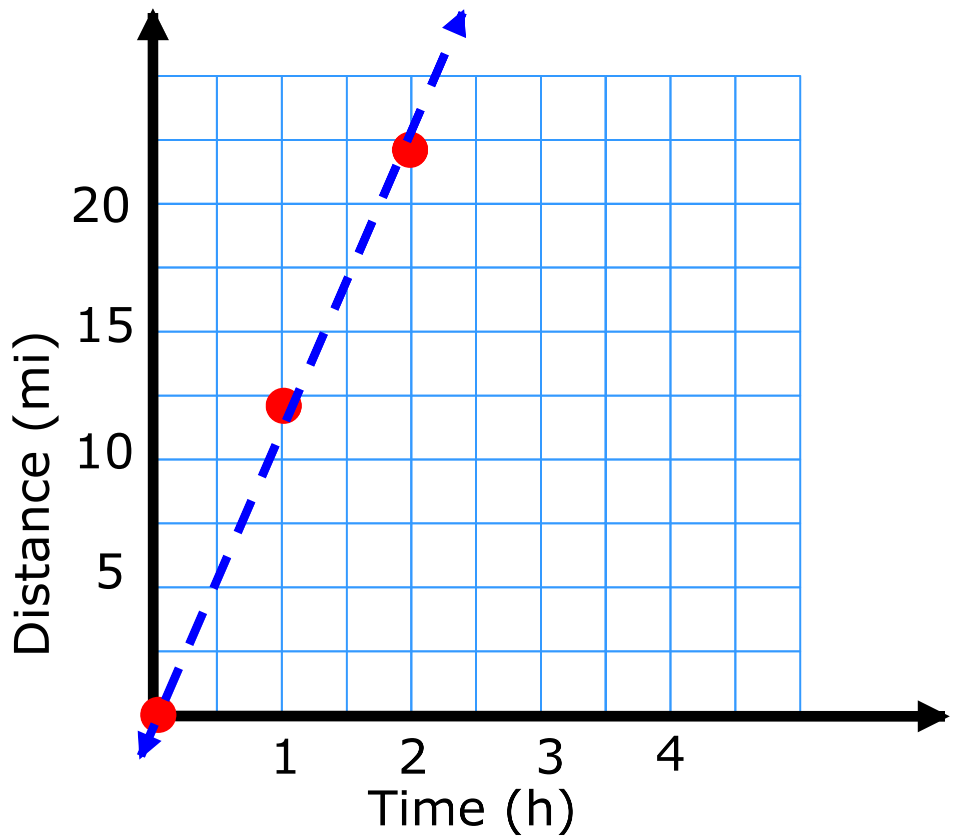
Make a table. Since time cannot be negative, use nonnegative number for x.

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.*

$96 = 12x$ *Substitute 96 for x.*

$\frac{96}{12} = \frac{12x}{12}$ *Divide both sides by 12.*

$8 = x$

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

Direct Variation

1. Fold paper in half, hotdog style. Label one side "Direct Variation" and the other "Not Direct Variation"
2. Separate by cutting the equations, tables, and word problems.
3. Place these in the appropriate column. Do NOT glue them yet!!!!!!!

Direct Variation	Not Direct Variation

$-3x + 2y = 0$

$3x – y = 0$

$y = 5x$

You go to the movies and buy tickets for $10.50 each.

x	y
4	8
7	14
10	20

x	y
-3	-2
3	2
9	6

x	y
-2	-2.8
3	4.2
8	-11.2

$x – 3y = 6$

$8x + 4y = 12$

$y = 3/4x - 7$

$y = 2x + 5$

You go to the fair and pay $5 admission and then $0.50 per ride.

Homework:
Workbook Pg. 217