

# Equations in $y = mx$ Form

## What You'll Learn

Scan the lesson. List two headings you would use to make an outline of the lesson.

- \_\_\_\_\_
- \_\_\_\_\_

## Essential Question

WHY are graphs helpful?

## Vocabulary

- direct variation
- constant of variation
- constant of proportionality

## Common Core State Standards

Content Standards  
8.EE.5, 8.EE.6, 8.F.2, 8.F.4  
Mathematical Practices  
1, 3, 4

## Real-World Link

**Charity** The amount of money David can raise for the Wish Upon A Rainbow Bike-a-thon is shown in the table.

Biking Time (h), $x$	Money Raised (\$), $y$
2	20
4	40
6	60

*Handwritten notes: +2 ← (next to x values), → +20 (next to y values)*

Recall that when the ratio of two variable quantities is constant, a proportional relationship exists. This relationship is called a direct variation. The constant ratio is called the constant of variation or constant of proportionality. *(same thing as slope!)*

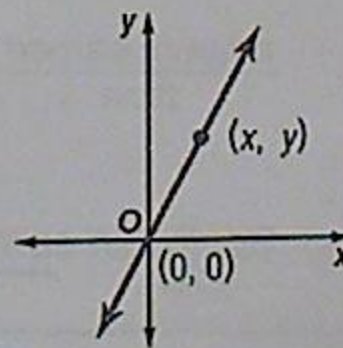
Complete the steps below to derive the equation for a direct variation.

$$\frac{y_2 - y_1}{x_2 - x_1} = m$$

Slope formula

$$\frac{y - 0}{x - 0} = m$$

$(x_1, y_1) = (0, 0)$   
 $(x_2, y_2) = (x, y)$



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

Simplify.

$$y = m x$$

Multiplication Property of Equality

- Use the table to find the rate of change. Then write an equation in  $y = mx$  form to represent the situation.

$$\frac{\Delta y}{\Delta x} = \frac{20}{2} \div 2 = 10$$

$$y = mx$$

$$y = 10x$$



# Key Concept

# Direct Variation

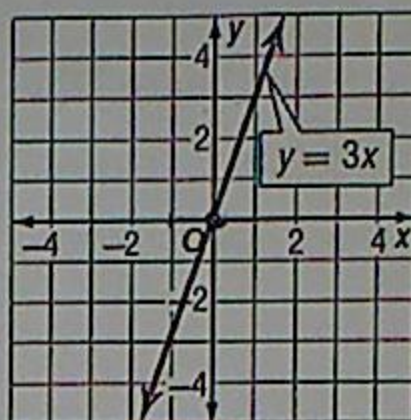
Work Zone

**Words** A linear relationship is a direct variation when the ratio of  $y$  to  $x$  is a constant,  $m$ . We say  $y$  varies directly with  $x$ .

**Symbols**  $m = \frac{y}{x}$  or  $y = mx$ , where  $m$  is the constant of variation and  $m \neq 0$

**Example**  $y = 3x$

Graph



$y = mx$   
 In a direct variation equation  $y = mx$ ,  $m$  represents the constant of variation, the constant of proportionality, the slope, and the unit rate.

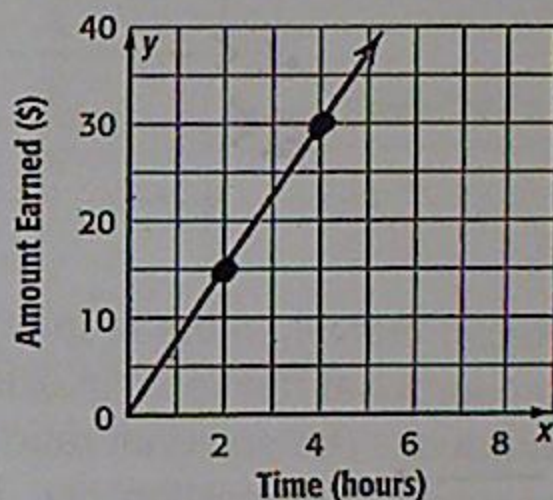
The slope of the graph of  $y = mx$  is  $m$ . Since  $(0, 0)$  is one solution of  $y = mx$ , the graph of a direct variation always passes through the origin.

a graph/an equation is proportional if:  
 - a straight line  
 - passes through the origin  $(0, 0)$



## Example

1. The amount of money Robin earns while babysitting varies directly with the time as shown in the graph. Determine the amount that Robin earns per hour.



To determine the amount Robin earns per hour, or the unit rate, find the constant of variation.

Use the points  $(2, 15)$ ,  $(3, 22.5)$ , and  $(4, 30)$ .

$$\frac{\text{amount earned}}{\text{time}} \rightarrow \frac{15}{2} \text{ or } \frac{7.5}{1} \quad \frac{22.5}{3} \text{ or } \frac{7.5}{1} \quad \frac{30}{4} \text{ or } \frac{7.5}{1}$$

So, Robin earned \$7.50 for each hour she babysits.

$(2, 15) \quad (4, 30)$   
 $\frac{15}{2} \div 2 = \$7.50$   
 $\frac{30}{4} \div 4 = \$7.50$

**Got It?** Do this problem to find out.

- a. Two minutes after a skydiver opens his parachute, he has descended 1,900 feet. After 5 minutes, he descended 4,750 feet. If the distance varies directly with the time, at what rate is the skydiver descending?

$(2, -1900)$   
 $(5, -4750)$   
 $\frac{-1900}{2} \div 2 = -950$

a. -950 ft/min

Show your work.