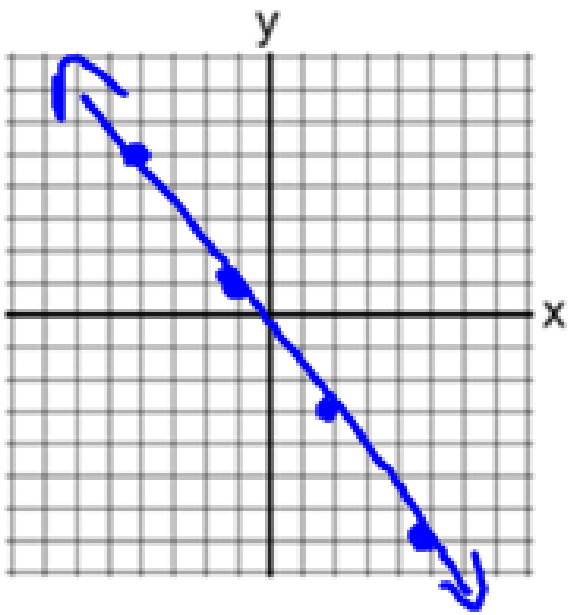
Grab a Warm Up off the front table and get to work. Have your homework out and ready to check.

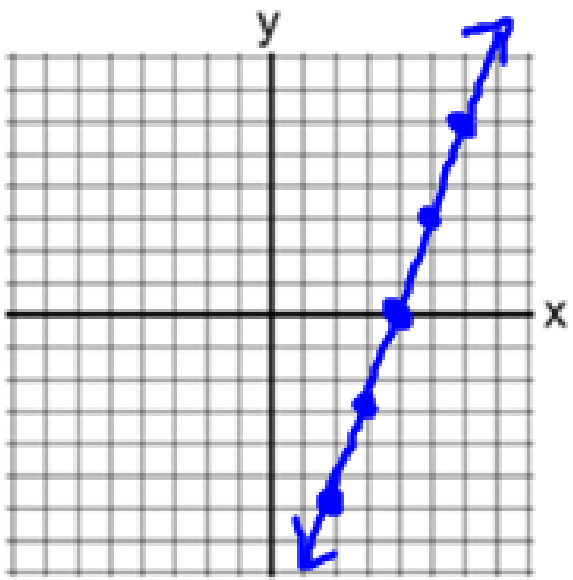
Classwork - Equations in y = mx form

Slope → $\frac{rise}{run}$ Example: $m = \frac{2}{3}$ → Go up 2, then right 3 to plot a new point

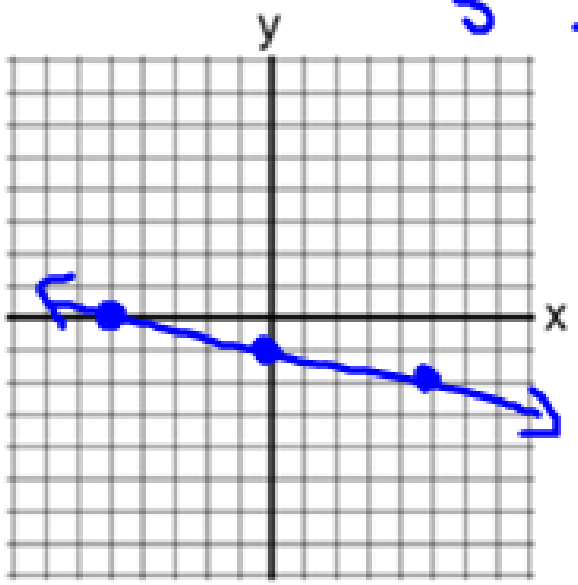
1) (-4, 5) and $m = -\frac{4}{3}$ $\frac{-4}{3}$



2) (4, 0) and $m = 3$ $\frac{3}{1}$ $\frac{-3}{-1}$

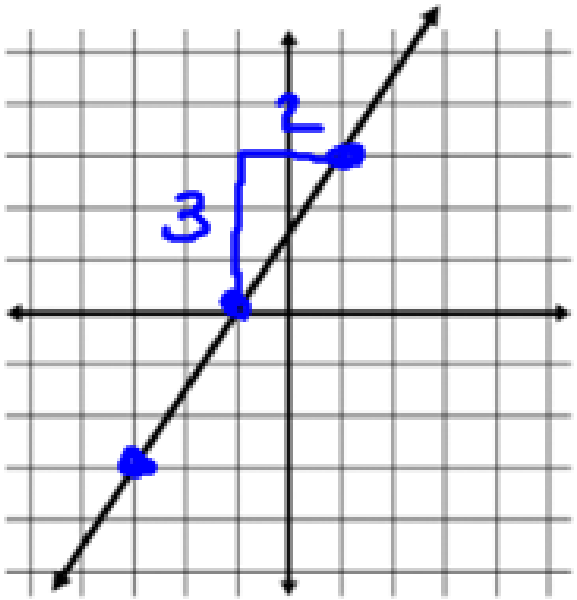


3) (0, -1) and $m = -\frac{1}{5}$ $\frac{-1}{5}$ $\frac{1}{-5}$

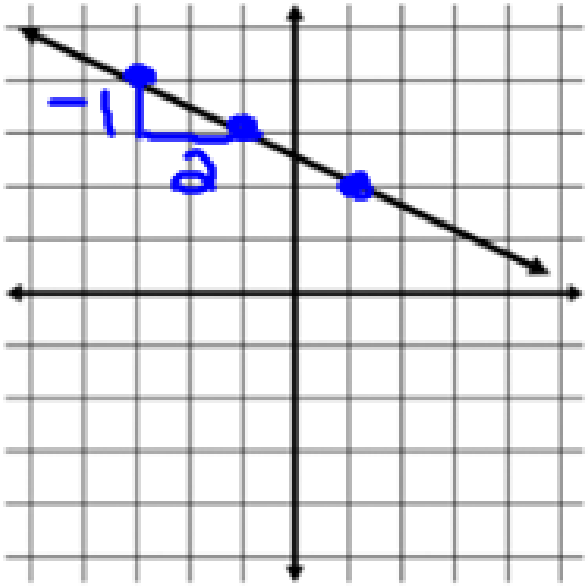


Find the slope of the following graphs. You will need to find two points that the line crosses.

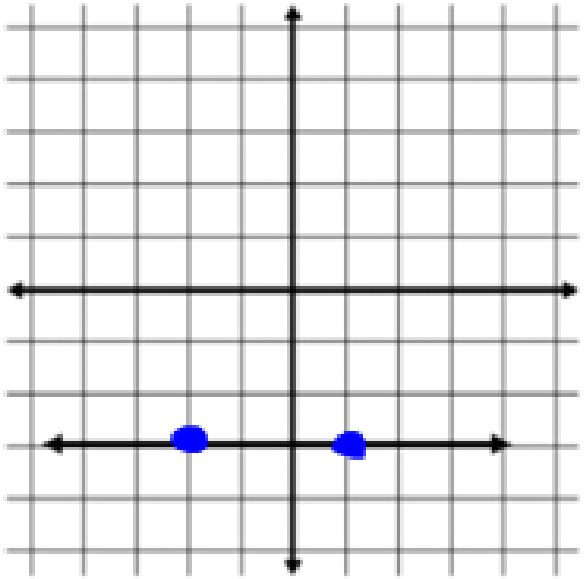
4) $m =$ $\frac{3}{2}$



5) $m =$ $-\frac{1}{2}$

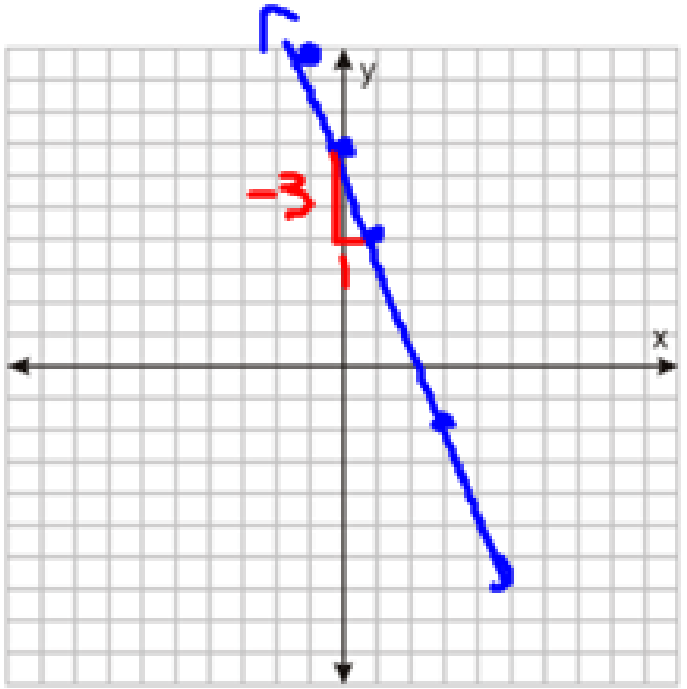


6) $m =$ $\frac{0}{3} = 0$



3) $y = -3x + 7$

x	$-3x + 7$	y	(x, y)
−1	$-3(-1)+7$	10	$(-1, 10)$
0	$-3(0)+7$	7	$(0, 7)$
1	$-3(1)+7$	4	$(1, 4)$
3	$-3(3)+7$	−2	$(3, -2)$

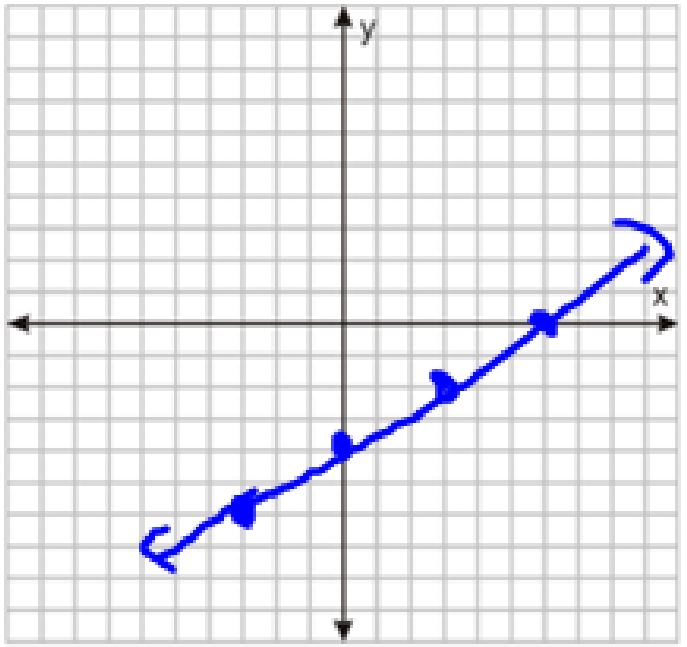


Slope

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

4) $y = \frac{2}{3}x - 4$

x	y
−3	−6
0	−4
3	−2
6	0



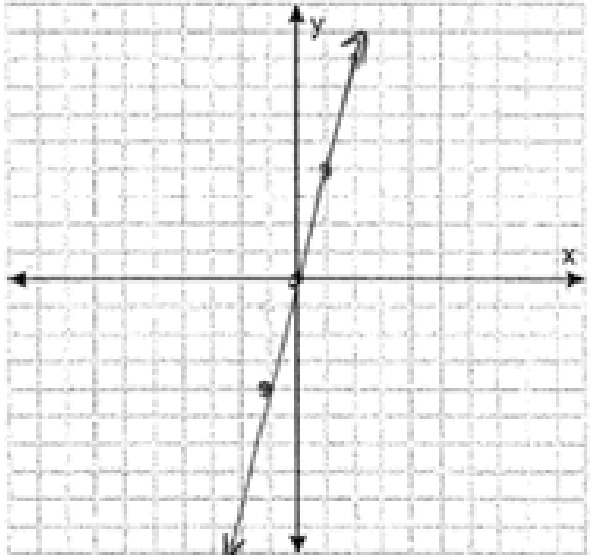
Slope

$m = \frac{2}{3}$

Make your own table and find at least three points to graph a line that represents the following equations. Find the slope of each equation.

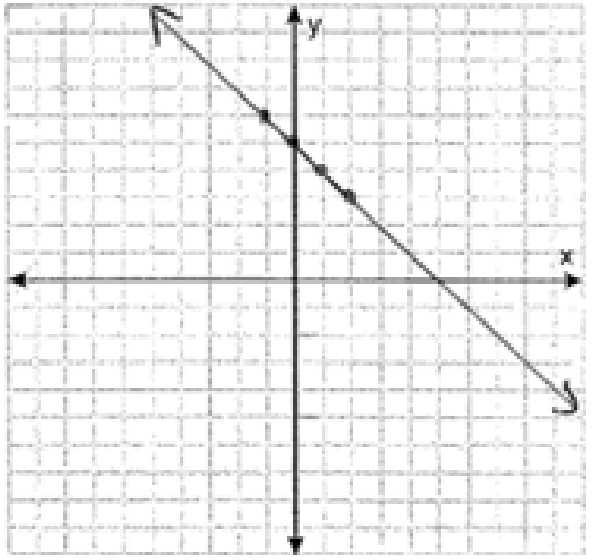
5) $4x = y$ $m =$ 4

x	y
-1	-4
0	0
1	4
2	8



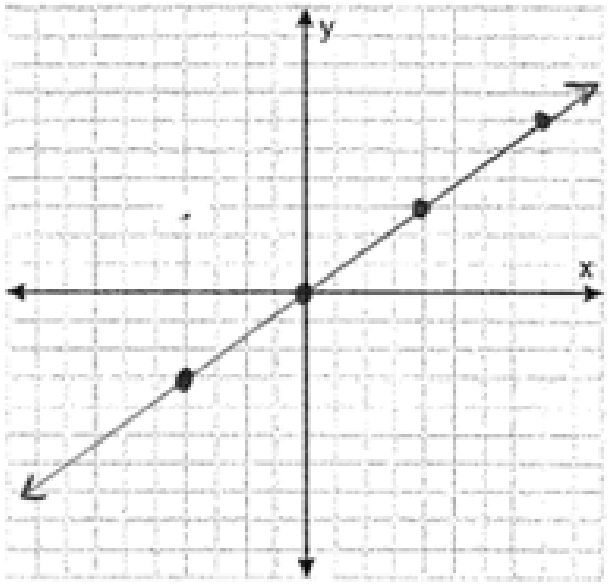
6) $y = -x + 5$ $m =$ -1

x	y
-1	6
0	5
1	4
2	3



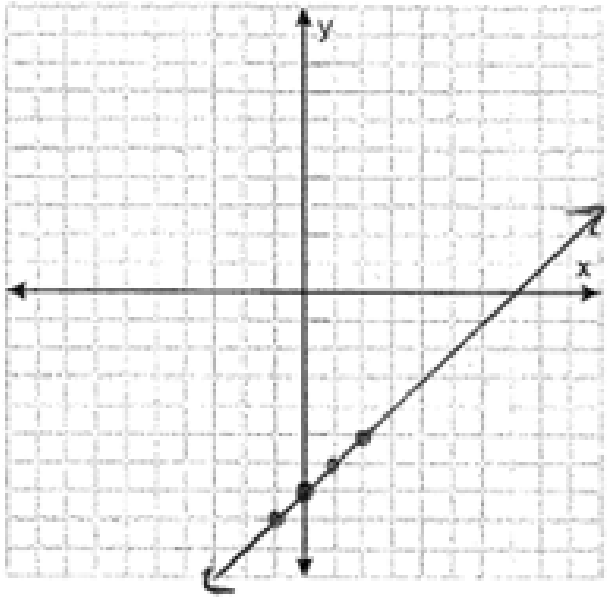
7) $y = \frac{3}{4}x$ $m =$ 3/4

x	y
-4	-3
0	0
4	3
8	6



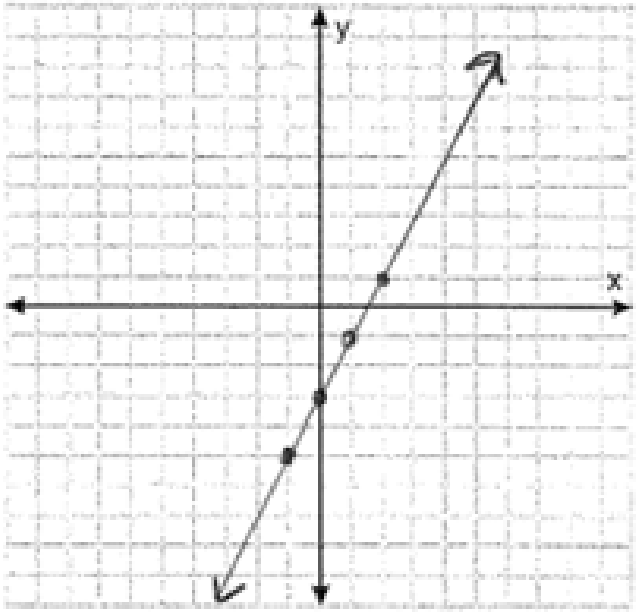
8) $x - 7 = y$ $m =$ 1

x	y
-1	-8
0	-7
1	-6
2	-5



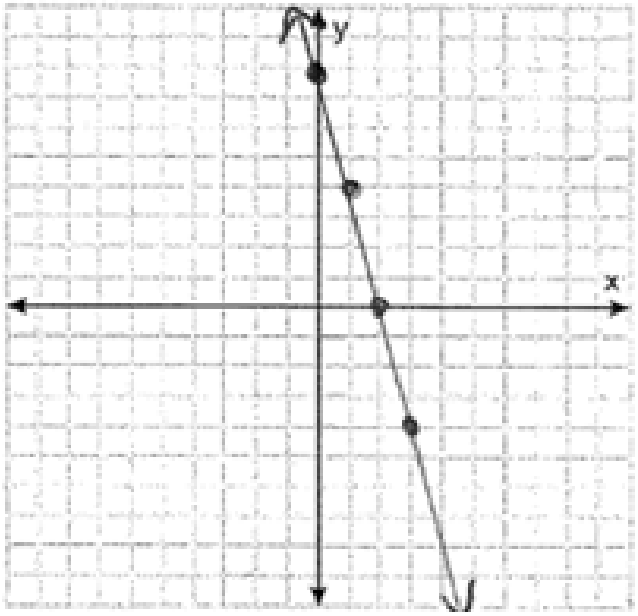
9) $y = 2x - 3$ $m =$ 2

x	y
-1	-5
0	-3
1	-1
2	1



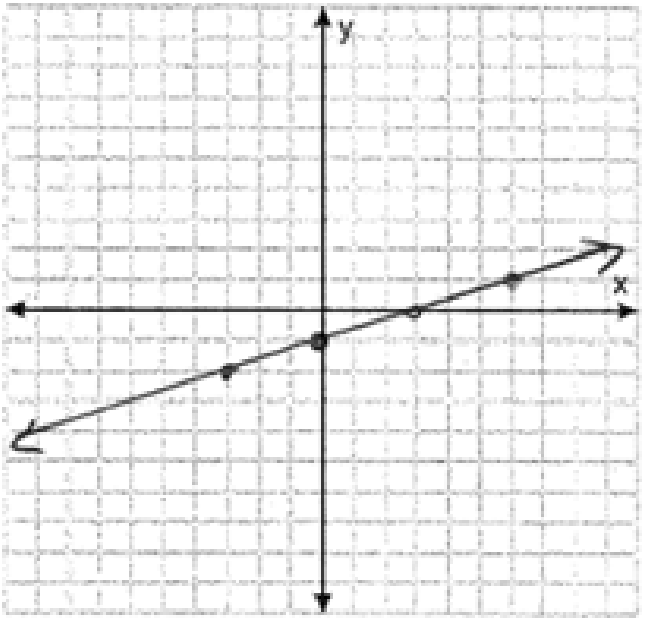
10) $y = -4x + 8$ $m =$ -4

x	y
0	8
1	4
2	0
3	-4



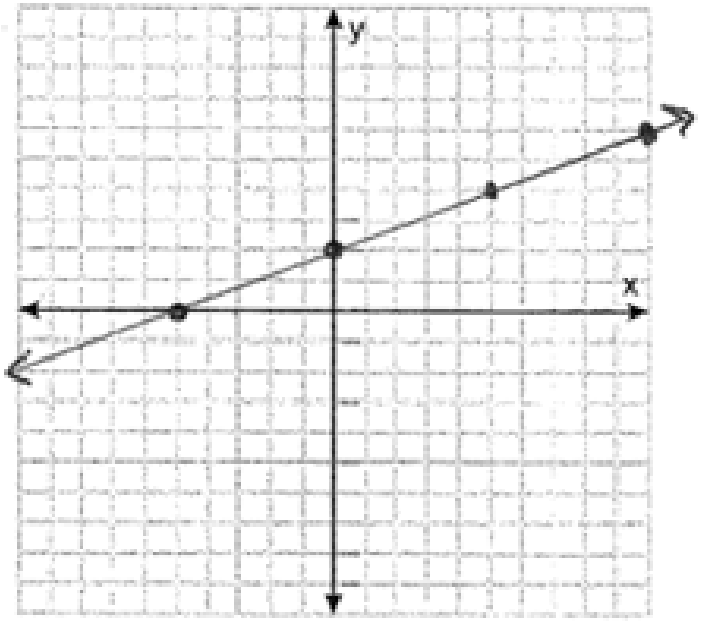
11) $\frac{1}{3}x - 1 = y$ $m =$ 1/3

x	y
-3	-2
0	-1
3	0
6	1



12) $y = \frac{2}{5}x + 2$ $m =$ 2/5

x	y
-5	0
0	2
5	4
10	6



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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

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**.

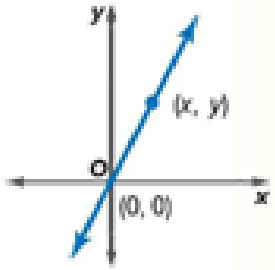
Complete the steps below to derive the equation for a direct variation.

$\frac{\square}{\square} = \square$ Slope formula

$\frac{y-0}{x-0} = m$ $(x_1, y_1) = (0, 0)$, $(x_2, y_2) = (x, y)$

$\frac{\square}{\square} = m$ Simplify.

$y = \square\square$ Multiplication Property of Equality



$y = mx$

$m = \text{slope}$

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

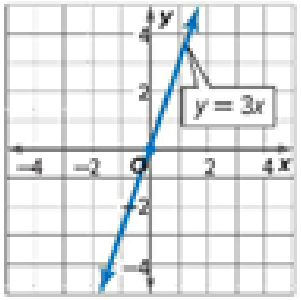
Direct Variation

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

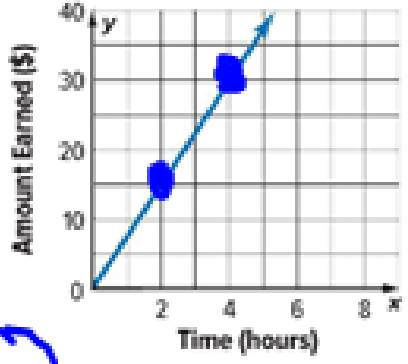


$m = \frac{3}{1}$

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.

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).

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

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

$y = mx + b$

The line doesn't go through the origin

$(2, 15)$ $(4, 30)$

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

$\frac{30 - 15}{4 - 2} = \frac{15}{2} = \frac{\$7.50}{1\text{h}}$

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 moving?

(minutes, feet)

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

(2, 1900) and (5, 4750)

$m = \frac{4750 - 1900}{5 - 2} = \frac{2850}{3} = 950 \text{ ft/min}$

Example

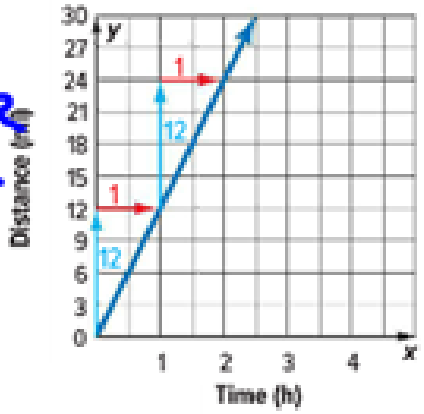
$y = mx$

2. **A cyclist can ride 3 miles in 0.25 hour. Assume that the distance biked in miles y varies directly with time in hours x. This situation can be represented by $y = 12x$. Graph the equation. How far can the cyclist ride per hour?**

Make a table of values. Then graph the equation $y = 12x$. In a direct variation equation, m represents the slope. So, the slope of the line is $\frac{12}{1}$.

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

+1 +1 +12 +12



The unit rate is the slope of the line. So, the cyclist can ride 12 miles per hour.

Got it? Do this problem to find out.

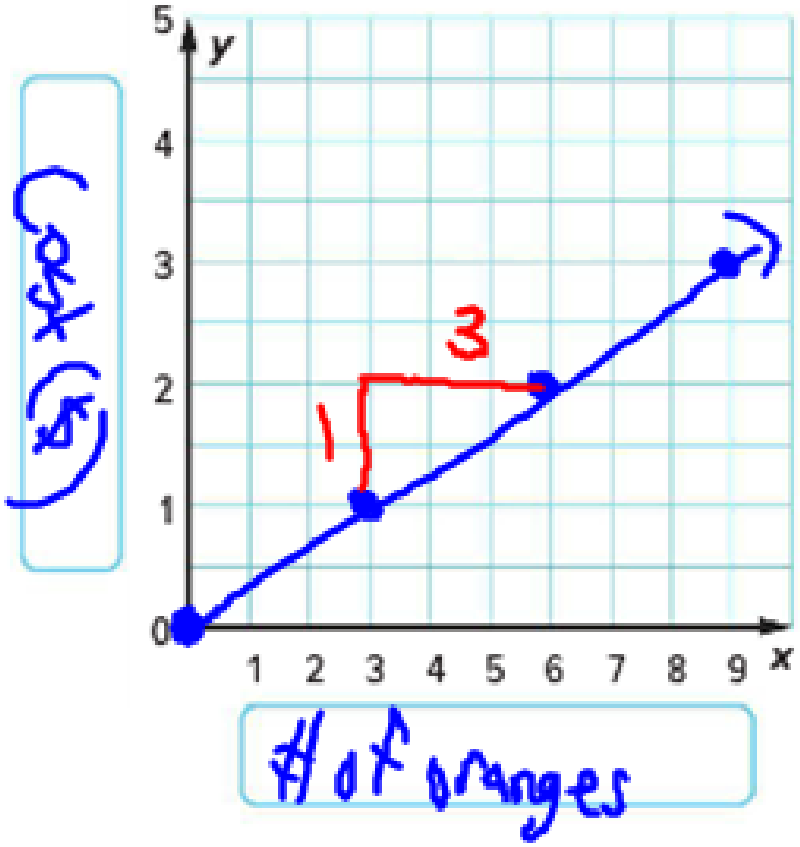
b. A grocery store sells 6 oranges for $2. Assume that the cost of the oranges varies directly with the number of oranges. This situation can be represented by $y = \frac{1}{3}x$. Graph the equation. What is the cost per orange?

$y = \frac{1}{3}x$

$\frac{\$2}{6} = \frac{1}{3}$

$m = \frac{1}{3}$

x	y
0	0
3	1
6	2
9	3



Compare Direct Variations

You can use tables, graphs, words, or equations to represent and compare proportional relationships.

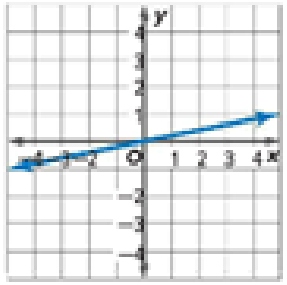
Table

x	15	20	25	30
y	3	4	5	6

+5 +5 +5

+1 +1 +1

Graph



Words y varies directly with x

Equation $y = \frac{1}{5}x$

$m = \frac{1}{5}$

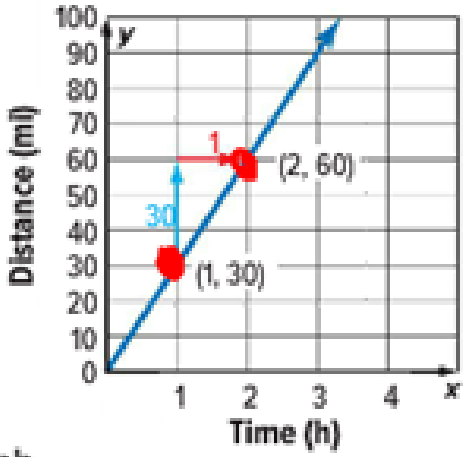
$y = mx$

When the x-value changes by an amount A, the y-value will change by the corresponding amount mA.

Example

Tutor

3. **The distance y in miles covered by a rabbit in x hours can be represented by the equation $y = 35x$. The distance covered by a grizzly bear is shown on the graph. Which animal is faster? Explain.**



Rabbit $y = 35x$

The slope or unit rate is 35 mph.

Grizzly Bear Find the slope of the graph.

$$\frac{\text{rise}}{\text{run}} = \frac{30}{1} \text{ or } 30$$

Since $35 > 30$, the rabbit is the faster animal.

Got it? **Do this problem to find out.** $y = 7.50x$

c. **Financial Literacy** Damon's earnings for four weeks from a part time job are shown in the table. Assume that his earnings vary directly with the number of hours worked.

IV-x

DV-y

Time Worked (h)	15	12	22	9
Total Pay ($)	112.50	90.00	165.00	67.50

He can take a job that will pay him $7.35 per hour worked. Which job has the better pay? Explain.

$y = mx$

$\frac{112.50}{15} = \frac{\$7.50}{1 \text{ hour}}$

x | y

+3 +3 +7

x	9	12	15	22
y	67.50	90	112.50	165

×22.5 ×22.5 ×52.5

$\frac{22.5}{3} = \frac{\$7.50}{1 \text{ h}}$

$\frac{52.50}{7} = \frac{\$7.50}{1 \text{ h}}$

Example

4. **A 3-year-old dog is often considered to be 21 in human years. Assume that the equivalent age in human years y varies directly with its age as a dog x. Write and solve a direct variation equation to find the human-year age of a dog that is 6 years old.**

Let x represent the dog's actual age and let y represent the human-equivalent age.

$y = mx$	Direct variation
$21 = m(3)$	$y = 21, x = 3$
$7 = m$	Simplify.
$y = 7x$	Replace m with 7.

You want to know the human-year age or y-value when the dog is 6 years old.

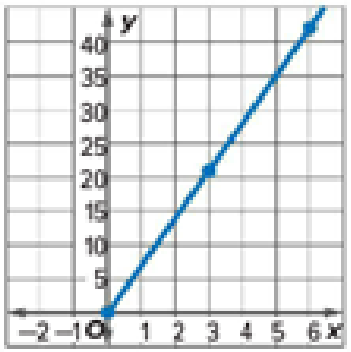
$y = 7x$	Write the equation.
$y = 7 \cdot 6$	$x = 6$
$y = 42$	Simplify.

So, when a dog is 6 years old, the equivalent age in human years is 42.

Check

Graph the equation $y = 7x$.

The y-value when $x = 6$ is 42. ✓



Got it? **Do these problems to find out.**

d. A charter bus travels 210 miles in $3\frac{1}{2}$ hours. Assume the distance traveled is directly proportional to the time traveled. Write and solve a direct variation equation to find how far the bus will travel in 6 hours.

$m = \frac{\text{miles}}{\text{hours}} = \frac{210}{3\frac{1}{2}} = 60 \text{ mi/h}$

$y = 60x$

$y = 60(6)$

$y = 360 \text{ miles}$

e. A Monarch butterfly can fly 93 miles in 15 hours. Assume the distance traveled is directly proportional to the time traveled. Write and solve a direct variation equation to find how far the Monarch butterfly will travel in 24 hours.

$\frac{\text{distance}}{\text{time}}$ $m = \frac{93 \text{ mi}}{15 \text{ h}} = 6.2 \text{ mi/h}$

$y = 6.2x$

$y = 6.2(24)$

$y = 148.8 \text{ miles}$

Guided Practice

1. A color printer can print 36 pages in 3 minutes and 108 pages in 9 minutes. If the number of pages varies directly with the time, at what rate is the color printer printing? (Example 1)

$m = \frac{108 - 36}{9 - 3}$

$m = \frac{72}{6}$

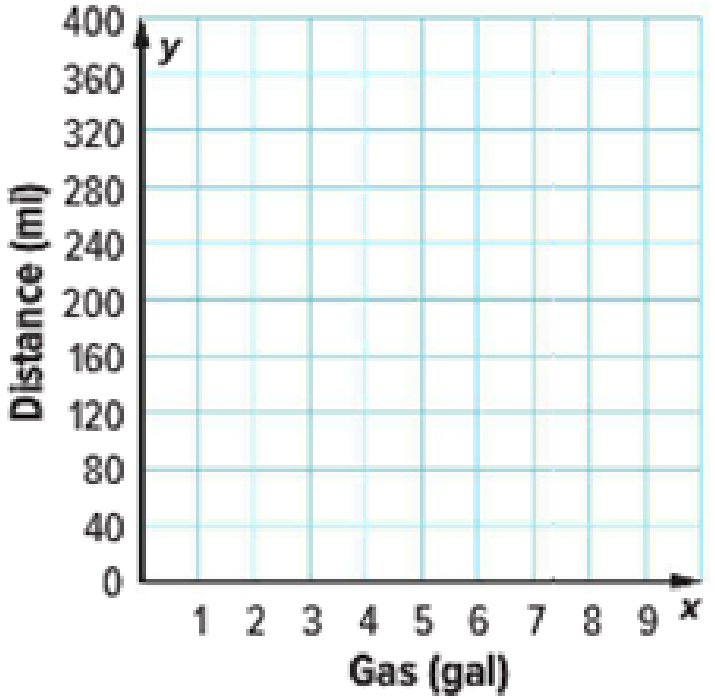
$\frac{12 \text{ pages}}{1 \text{ min}}$

Write equation

(min, pages) → (3, 36) and (9, 108)

$y = 12x$

2. A new compact car can travel 288 miles on nine gallons of gas. The distance driven in miles y varies directly with the number of gallons of gas x. This situation can be represented by the equation $y = 32x$. (Examples 2 and 3)



   a. Graph the equation on the coordinate plane shown.

   b. How many miles per gallon does the car get?

   c. The distance y traveled by a hybrid car using x gallons of gas can be represented by $y = 42x$. Which car gets better gas mileage? Explain.