Direct Variation (proportional relationships)

The number of gallons of water used depends <u>directly</u> on the amount of time spent in the shower. The equation that relates the number of gallons of water used to the amount of time, x is given by the equation $y = 6x$. We say, "y varies directly as x".

↖ minutes

1. Complete the table that shows the relationship between the time spent showering and the amount of water used.

x (minutes)	3	6	7.5	12	20.5
y (gallons)	18	36	45	72	123

$$\begin{array}{r} 7 \\ 6\overline{)45} \\ \underline{42} \\ 3 \end{array}$$

$$\begin{array}{r} 20.5 \\ 6\overline{)123.0} \\ 12\downarrow\downarrow \\ \overline{0\ 30} \end{array}$$

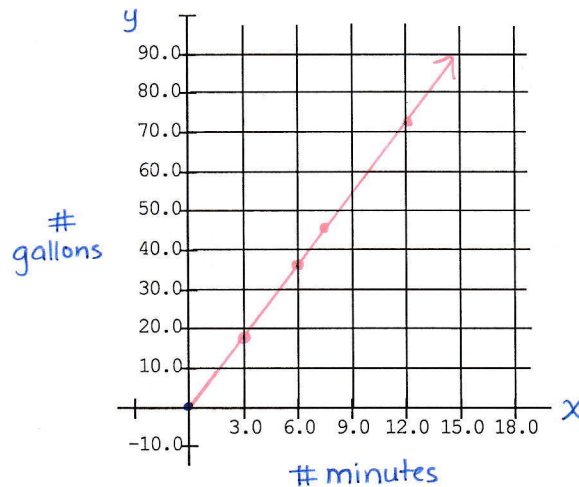This type of relationship is called a direct variation.

2. Graph the line $y = 6x$ on the axes provided.

3. What does the 6 represent?

6 gallons per minute

4. What is the y-intercept?

0 min = 0 gallons

#gallons

minutes

**Definition**: A direct variation is a relationship that can be described by an equation of the form

___$y = kx$___ where $k \neq 0$ and k is called the ___Constant of variation___.

Note: the graphs of direct variation equations always pass through ___origin___.
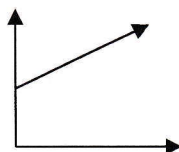
If the ratio of two variables is a constant, then direct variation is the way of expressing the relationship between the two variables. That is $k = $ ___y/x___ or $y = $ ___kx___. The constant k has the same value as the slope of the line. So when you graph a direct variation, you are graphing lines with slope k.

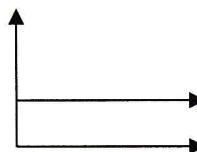5. **Which of these graphs show direct variation?**

   a. (circled)
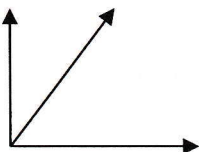
   b.

   c.

Solve for k, and then solve for the missing variable.

6. If y = 16 when x = 4, find y when x = 8.

① Find K.

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

$$K = \frac{16}{4}$$

$$\boxed{K = 4}$$

$$y = 4x$$

② Find y.

$$y = 4x$$

$$y = 4(8)$$

$$\boxed{y = 32}$$

7. If y = -4 when x = 2, find y when x = -10.

① Find K.

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

$$k = \frac{-4}{2}$$

$$\boxed{K = -2}$$

$$y = -2 \cdot x$$

② Find y.

$$y = -2x$$

$$y = -2(-10)$$

$$\boxed{y = 20}$$

8. Which of the following tables show direct variation? If possible, find k for each table.

$K = \frac{y}{x}$ must be constant.

a.

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

x	y
2	22	$22/2 = 11$
3	33	$33/3 = 11$
5	55	$55/5 = 11$

D.V. k = _11_

b.

y/x

x	y
2	14	$14/2 = 7$
3	19	$19/3 =$ Not 7
5	29

k = _Not D.V._

c.

y/x

x	y
2	7.4	$7.4/2 = 3.7$
3	11.1	$11.1/3 = 3.7$
5	18.5	$18.5/5 = 3.7$

D.V.
k = _3.7_

$2\overline{)7.4}$

$3\overline{)11.1}$

$5\overline{)18.5}$

One of these scenarios represents a direct variation and one does not. How can you tell the difference?

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

(a) A large pizza with one topping costs $15.50. A large pizza with four toppings costs $20. Does the price vary directly with the number of toppings?

(b) A marathoner ran 5 miles in 40 minutes and 15 miles in 120 minutes. Does the time vary directly with the number of miles? $K = 8$

$$\frac{40}{5} = 8$$

$$\frac{120}{15} = 8$$

Practice STAAR Question

The value of y is directly proportional to the value of x. When x = 3.5, the value of y is 14.

What is the value of y when x = 28?

Record your answer and fill in the bubbles on your answer document.

① Find K.

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

$$K = \frac{14}{3.5}$$

$$K = 4$$

② Find y.

$$y = 4x$$

$$y = 4(28)$$

$$\boxed{y = 112}$$

$$\begin{array}{r} 3 \\ 2 8 \\ \times 4 \\ \hline 112 \end{array}$$