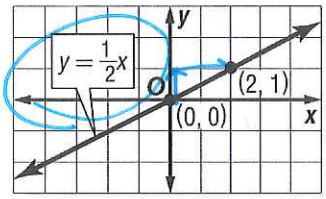
3-4 Notes: Direct Variation

equation → $y = kx$

Direct Variation Equations A **direct variation** is described by an equation of the form $y = kx$, where $k \neq 0$. We say that *y varies directly as x*. In the equation $y = kx$, k is the **constant of variation**. Slope = $k = \frac{y}{x}$

Example 1: Name the constant of variation for the equation. Then find the slope of the line that passes through the pair of points.



$y = kx$

$k = \frac{1}{2}$ slope = $\frac{\text{rise}}{\text{run}}$

$\frac{y_2 - y_1}{x_2 - x_1} = \frac{1-0}{2-0} = \frac{1}{2}$

Example 2: Suppose *y* varies directly as *x*, and $y = 30$ when $x = 5$.

a. Write a direct variation equation that relates *x* and *y*.

$y = kx$

$\frac{30}{5} = \frac{k(5)}{5}$

$k = 6$

$y = 6x$

b. Use the direct variation equation to find *x* when $y = 18$.

$y = 6x$

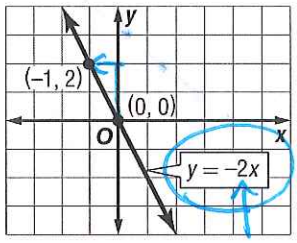
$\frac{18}{6} = \frac{6x}{6}$

$x = 3$

Exercises

Name the constant of variation for each equation. Then determine the slope of the line that passes through each pair of points.

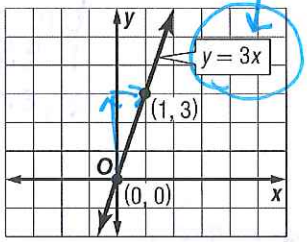
1.



slope = $\frac{\text{rise}}{\text{run}} = \frac{2}{-1} = -2$

slope = −2 $k = -2$

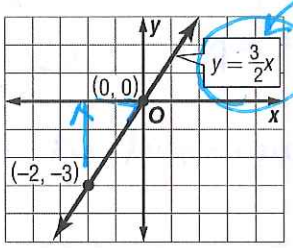
2.



$k = 3$

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

3.



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

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

Suppose *y* varies directly as *x*. Write a direct variation equation that relates *x* to *y*. Then solve.

4. If $y = 4$ when $x = 2$, find *y* when $x = 16$.

$y = kx$

$\frac{4}{2} = \frac{k(2)}{2}$

$k = 2$

$y = 2x$

$y = 2(16)$

$y = 32$

6. If $y = -4.8$ when $x = -1.6$, find *x* when $y = -24$.

$y = kx$

$\frac{-4.8}{-1.6} = \frac{k(-1.6)}{-1.6}$

$k = 3$

$y = 3x$

$y = 3x$

$\frac{-24}{3} = \frac{3x}{3}$

$x = -8$

Direct Variation Problems The **distance formula** $d = rt$ is a direct variation equation. In the formula, distance d varies directly as time t, and the rate r is the constant of variation.

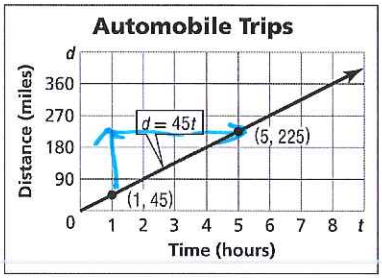
Example: TRAVEL A family drove their car 225 miles in 5 hours.

d t

a. Write a direct variation equation to find the distance traveled for any number of hours.
Use given values for d and t to find r.

$d = rt$ $\quad \frac{225}{5} = \frac{r(5)}{5}$ $\quad r = 45$ $\rightarrow$ $d = 45t$

b. Graph the equation.



note slope

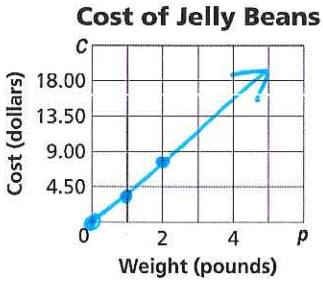
$m = \frac{225 - 45}{5 - 1} = \frac{180}{4} = 45$

c. Estimate how many hours it would take the family to drive 360 miles.

$d = 45t$ $\quad \frac{360}{45} = \frac{45(t)}{45}$ $\quad t = 8$ hours

Exercises

1. RETAIL The total cost C of bulk jelly beans is \$4.49 times the number of pounds p.



a. Write a direct variation equation that relates the variables.

$C = kp$ $\quad C = 4.49p$

p	C
0	0
1	4.49
2	8.98

b. Graph the equation on the grid at the right.

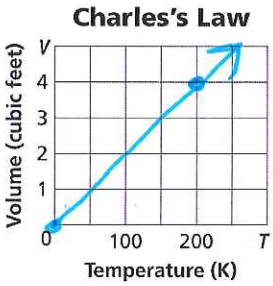
*Always start at (0,0)

c. Find the cost of $\frac{3}{4}$ pound of jelly beans.

$C = 4.49p \Rightarrow C = 4.49(.75)$

$C = \$3.37$

2. CHEMISTRY Charles's Law states that, at a constant pressure, volume of a gas V varies directly as its temperature T. A volume of 4 cubic feet of a certain gas has a temperature of 200 degrees Kelvin.



a. Write a direct variation equation that relates the variables.

$V = kT$ $\quad \frac{4}{200} = \frac{k(200)}{200}$ $\quad k = \frac{1}{50}$ $\quad V = \frac{1}{50}T$

b. Graph the equation on the grid at the right.

T	V
0	0
200	4

c. Find the volume of the same gas at 250 degrees Kelvin.

$V = \frac{1}{50}T$

$V = \frac{1}{50}(250)$

$V = 5$ cubic feet