4.6: Model Direct Variation

Goals: *Identify a direct variation equation given an *x*/*y* relationship
*Graph a direct variation equation
*Write a direct variation equation given data

INVESTIGATION! What is direct variation??

Follow the steps below:

1. Find the slope between the points on graph A (Use *rise* over *run*). What do you notice? The slope is always 3 regardless of which two points used.

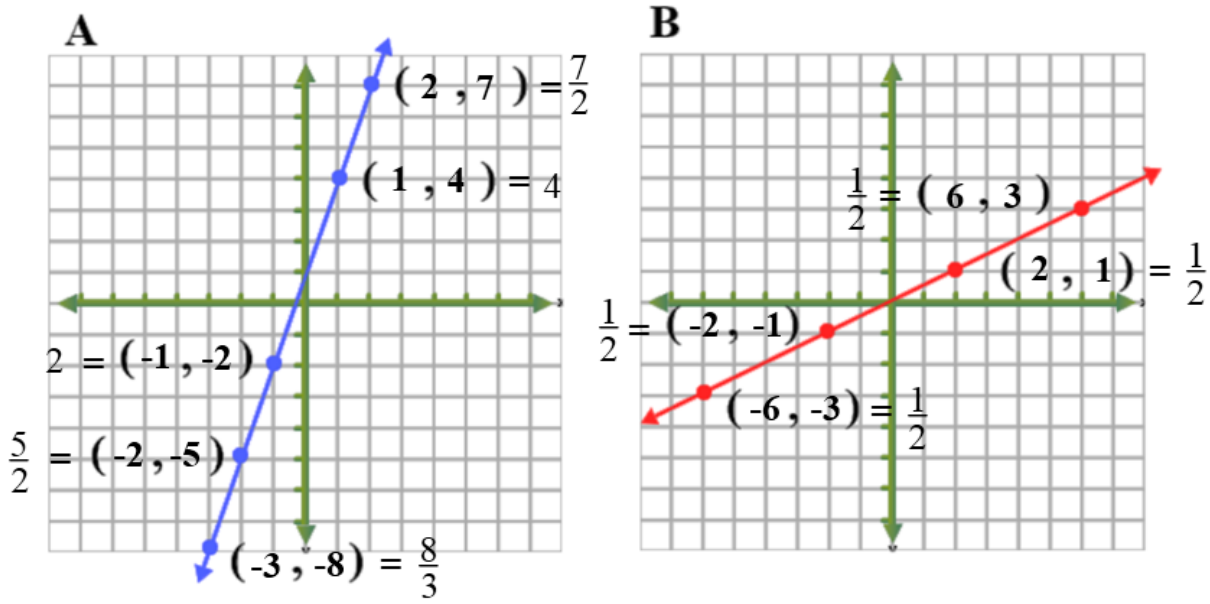
2. Find the slope between the points on graph B (Use *rise* over *run*). What do you notice? The slope is always ½ regardless of which two points used.

3. Fill in each ordered pair on graphs A and B.

4. For each ordered pair, divide *y* by *x*. $\left(\frac{y}{x}\right)$ Write your answer next to each ordered pair.

5. Does anything stand out about the ratios in either graph? The ratios are always different on the first graph (A) and the ratios are always the same on the second graph (B)

6. Do you notice anything about the ratios in either graph compared to the slope in the same graph? The ratio in graph B is the same as the slope (½)



Direct Variation: a linear equation where the ratio of $\frac{y}{x}$ remains constant. Two variables show direct variation if they can be written in the form.

$$y = ax$$

a = constant of variation and cannot equal 0.

Similar to: $y = mx + b$ but: $b = 0$ Since: $b = 0$

Graph will always: Pass through the origin

1. Decide whether the equation represents direct variation. If so, identify the constant of variation.

Ex: $2x - 3y = 0$

$-2x \quad -2x$

$-3y = -2x$

$-3 \quad -3$

$y = \frac{2}{3}x$

Can the equation be rewritten so it is in the form $y = ax$?

Try and rewrite the equation in that form.

Yes, it is a direct variation equation and $a = \frac{2}{3}$

Ex: $-x + y = 4$

$+x \quad +x$

$y = 4 + x$

Ex: $-x + y = 1$

$+x \quad +x$

$y = x + 1$

No, neither of these equations are direct variation because they are not in the form $y = ax$

Ex: $2x + y = 0$

$-2x \quad -2x$

$y = -2x$

Yes, $a = -2$

Ex: $4x - 5y = 0$

$-4x \quad -4x$

$-5y = -4x$

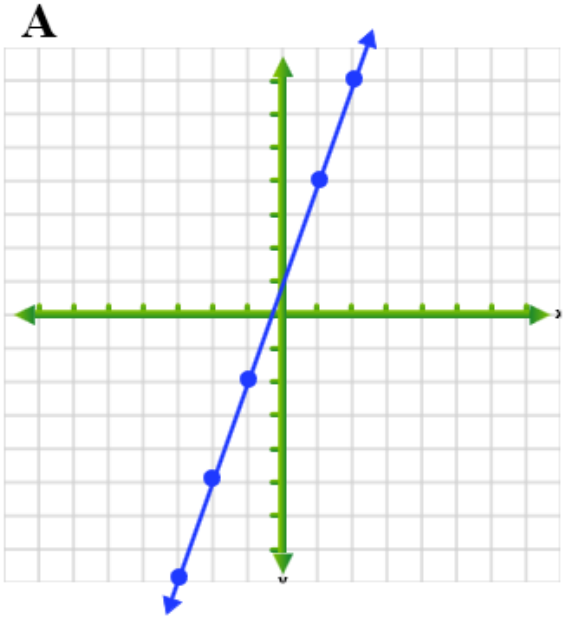
$-5 \quad -5$

$y = \frac{4}{5}x$

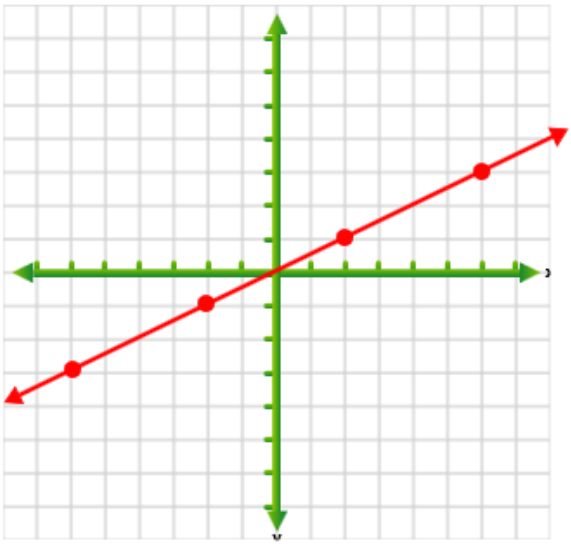
Yes, $a = \frac{4}{5}$

For the graphs draw below, which equation represents direct variation? How do you know?

A



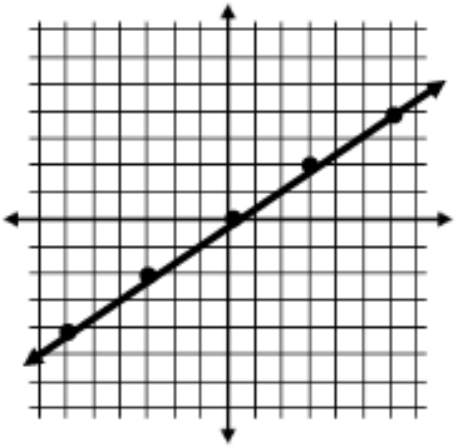
B



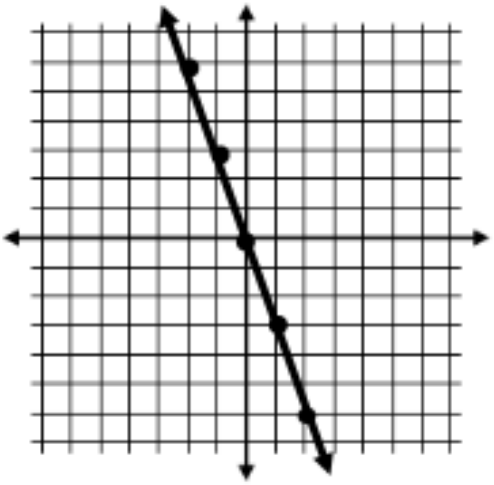
Graph B because it passes through the origin

2. Graph a direct variation equation. **(**Graph the same way as: $y = mx + b$)

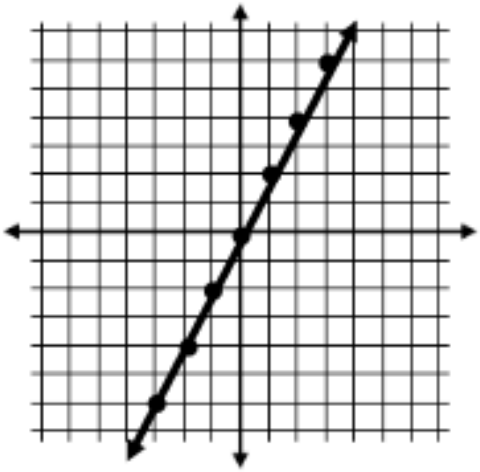
Ex: $y = \frac{2}{3}x$



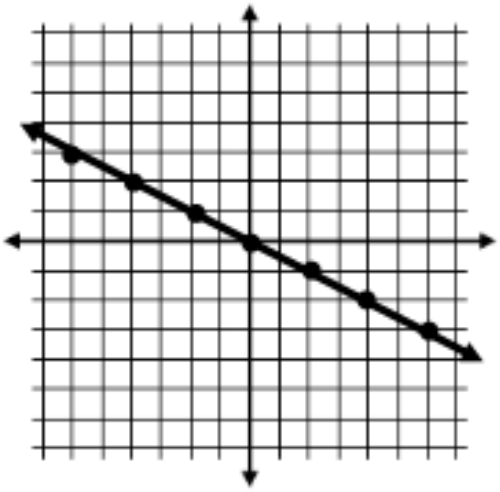
Ex: $y = -3x$



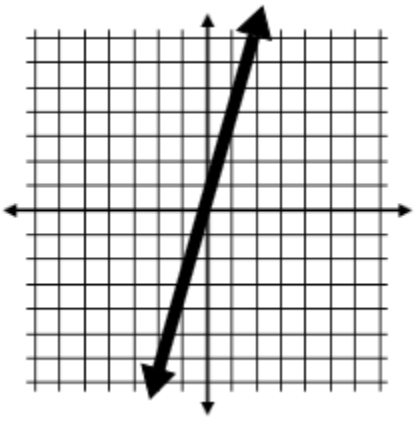
Ex: $y = 2x$



Ex: $y = -\frac{1}{2}x$



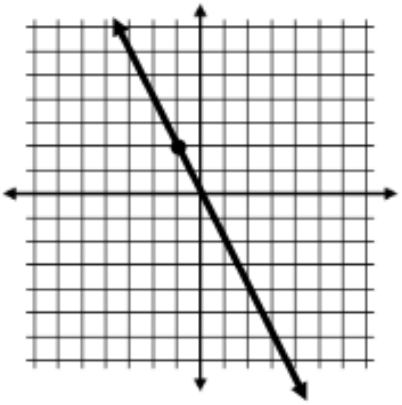
Ex: Draw a line that represents direct variation and *explain* why your line represents a direct variation relationship.



Any graph that passes through the origin is a direct variation relationship.

3. Write a direct variation equation.

Ex:



$y = ax$

$2 = a(-1)$

$-2 = a$

$y = -2x$

1. Start with general D.V. equation
2. Substitute in everything you know
3. Find constant of variation
4. Write final D.V. equation

b) THEN Find y when $x = 60$.

$y = -2(60)$

$y = -120$

Ex: The graph of a direct variation equation passes through the point (4, 8).

a) Write a direct variation equation relating x and y.

$y = ax$

$\frac{8}{4} = \frac{a(4)}{4}$

$2 = a$

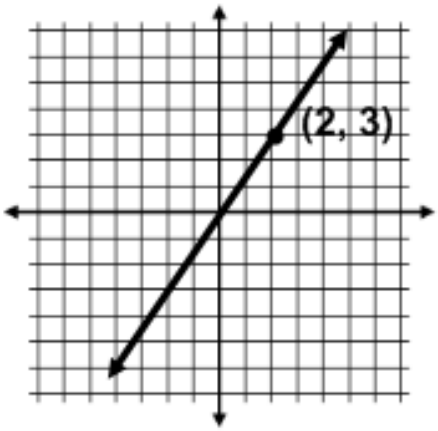
$y = 2x$

b) Find y when $x = 24$.

$y = 2(24)$

$y = 48$

Ex: Write a direct variation equation and find y when $x = 14$.



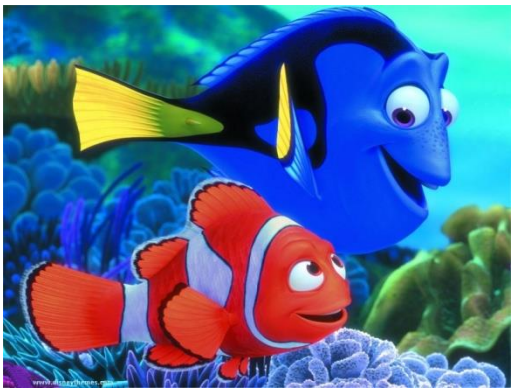
$y = ax$

$3 = a(2)$

$y = \frac{3}{2}x$

$y = 21$ when $x = 14$

Ex: The number *s*, of tablespoons of sea salt needed in a saltwater fish tank varies directly with the number *w*, of gallons of water in the tank. A pet shop owner recommends adding 100 tablespoons of sea salt to a 20 gallon tank.



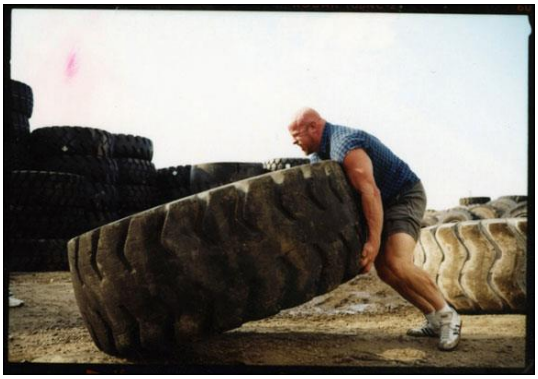
a) Write a direct variation equation relating *w* and *s*.

$s = aw$
$100 = a(20)$
$5 = a$
$s = 5w$

b) Find the number of tablespoons needed in a 30 gallon tank.

$s = 5(30)$
$s = 150$ tablespoons

Ex: An object that weighs 100 pounds on Earth would weigh just 6 pounds on Pluto. Assume that weight *p*, on Pluto varies directly with weight *e*, on Earth.



a) Write a direct variation equation relating *e* and *p*.

$p = ae$
$6 = a(100)$
$0.06 = a$
$p = 0.06e$

b) What would a 750 pound rock weigh on Pluto?

$p = 0.06(750)$
$p = 45$ pounds

Ex: The table shows the total cost *c*, of downloading *s* songs at an internet music site. Explain why *c* varies directly with *s*. Then write the direct variation equation.

y varies with *x* → $y = ax$
c varies with *s* → $c = as$

s	***c* ($)**
3	2.97
5	4.95
7	6.93

x and *y* vary directly if every time you do $\frac{y}{x}$ the answer is constant. In this case, we are dealing with *c* and *s*, so to check for direct variation you do $\frac{c}{s}$ to see if the answer is constant every time.

$\frac{2.97}{3} = 0.99$ $\frac{4.95}{5} = 0.99$ $\frac{6.93}{7} = 0.99$

Since every time you divide *c* by *s* you get 0.99, then this is direct variation with a constant of variation (*a*) of 0.99 so the equation is:

$c = 0.99s$

Ex: The table shows the total cost *c*, of buying *d* used DVD's at a music store.

y varies with *x* → *y* = *ax*
c varies with *d* → *c* = *ad*

d	***c* ($)**
3	25.77
6	51.54
9	77.31

a) Explain why *c* varies directly with *d*.

x and *y* vary directly if every time you do $\frac{y}{x}$ the answer is constant. In this case, we are dealing with *c* and *d*, so to check for direct variation you do $\frac{c}{d}$ to see if the answer is constant every time.

$\frac{25.77}{3} = 8.59$ $\frac{51.54}{6} = 8.59$ $\frac{77.31}{9} = 8.59$

Since every time you divide *c* by *d* you get 8.59, then this is direct variation with a constant of variation (*a*) of 8.59

b) Write the direct variation equation.

c = 8.59*d*