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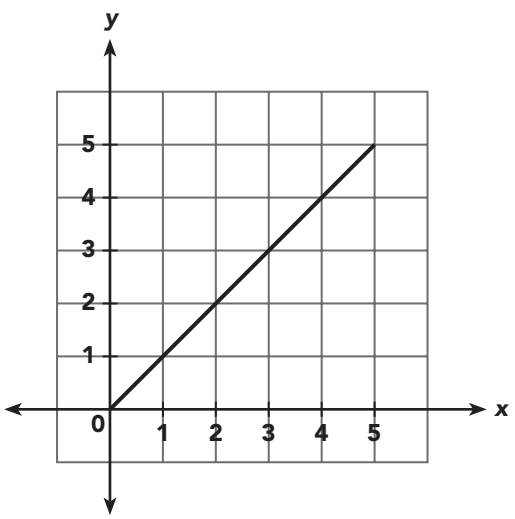
CHAPTER

Lines and Linear Equations

Lesson 4.1 Finding and Interpreting Slopes of Lines

Tell whether each graph represents a direct proportion. If so, find the constant of proportionality. Then write a direct proportion equation.

1.



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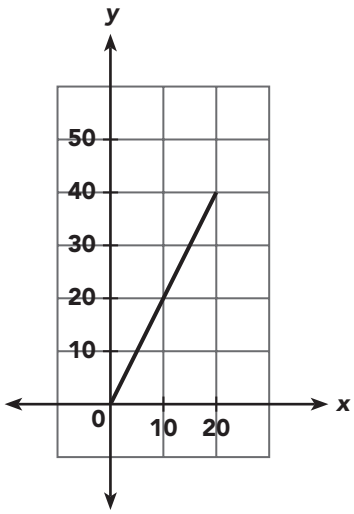

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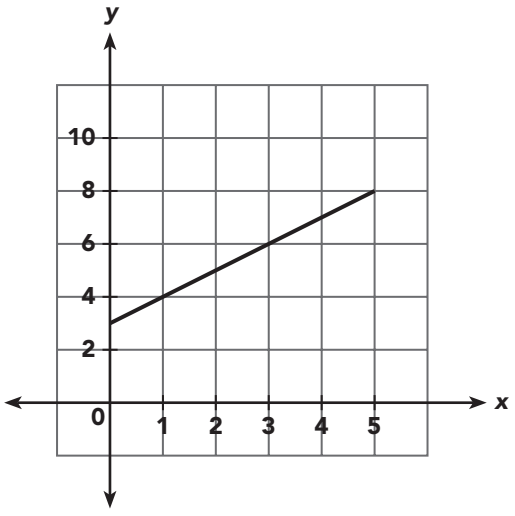

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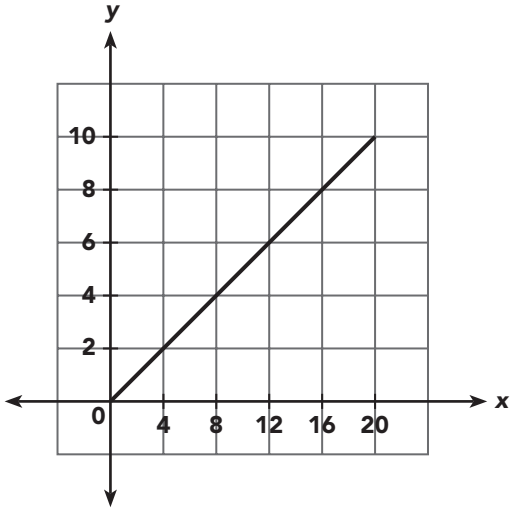

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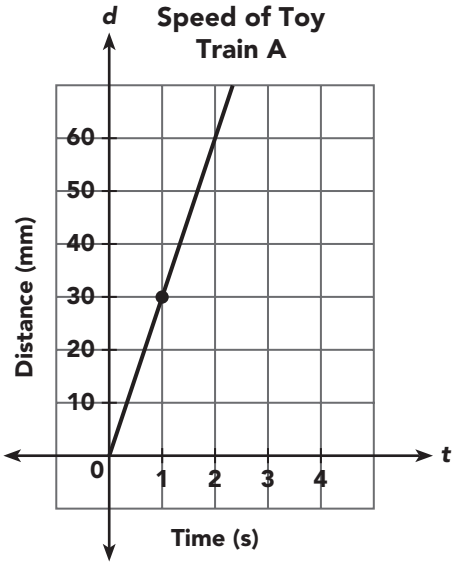
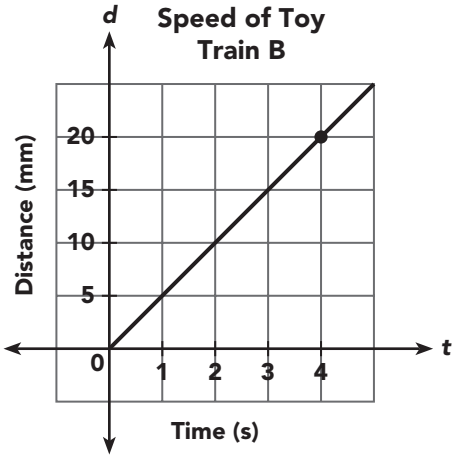
Use slopes to compare two unit rates.

Example

The graphs give information about the distance, *d*, traveled over time, *t*, by two automated toy trains A and B on a straight track. Which train moves at a slower rate of speed?





Speed of toy train A: Unit rate $= \frac{\text{Rise}}{\text{Run}}$

$= \frac{30}{1}$

$= 30$ mm/s

Speed of toy train B: Unit rate $= \frac{\text{Rise}}{\text{Run}}$

$= \frac{20}{4}$

$= 5$ mm/s

Remember that the ratio $\frac{\text{Rise}}{\text{Run}}$ will help you find the slopes of the graphs.

The slope for the distance moved by toy train A is 30, so the unit rate is 30 millimeters per second. The slope for the distance moved by toy train B is 5, so the unit rate is 5 millimeters per second.

Toy train B has a slower rate of speed.

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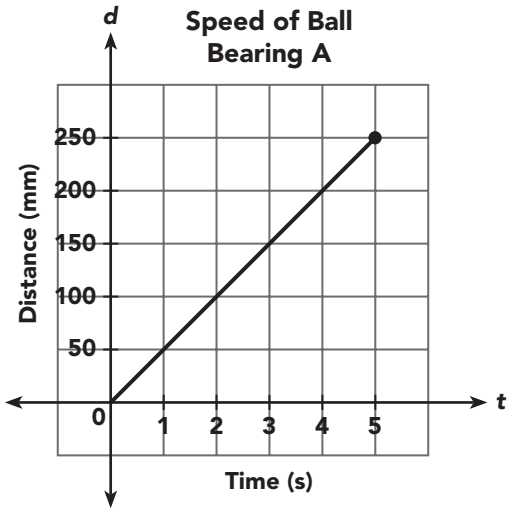
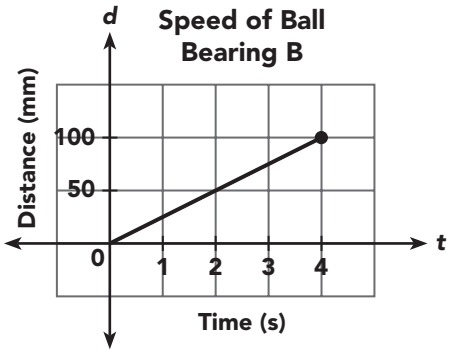
Complete.

5. The graphs give information about the distance, *d*, over time, *t*, by two ball bearings, A and B, of different weights rolling down a ramp. Which ball bearing has a faster speed?





Speed of ball bearing A: Unit rate = $\frac{\text{Rise}}{\text{Run}}$

$= \frac{\square}{\square}$

= _____ mm/s

Speed of ball bearing B: Unit rate = $\frac{\text{Rise}}{\text{Run}}$

$= \frac{\square}{\square}$

= _____ mm/s

The slope for the speed moved by ball bearing A is _____, so the unit rate is _____ millimeters per second. The slope for the speed moved by ball bearing B is _____, so the unit rate is _____ millimeters per second. _____ has a faster speed.

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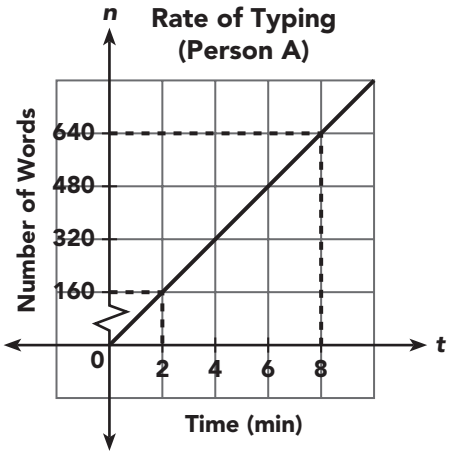
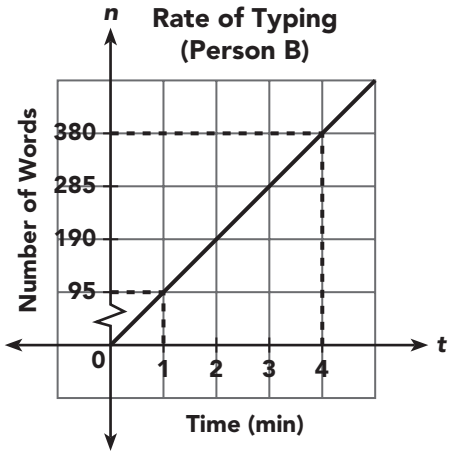
Solve. Show your work.

6. The graphs give information about the average number of words, *n*, over time, *t*, typed by persons A and B. Which person types at the faster rate?



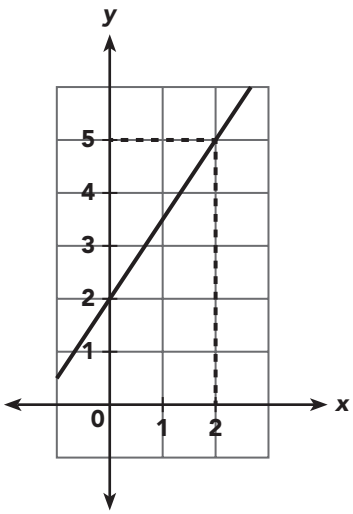


Find the slope of a line given the graph.

Example

Find the slope of each line.

a)

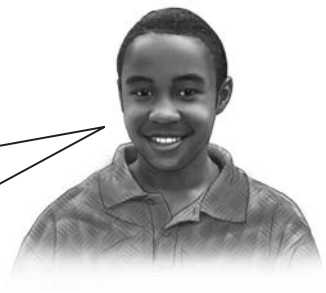


The graph passes through the points (0, 2) and (2, 5).

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{5-2}{2-0} = \frac{3}{2}$$

The slope is $\frac{3}{2}$.

Remember to subtract the coordinates in the same order in both numerator and denominator.



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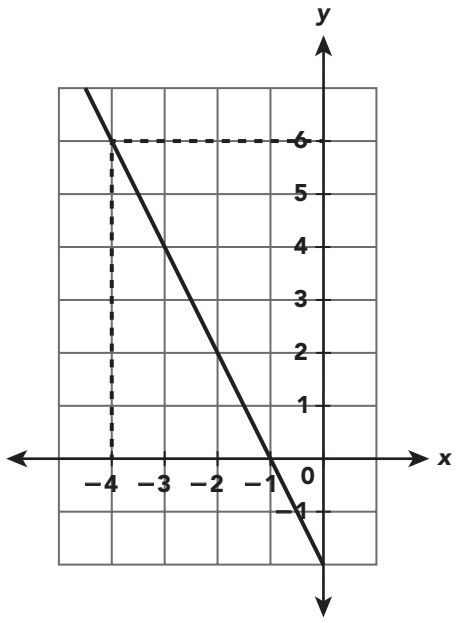
b)



The graph passes through the points (−4, 6) and (−1, 0).

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

$$= \frac{0 - 6}{-1 - (-4)}$$

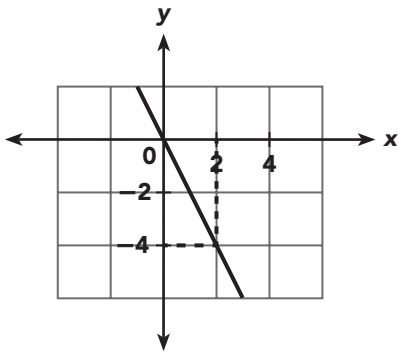
$$= \frac{-6}{3}$$

$$= -2$$

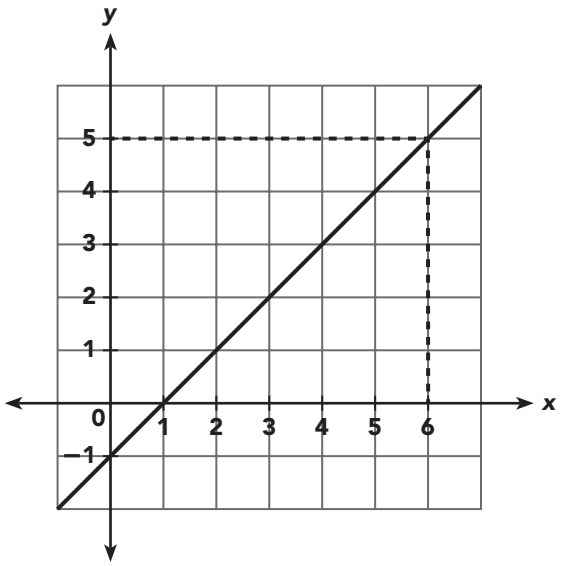
The slope is -2.

Find the slope of the line given the graph.

7.



8.



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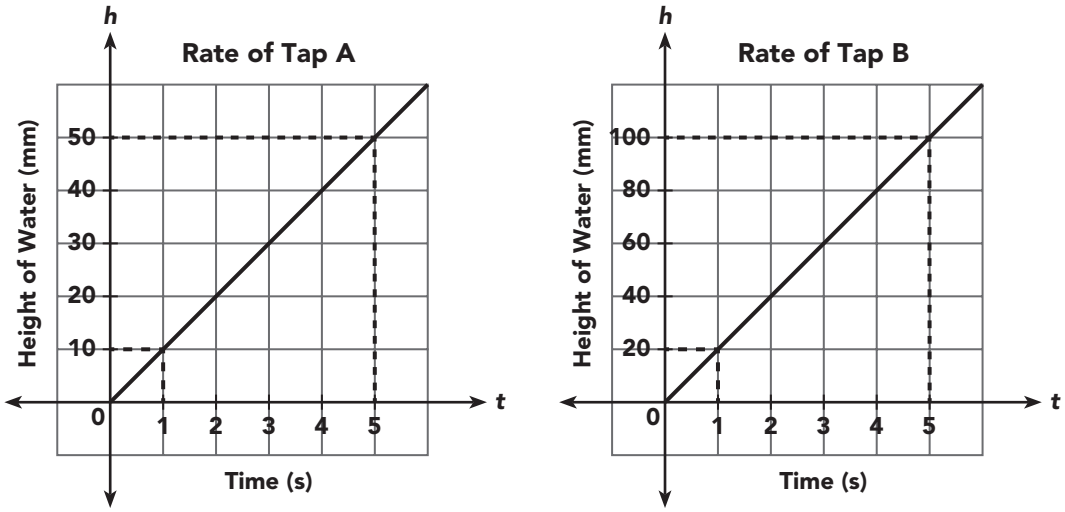
Compare two slopes to make a conclusion about real-world situations.

Example

Tap A fills tank A and tap B fills tank B with water at the same time. Tanks A and B are identical. The graphs represent the height, *h*, of the water level over time, *t*.



a) Find the slope of the line graph for tap A. What does it represent?

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$
$$= \frac{50}{5}$$
$$= 10 \text{ mm/s}$$

The slope is 10 millimeters per second. The slope represents the rate of change in the height of the water level in tank A.

b) Find the slope of the line graph for tap B. What does it represent?

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$
$$= \frac{100}{5}$$
$$= 20 \text{ mm/s}$$

The slope is 20 millimeters per second. The slope represents the rate of change in the height of the water level in tank B.

c) Which tap is able to fill its tank faster?

The rate at which the height of the water level in tank B changes is faster than that of tank A. Tap B is able to fill its tank faster.

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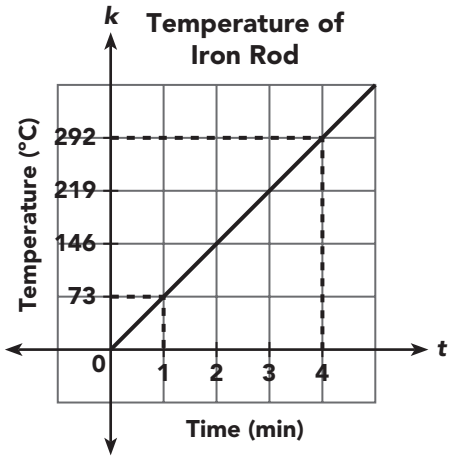
Complete.

9. When two metal rods of the same length and width were heated, the temperature increases steadily until the rods reach their melting point. The graph represents the temperature, °C, of the iron rod over time, *t*. The temperature of the copper rod is 247°C over the same length of time.



a) At what rate is the iron rod being heated?

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

$$= \frac{\square}{\square}$$

$$= \_\_\_\_\_ \text{°C/min}$$

The iron rod is being heated at a rate of _____°C per minute.

b) At what rate is the copper rod being heated? Round your answer to the nearest tenth.

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

$$= \frac{\square}{\square}$$

$$\approx \_\_\_\_\_ \text{°C/min}$$

The copper rod is being heated at a rate of _____°C per minute.

c) Which rod is a better conductor of heat?

The _____ rod is a better conductor of heat.

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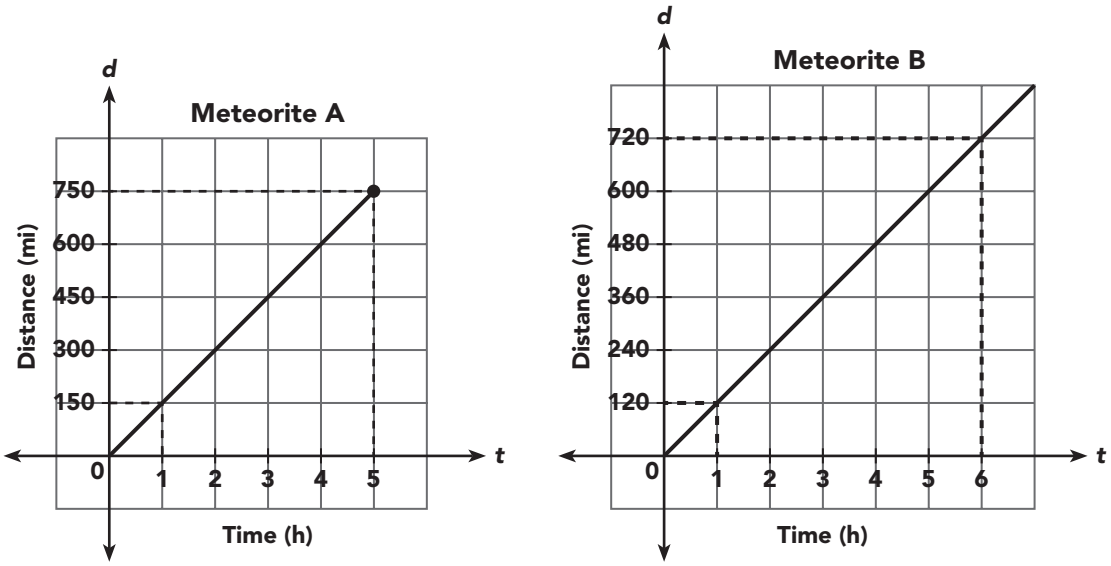
Solve. Show your work.

10. A force from a collision in space causes two meteorites, A and B, to move in two directions. The graphs represent the distance, *d*, traveled by the two meteorites over time, *t*.



a) Find the slope of the line graph for meteorite A. What does it represent?

b) Find the slope of the line graph for meteorite B. What does it represent?

c) The force experienced by the two meteorites is the same. So the distance moved by the meteorites depends on the mass of the meteorites. Which meteorite has the greater mass?

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Find the slope of horizontal and vertical lines.

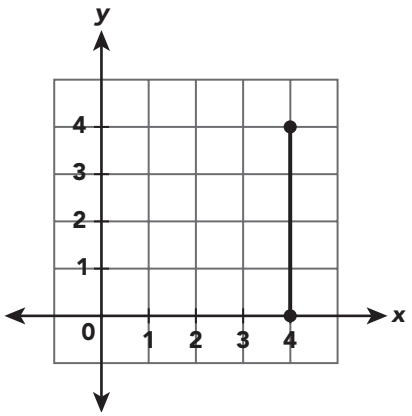
Example

Find the slope of the line.

Use the points (4, 4) and (4, 0).

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$
$$= \frac{0 - 4}{4 - 4}$$
$$= \frac{4}{0}$$
$$= \text{undefined}$$

The slope is undefined.

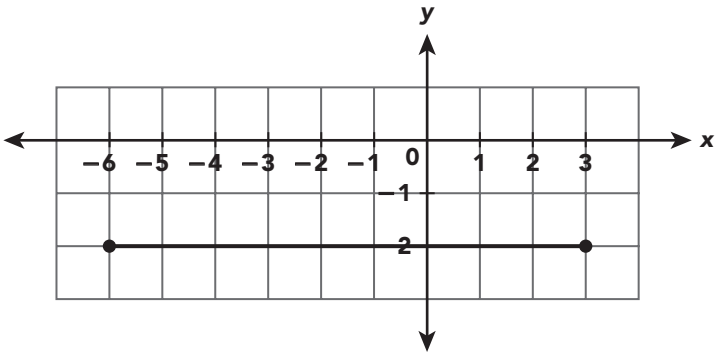


Complete.

11. Use the points (_____, _____) and (_____, _____).

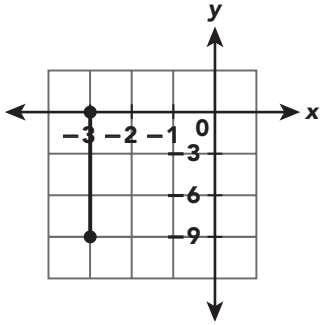
$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$
$$= \frac{\square - \square}{\square - \square}$$
$$= \frac{\square}{\square}$$
$$= \_\_\_\_\_$$

The slope is _____.



Find the slope of the line.

12.



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Find the slope *m* of a line passing through two given points.

Example

Find the slope of the line.

$P(4, 10)$ and $Q(2, 5)$

Let $P(4, 10)$ be (x_1, y_1) and $Q(2, 5)$ be (x_2, y_2).

Method 1

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{5 - 10}{2 - 4}$$

$$= \frac{-5}{-2}$$

$$= \frac{5}{2}$$

The slope is $\frac{5}{2}$.

Method 2

$$\text{Slope} = \frac{y_1 - y_2}{x_1 - x_2}$$

$$= \frac{10 - 5}{4 - 2}$$

$$= \frac{5}{2}$$

The slope is $\frac{5}{2}$.

You can find the slope of the line by calculating the rise and the run either from point *P* to point *Q* or point *Q* to point *P*.

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Complete.

13. Find the slope of the line passing through the points $X(6, 8)$ and $Y(1, 2)$.

Let $X(6, 8)$ be (x_1, y_1) and $Y(1, 2)$ be (x_2, y_2).

Method 1

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

$= \frac{\square - \square}{\square - \square}$

$= \frac{\square}{\square}$

$= \frac{\square}{\square}$

Method 2

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

$= \frac{\square - \square}{\square - \square}$

$= \frac{\square}{\square}$

The slope is _____.

Find the slope of the line passing through each of the following pairs of points.

14. $A(10, 15)$ and $B(15, 25)$

15. $J(-1, -9)$ and $B(3, -3)$