Name _____

5-1 Rate of Change and Slope

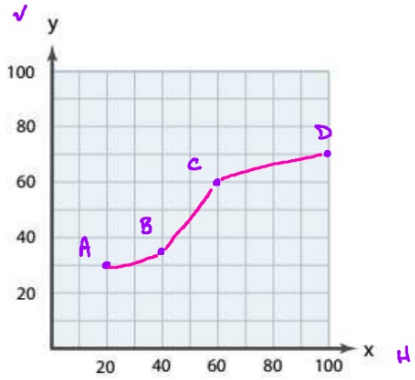
OBJECTIVE: I can find rates of change from tables to find slope

Warm-Up

The table shows the horizontal and vertical distances from the base of the mountain at several poles along the path of a ski lift. The poles are connected by cable. Between which two poles is the cable's path the steepest? How do you know?

Pole	Horizontal Distance	Vertical Distance
A	20	30
B	40	35
C	60	60
D	100	70

From B to C is the steepest



Essential Understanding

Essential Understanding You can use ratios to show a relationship betweenchanging quantities, such as vertical and horizontal change.

Rate of change shows the relationship between two changing quantities. When one quantity depends on the other, the following is true.

$$\text{rate of change} = \frac{\text{change in the dependent variable}}{\text{change in the independent variable}}$$

Example #1 Finding Rate of Change Using a Table

Marching Band The table shows the distance a band marchesover time. Is the rate of change in distance with respect to time constant? What does the rate of change represent?

Time (min)	Distance (ft)
1	260
2	520
3	780
4	1040

① $\frac{520-260}{2-1} = \frac{260}{1}$ ② $\frac{780-520}{3-2} = \frac{260}{1}$ ③ $\frac{1040-780}{4-3} = \frac{260}{1}$

The rate of change is constant and equals $\frac{260\text{ ft}}{1\text{ min}}$ 260 ft per minute

Your Turn to Work it Out

In example 1, do you get the same rate of change if you use nonconsecutive rows of the table? Explain

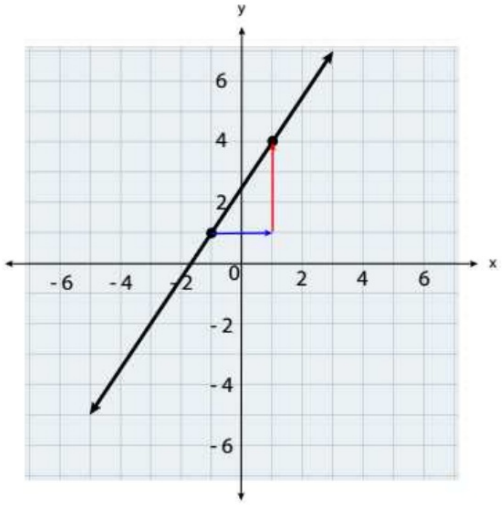
$$\frac{1040 - 260}{4 - 1} = \frac{780}{3}$$

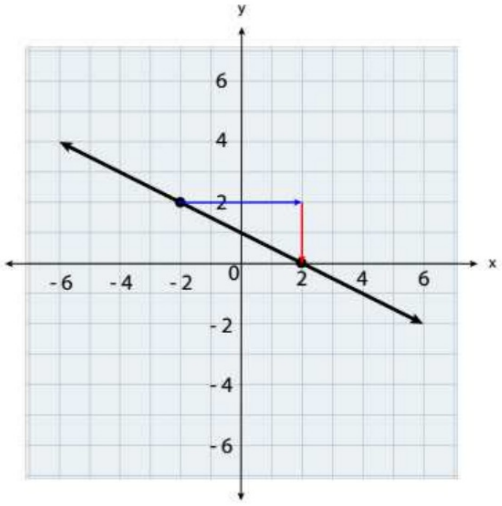
$$\frac{260}{1}$$

Concept Understanding

Notice that the rate of change found in Example 1 is just the ratio of the vertical change (or rise) to the horizontal change (or run) between two points on the line. The rate of change is called the slope of the line.

$$\text{slope} = \frac{\text{vertical change}}{\text{horizontal change}} \quad \frac{\text{rise}}{\text{run}}$$

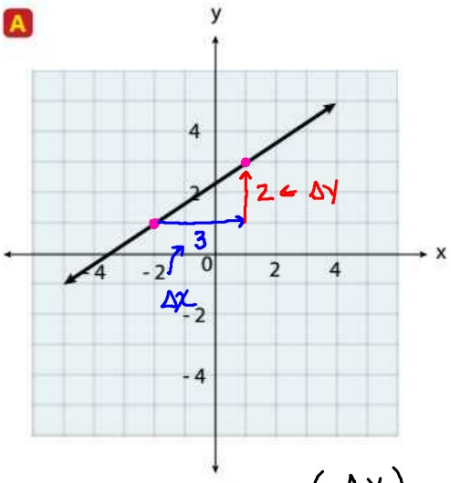




Example #2 Finding Slope Using a Graph

What is the slope of each line?

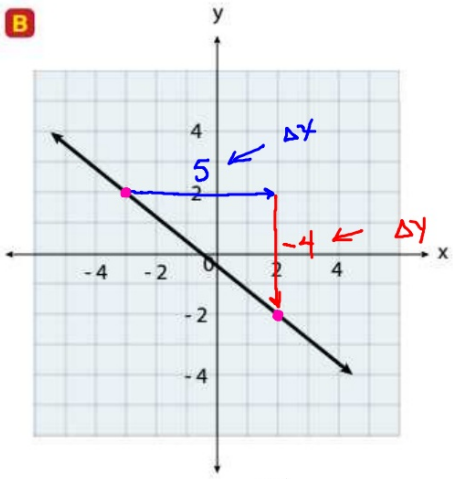
A



slope = $\frac{\text{rise}}{\text{run}}$ $\frac{(\Delta y)}{(\Delta x)}$

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

B



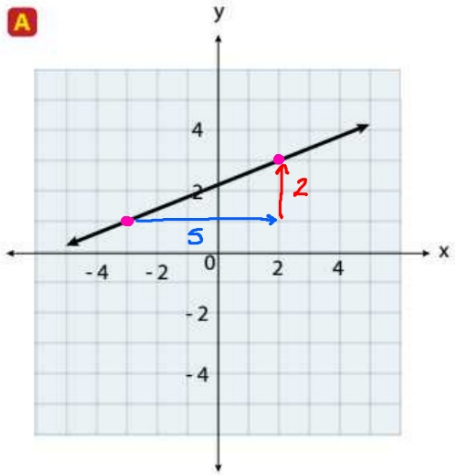
slope = $\frac{\Delta y}{\Delta x}$

slope = $\frac{-4}{5}$

Your Turn to Work it Out

2. What is the slope of each line in parts (a) and (b)?

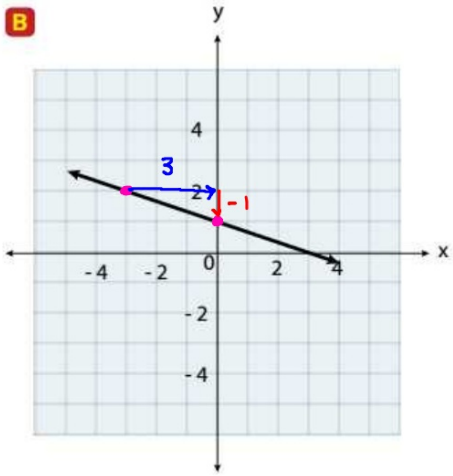
A



$\text{slope} = \frac{\Delta y}{\Delta x}$

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

B

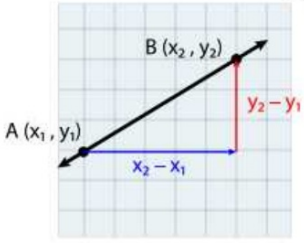


$\text{slope} = \frac{\Delta y}{\Delta x}$

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

Concept Understanding

You can use any two points on a line to find its slope. Use subscripts to distinguish between the two points. In the diagram, (X_1, Y_1) are the coordinates of point A, and (X_2, Y_2) are the coordinates of point B. To find the slope of AB ·, you can use the slope formula.



Key Concept:

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}, \text{ where } x_2 - x_1 \neq 0$$

The x-coordinate you use first in the denominator must belong to the same ordered pair as the y-coordinate you use first in the numerator.

Use this template for all calculations

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

Example #3 Finding Slope Using Points

What is the slope of the line through (−1, 0) and (3, −2)?

$$\text{slope} = \frac{Y_2 - Y_1}{X_2 - X_1}$$

① (−1, 0) x_1 y_1 ② (3, −2) x_2 y_2

$$\text{slope} = \frac{-2 - 0}{3 - (-1)} \rightarrow -2$$

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

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

② (−1, 0) x_2 y_2 ① (3, −2) x_1 y_1

$$\text{slope} = \frac{0 - (-2)}{-1 - 3} =$$

$$\text{slope} = \frac{2}{-4}$$

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

Your Turn to Work it Out

3. What is the slope of the line through the following points?

a. (1, 3) and (4, –1)

① ②

(1, 3) (4, –1)

x_1 y_1 x_2 y_2

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

$$\text{slope} = \frac{-1 - 3}{4 - 1}$$

$$\text{slope} = \frac{-4}{3}$$

b. (1, –2), (5, 5)

① ②

(1, –2) (5, 5)

x_1 y_1 x_2 y_2

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

$$\text{slope} = \frac{5 - (-2)}{5 - 1} \qquad 5 + 2$$

$$\text{slope} = \frac{7}{4}$$