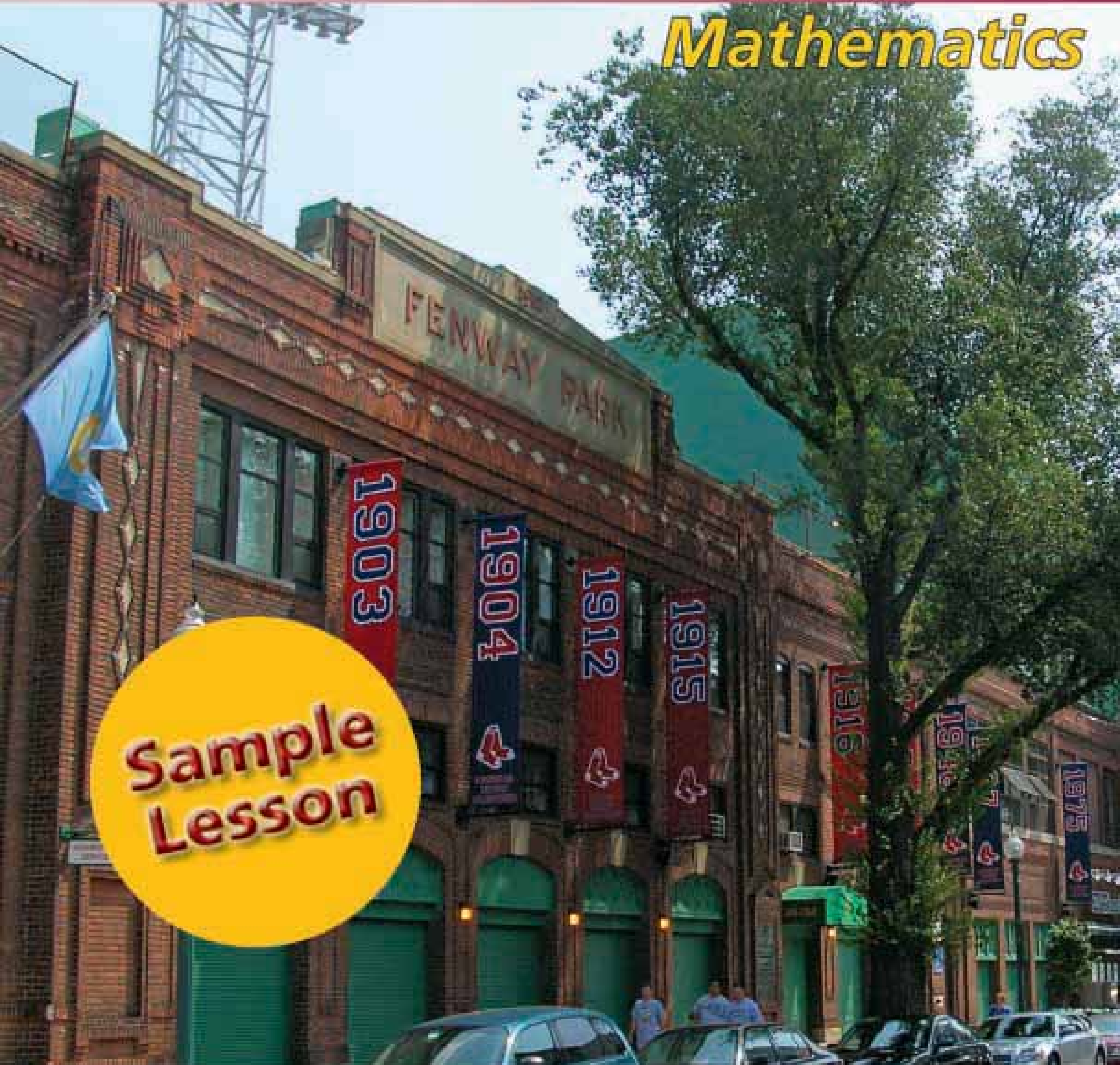
GRADE 10

MCAS Finish Line

Mathematics



Sample Lesson

Continental Press

Contents

LESSON 2

Slope and Intercepts of a Line

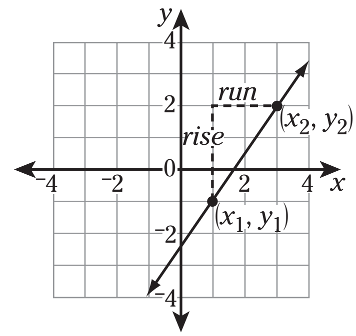
Standard 10.P.2

Slope

Slope is a measure of the steepness of a line. It describes a rate of change. The slope of a line can be found using either of these methods:

1. On the graph of a line, determine the vertical change (the "rise") over the horizontal change (the "run") from one point to another.

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



2. Use the **slope formula.** For any two points on a line, (x_1, y_1) and (x_2, y_2) and $x_1 \neq x_2$, slope $= \frac{y_2 - y_1}{x_2 - x_1}$.

A line that slants upward from left to right always has a positive slope. A line that slants downward from left to right always has a negative slope.

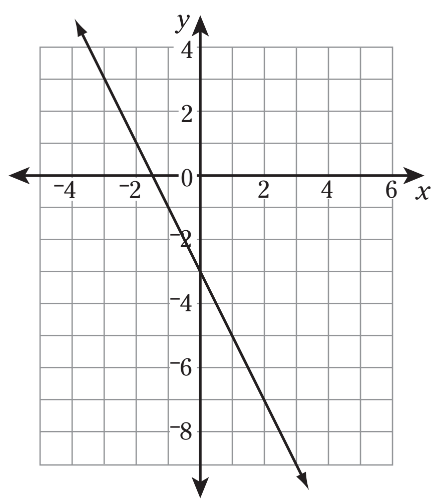
Horizontal lines have a slope of 0.

Vertical lines have an undefined slope.

It is a good idea to check the slope of a line found when looking at a graph using rise over run by also using the slope formula.

The sample problem below shows how both methods for finding the slope can be used.

S-1 What is the slope of the line graphed below?

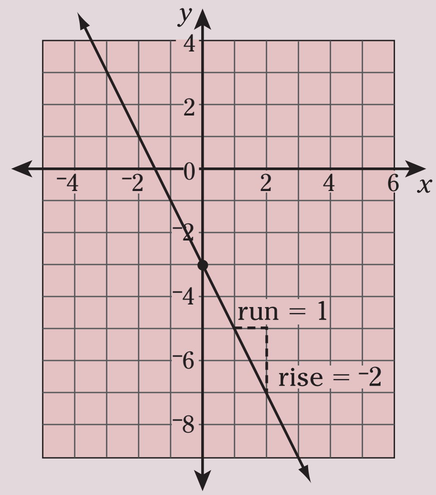


A -3 **B** -2 **C** $-\frac{1}{2}$ **D** $-\frac{1}{3}$

Find the slope using the rise over the run, or $\frac{rise}{run}$. By looking at the graph, you can see that the line has a rise of −2 and a run of 1, so the slope is $\frac{-2}{1}$ or −2. Verify this slope by using the slope formula with any two points on the graph.

$$\text{Slope} = \frac{-5 - (-3)}{1 - 0} = \frac{-5 + 3}{1} = \frac{-2}{1} \text{ or } -2.$$

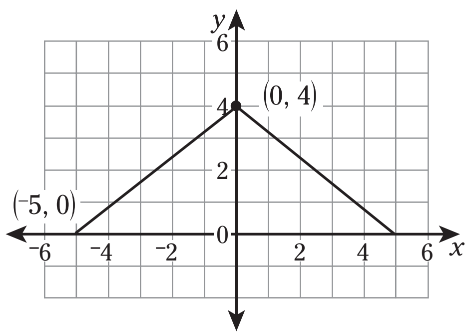
Both methods result in the same slope. Choice B is correct.



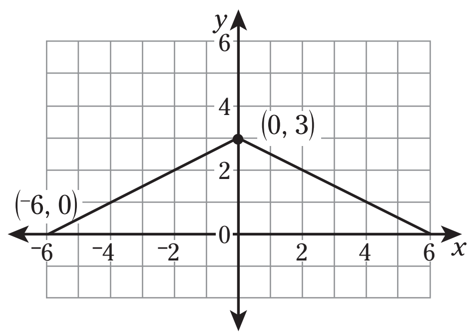
Applications of Slope

Slope can be used to find different rates of change, such as the grade of a road or the pitch of a roof. The greater the slope, the steeper the road or the roof pitch. For example, suppose an architect draws the two roofs shown on the coordinate planes below.

Roof A



Roof B



The coordinates of the left sides of each roof drawing are shown. Use these coordinates and the slope formula to find the slope of each roof.

The slope of roof A is $\frac{4 - 0}{0 - (-5)} = \frac{4}{5}$. The slope of roof B is $\frac{3 - 0}{0 - (-6)} = \frac{3}{6} = \frac{1}{2}$. The slope of roof A is greater than the slope of roof B since $\frac{4}{5} > \frac{1}{2}$. So, roof A is steeper than roof B.

> For any two points on a line (x_1, y_1) and (x_2, y_2) and $x_1 \neq x_2$, the slope of the line is $\frac{y_2 - y_1}{x_2 - x_1}$.

Now try this example.

S-2 Rosemary grows a plant from seed. In 2 weeks, the plant is 5 centimeters tall. In 6 weeks, the plant is 17 centimeters tall. What is the average growth rate each week of this plant between weeks 2 and 6?

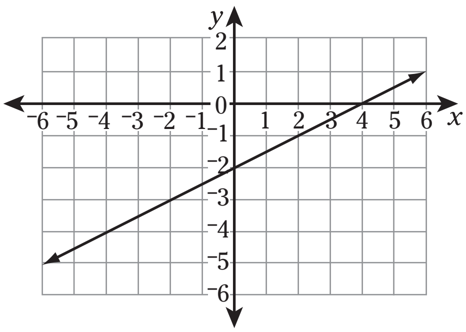
A 3 cm **B** 4 cm **C** 8 cm **D** 12 cm

To find the average growth rate each week, find the slope of the line between the points (2, 5) and (6, 17). Slope $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{17 - 5}{6 - 2} = \frac{12}{4} = 3$. Choice A is correct.

Finding Intercepts from Graphs

On the graph of a line, the point where the line touches the *x*-axis is the ***x*-intercept** of the line. The point where the line touches the *y*-axis is the ***y*-intercept** of the line.

For example, on the graph below, the line touches the *x*-axis at $x = 4$ and the *y*-axis at $y = -2$. The *x*-intercept of this line is the point (4, 0). The *y*-intercept is the point (0, −2).

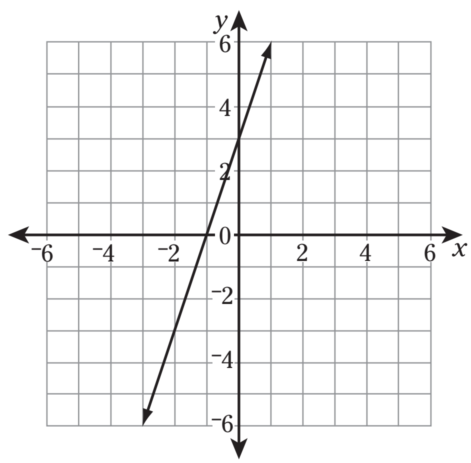


If a line touches the *x*-axis at $x = a$, the *x*-intercept is the point $(a, 0)$.

If a line touches the *y*-axis at $y = b$, the *y*-intercept is the point $(0, b)$.

Try this sample question.

S-3 Which statement best describes the graph of the line shown below?



A The slope is positive and the *x*-intercept is −1.

B The slope is negative and the *x*-intercept is 3.

C The slope is positive and the *y*-intercept is −1.

D The slope is negative and the *y*-intercept is 3.

The line on the graph slants upward from left to right, so the slope is positive. The line touches the *x*-axis at −1 and it touches the *y*-axis at 3. So, the *x*-intercept is −1 and the *y*-intercept is 3. Choice A is correct.

IT'S YOUR TURN

Read each problem. Circle the letter of the best answer.

1. Line p passes through the points $(3, -2)$ and $(5, 3)$. What is the slope of line p?

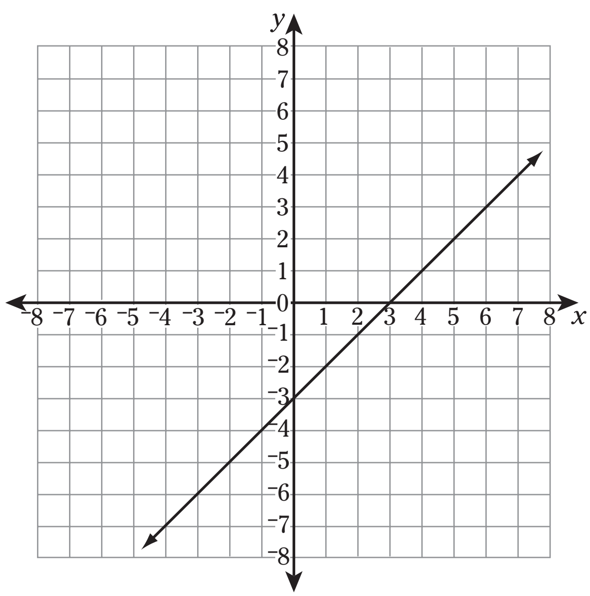
A $\frac{2}{5}$

B $\frac{1}{2}$

C $\frac{2}{1}$

D $\frac{5}{2}$

2. What is the y-intercept of the line graphed below?



A -3

B -1

C 1

D 3

3. Which intercepts *must* be on a line with a negative slope?

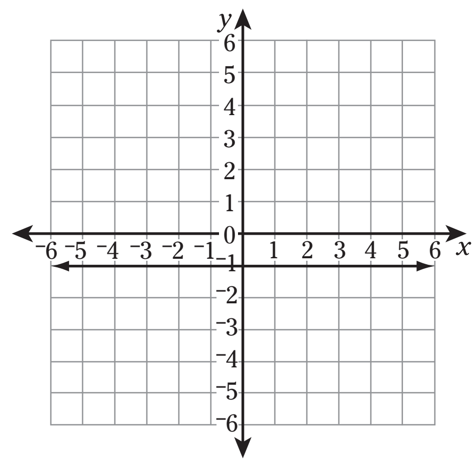
A x-intercept $= 0$, y-intercept $= 0$

B x-intercept $= 1$, y-intercept $= 6$

C x-intercept $= -4$, y-intercept $= 3$

D x-intercept $= 5$, y-intercept $= -2$

4. What is the slope of the line shown below?



A -1

B 0

C 1

D undefined

5. A pole is placed against a house 6 feet from its base. The top of the pole reaches a height 10 feet off the ground. Which number best represents the slope of the pole?

A $\frac{1}{4}$

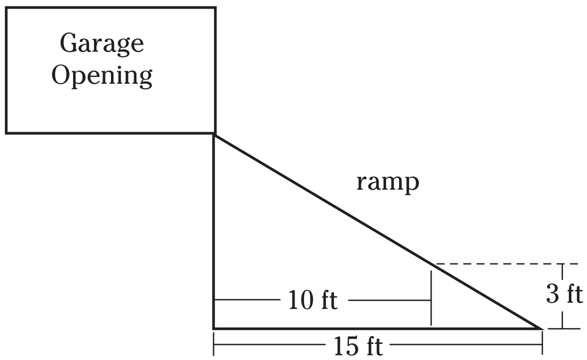
B $\frac{3}{5}$

C $\frac{5}{3}$

D $\frac{4}{1}$

Read the problem. Write your answer.

6. The bottom of a ramp is placed 15 feet from a garage opening at a warehouse. The ramp is 3 feet off the ground when it is 10 feet from the garage opening.



How many feet off the ground is the top of the ramp?

Answer: ____________