4-1 Understanding Slope

Check Skills You'll Need

1. **Vocabulary Review** Do the *negative integers* include zero?

Simplify each expression.

2. $-3 - 1$
3. $10 - (-4)$
4. $1 - 7$
5. $-8 - (-6)$

GO for Help Lesson 2-2

CONTENT STANDARDS
8.EE.6, 8.F.4

What You'll Learn

To find the slope of a line from a graph or table

New Vocabulary slope, slope of a line

Why Learn This?

You can use slope to describe the steepness of an incline or hill. The steepness of a ramp is the ratio of the vertical change to the horizontal change. In math, slope is a number that describes the steepness of a line.

You can also use slope to describe rate of change of a quantity.

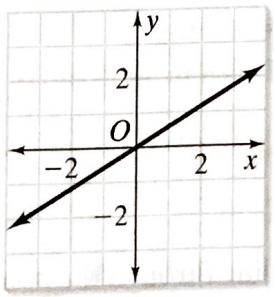
$$\text{slope} = \frac{\text{vertical change}}{\text{horizontal change}} \quad \begin{matrix} \leftarrow \text{rise} \\ \leftarrow \text{run} \end{matrix}$$

Slope describes the steepness of lines in the coordinate plane. You can find the slope of a line by subtracting the coordinates of any two points on the line.

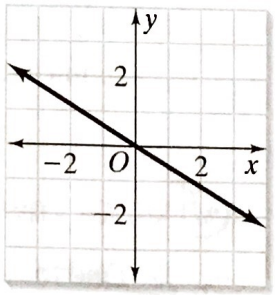
KEY CONCEPTS **Slope of a Line**

$$\text{slope of a line} = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} \quad \begin{matrix} \leftarrow \text{rise} \\ \leftarrow \text{run} \end{matrix}$$

The direction of the slant of a line indicates a positive or a negative slope.



Positive slope



Negative slope

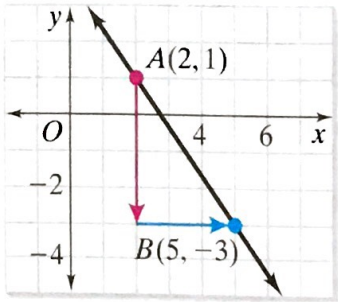
When you find the slope of a line, the first y-coordinate you use for the rise must belong to the same point as the first x-coordinate you use for the run.

EXAMPLE 1 Finding the Slope of a Line

Online active math

For: Exploring Slope Activity
Use: Interactive Textbook, 4-1

Find the slope of the line in the graph below.



$$\text{slope} = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}}$$

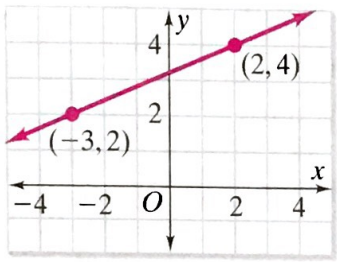
$$= \frac{-3 - 1}{5 - 2} \leftarrow \text{Subtract coordinates of } A \text{ from coordinates of } B.$$

$$= \frac{-4}{3} \text{ or } -\frac{4}{3} \leftarrow \text{Simplify.}$$

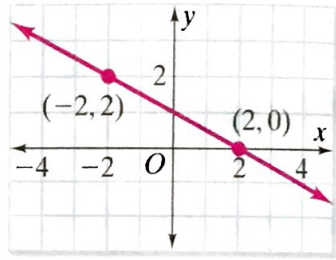
Quick Check

1. Find the slope of each line.

a.



b.



Some lines have slopes that are neither positive nor negative.

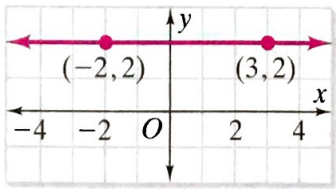
EXAMPLE 2 Slopes of Horizontal and Vertical Lines

Vocabulary Tip

Do not confuse the terms *zero* and *undefined*. The slope of a horizontal line is zero. The slope of a vertical line is undefined.

Find the slope of each line. State whether the slope is zero or undefined.

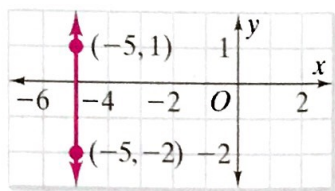
a.



$$\text{slope} = \frac{2 - 2}{3 - (-2)} = \frac{0}{5} = 0$$

The slope of a horizontal line is zero.

b.



$$\text{slope} = \frac{1 - (-2)}{-5 - (-5)} = \frac{3}{0}$$

Division by zero is undefined. So, the slope of a vertical line is undefined.

Quick Check

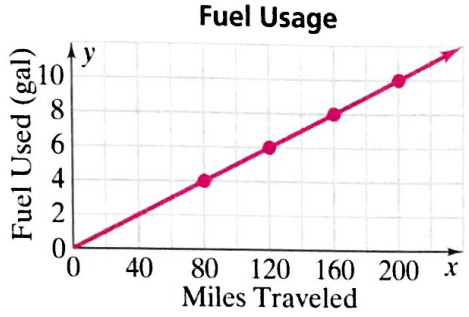
2. Find the slope of a line through the points $(3, 1)$ and $(3, -2)$. State whether the slope is zero or undefined.

When you graph some data, all the points lie on a line. For such data, you can find slope, or rate of change, using a table.

EXAMPLE 3 Finding Slope From a Table

Miles Traveled	Fuel Used (gallons)
80	4
120	6
160	8
200	10

Graph the fuel-usage data at the left. Connect the points with a line. Then find the rate of change.



← Draw the graph.

$$\text{rate of change} = \text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{10 - 4}{200 - 80}$$ ← Use coordinates of two points.

$$= \frac{6}{120} = \frac{1}{20}$$ ← Subtract and simplify.

The amount of fuel used is 1 gallon for every 20 miles traveled.

Quick Check

3. Graph the data in the table and connect the points with a line. Then find the slope.

x	−1	0	1	2
y	2	0	−2	−4

Check Your Understanding

1. **Vocabulary** The slope of a line is the rise over the ___?___.
2. Draw one line for each slope: 0, undefined, +1, and −1.

Find the slope of the line that passes through each pair of points.

3. (0, 3) and (6, 1)
4. (2, 2) and (6, −1)

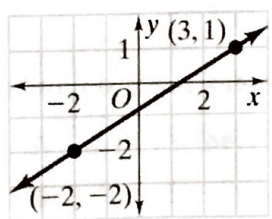
Homework Exercises

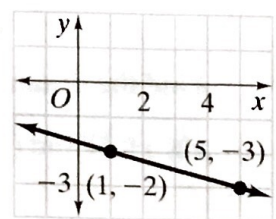
For more exercises, see Extra Skills and Word Problems.

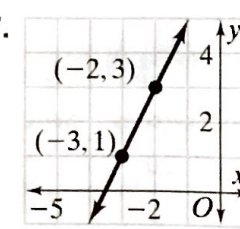
GO for Help

For Exercises	See Examples
5–7	1-2
8–9	3

Find the slope of each line.

5. 

6. 

7. 

Graph the data in each table and connect the points with a line. Then find the slope of the line.

8.

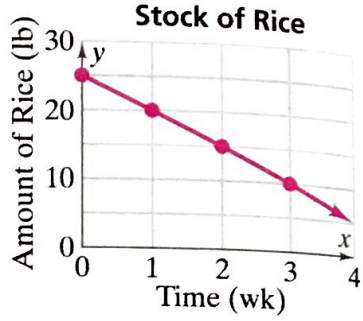
x	4	5	6	7
y	−2	0	2	4

9.

x	−2	−1	0	1
y	3	2	1	0

GPS

10. **Guided Problem Solving** The graph at the right shows the amount of rice a store has in stock at different times. Use the slope to describe how the amount of rice changes over time.
    - How is the rate of change related to the slope?



11. **Error Analysis** Your classmate said that the slope of a line through (1, 3) and (7, 5) is 3. What error did your classmate make?

12. Which roof is steeper: a roof with a rise of 12 and a run of 7 or a roof with a rise of 8 and a run of 4?

13. **Writing in Math** Point $A(-2, 3)$ lies on a line with a slope of 2. Describe how to find two points on the line on either side of A.

14. **Challenge** Determine whether this statement is *true* or *false*. If the statement is false, rewrite it to make it true. If two lines have the same slope, their equations describe the same line.

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Test Prep and Mixed Review

Practice

Multiple Choice

15. The slope of the line passing through the points (2, 3) and $(4, y)$ is $\frac{3}{2}$. Which is the value of y?
    Ⓐ 9 Ⓑ 6 Ⓒ −6 Ⓓ −9

16. The height of a melting ice sculpture is given by the function $h = 54 - \frac{1}{3}t$ where h is its height in inches and t is time in minutes. How long will it take the ice sculpture to completely melt?
    Ⓕ 162 min Ⓖ 81 min Ⓗ 54 min Ⓙ 18 min

17. A farmer has 35 square miles of land in the shape of a square. Which is closest to the measure of each side of the farm?
    Ⓐ 6 mi Ⓑ 9 mi Ⓒ 18 mi Ⓓ 36 mi

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For Exercises	See Lesson
18–20	1-7

Find the distance between the two points.

18. (1, 5) and (4, 7)
19. (3, 6) and (0, 10)
20. (−1, 2) and (−2, −6)