Lesson 2

Slope

What You'll Learn

Scan the lesson. Predict two things you will learn about slope.

- Sample answers: definition of slope
- finding the slope using a graph or table

Essential Question

WHY are graphs helpful?

Vocabulary

slope
rise
run

Common Core State Standards

Content Standards
Preparation for 8.EE.5

Mathematical Practices
1, 3, 4

Vocabulary Start-Up

Vocab

The term *slope* is used to describe the steepness of a straight line. **Slope** is the ratio of the **rise**, or vertical change, to the **run** or horizontal change.

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The term *slope* is used to describe the steepness of a straight line. **Slope** is the ratio of the **rise**, or vertical change, to the **run** or horizontal change.

Complete the graphic organizer. Sample answers are given.

slope

I think this word means...
downward or slant

How is this concept related to other math concepts?
It is a ratio.

Where have I heard this word in my life?
to describe a roof or hillside

What makes this an important word for me to know?
so I can describe the steepness of a straight line

CCSS Common Co... State Stand...

Content Standards
Preparation for 8.EE.5

Mathematical Practice
1, 3, 4

Real-World Link

A ride at an amusement park rises 8 feet every horizontal change of 2 feet. How could you determine the slope of the ride?

Sample answer: Write the ratio of rise to run or 8 feet to 2 feet and simplify to 4.

Find Slope Using a Graph or Table

Slope is a rate of change. It can be positive (slanting upward) or negative (slanting downward).

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

← vertical change between any two points

← horizontal change between the same two points

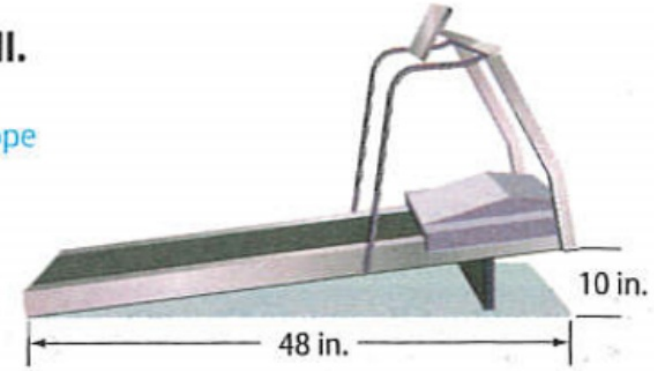
Example

1. Find the slope of the treadmill.

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$ Definition of slope

$$= \frac{10 \text{ in.}}{48 \text{ in.}}$$ rise = 10 in., run = 48 in.

$$= \frac{5}{24}$$ Simplify.



The slope of the treadmill is $\frac{5}{24}$.

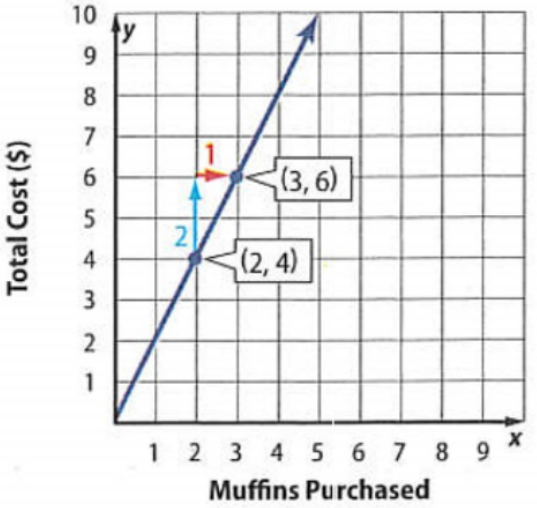
Translating Rise and Run

up → positive
down → negative
right → positive
left → negative

Examples

Tutor

2. The graph shows the cost of muffins at a bake sale. Find the slope of the line.



Choose two points on the line. The vertical change is 2 units and the horizontal change is 1 unit.

$$\text{slope} = \frac{\text{rise}}{\text{run}} \quad \text{Definition of slope}$$

$$= \frac{2}{1} \quad \text{rise} = 2, \text{run} = 1$$

The slope of the line is $\frac{2}{1}$ or 2.

3. **The table shows the number of pages Garrett has left to read after a certain number of minutes. The points lie on a line. Find the slope of the line.**

Time (min), x	Pages left, y
1	12
3	9
5	6
7	3

x_2 y_2

x_1 y_1

Choose any two points from the table to find the changes in the x- and y-values.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x}$$ Definition of slope

$$= \frac{9 - 12}{3 - 1}$$ Use the points (1, 12) and (3, 9).

$$= \frac{-3}{2} \text{ or } -\frac{3}{2}$$ Simplify.

To check, choose two different points from the table and find the slope.

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

$$= \frac{3 - 6}{7 - 5}$$

$$= \frac{-3}{2} \text{ or } -\frac{3}{2}$$ ✓

$$m = \frac{12 - 3}{1 - 7} = \frac{9}{-6}$$

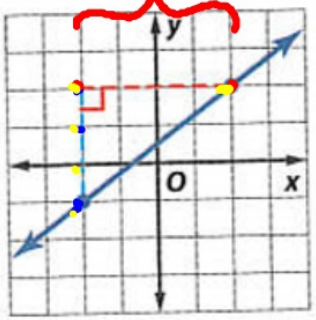
$$= -\frac{3}{2}$$

Got It? Do these problems to find out.

Show your work.

Find the slope of each line.

b.



c.

x	−6	−2	2	6
y	−2	−1	0	1

b. $\frac{3}{4}$

c. $\frac{1}{4}$

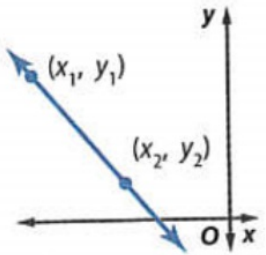
Slope Formula

Key Concept

Words The slope m of a line passing through points (x_1, y_1) and (x_2, y_2) is the ratio of the difference in the y-coordinates to the corresponding difference in the x-coordinates.

Symbols $m = \frac{y_2 - y_1}{x_2 - x_1}$, where $x_2 \neq x_1$

Model



It does not matter which point you define as (x_1, y_1) and (x_2, y_2). However the coordinates of both points must be used in the same order.

Using the Slope Formula

To check Example 4, let $(x_1, y_1) = (-4, 3)$ and $(x_2, y_2) = (1, 2)$. Then find the slope.

d

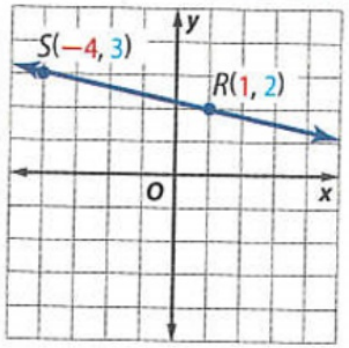
e

Show your work.

Example

Watch Tutor

4. **Find the slope of the line that passes through $R(1, 2)$, $S(-4, 3)$.**



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

$$m = \frac{3 - 2}{-4 - 1}$$ $(x_1, y_1) = (1, 2)$, $(x_2, y_2) = (-4, 3)$

$$m = \frac{1}{-5} \text{ or } -\frac{1}{5}$$ Simplify.

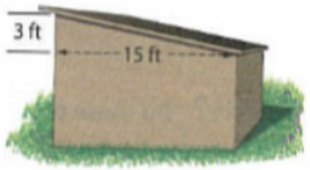
Got It? **Do these problems to find out.**

d. $A(2, 2)$, $B(5, 3)$

e. $J(-7, -4)$, $K(-3, -2)$

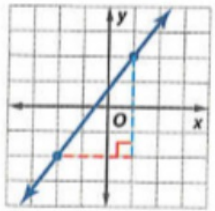
1. Find the slope of the storage shed's roof. (Example 1)

$\frac{1}{5}$ or $-\frac{1}{5}$



Find the slope of each line. (Examples 2 and 3)

2. $\frac{4}{3}$



3. 2

x	0	1	2	3
y	1	3	5	7

Find the slope of the line that passes through each pair of points. (Example 4)

4. $A(-3, -2), B(5, 4)$ $\frac{3}{4}$

5. $E(-6, 5), F(3, -3)$ $-\frac{8}{9}$

6. **Building on the Essential Question** In any linear relationship, explain why the slope is always the same.

Sample answer: The slope is the same as the rate of change. In a linear relationship, the rate of change is constant.

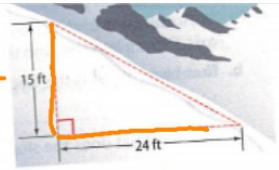
Rate Yourself!

How well do you understand slope? Circle the image that applies.

For more help, go online to access a Personal Tutor. Tutor

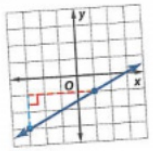
1 Find the slope of a ski run that descends 15 feet for every horizontal change of 24 feet. (Example 1)

$\frac{5}{8}$



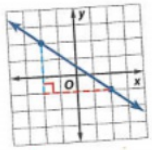
Find the slope of each line. (Example 2)

2.



$\frac{1}{2}$

3.



$\frac{3}{4}$

The points given in the table lie on a line. Find the slope of each line. (Example 3)

4.

x	0	2	4	6
y	9	4	−1	−6

$\frac{5}{2}$

5.

x	0	1	2	3
y	3	5	7	9

2

Find the slope of the line that passes through each pair of points. (Example 4)

6. $A(0, 1), B(2, 7)$ 3

7 $C(2, 5), D(3, 1)$ −4

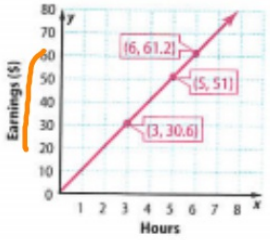
$$\frac{5-1}{2-3} = \frac{4}{-1}$$

8. $E(1, 2), F(4, 7)$ $\frac{5}{3}$

9. CCSS **Justify Conclusions** Wheelchair ramps for access to public buildings are allowed a maximum of one inch of vertical increase for every one foot of horizontal distance. Would a ramp that is 10 feet long and 8 inches tall meet this guideline? Explain your reasoning to a classmate.

yes; $\frac{1}{15} < \frac{1}{12}$

10. **Multiple Representations** For working 3 hours, Sofia earns $30.60. For working 5 hours, she earns $51. For working 6 hours, she earns $61.20.



a. **Graphs** Graph the information with hours on the horizontal axis and money earned on the vertical axis. Draw a line through the points.

b. **Numbers** What is the slope of the line?

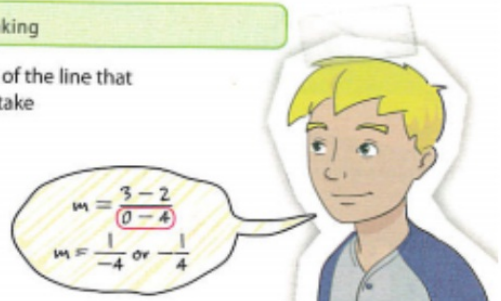
10.2

c. **Words** What does the slope of the line represent?

How does the slope relate to the unit rate? the amount she made per hour, $10.20; the slope and the unit rate are the same

H.O.T. Problems Higher Order Thinking

11. **Find the Error** Jacob is finding the slope of the line that passes through $X(0, 2)$ and $Y(4, 3)$. Circle his mistake and correct it.

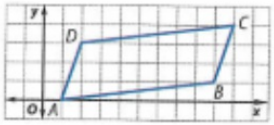


Jacob did not use the x-coordinates in the same order as the y-coordinates.

$$m = \frac{3-2}{4-0}$$

$$m = \frac{1}{4}$$

12. **Persevere with Problems** Two lines that are parallel have the same slope. Determine whether quadrilateral $ABCD$ is a parallelogram. Justify your reasoning.



Slope of $\overline{AB}$: $m = \frac{1-0}{9-1}$ or $\frac{1}{8}$

Slope of $\overline{BC}$: $m = \frac{4-1}{10-9}$ or 3

Slope of $\overline{CD}$: $m = \frac{3-4}{2-10}$ or $\frac{1}{8}$

Slope of $\overline{DA}$: $m = \frac{0-3}{1-2}$ or 3

Since $\overline{AB}$ and $\overline{CD}$ are parallel, and $\overline{BC}$ and $\overline{DA}$ are parallel, quadrilateral $ABCD$ is a parallelogram.

13. **Model with Mathematics** Give three points that lie on a line with each of the following slopes. Sample answers are given.

a. 5 (1, 1), (2, 6), (3, 11)

b. $\frac{1}{5}$ (1, 1), (6, 2), (11, 3)

c. -5 (1, 1), (0, 6), (−1, 11)