

Solve & Discuss It!

In the fall, Rashida earns money as a soccer referee for her town's under-10 soccer league. So far, she has worked 5 games and has been paid \$98.50. She will work a total of 14 games this fall. How can Rashida determine how much she will earn refereeing soccer games this fall?


Look for Relationships
How is the number of games Rashida works related to her earnings?

Lesson 7-6

Connect Proportional Relationships and Slope

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I can...
understand the slope of a line.



Focus on math practices

Reasoning How would Rashida's earnings change if she were paid by the hour instead of by the game?

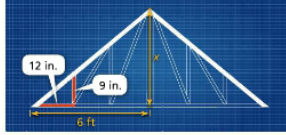
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Essential Question

What is slope?

EXAMPLE 1 Understand Slope

Maya and her father are building a tree house. The roof will have a 9:12 pitch; that is, for every 12 inches of horizontal distance, the roof rises 9 inches. How can Maya determine the height of the roof at its peak?

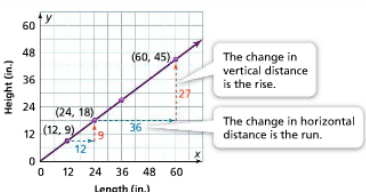


STEP 1 Make a table of values that show the 9 : 12 pitch.

Vertical distance	9	18	27	45
Horizontal distance	12	24	36	60
vertical distance / horizontal distance	$\frac{9}{12} = \frac{3}{4}$	$\frac{18}{24} = \frac{3}{4}$	$\frac{27}{36} = \frac{3}{4}$	$\frac{45}{60} = \frac{3}{4}$

Find the constant of proportionality.

STEP 2 Graph the ordered pairs from the table and draw a line to connect them. The line shows the steepness of the roof. The steepness is also called the slope of the line. The **slope** of the line is the ratio $\frac{\text{rise}}{\text{run}}$. Maya can use a graph to find that the roof is 54 inches in height at its peak.




Try It!

Jack graphs how far he plans to bike over a 3-day charity ride. Find the slope of the line.

slope = $\frac{\text{rise}}{\text{run}} = \frac{\square}{\square}$. The slope of the line is \square .

Convince Me! How do the unit rate and constant of proportionality relate to the slope of a line?



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EXAMPLE 2 Find the Slope from Two Points

The graph represents the depth of a diving submarine over time. At what speed is the submarine descending?

Find the slope of the line.

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

$$= \frac{-800 - (-400)}{10 - 5}$$

$$= \frac{-400}{5}$$

$$= -80$$

The slope of the line is -80 . The submarine is descending at a rate of 80 feet per minute.

Reasoning How do the x - and y -coordinates relate when the slope is negative?

The rise is the change in the y -coordinates or $y_2 - y_1$.

The run is the change in the x -coordinates or $x_2 - x_1$.

EXAMPLE 3 Interpret Slope

The graph shows the distance a car travels over time. Find the slope of the line. What does it mean in the problem situation?

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

$$= \frac{220 - 110}{4 - 2}$$

$$= 55$$

The slope of the line is 55. The car travels 55 miles per hour.

Try It!

The graph shows the proportions of red and blue food coloring that Taylor mixes to make purple frosting. What is the slope of the line? Tell what it means in the problem situation.

Purple Food Coloring

KEY CONCEPT

Slope is the measure of the steepness of a line. It represents the ratio of the rise (that is, the vertical distance) to the run (the horizontal distance) between two points on the line. In proportional relationships, slope is the same as the unit rate and constant of proportionality.

$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x}$

$\frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - 45}{1 - 3}$

Theater Price

rise = 30
run = 2
slope = $\frac{30}{2} = 15$. The slope of the line is 15.

rise = 75 - 45 = 30
run = 5 - 3 = 2

1 ticket costs \$15. The constant of proportionality is 15.

- Do You Understand?**
- Essential Question** What is slope?
 - Reasoning** How is the slope related to a unit rate?
 - Look for Relationships** Why is the slope between any two points on a straight line always the same?

- Do You Know How?**
- What is the slope of the line?
 - The scale of a model airplane is shown in the graph.
 - Find the slope of the line using $\frac{y_2 - y_1}{x_2 - x_1}$.
 - What does the slope mean in the problem situation?

$$\frac{\Delta y}{\Delta x} = \frac{150 - 50}{6 - 2} = \frac{100}{4} = \frac{25}{1} \quad (x, y)$$

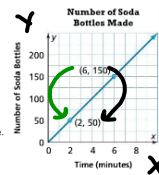
Practice & Problem Solving

Leveled Practice In 6 and 7, find the slope of each line.

6. The graph shows the number of soda bottles a machine can make over time. Use the two points shown to find the number of soda bottles the machine can make per minute.

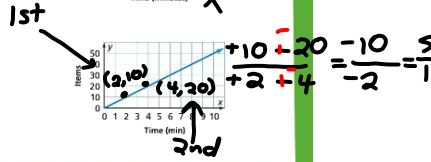
$$\frac{150 - 50}{6 - 2} = \frac{100}{4} = 25$$

The machine can make 25 soda bottles each minute.



7. Find the slope of the line.

slope = $\frac{\Delta y}{\Delta x}$
 $\frac{-10}{-2} = \frac{5}{1}$
 The slope is 5

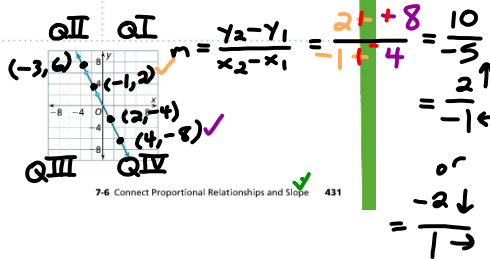


8. Reasoning How can you find the slope of the line that passes through the points (0, 0) and (2, 4)? Explain.

9. The points (2, 1, -4, 2) and (2, 5, -5) form a proportional relationship. What is the slope of the line that passes through these two points?

Quadrant

10. Find the slope of the line.

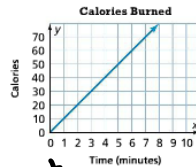


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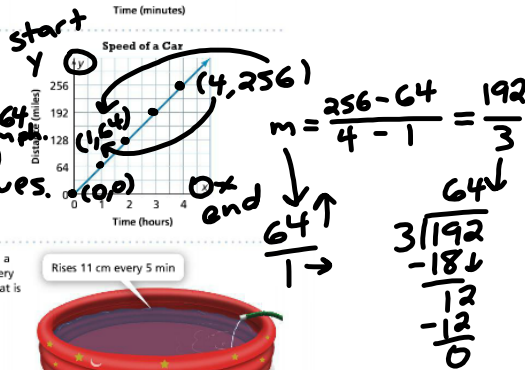
11. The graph shows the number of Calories Natalia burned while running.

- What is the slope of the line?
- What does the slope tell you?

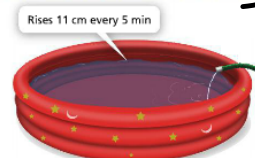


12. Critique Reasoning A question on a test provides this graph and asks students to find the speed at which the car travels. Anna incorrectly says that the speed of the car is $\frac{1}{64}$ mile per hour.

The speed of the car is 64 mph. She might have mixed up the x and y values.



13. Higher Order Thinking You use a garden hose to fill a wading pool. If the water level rises 11 centimeters every 5 minutes and you record the data point of (10, y), what is the value of y? Use slope to justify your answer.



Assessment Practice

14. The points (15, 21) and (25, 35) form a proportional relationship.
- Find the slope of the line that passes through these points.
 - Which graph represents this relationship?

