

Explore It!

The graph shows the time it takes Jacey to print T-shirts for her school's math club.

Lesson 2-5

Graph Proportional Relationships

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I can... use a graph to determine whether two quantities are proportional.

A. Use the points on the graph to complete the table. Are the quantities proportional? Explain.

Number of T-Shirts (x)	Time in Minutes (y)

B. Start at (1, 5). As you move from one point to the next on the graph, how does the x-coordinate change? How does the y-coordinate change?

C. Write the points for 0 T-shirts and for 5 T-shirts as ordered pairs. Graph the points and draw the line that passes through all six points.

Focus on math practices

Reasoning Suppose that after printing 4 T-shirts it takes Jacey 4 minutes to change the ink cartridge. Would this point for 5 T-shirts lie on the line you drew in Part C? Explain.

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Essential Question

What does the graph of a proportional relationship look like?

EXAMPLE 1

Graph to Recognize a Proportional Relationship

Scan for Multimedia

Tanya exercised for 30 minutes. She noted the Calories burned at three times during her workout. How can Tanya use this information to find how many Calories she burned after 15 minutes of exercise?

10:00
TIME

95
CALORIES

20:00
TIME

190
CALORIES

30:00
TIME

285
CALORIES

Model with Math You can represent the situation on the coordinate plane.

STEP 1 Use a graph to display the data.

The graph is a straight line through the origin, (0, 0).

The relationship between exercise time, x , and Calories burned, y , is proportional.

STEP 2 Use the graph to find the constant of proportionality.

Find the differences between the coordinates of any two ordered pairs.

The constant of proportionality is $\frac{95}{10}$ or 9.5.

Tanya can use the graph and the constant of proportionality to determine that she burned 142.5 Calories in 15 minutes.

Try It!

Each $\frac{1}{4}$ -cup serving of cereal has 3 grams of protein. How can you use the graph at the right to determine whether the quantities are proportional and to find how many grams of protein are in 1 cup of the cereal?

Convince Me! How can you find the constant of proportionality from the coordinates of one point on the graph?

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EXAMPLE 2 Interpret the Graph of a Proportional Relationship

The graph shows a proportional relationship between the distance and the amount of time Mr. Brown drives.

a. What does each of these points represent in this situation: (0, 0), (1, 55), and (5, 275)?

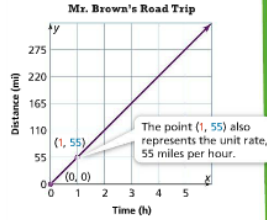
(0, 0): Mr. Brown drives 0 miles in 0 hours.
 (1, 55): Mr. Brown drives 55 miles in 1 hour.
 (5, 275): Mr. Brown drives 275 miles in 5 hours.

b. What is the constant of proportionality?

Find the y-coordinate when x is 1.
 The constant of proportionality is 55.

c. What equation relates the distance, y, and the time, x?

$y = 55x$



Try It!

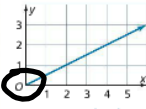
Suppose the graph of Mr. Brown's Road Trip is extended. Find the ordered pair with an x-coordinate of 7. What does this point represent in the situation?

If the graph is extended, it will pass through the point (7,). This means

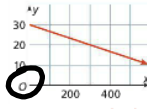
Mr. Brown drives miles in hours.

EXAMPLE 3 Recognize Graphs of Proportional Relationships

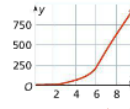
Explain why each graph does or does not show a proportional relationship.



Proportional
 The graph is a straight line that passes through the origin.



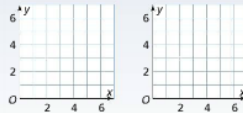
NOT Proportional
 The graph is a straight line but does not pass through the origin.



NOT Proportional
 The graph passes through the origin but is not a straight line.

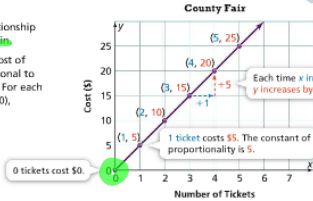
Try It!

Draw two graphs that pass through the point (2, 3), one that represents a proportional relationship and one that does not. Label your graphs as *Proportional* or *NOT Proportional*.



KEY CONCEPT

The graph of a proportional relationship is a **straight line through the origin**. This graph shows that the total cost of tickets at a county fair is proportional to the number of tickets purchased. For each point (x, y) on the line except (0, 0), $\frac{y}{x} = 5$, which is the constant of proportionality.



(x, y)

↑ +
 ↓ -
 ← +
 → +

Do You Understand?

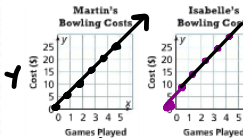
- Essential Question** What does the graph of a proportional relationship look like?
- Reasoning** Why will the graph of every proportional relationship include the point (0, 0)?
- Construct Arguments** Makyla plotted two points, (0, 0) and (3, 33), on a coordinate grid. Noah says that she is graphing a proportional relationship. Is Noah correct? Explain.

Do You Know How?

For 4-7, use the information below.

Martin and Isabelle go bowling. Each game costs \$10, and they split that cost. Martin has his own bowling shoes, but Isabelle pays \$3 to rent shoes.

4. Complete the graphs below.



Games	Martin Cost \$	Isabelle Cost \$
0	0	0
1	5	8
2	10	13
3	15	18
4	20	23
5	25	28

- Which graph shows a proportional relationship? Explain why.
Martin has a k value of 5 so his graph is proportional.
- Choose one point on the graph of the proportional relationship and explain what this point means in terms of the situation.

7. What equation represents the proportional relationship?

$y = k \cdot x$

$y = 5x$

Name: _____

Practice & Problem Solving

8. For each graph shown, tell whether it shows a proportional relationship. Explain your reasoning.

a.

b.

c.

9. The graph shows the number of boxes a machine packages over time. Is the relationship proportional? How many boxes does the machine package in 4 minutes?

10. Does the graph show a proportional relationship? If so, use the graph to find the constant of proportionality.

11. The graph shows a proportional relationship between the cups of flour a baker uses and the number of cookies made.

a. Use Structure What does the point (0, 0) represent in the situation?

b. What does the point (1, 18) represent?

Proportional straight line through the origin (0,0)

not proportional
crossed line

Not proportional since it does not start at the origin (0,0)

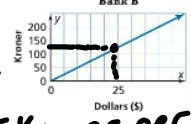
One cup of flour makes 18 cookies.

12. The points $(0.5, \frac{1}{10})$ and $(7, \frac{1}{2})$ are on the graph of a proportional relationship.
- What is the constant of proportionality?
 - Name one more point on the graph.
 - Write an equation that represents the proportional relationship.

13. Higher Order Thinking Denmark uses the kroner as its currency. Before a trip to Denmark, Mia wants to exchange \$1,700 for kroner.
- Does Bank A or Bank B have the better exchange rate? Explain.
 - How many more kroner would Mia get if she exchanged her \$1,700 at the bank with the better exchange rate?

Bank A	
Dollars (\$)	Kroner
80	408
100	510
120	612

5.1 Kroner per \$



125 / 25 = 5 Kroner per \$

$$\frac{\text{Kr}}{\$} = \frac{408}{80} = 5.1$$

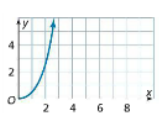
$$\frac{510}{100} = 5.1$$

$$\frac{612}{120} = 5.1$$

"constant" → K

Assessment Practice

14. Does the graph at the right show a proportional relationship between x and y ? Explain.



15. The graph at the right shows the relationship between rainfall during the growing season and the growth of a type of plant. Which of the following is true? Select all that apply.
- The point $(1, 10)$ shows the constant of proportionality.
 - The constant of proportionality is $\frac{5}{7}$.
 - The graph does not show a proportional relationship.
 - The point $(0, 0)$ means without rain, there is no plant growth.
 - The point $(28, 20)$ means the type of plant grows 20 mm when it rains 28 cm.

