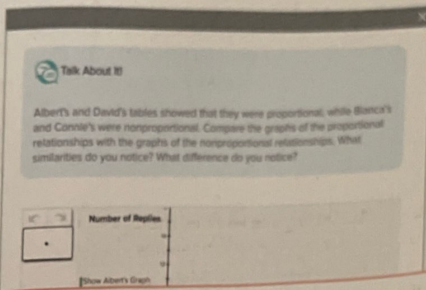


Graphs of Proportional Relationships

I Can... determine if a relationship is proportional by analyzing its graph and explain what the points $(0, 0)$ and $(1, r)$ mean on the graph of a proportional relationship.

Explore Proportional Relationships, Tables, and Graphs

Online Activity You will use Web Sketchpad to explore the graphs of proportional and nonproportional linear relationships.

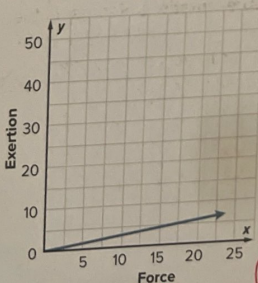


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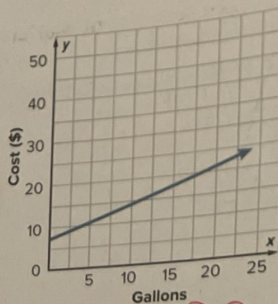
Learn Proportional Relationships and Graphs

A graph shows a proportional relationship if it is a straight line through the origin. A graph shows a nonproportional relationship if it is not a straight line, or is a straight line that does not pass through the origin.

Determine if the relationship shown in each graph is *proportional* or *nonproportional*.



proportional



Non proportional

Talk About It!
Why does the line of the graph of a proportional relationship need to be straight and pass through the origin?

Example 1 Proportional Relationships and Graphs



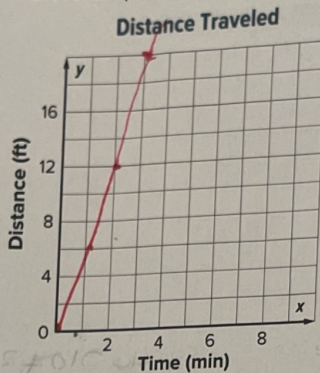
Think About It!
How will the table help you graph the relationship?

A rabbit challenges a tortoise to a race. The table shows the distance that the tortoise moved after 0, 1, 2, and 3 minutes.

Time (min)	Distance (ft)
0	0
1	6
2	12
3	18

Determine whether the number of feet the tortoise moves is proportional to the number of minutes by graphing the relationship on the coordinate plane.

Part A Graph the relationship.



Part B Describe the relationship.

The line is straight and passes through the origin. So, the relationship is proportional.



Talk About It!
If the graph of a proportional relationship must be a straight line through the origin, how does the table illustrate that same information?

Check

In a pack of snacks, one piece has 5 Calories, two pieces have 10 Calories, and three pieces have 15 Calories.

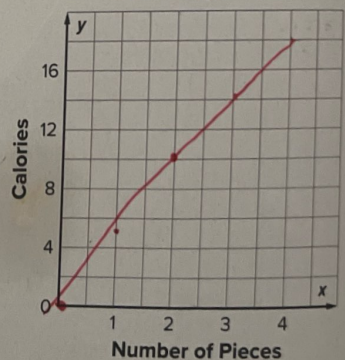
Part A Graph the relationship for 0, 1, 2, and 3 pieces on the coordinate plane.

Part B Describe the relationship.

constant = 5

x	y
0	0
1	5
2	10
3	15

Calories per Piece



Go Online You can complete an Extra Example online.

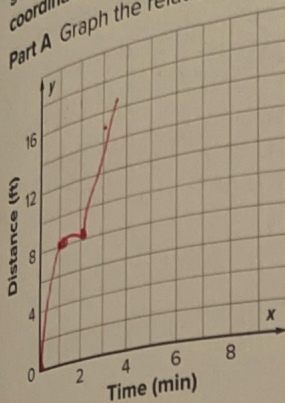
Example 2 Proportional Relationships and Graphs

A rabbit challenges a tortoise to a race. The table shows the distance that the rabbit moved after 0, 1, 2, and 3 minutes.

Time (min)	Distance (ft)
0	0
1	8
2	8
3	15

Determine if the distance the rabbit moves is proportional to the time by graphing the relationship on the coordinate plane.

Part A Graph the relationship.



Part B Describe the relationship.

The relationship between time and distance is not proportional because the graph is not a straight line.

Talk About It!

Is there another way to determine if the relationship is proportional or nonproportional?

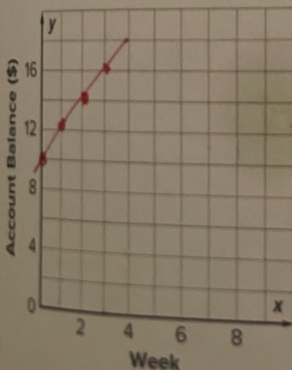
Check

The table shows the account balance in a savings account at the end of each week.

Determine if the account balance is proportional to the time by graphing the relationship on the coordinate plane.

Time (wk)	Account Balance (\$)
0	10
1	12
2	14
3	16

Part A Graph the relationship.



Part B Describe the relationship.

Talk About It!

What part of the scenario makes the relationship nonproportional?

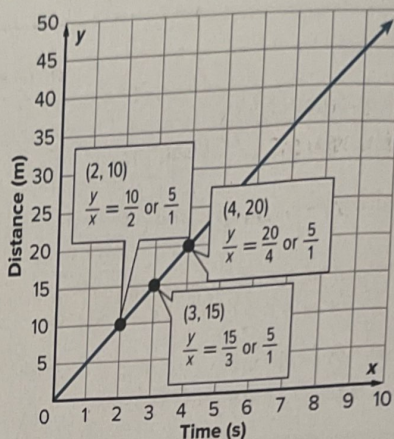
Not proportional
Because it doesn't start from the origin

Go Online
You can complete an Extra Example online.

Learn Find the Constant of Proportionality from Graphs

When a proportional relationship is graphed, you can determine the constant of proportionality using any point on the line other than the origin. The constant of proportionality is the ratio of $\frac{y}{x}$ for any point on the line, except (0, 0), when $x = 1$.

Write each ordered pair and write the ratio $\frac{y}{x}$, when $x = 1$, for each.



Example 3 Find the Constant of Proportionality from Graphs

Think About It!

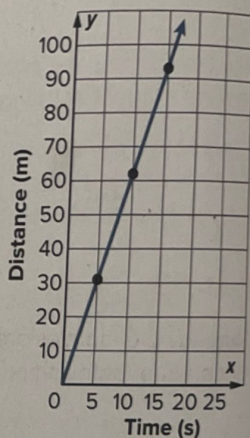
How would you begin solving the problem?

In a 100-meter race, assuming the runner's rate is constant, the distance run is proportional to the time spent running. One runner's data are shown on the graph.

Find the constant of proportionality and describe what it means.

Part A Find the constant of proportionality.

The ratios $\frac{y}{x}$ or $\frac{\text{distance}}{\text{time}}$ for all of the given points are shown.



$$\frac{y}{x} = \frac{31}{5} = \frac{6.2}{1} \quad \frac{y}{x} = \frac{62}{10} = \frac{6.2}{1} \quad \frac{y}{x} = \frac{93}{15} = \frac{6.2}{1}$$

Write the ratios with a denominator of 1 to find the constant of proportionality. Each ratio has a denominator of 1, so the constant of proportionality is 6.2.

Part B Describe the constant of proportionality.

Because the constant of proportionality is 6.2, this means that the runner moves at a rate of 6.2 meters per second.

Talk About It!

Based on the constant of proportionality, 6.2, how far will the runner travel after 20 seconds? Explain your reasoning.

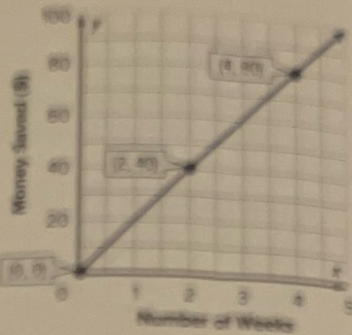
Check

Briana decides to save money each week for her family vacation. Use the graph to find the constant of proportionality. Then describe what it means.

Part A The constant of proportionality is 20.

Part B The constant of proportionality means that Briana saves 20 each week.

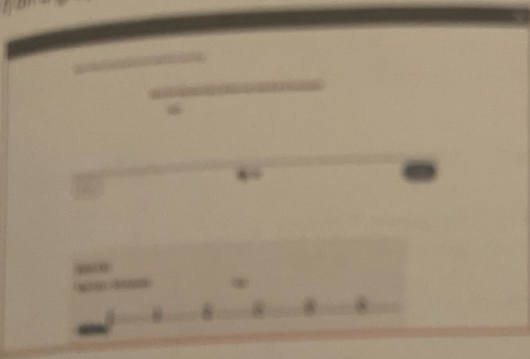
Go Online You can complete an Extra Example online.



Constant of Proportionality = Unit Rate

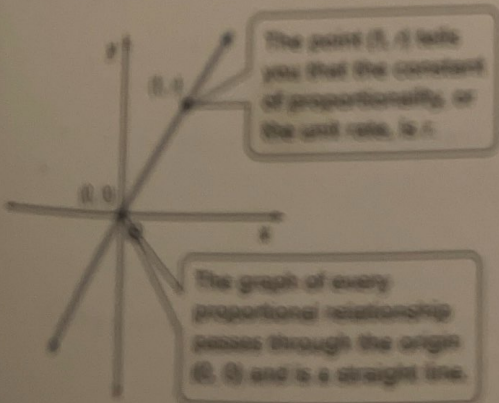
Explore Analyze Points

Online Activity You will explore and analyze the points $(0, 0)$ and $(1, 1)$ on a graph of a proportional relationship.



Learn Analyze Points on a Graph

When two quantities are proportional, you can use a graph to find the constant of proportionality and to interpret the point $(0, 0)$.



Talk About It

What is the significance of $(0, 0)$ on the graph of a proportional relationship?

Think About It!

In the ordered pairs, what does the x -coordinate represent? the y -coordinate?

constant
is 25

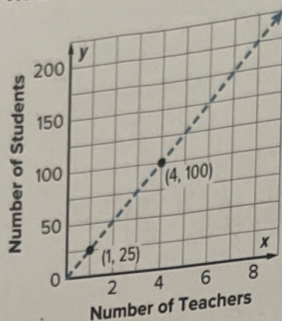
Talk About It!

Can you find the unit rate from any point on a graph that shows a proportional relationship? Explain your reasoning.

Example 4 Analyze Points on a Graph

The number of students on a school trip is proportional to the number of teachers as shown in the graph. The line representing the relationship is a dashed line because the number of teachers can only be a whole number.

What do the points $(0, 0)$ and $(1, 25)$ represent?



1 teacher takes
25 student

The point $(0, 0)$ means that, for zero teachers, there are zero students.

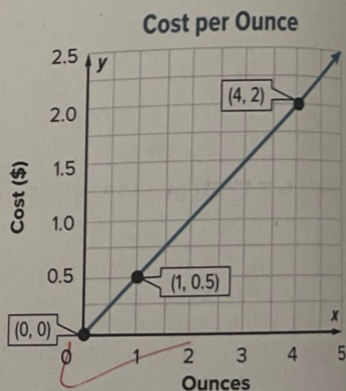
The point $(1, 25)$ means that, for one teacher, there are 25 students. This also means that the constant of proportionality is 25 and the unit rate is 25 students for every 1 teacher.

Check

The cost of a smoothie is proportional to the number of ounces as shown in the graph.

Select all statements that apply.

- ☐ The unit rate is 0.
- ☒ The unit rate is 0.5.
- ☐ The unit rate is 1.
- ☐ For each smoothie, it costs \$1.50 for every 1 ounce.
- ☐ For each smoothie, it costs \$2 for every 1 ounce.
- ☒ For each smoothie, it costs \$1 for every 2 ounces.
- ☒ For each smoothie, it costs \$2.00 for every 4 ounces.

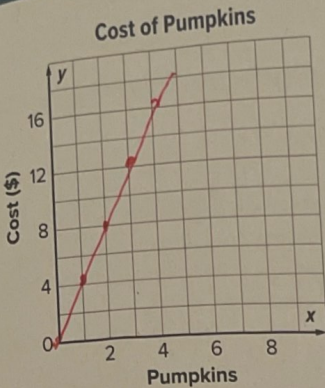


Go Online You can complete an Extra Example online.

Practice

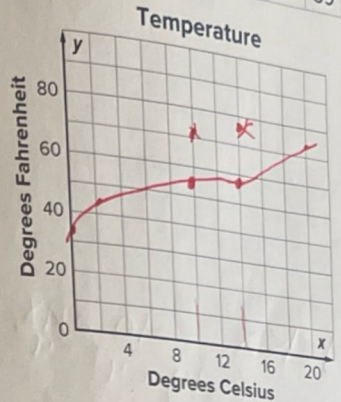
1. The cost of pumpkins is shown in the table. Determine whether the cost of a pumpkin is proportional to the number bought by graphing the relationship on the coordinate plane. Explain. (Example 1)

Number of Pumpkins	0	1	2	3	4
Cost (\$)	0	4	8	12	16



2. The table shows temperatures in degrees Celsius and their equivalent temperatures in degrees Fahrenheit. Determine whether the temperature in degrees Fahrenheit is proportional to the temperature in degrees Celsius by graphing the relationship on the coordinate plane. Explain. (Example 2)

Celsius (degrees)	0	5	10	15	20
Fahrenheit (degrees)	32	41	50	59	68

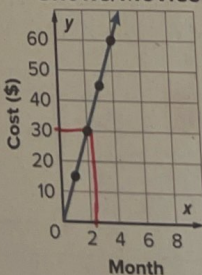


Not proportional

Test Practice

3. The total cost of online streaming is proportional to the number of months. What is the constant of proportionality? (Example 3)

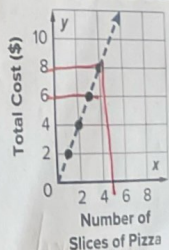
Online Streaming of TV Shows/Movies



$$\frac{30}{2} = 15$$

4. **Open Response** The cost per slice of pizza is proportional to the number of slices as shown in the graph. What do the points (0, 0) and (1, 2) represent? (Example 4)

Pizza Slices Cost

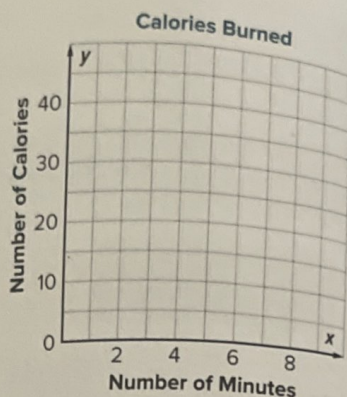


$$\frac{8}{4} = 2$$

Apply

5. The table shows the number of Calories José and Natalie burned after 1, 2, and 3 minutes of running. Graph the relationship between the number of minutes running and the number of Calories burned for each person. By which ordered pair is a unit rate represented?

Time (min)	Calories Burned	
	José	Natalie
0	0	0
1	8	5
2	15	10
3	23	15



6. **MP Identify Repeated Reasoning** Suppose a relationship is proportional and the point (4, 10) lies on the graph of the proportional relationship. Name another point, other than (0, 0), that lies on the graph of the line.

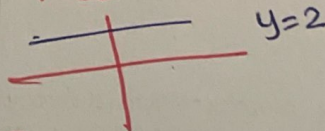
$$y = kx \quad \frac{10}{4} = \frac{kx}{x}$$

$$x = \frac{10}{\frac{5}{2}} = 4$$

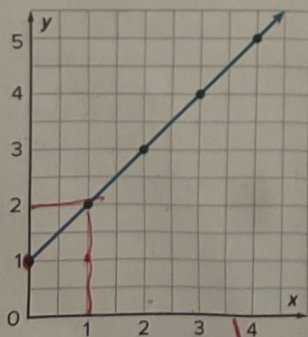
$$x = 2 \quad y = 5 \quad (2, 5)$$

7. **MP Make an Argument** Determine if a line can have a constant rate and not be proportional. Write an argument to defend your response.

yes, a line with a constant rate could be disproportional



8. **MP Find the Error** Karl said the point (1, 1) represents the constant of proportionality for the graph shown. Find his error and correct it.



Not proportional

9. **Create** The graph of a proportional relationship is shown. Describe a real-world situation that could be represented by the graph. Be sure to include the meaning of the constant of proportionality.

