Proportional Linear Relationships

Key Concept

Words Two quantities a and b have a proportional linear relationship if they have a constant ratio and a constant rate of change.

Symbols $\frac{b}{a}$ is constant and $\frac{\text{change in } b}{\text{change in } a}$ is constant.

To determine if two quantities are proportional, compare the ratio $\frac{b}{a}$ for several pairs of points to determine if there is a constant ratio.

Example

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2. Use the table to determine if there is a proportional linear relationship between a temperature in degrees Fahrenheit and a temperature in degrees Celsius. Explain your reasoning.

x	Degrees Celsius	0	5	10	15	20
y	Degrees Fahrenheit	32	41	50	59	68

und +5 +5 +5 +5

+9 +9 +9 +9

Constant Rate of Change

$$\frac{\text{change in °F}}{\text{change in °C}} = \frac{9}{5}$$

Since the rate of change is constant, this is a linear relationship.

To determine if the two scales are proportional, express the relationship between the degrees for several columns as a ratio.

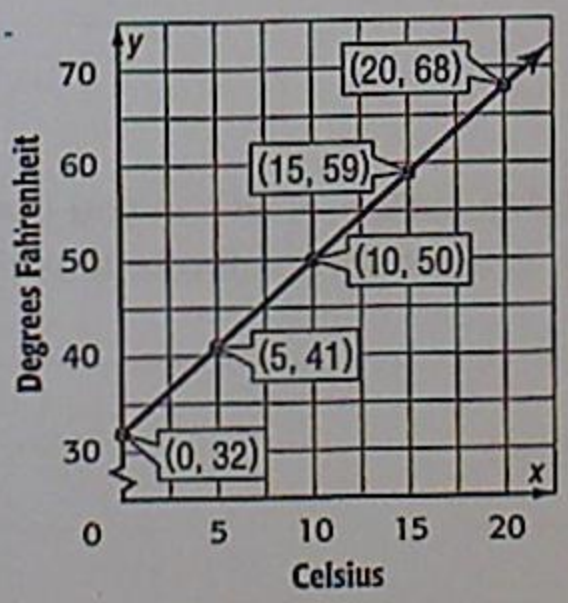
$$\frac{\text{degrees Fahrenheit}}{\text{degrees Celsius}} \rightarrow \frac{41}{5} = 8.2 \qquad \frac{50}{10} = 5 \qquad \frac{59}{15} \approx 3.9$$

Since the ratios are not the same, the relationship between degrees Fahrenheit degrees Celsius is *not* proportional.

Check: Graph the points on the coordinate plane. Then connect them with a line.

The points appear to fall in a straight line so the relationship is linear. ✓

The line connecting the points does not pass through the origin so the relationship is not proportional. ✓



① See if there's a constant rate of change
② If it does, take each y ÷ x
③ If those #s are the same, it's proportional

Proportional Relationships

Two quantities are proportional if they have a constant ratio.

$9 \div 5$
$5 \div 5 = 1.8$
linear

$32 \div 0 =$ und
$41 \div 5 = 8.2$
$50 \div 10 = 5$
$59 \div 15 = 3.9\overline{3}$
$68 \div 20 = 3.4$
not proportional

Show your work

Got It? Do this problem to find out.

c. Use the table to determine if there is a proportional linear relationship between mass of an object in kilograms and the weight of the object in pounds. Explain your reasoning.

Weight (lb)	20	40	60	80
Mass (kg)	9	18	27	36

+20 +20 +20 (Weight) +9 +9 +9 (Mass)

c. Yes because the rate of change is constant (0.45) and there is a constant ratio of 0.45

$\frac{9}{20} = 0.45$ $\frac{9}{20} = 0.45$ $\frac{18}{40} = 0.45$ $\frac{27}{60} = 0.45$ $\frac{36}{80} = 0.45$

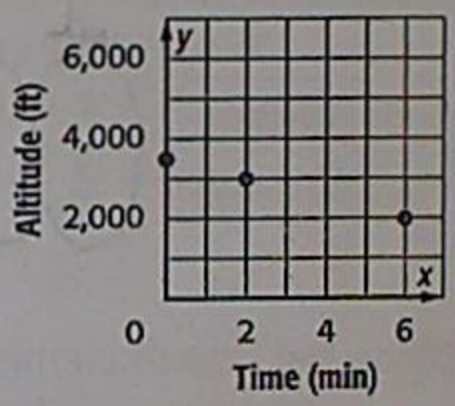
Guided Practice

Check

1. The amount of paint y needed to paint a certain amount of chairs x is shown in the table. Is the relationship between the two quantities linear? If so, find the constant rate of change. If not, explain your reasoning. (Example 1)

Paint Needed for Chairs	
Chairs, x	Cans of Paint, y
5	6
10	12
15	18

2. The altitude y of a certain airplane after a certain number of minutes x is shown in the graph. Is the relationship linear? If so, find the constant rate of change. If not, explain your reasoning. (Example 1)

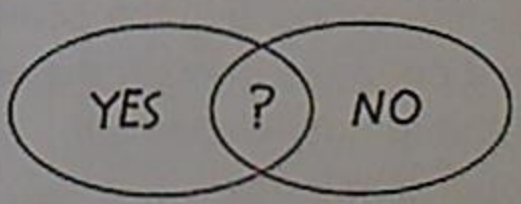


3. Determine whether a proportional relationship exists between the two quantities shown in Exercise 1. Explain your reasoning. (Example 2)

4. **Building on the Essential Question** How can you use a table to determine if there is a proportional relationship between two quantities?

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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