

# Proportional and Nonproportional Relationships



### What You'll Learn

Scan the lesson. Write the definitions of proportional and nonproportional.

- proportional \_\_\_\_\_
- nonproportional \_\_\_\_\_



### Essential Question

HOW can you show that two objects are proportional?



### Vocabulary

proportional  
nonproportional  
equivalent ratios



### Common Core State Standards

**Content Standards**  
7.RP.2, 7.RP.2a, 7.RP.2b

**Mathematical Practices**  
1, 3, 4



### Real-World Link

**Pizza Party** Ms. Cochran is planning a year-end pizza party for her students. Ace Pizza offers free delivery and charges \$8 per medium pizza.



- Complete the table to determine the cost for different numbers of pizzas ordered.

Cost (\$)	8	16	24	32	40	80	120
Pizza	1	2	3	4	5	10	15

PROPORTIONAL  
RELATIONSHIP



- For each number of pizzas, fill in the boxes to write the relationship of the cost and number of pizzas as a ratio in simplest form.

$$\frac{16}{2} = \frac{8}{1} \quad \frac{24}{3} = \frac{8}{1}$$

$$\frac{32}{4} = \frac{8}{1} \quad \frac{40}{5} = \frac{8}{1}$$



- What do you notice about the simplified ratios?

\_\_\_\_\_

\_\_\_\_\_



## Identify Proportional Relationships

Two quantities are **proportional** if they have a constant ratio or unit rate. For relationships in which this ratio is not constant, the two quantities are **nonproportional**.

In the pizza example on the previous page, the cost of an order is *proportional* to the number of pizzas ordered.

$$\frac{\text{cost of order}}{\text{pizzas ordered}} = \frac{8}{1} = \frac{16}{2} = \frac{24}{3} = \frac{32}{4} = \frac{40}{5} \text{ or } \$8 \text{ per pizza}$$

All of the ratios above are **equivalent ratios** because they all have the same value.



### Example



- Andrew earns \$18 per hour for mowing lawns. Is the amount of money he earns proportional to the number of hours he spends mowing? Explain.

Find the amount of money he earns for working a different number of hours. Make a table to show these amounts.

Earnings (\$)	18	36	54	72
Time (h)	1	2	3	4

For each number of hours worked, write the relationship of the amount he earned and hour as a ratio in simplest form.

$$\frac{\text{amount earned}}{\text{number of hours}} \rightarrow \frac{18}{1} \text{ or } 18 \quad \frac{36}{2} \text{ or } 18 \quad \frac{54}{3} \text{ or } 18 \quad \frac{72}{4} \text{ or } 18$$

All of the ratios between the two quantities can be simplified to 18.

The amount of money he earns is proportional to the number of hours he spends mowing.

### Got It? Do this problem to find out.

- At Lakeview Middle School, there are 2 homeroom teachers assigned to every 48 students. Is the number of students at this school proportional to the number of teachers? Explain your reasoning.

$$\frac{\text{STUDENTS}}{\text{TEACHERS}} = \frac{48}{2} = \frac{24}{1}$$

$$\frac{96}{4}$$

Show your work.



## Examples



2. Uptown Tickets charges \$7 per baseball game ticket plus a \$3 processing fee per order. Is the cost of an order proportional to the number of tickets ordered? Explain.

Cost (\$)	10	17	24	31
Tickets Ordered	1	2	3	4

For each number of tickets, write the relationship of the cost and number of tickets as a ratio in simplest form.

$$\frac{\text{cost of order}}{\text{tickets ordered}} \rightarrow \frac{10}{1} \text{ or } 10 \quad \frac{17}{2} \text{ or } 8.5 \quad \frac{24}{3} \text{ or } 8 \quad \frac{31}{4} \text{ or } 7.75$$

Since the ratios of the two quantities are not the same, the cost of an order is *not* proportional to the number of tickets ordered.



3. You can use the recipe shown to make a fruit punch. Is the amount of sugar used proportional to the amount of mix used? Explain.

Find the amount of sugar and mix needed for different numbers of batches. Make a table to help you solve.

Cups of Sugar	$\frac{1}{2}$	1	$1\frac{1}{2}$	2
Envelopes of Mix	1	2	3	4

For each number of cups of sugar, write the relationship of the cups and number of envelopes of mix as a ratio in simplest form.

$$\frac{\text{cups of sugar}}{\text{envelopes of mix}} \rightarrow \frac{\frac{1}{2}}{1} \text{ or } 0.5 \quad \frac{1}{2} \text{ or } 0.5 \quad \frac{1\frac{1}{2}}{3} \text{ or } 0.5 \quad \frac{2}{4} \text{ or } 0.5$$

All of the ratios between the two quantities can be simplified to 0.5. The amount of mix used is proportional to the amount of sugar used.



**Got It?** Do this problem to find out.

- b. At the beginning of the year, Isabel had \$120 in the bank. Each week, she deposits another \$20. Is her account balance proportional to the number of weeks of deposits? Use the table below. Explain your reasoning.

Time (wk)	1	2	3
Balance (\$)	140	160	180

*120    140    160*

**NON PROPORTIONAL**

$$\frac{10}{1} \neq \$7 \text{ TICKET} + \$3$$

$$\frac{20}{2} = \frac{10}{1}$$

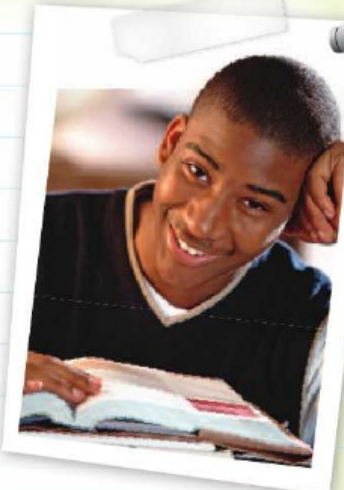


$$\frac{120}{1} = \frac{120}{1}$$

$$\frac{140}{2} = \frac{70}{1}$$

$$\frac{140}{1} = \frac{140}{1}$$

$$\frac{160}{2} = \frac{80}{1}$$



## Example



4. The tables shown represent the number of pages Martin and Gabriel read over time. Which situation represents a proportional relationship between the time spent reading and the number of pages read? Explain.

Pages Martin Read	2	4	6	8	Pages Gabriel Read	3	4	7	$\frac{10}{20}$
Time (min)	5	10	15	20	Time (min)	5	10	15	

Write the ratios for each time period in simplest form.

$$\frac{\text{pages}}{\text{minutes}} \rightarrow \frac{2}{5}, \frac{4}{10} \text{ or } \frac{2}{5}, \frac{6}{15} \text{ or } \frac{2}{5} \quad \frac{3}{5}, \frac{4}{10} \text{ or } \frac{2}{5}, \frac{7}{15}$$

All of the ratios between Martin's quantities are  $\frac{2}{5}$ . So, Martin's reading rate represents a proportional relationship.

## Guided Practice



1. The Vista Marina rents boats for \$25 per hour. In addition to the rental fee, there is a \$12 charge for fuel. Use a table to determine if the number of hours you rent the boat is proportional to the total cost. Explain. (Examples 1–3)

Rental Time (h)	1	2	3
Cost (\$)	37	62	87

$$\frac{37}{1} = \frac{37}{1} \quad \frac{62}{2} = \frac{31}{1}$$

$$\frac{37}{1} \neq \frac{31}{1}$$

2. Which situation represents a proportional relationship between the hours worked and amount earned for Matt and Jane? Explain. (Example 4)

*NON PROPORTIONAL*

*PROPORTIONAL*

Matt's Earnings (\$)	12	20	31
Time (h)	1	2	3

Jane's Earnings (\$)	12	24	36
Time (h)	1	2	3

$$\frac{12}{1} \quad \frac{18}{1.5}$$

### Rate Yourself!

How confident are you about determining proportional relationships? Shade the ring on the target.



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



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