Chapter 1 Ratios and Proportional Reasoning

Lesson 1-1 Rates
Page 13

3 Find the unit rate for 45.5 meters in 13 seconds. Round to the nearest hundredth if necessary.

45.5 meters in 13 seconds	$= \frac{45.5\text{m}}{13\text{s}}$	Write the rate as a fraction.
	$= \frac{45.5 \div 13}{13 \div 13}$	Divide the numerator and the denominator by 13.
	$= \frac{3.5\text{m}}{1\text{s}}$	Simplify.

The unit rate is 3.5 meters per second.

9 The record for the Boston Marathon's wheelchair division is 1 hour, 18 minutes, and 27 seconds.

a. The Boston Marathon is 26.2 miles long. What was the average speed of the record winner of the wheelchair division? Round to the nearest hundredth.

1 hr, 18 minutes, 27 seconds is $(1 + 18 \div 60 + 27 \div 3{,}600)$ hr or 1.3075 hr.	Write the time in hours.

26.2 miles in 1.3075 hours	$= \frac{26.2\text{miles}}{1.3075\text{hr}}$	Write the rate as a fraction.
	$= \frac{26.2 \div 1.3075}{1.3075 \div 1.3075}$	Divide the numerator and the denominator by 1.3075.
	$= \frac{20.04}{1}$	Simplify.

The average speed about was 20.04 mph.

b. At this rate, about how long would it take this competitor to complete a 30-mile race?

Divide the distance by the average speed to find the time.

$\frac{30 \text{ miles}}{20.04 \text{ mph}} \approx 1.497$ hours	
= 1 hr 29.82 min	Multiply 0.497 by 60 to find the number of minutes.
= 1 hr 29 min 49.2 s	Multiply 0.82 by 60 to find the number of seconds.

So, it would take about 1 hr 29 min 49 s

NAME ______________________ DATE ______________ PERIOD ________

Lesson 1 Reteach

Rates

A ratio that compares two quantities with different kinds of units is called a **rate**. When a rate is simplified so that it has a denominator of 1 unit, it is called a **unit rate.**

Example 1

DRIVING Alita drove her car 78 miles and used 3 gallons of gas. What is the car's gas mileage in miles per gallon?

Write the rate as a fraction. Then find an equivalent rate with a denominator of 1.

78 miles using 3 gallons $= \frac{78 \text{ mi}}{3 \text{ gal}}$ — Write the rate as a fraction.

$= \frac{78 \text{ mi} \div 3}{3 \text{ gal} \div 3}$ — Divide the numerator and the denominator by 3.

$= \frac{26 \text{ mi}}{1 \text{ gal}}$ — Simplify.

The car's gas mileage, or unit rate, is 26 miles per gallon.

Example 2

SHOPPING Joe has two different sizes of boxes of cereal from which to choose. The 12-ounce box costs $2.54, and the 18-ounce box costs $3.50. Which box costs less per ounce?

Find the unit price, or the cost per ounce, of each box. Divide the price by the number of ounces.

12-ounce box — $2.54 ÷ 12 ounces ≈ $0.21 per ounce
18-ounce box — $3.50 ÷ 18 ounces ≈ $0.19 per ounce

The 18-ounce box costs less per ounce.

Exercises

Find each unit rate. Round to the nearest hundredth if necessary.

1. 18 people in 3 vans

2. $156 for 3 books

3. 115 miles in 2 hours

4. 8 hits in 22 games

5. 65 miles in 2.7 gallons

6. 2,500 Calories in 24 hours

Choose the lower unit price.

7. $12.95 for 3 pounds of nuts or $21.45 for 5 pounds of nuts

8. A 32-ounce bottle of apple juice for $2.50 or a 48-ounce bottle for $3.84.

NAME ____________________ DATE ____________________ PERIOD __________

Lesson 1 Homework Practice

Rates

Find each unit rate. Round to the nearest hundredth if necessary.

1. \$11.49 for 3 packages

2. 2,550 gallons in 30 days

3. 88 students for 4 classes

4. 15.6°F in 13 minutes

5. 175 Calories in 12 ounces

6. 258.5 miles in 5.5 hours

7. 549 vehicles on 9 acres

8. \$920 for 40 hours

9. 13 apples for 2 pies

10. MANUFACTURING A machinist can produce 114 parts in 6 minutes. At this rate, how many parts can the machinist produce in 15 minutes?

11. RECIPES A recipe that makes 8 jumbo blueberry muffins calls for $1\frac{1}{2}$ teaspoons of baking powder. How much baking powder is needed to make 3 dozen jumbo muffins?

Estimate the unit rate for each item. Justify your answers.

12. \$299 for 4 tires

13. 3 yards of fabric for \$13.47

14. UTILITIES Use the table that shows the average monthly electricity and water usage.

Family Name	Family Size	Electricity (kilowatt-hours)	Water (gal)
Melendez	4	1,560	3,500
Barton	6	2,130	6,400
Stiles	2	1,490	2,500

a. Which family uses about twice the amount of electricity per person than the other two families? Explain your reasoning.

b. Which family uses the least amount of water per person? Explain your reasoning.

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-2 Complex Fractions and Unit Rates
Page 21

3 Simplify.

$\frac{\frac{8}{9}}{6} = \frac{8}{9} \div 6$ Write the complex fraction as a division problem.

$= \frac{8}{9} \times \frac{1}{6}$ Multiply by the reciprocal of 6.

$= \frac{8}{54}$ or $\frac{4}{27}$ Simplify.

7 Mary is making pillows for her Life Skills class. She bought $2\frac{1}{2}$ yards of fabric. Her total cost was $15. What was the cost per yard?

$\frac{15}{2\frac{1}{2}} = 15 \div 2\frac{1}{2}$ Write the complex fraction as a division problem.

$= 15 \div \frac{5}{2}$ Write the mixed number as an improper fraction.

$= 15 \times \frac{2}{5}$ Multiply by the reciprocal of $\frac{5}{2}$.

$= \frac{30}{5}$ or 6 Simplify.

Mary spent $6 per yard of fabric.

NAME ______________________ DATE ______________ PERIOD ________

Lesson 2 Reteach

Complex Fractions and Unit Rates

Fractions like $\frac{\frac{2}{3}}{4}$ are called complex fractions. **Complex fractions** are fractions with a numerator, denominator, or both that are also fractions.

Example 1

Simplify $\frac{2}{\frac{3}{4}}$.

A fraction can also be written as a division problem.

$\frac{2}{\frac{3}{4}} = 2 \div \frac{3}{4}$	Write the complex fraction as a division problem.
$= \frac{2}{1} \times \frac{4}{3}$	Multiply by the reciprocal of $\frac{3}{4}$ which is $\frac{4}{3}$.
$= \frac{8}{3}$ or $2\frac{2}{3}$	Simplify.

So, $\frac{2}{\frac{3}{4}}$ is equal to $2\frac{2}{3}$.

Exercises

Simplify.

1. $\frac{3}{\frac{1}{3}}$

2. $\frac{5}{\frac{3}{7}}$

3. $\frac{4}{\frac{1}{5}}$

4. $\frac{2}{\frac{4}{9}}$

5. $\frac{1}{\frac{4}{5}}$

6. $\frac{10}{\frac{7}{8}}$

7. $\frac{\frac{3}{5}}{\frac{3}{7}}$

8. $\frac{\frac{1}{6}}{\frac{5}{6}}$

9. $\frac{\frac{4}{5}}{\frac{9}{10}}$

10. $\frac{\frac{3}{5}}{\frac{3}{10}}$

NAME ______________________ DATE ______________________ PERIOD __________

Lesson 2 Homework Practice

Complex Fractions and Unit Rates

Simplify.

1. $\dfrac{4}{\frac{1}{5}}$

2. $\dfrac{\frac{3}{4}}{\frac{6}{7}}$

3. $\dfrac{2}{\frac{5}{6}}$

4. $\dfrac{\frac{7}{9}}{7}$

5. $\dfrac{\frac{8}{11}}{4}$

6. $\dfrac{\frac{4}{15}}{\frac{2}{5}}$

7. $\dfrac{\frac{9}{10}}{6}$

8. $\dfrac{20}{\frac{8}{15}}$

9. $\dfrac{\frac{6}{7}}{\frac{9}{14}}$

10. RUNNING Johnathan can jog $3\frac{2}{5}$ miles in $\frac{7}{8}$ hour. Find his average speed in miles per hour.

11. DRIVING A truck driver drove 120 miles in $1\frac{3}{4}$ hours. What is the speed of the truck in miles per hour?

12. READING Charlotte reads $8\frac{1}{3}$ pages of a book in 10 minutes. What is her average reading rate in pages per minute?

Write each percent as a fraction in simplest form.

13. $45\frac{1}{2}\%$

14. $30\frac{1}{4}\%$

15. $75\frac{1}{3}\%$

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-3 Convert Unit Rates
Page 29

1 A go-kart's top speed is 607,200 feet per hour. What is the speed in miles per hour?

You can use 1 mile = 5,280 feet to convert.

$$\frac{607{,}200 \text{ ft}}{1 \text{hr}} = \frac{607{,}200 \text{ ft}}{1 \text{hr}} \times \frac{1 \text{ mi}}{5{,}280 \text{ft}} \quad \text{Multiply by } \frac{1 \text{ mi}}{5{,}280 \text{ ft}}.$$

$$= \frac{607{,}200}{1 \text{hr}} \times \frac{1 \text{ mi}}{5{,}280} \quad \text{Divide out common units.}$$

$$= \frac{607{,}200 \times 1 \text{mi}}{1 \times 5{,}280 \text{hr}} \quad \text{Simplify.}$$

$$= \frac{115 \text{mi}}{1 \text{ hr}} \quad \text{Simplify.}$$

The go-kart's top speed is 115 mph.

3 A peregrine falcon can fly 322 kilometers per hour. How many meters per hour can the falcon fly?

You can use 1 kilometers = 1,000 meters.

$$\frac{322 \text{ km}}{1 \text{hr}} = \frac{322 \text{ km}}{1 \text{hr}} \times \frac{1{,}000 \text{ m}}{1 \text{km}} \quad \text{Multiply by } \frac{1{,}000 \text{ m}}{1 \text{km}}.$$

$$= \frac{322}{1 \text{hr}} \times \frac{1{,}000 \text{ m}}{1} \quad \text{Divide out common units.}$$

$$= \frac{322 \times 1{,}000 \text{m}}{1 \times 1 \text{hr}} \quad \text{Simplify.}$$

$$= \frac{322{,}000 \text{m}}{1 \text{ hr}} \quad \text{Simplify.}$$

It can fly 322,000 kilometers per hour.

NAME ______________________________ DATE ____________________ PERIOD __________

Lesson 3 Reteach

Convert Unit Rates

Unit ratios and their reciprocals can be used to convert rates. Sometimes you have to multiply more than once.

Example

The speed limit on the interstate is 65 miles per hour. How many feet per minute is the speed limit?

Because the unit of miles must divide out, use the unit ratio $\frac{5{,}280 \text{ ft}}{1 \text{ mi}}$ because the unit of miles is in the denominator. Use $\frac{1 \text{ h}}{60 \text{ min}}$ to convert from hours to minutes.

$$\frac{65 \text{ mi}}{1 \text{ h}} = \frac{65 \text{ mi}}{1 \text{ h}} \cdot \frac{5{,}280 \text{ ft}}{1 \text{ mi}} \cdot \frac{1 \text{ h}}{60 \text{ min}}$$ Multiply by the appropriate ratios.

$$= \frac{65 \cancel{\text{mi}}}{1 \cancel{\text{h}}} \cdot \frac{5{,}280 \text{ ft}}{1 \cancel{\text{mi}}} \cdot \frac{1 \cancel{\text{h}}}{60 \text{ min}}$$ Divide out common units.

$$= \frac{65 \cdot 5{,}280 \text{ ft} \cdot 1}{1 \cdot 1 \cdot 60 \text{ min}} = \frac{343{,}200 \text{ ft}}{60 \text{ min}} \text{ or } \frac{5{,}720 \text{ ft}}{1 \text{ min}}$$ Simplify.

The speed limit is 5,720 feet per minute.

Exercises

Convert each rate.

1. 10 mi/h = ______________ ft/min

2. 35 cm/sec = ______________ m/min

3. 4.5 mi/h = ______________ ft/sec

4. WALK Tina walks at a rate of 180 feet per minute. How many feet per second does Tina walk?

5. TRAVELING A car is traveling at a rate of 55 miles per hour. How many feet per hour does the car travel?

NAME ________________ DATE ________________ PERIOD ________

Lesson 3 Homework Practice

Convert Unit Rates

Convert each rate. Round to the nearest hundredth if necessary.

1. 345 ft/min = ____________ ft/h

2. 64 mi/h ≈ ____________ ft/s

3. 17 cm/min = ____________ m/h

4. 815 gal/h ≈ ____________ qt/sec

5. 39 ft/min ≈ ____________ yd/s

6. 6,000 lb/day = ____________ T/wk

7. 110 mi/h = ____________ mi/day

8. 2 lb/wk ≈ ____________ oz/day

9. 90 mi/h = ____________ mi/min

10. 44 mi/h ≈ ____________ yd/min

11. 22 lb/day ≈ ____________ oz/h

12. 720 pt/h ≈ ____________ qt/min

Use the table below showing the speed in miles per hour of several bikers.

Speeds While Biking	
Name	**Speed (miles per hour)**
Zoe	24
Jermaine	22.5
Ragsak	31.8
Yuzo	27

13. What is Ragsak's speed in feet per second? Round to the nearest tenth.

14. What is Zoe's speed in yards per minute?

15. How many feet per minute faster is Yuzo's speed than Jermaine's speed?

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-4 Proportional and Nonproportional Relationships
Page 37

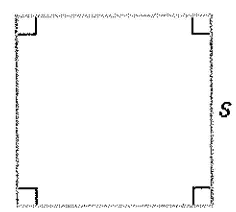
1 An adult elephant drinks about 225 liters of water each day. Is the number of days the water supply lasts proportional to the number of liters of water the elephants drinks?

Make a table and compare the values.

Time (days)	1	2	3	4
Water (L)	225	450	675	900

The time to water ratio for 1, 2, 3, and 4 days is $\frac{1}{225}$, $\frac{2}{450}$ or $\frac{1}{225}$, $\frac{3}{675}$ or $\frac{1}{225}$, and $\frac{4}{900}$ or $\frac{1}{225}$. Since these ratios are all equal to $\frac{1}{225}$, the number of days the supply lasts is proportional to the amount of water the elephant drinks.

5 Determine whether the measures for the figure shown are proportional.



a. Make a table and compare the side length to the perimeter.

Side length (units)	1	2	3	4
Perimeter (units)	4	8	12	16

The side length to perimeter ratio for side lengths of 1, 2, 3, and 4 units is $\frac{1}{4}$, $\frac{2}{8}$ or $\frac{1}{4}$, $\frac{3}{12}$ or $\frac{1}{4}$, and $\frac{4}{16}$ or $\frac{1}{4}$. Since these ratios are all equal to $\frac{1}{4}$, the measure of the perimeter of a square is proportional to its side length.

b. Make a table and compare the side length to the area.

Side length (units)	1	2	3	4
Area (units^2)	1	4	9	16

The side length to area ratio for side lengths of 1, 2, 3, and 4 units is $\frac{1}{1}$ or 1, $\frac{2}{4}$ or $\frac{1}{2}$, $\frac{3}{9}$ or $\frac{1}{3}$, and $\frac{4}{16}$ or $\frac{1}{4}$.

Since these ratios are not all equal, the measure of the area of a square is not proportional to its side length.

NAME ______________________ DATE ______________ PERIOD ________

Lesson 4 Reteach

Proportional and Nonproportional Relationships

Two related quantities are **proportional** if they have a constant ratio between them. If two related quantities do not have a constant ratio, then they are **nonproportional.**

Example 1

The cost of one CD at a record store is $12. Create a table to show the total cost for different numbers of CDs. Is the total cost proportional to the number of CDs purchased?

Number of CDs	1	2	3	4
Total Cost	$12	$24	$36	$48

$\frac{\text{Total Cost}}{\text{Number of CDs}} = \frac{12}{1} = \frac{24}{2} = \frac{36}{3} = \frac{48}{4} = \$12$ per CD

Divide the total cost for each by the number of CDs to find a ratio. Compare the ratios.

Since the ratios are the same, the total cost is proportional to the number of CDs purchased.

Example 2

The cost to rent a lane at a bowling alley is $9 per hour plus $4 for shoe rental. Create a table to show the total cost for each hour a bowling lane is rented if one person rents shoes. Is the total cost proportional to the number of hours rented?

Number of Hours	1	2	3	4
Total Cost	$13	$22	$31	$40

$\frac{\text{Total Cost}}{\text{Number of Hourse}} \rightarrow \frac{13}{1}$ or 13 $\frac{22}{2}$ or 11 $\frac{31}{3}$ or 10.34 $\frac{40}{4}$ or 10

Divide each cost by the number of hours.

Since the ratios are not the same, the total cost is nonproportional to the number of hours rented with shoes.

Exercises

1. **PICTURES** A photo developer charges $0.25 per photo developed. Is the total cost proportional to the number of photos developed?

2. **SOCCER** A soccer club has 15 players for every team, with the exception of two teams that have 16 players each. Is the number of players proportional to the number of teams?

NAME ______________________ DATE ______________________ PERIOD __________

Lesson 4 Homework Practice

Proportional and Nonproportional Relationships

1. **ANIMALS** The world's fastest fish, a sailfish, swims at a rate of 69 miles per hour. Is the distance a sailfish swims proportional to the number of hours it swims?

FOSSILS Use the following information for Exercises 2 and 3.
In July, a paleontologist found 368 fossils at a dig. In August, she found about 14 fossils per day.

2. Is the number of fossils the paleontologist found in August proportional to the number of days she spent looking for fossils that month?

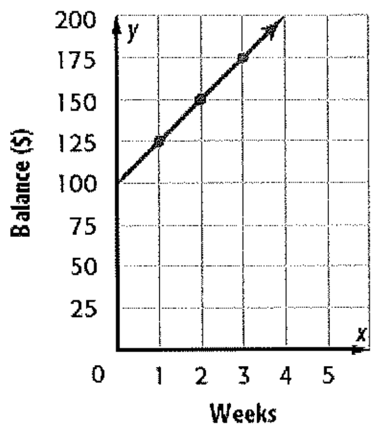
3. Is the total number of fossils found during July and August proportional to the number of days the paleontologist spent looking for fossils in August?

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-5 Graph Proportional Relationships
Page 49

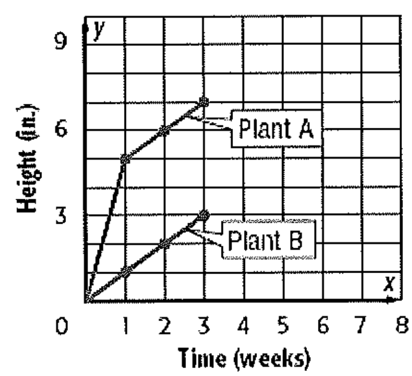
1 Model with Mathematics Determine whether the relationship between the two quantities shown in the table are proportional by graphing on the coordinate plane. Explain your reasoning.

Savings Account	
Week	Account Balance ($)
1	125
2	150
3	175



The relationship between the two quantities shown in the table are not proportional. They are not proportional because when they are graphed as ordered pairs on the coordinate plane, the line does not pass through the origin.

3 The height of two plants is recorded after 1, 2, and 3 weeks as shown in the graph at the right. Which plants' growth represents a proportional relationship between time and height? Explain.



The growth rate of Plant A is not proportional because the line is not straight.

The growth rate of Plant B is proportional because when the data is graphed on the coordinate plane, the line formed is a straight line that passes through the origin.

NAME ______________________ DATE ______________ PERIOD ________

Lesson 5 Reteach

Graph Proportional Relationships

A way to determine whether two quantities are proportional is to graph them on a coordinate plane. If the graph is a straight line through the origin, then the two quantities are proportional.

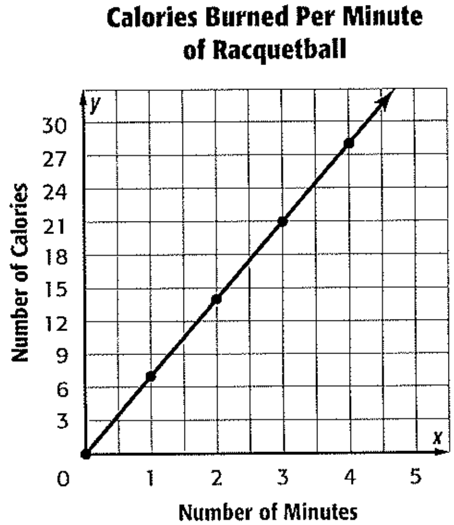
Example 1

A racquetball player burns 7 Calories a minute. Determine whether the number of Calories burned is proportional to the number of minutes played by graphing on the coordinate plane.

Step 1 Make a table to find the number of Calories burned for 0, 1, 2, 3, and 4 minutes of playing racquetball.

Time (min)	0	1	2	3	4
Calories Burned	0	7	14	21	28

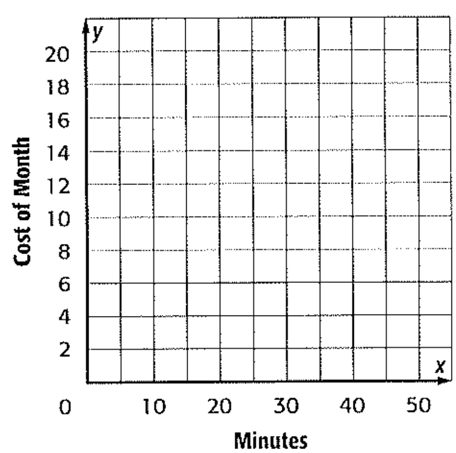
Step 2 Graph the ordered pairs on the coordinate plane. Then connect the ordered pairs.



The line passes through the origin and is a straight line. So, the number of Calories burned is proportional to the number of minutes of racquetball played.

Exercise

1. Shontell spends $7 a month plus $0.10 per minute. Determine whether the cost per month is proportional to the number of minutes by graphing on the coordinate plane.



NAME ______________________ DATE ______________________ PERIOD __________

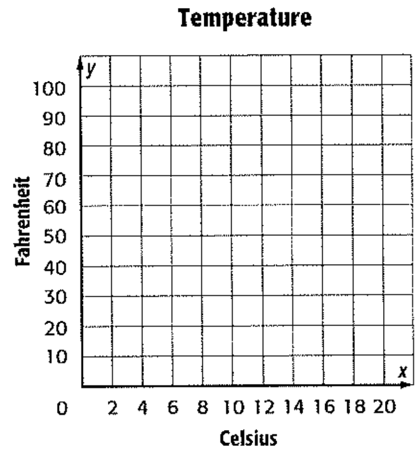
Lesson 5 Homework Practice

Graph Proportional Relationships

For Exercises 1 and 2, determine whether the relationship between the two quantities shown in each table are proportional by graphing on the coordinate plane. Explain your reasoning.

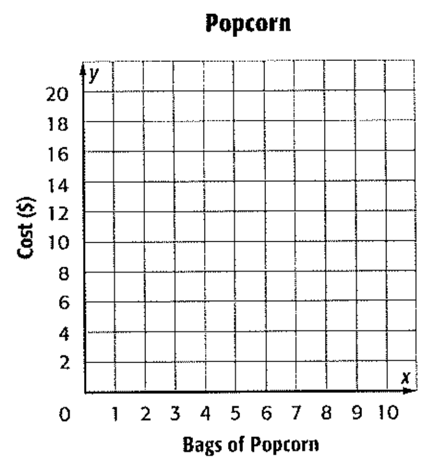
1.

Temperature (Degrees)	
Celsius	**Fahrenheit**
0	32
5	41
10	50
15	59
20	68

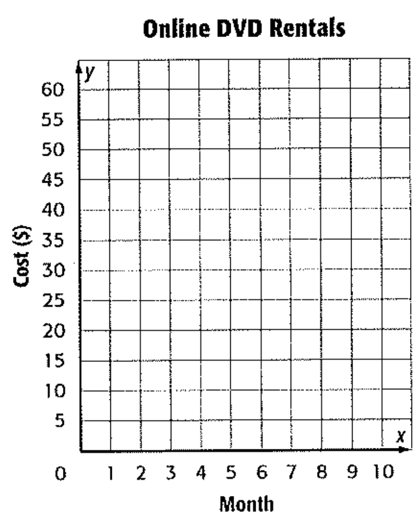


2.

Popcorn	
Bags of Popcorn	**Cost ($)**
0	0
1	4
2	8
3	12
4	16



3. MOVIES An online DVD rental company charges $15 a month for unlimited rentals. Determine whether the total paid after each month is proportional to number of months by graphing on the coordinate plane. Explain your reasoning.



Chapter 1 Ratios and Proportional Reasoning

Lesson 1-6 Solve Proportional Relationships
Page 59

1 Solve the proportion.

$\frac{1.5}{6}=\frac{10}{p}$	
$1.5p = 10(6)$	Find the cross products.
$1.5p = 60$	Multiply.
$\frac{1.5p}{1.5}=\frac{60}{1.5}$	Divide each side by 1.5.
$p = 40$	Simplify.

7 Mrs. Baker paid \$2.50 for 5 pounds of bananas. Write an equation relating the cost *c* to the number of pounds *p* of bananas. How much would Mrs. Baker pay for 8 pounds of bananas?

$\frac{\$2.50}{5 \text{ lbs}}=\frac{\$0.50}{1 \text{ lb}}$	The unit cost of the bananas is \$0.50 per pound.

Write an equation to find the cost of any number of pounds of bananas.

$c = 0.50p$	Let c represent the cost. Let p represent the pounds of bananas.
$c = 0.50(8)$	Replace p with 8.
$c = \$4.00$	Simplify.

It would cost \$4 to purchase 8 pounds of bananas.

NAME ______________________________ DATE ____________________ PERIOD __________

Lesson 6 Reteach

Solve Proportional Relationships

A **proportion** is an equation that states that two ratios are equivalent. To determine whether a pair of ratios forms a proportion, use cross products. You can also use cross products to solve proportions.

Example 1

Determine whether the pair of ratios $\frac{20}{24}$ and $\frac{12}{18}$ form a proportion.

Find the cross products.

$\frac{20}{24} \stackrel{?}{=} \frac{12}{18}$ → $24 \bullet 12 = 288$
→ $20 \bullet 18 = 360$

Since the cross products are not equal, the ratios do not form a proportion.

Example 2

Solve $\frac{12}{30} = \frac{k}{70}$.

$\frac{12}{30} = \frac{k}{70}$	Write the equation.
$12 \bullet 70 = 30 \bullet k$	Find the cross products.
$840 = 30k$	Multiply.
$\frac{840}{30} = \frac{30k}{30}$	Divide each side by 30.
$28 = k$	Simplify.

The solution is 28.

Exercises

Determine whether each pair of ratios forms a proportion.

1. $\frac{17}{10}, \frac{12}{5}$
2. $\frac{6}{9}, \frac{12}{18}$
3. $\frac{8}{12}, \frac{10}{15}$
4. $\frac{7}{15}, \frac{12}{32}$
5. $\frac{7}{9}, \frac{49}{63}$
6. $\frac{8}{24}, \frac{12}{28}$
7. $\frac{4}{7}, \frac{12}{71}$
8. $\frac{20}{35}, \frac{30}{45}$
9. $\frac{18}{24}, \frac{3}{4}$

Solve each proportion.

10. $\frac{x}{5} = \frac{12}{25}$
11. $\frac{3}{4} = \frac{12}{c}$
12. $\frac{6}{9} = \frac{10}{r}$
13. $\frac{16}{24} = \frac{z}{15}$
14. $\frac{5}{8} = \frac{s}{12}$
15. $\frac{14}{t} = \frac{10}{11}$
16. $\frac{w}{6} = \frac{2.8}{7}$
17. $\frac{5}{y} = \frac{7}{16.8}$
18. $\frac{x}{18} = \frac{7}{36}$

NAME ______________________ DATE ______________ PERIOD ________

Lesson 6 Homework Practice

Solve Proportional Relationships

Solve each proportion.

1. $\frac{b}{5} = \frac{8}{16}$

2. $\frac{18}{x} = \frac{6}{10}$

3. $\frac{t}{6} = \frac{30}{36}$

4. $\frac{11}{10} = \frac{n}{14}$

5. $\frac{2.5}{35} = \frac{2}{d}$

6. $\frac{3.5}{18} = \frac{z}{36}$

7. $\frac{0.45}{4.2} = \frac{p}{14}$

8. $\frac{2.4}{6} = \frac{2.8}{s}$

9. $\frac{3.6}{k} = \frac{0.2}{0.5}$

For Exercises 10 –12, assume all situations are proportional.

10. CLASSES For every girl taking classes at the martial arts school, there are 3 boys who are taking classes at the school. If there are 236 students taking classes, write and solve a proportion to predict the number of boys taking classes at the school.

11. BICYCLES An assembly line worker at Rob's Bicycle factory adds a seat to a bicycle at a rate of 2 seats in 11 minutes. Write a proportion relating the number of seats s to the number of minutes m. At this rate, how long will it take to add 16 seats? 19 seats?

12. PAINTING Lisa is painting a fence that is 26 feet long and 7 feet tall. A gallon of paint will cover 350 square feet. Write and solve a proportion to determine how many gallons of paint Lisa will need.

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-7 Constant Rate of Change
Page 69

1 Find the constant rate of change for the table.

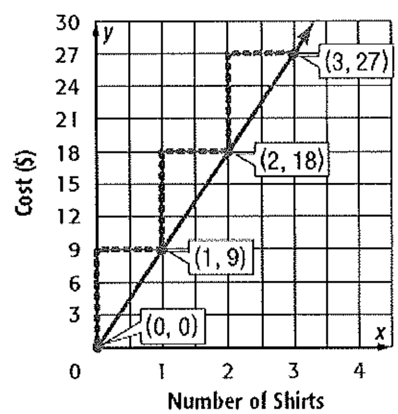
Time (s)	Distance (m)
1	6
2	12
3	18
4	24

Find the unit rate to find the constant rate of change.

$$\frac{\text{change in meters}}{\text{change in seconds}} = \frac{6\text{ m}}{1\text{ s}}$$

So, the constant rate of change is 6 meters per second.

3 The graph shows the cost of purchasing T-shirts. Find the constant rate of change for the graph. Then explain what points (0, 0) and (1, 9) represent.



Find the constant rate of change from the graph.

$$\frac{\text{change in cost}}{\text{change in number of T-shirts}} = \frac{9-0}{1-0} = \frac{9}{1}$$

So, the constant rate of change is \$9 per T-shirt;

The point (0, 0) represents 0 T-shirts purchased and 0 dollars spent. The point (1, 9) represents 9 dollars spent for 1 T-shirt.

NAME ______________________ DATE ______________ PERIOD ________

Lesson 7 Reteach

Constant Rate of Change

A **rate of change** is a rate that describes how one quantity changes in relation to another.

A **constant rate of change** is the rate of change of a linear relationship.

Example 1

Find the constant rate of change for the table.

Students	Number of Textbooks
5	15
10	30
15	45
20	60

The change in the number of textbooks is 15. The change in the number of students is 5.

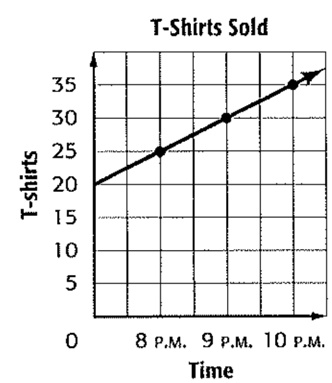
$\frac{\text{change in number of textbooks}}{\text{change in number of students}} = \frac{\text{15 textbooks}}{\text{5 students}}$ The number of textbooks increased by 15 for every 5 students.

$= \frac{\text{3 textbooks}}{\text{1 students}}$ Write as a unit rate.

So, the number of textbooks increases by 3 textbooks per student.

Example 2

The graph represents the number of T-shirts sold at a band concert. Use the graph to find the constant rate of change in number per hour.



To find the rate of change, pick any two points on the line, such as (8, 25) and (10, 35).

$\frac{\text{change in number}}{\text{change in time}} = \frac{(35-25)}{(10-8)} = \frac{10}{2}$ or 5 T-shirts per hour

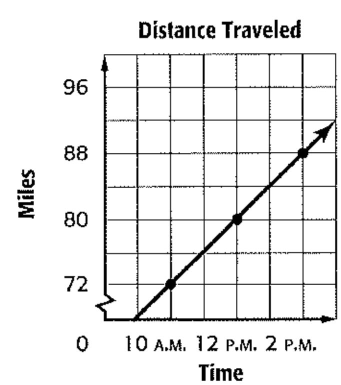
Exercises

Find the each constant rate of change.

1.

Side Length	Perimeter
1	4
2	8
3	12
4	16

2.



NAME ______________________ DATE ______________ PERIOD ________

Lesson 7 Homework Practice

Constant Rate of Change

Find the constant rate of change for each table.

1.

Number of Pounds of Ham	Cost ($)
0	0
3	12
6	24
9	36

2.

Number of Hours Worked	Money Earned ($)
4	80
6	120
8	160
10	200

3.

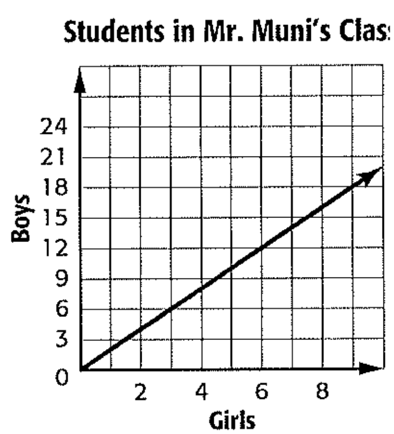
Days	Plant Height (in.)
7	4
14	11
21	18
28	25

4.

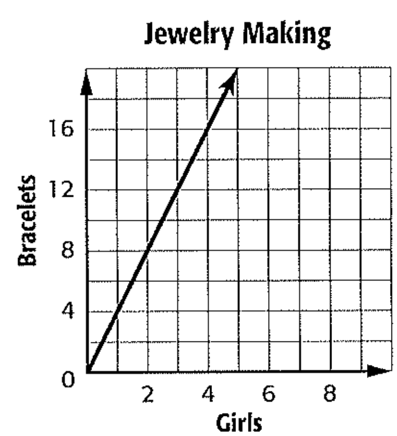
Months	Money Spent on Cable TV
2	82
4	164
6	246
8	328

Find the constant rate of change for each graph.

5.



6.



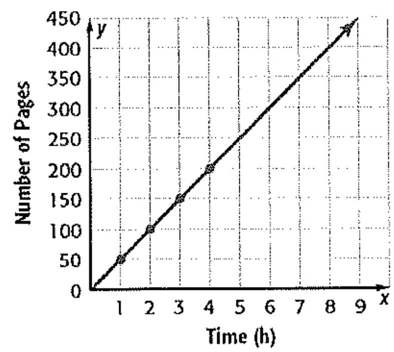
7. **SEAGULLS** At 1 P.M., there were 16 seagulls on the beach. At 3 p.m., there were 40 seagulls. What is the constant rate of change?

Chapter 1 Ratios and Proportional Reasoning

Lesson 1-8 Slope
Page 77

1 The table shows the number of pages Adriano read in x minutes. Graph the data. Then find the slope of the line. Explain what the slope represents.

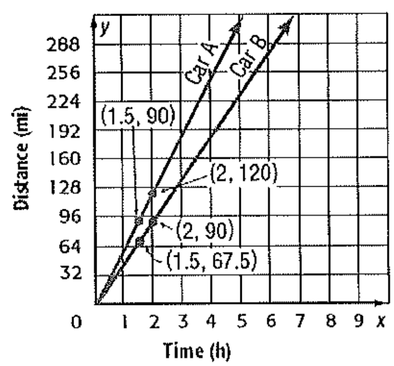
Time (h)	1	2	3	4
Number of pages	50	100	150	200



The slope represents the constant rate of change, $\frac{50}{1}$.

Adriano reads 50 pages per hour.

3 The graph shows the average speed of two cars on the highway.



a. What does (2, 120) represent?
The point (2, 120) represents the fact that Car A had traveled 120 miles in 2 hours.

b. What does (1.5, 67.5) represent?
The point (1.5, 67.5) represents the fact that Car B had traveled 67.5 miles in 1.5 hours.

c. What does the ratio of the y-coordinate to the x-coordinate for each pair of points on the graph represent.
The ratio of the y-coordinate to the x-coordinate for each pair of points represents the speed of each vehicle at that point.

d. What does the slope of each line represent?
The slope of each line represents the speed of each vehicle.

e. Which car is traveling faster? How can you tell from the graph?
Car A is traveling faster. Since its slope is steeper, and its graph is rising more rapidly, its speed is greater.

NAME ______________________ DATE ______________________ PERIOD ____________

Lesson 8 Reteach

Slope

Slope is the rate of change between any two points on a line.

$$\text{slope} = \frac{\text{change in y}}{\text{chabge in x}} = \frac{\text{vertical change}}{\text{horizontal change}} \text{ or } \frac{\text{rise}}{\text{run}}$$

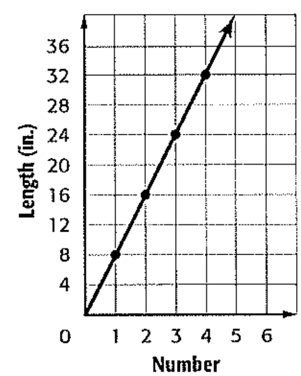
Example

The table shows the length of a patio as blocks are added.

Number of Patio Blocks	0	1	2	3	4
Length (in.)	0	8	16	24	32

Graph the data. Then find the slope of the line.

Explain what the slope represents.



$\text{slope} = \frac{\text{change in } y}{\text{change in } x}$ Definition of slope

$= \frac{24 - 8}{3 - 1}$ Use (1, 8) and (3, 24).

$= \frac{16}{2}$ $\frac{\text{length}}{\text{number}}$

$= \frac{8}{1}$ Simplify.

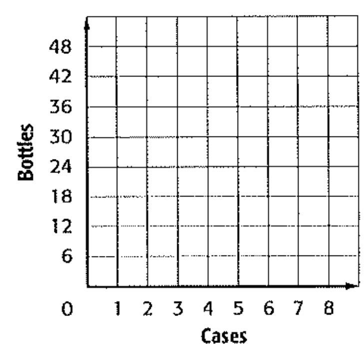
So, for every 8 inches, there is 1 patio block.

Exercises

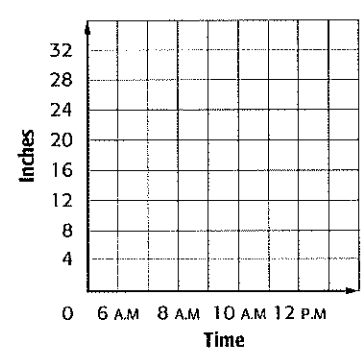
Graph the data. Then find the slope of the line. Explain what the slope represents.

1. The table shows the number of juice bottles per case.

Cases	1	2	3	4
Juice Bottles	12	24	36	48



2. At 6 A.M., the retention pond had 28 inches of water in it. The water receded so that at 10 A.M. there were 16 inches of water left.



NAME ______________________ DATE ______________ PERIOD ________

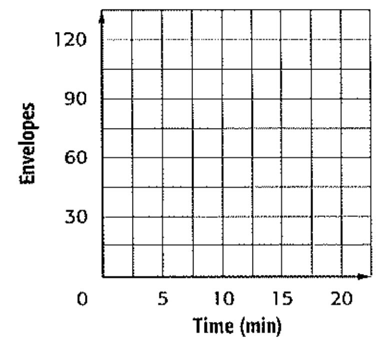
Lesson 8 Homework Practice

Slope

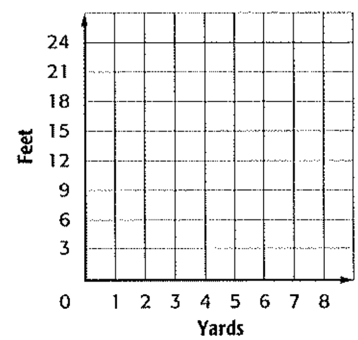
For Exercises 1 and 2, graph the data. Then find the slope. Explain what the slope represents.

1. **ENVELOPES** The table shows the number of envelopes stuffed for various times.

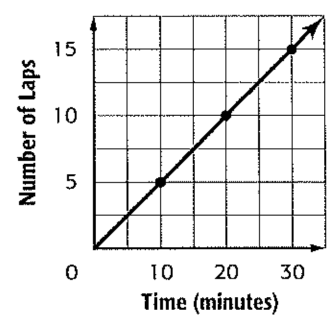
Time (min)	5	10	15	20
Envelopes Stuffed	30	60	90	120



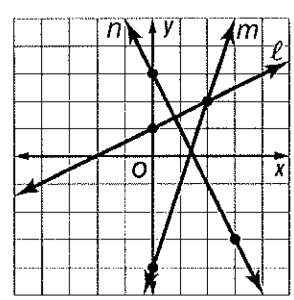
2. **MEASUREMENT** There are 3 feet for every yard.



3. Use the graph that shows the number of laps completed over time. Find the slope of the line.



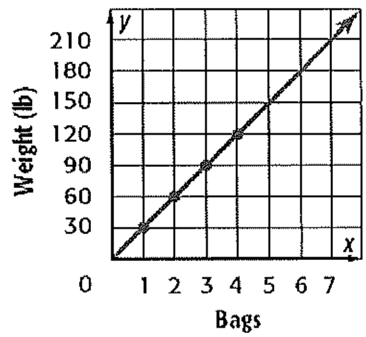
4. Which line is the steepest? Explain using the slopes of lines ℓ, m, and n.



Chapter 1 Ratios and Proportional Reasoning

Lesson 1-9 Direct Variation
Page 85

1 Veronica is mulching her front yard. The total weight of mulch varies directly with the number of bags of mulch. What is the rate of change?



Since the graph forms a line, the rate of change is constant. Use the graph to find the constant of proportionality.

$$\frac{\text{weight (lb)}}{\text{bags}} = \frac{30}{1}$$

The rate of change is 30 pounds per bag.

5 Determine whether the linear function is a direct variation. If so, state the constant of proportionality.

Minutes, x	185	235	275	325
Cost, y	60	115	140	180

Compare the ratios to check for a common ratio.

$$\frac{\text{cost}}{\text{minutes}} \quad \frac{60}{185} \text{ or } \frac{12}{37} \neq \frac{115}{235} \text{ or } \frac{23}{47} \neq \frac{140}{275} \text{ or } \frac{28}{55} \neq \frac{180}{325} \text{ or } \frac{36}{65}$$

The linear function shown in the table is not a direct variation because there is no common ratio.

NAME ______________________ DATE ______________ PERIOD ________

Lesson 9 Reteach

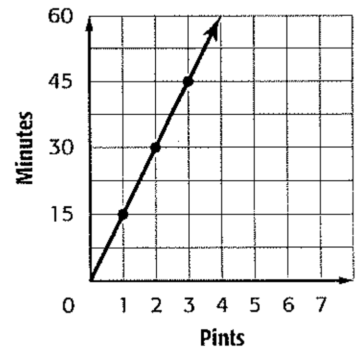
Direct Variation

When two variable quantities have a constant ratio, their relationship is called a **direct variation**.

The constant ratio is called the **constant of proportionality**.

Example 1

The time it takes Lucia to pick pints of blackberries is shown in the graph. Determine the constant of proportionality.



Since the graph forms a line, the rate of change is constant. Use the graph to find the constant of proportionality.

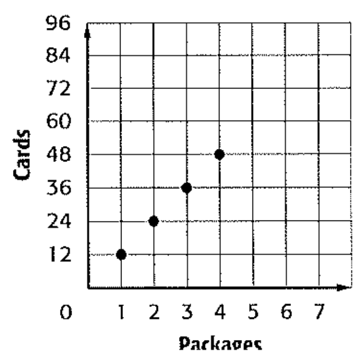
$\frac{\text{minutes}}{\text{number of pints}} = \frac{15}{1}$ $\quad \frac{30}{2}$ or $\frac{15}{1}$ $\quad \frac{45}{3}$ or $\frac{15}{1}$

It takes 15 minutes for Lucia to pick 1 pint of blackberries.

Example 2

There are 12 trading cards in a package. Make a table and graph to show the number of cards in 1, 2, 3, and 4 packages. Is there a constant rate? a direct variation?

Numbers of Packages	1	2	3	4
Number of Cards	12	24	36	48



Because there is a constant increase of 12 cards, there is a constant rate of change. The equation relating the variables is $y = 12x$, where y is the number of cards and x is the number of packages. This is a direct variation. The constant of proportionality is 12.

Exercises

1. **SOAP** Wilhema bought 6 bars of soap for $12. The next day, Sophia bought 10 bars of the same kind of soap for $20. What is the cost of 1 bar of soap?

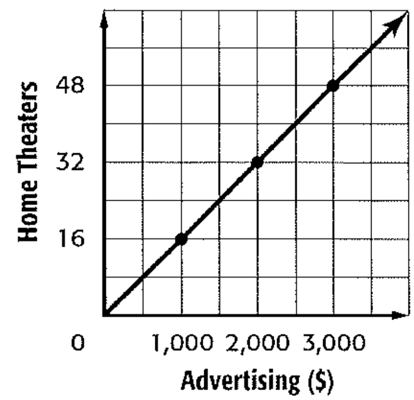
2. **COOKING** Franklin is cooking a 3-pound turkey breast for 6 people. If the number of pounds of turkey varies directly with the number of people, make a table to show the number of pounds of turkey for 2, 4, and 8 people.

NAME ______________________________ DATE ______________________ PERIOD __________

Lesson 9 Homework Practice

Direct Variation

1. **HOME THEATER** The number of home theaters a company sells varies directly as the money spent on advertising. How many home theaters does the company sell for each $500 spent on advertising?



2. **DUNE BUGGY** Beach Travel rents dune buggies for $50 for 4 hours or $75 for 6 hours. What is the hourly rate?

3. **FERTILIZER** Leroy uses 20 pounds of fertilizer to cover 4,000 square feet of his lawn and 50 pounds to cover 10,000 square feet. How much does he need to cover his entire yard which has an area of 26,400 square feet?

Determine whether each linear function is a direct variation. If so, state the constant of variation.

4.

Gallons, x	6	8	10	12
Miles, y	180	240	300	360

5.

Time (min), x	10	11	12	13
Temperature, y	82	83	84	85

6.

Number of Payments, x	6	11	16	21
Amount Paid, y	$1,500	$2,750	$4,000	$5,250

If y varies directly with x, write an equation for the direct variation. Then find each value.

7. If $y = -4$ when $x = 10$, find y when $x = 5$.

8. If $y = 12$ when $x = -15$, find y when $x = 2$.

9. Find x when $y = 18$, if $y = 9$ when $x = 8$.