Chapter 3

Name_____

Chapter 3 Ratios and Rates

Dear Family,

Sports and games provide an opportunity to relax and have fun with our families and friends. The nature of competition gives us an opportunity to explore mathematics at the same time.

When we are competing, we are often thinking about how we are doing. Are we hitting the ball as well as we did last year? Are we running faster now than at the beginning of the season? Are we currently winning, or is our opponent winning? Even if we are only watching a game, many of us tend to obsess over our favorite player's and team's performances.

Spend some time with your student talking about your family's favorite sport or game. What kinds of "stats" are kept about the players and events? How does that help you understand the game? For example, you and your student might talk about the following:

- How are batting averages figured out in baseball and softball? What does this tell you about the next time your favorite player is at bat?
- What does the ratio of red pieces to black pieces tell you about how a game of checkers is going? Who's winning?
- How fast can you run a 100-meter sprint? Do you think you could run the same speed in the 200-meter or the 400-meter?

Next time your team is playing their big rival, ask your student how he or she could predict who will win. Do you think it matters more what each team's average score is, or what the win-loss ratio is for the two teams? What kind of information could help you decide which team is better?

Enjoy the game!

Ratios and Rates (continued)

Lesson	Learning Target	Success Criteria
3.1 Ratios	Understand the concepts of ratios and equivalent ratios.	• I can write and interpret ratios using appropriate notation and language. • I can recognize multiplicative relationships in ratios. • I can describe how to determine whether ratios are equivalent. • I can name ratios equivalent to a given ratio.
3.2 Using Tape Diagrams	Use tape diagrams to model and solve ratio problems.	• I can interpret tape diagrams that represent ratio relationships. • I can draw tape diagrams to model ratio relationships. • I can find the value of one part of a tape diagram. • I can use tape diagrams to solve ratio problems.
3.3 Using Ratio Tables	Use ratio tables to represent equivalent ratios and solve ratio problems.	• I can use various operations to create tables of equivalent ratios. • I can use ratio tables to solve ratio problems. • I can use ratio tables to compare ratios.
3.4 Graphing Ratio Relationships	Represent ratio relationships in a coordinate plane.	• I can create and plot ordered pairs from a ratio relationship. • I can create graphs to solve ratio problems. • I can create graphs to compare ratios.
3.5 Rates and Unit Rates	Understand the concept of a unit rate and solve rate problems.	• I can find unit rates. • I can use unit rates to solve rate problems. • I can use unit rates to compare rates.
3.6 Converting Measures	Use ratio reasoning to convert units of measure.	• I can write conversion facts as unit rates. • I can convert units of measure using ratio tables. • I can convert units of measure using conversion factors. • I can convert rates using conversion factors.

Nombre_____

Capítulo 3 Razones y tasas

Querida familia:

El deporte y los juegos nos dan la oportunidad de relajarnos y divertirnos con nuestras familias y amigos. La naturaleza de la competencia nos da la oportunidad de explorar las matemáticas, al mismo tiempo.

Cuando estamos compitiendo, generalmente pensamos en cómo lo estamos haciendo. ¿Estamos pateando el balón tan bien como lo hicimos el año pasado? ¿Estamos corriendo más rápidamente ahora que al principio de la temporada? ¿Estamos ganando en este momento, o está ganando nuestro adversario? Aunque solo estemos viendo el partido, muchos de nosotros tendemos a obsesionarnos con el desepeño de nuestros equipos y jugadores favoritos.

Pase un rato hablando con su estudiante sobre el deporte o juego favorito de su familia. ¿Qué clase de estadísticas se mantienen para los jugadores y eventos deportivos? ¿De qué manera ayudan esas estadísticas a entender el juego? Pueden comentar las siguientes preguntas, por ejemplo:

- ¿Cómo se calcula el promedio de bateo en béisbol y sófbol? ¿Qué indica eso con respecto a la próxima vez que tu jugador favorito tenga el bate?
- ¿Qué indica la razón de fichas rojas a fichas negras en un juego de damas? ¿Cómo va el juego? ¿Quién está ganando?
- ¿Qué tan rápido puedes correr una carrera de 100 metros? ¿Crees que puedes correr a la misma velocidad la carrera de 200 metros o de 400 metros?

La próxima vez que su equipo esté jugando contra su gran rival, pregunte a su estudiante cómo podría predecir el ganador. ¿Piensa que importa más cuál es el promedio del marcador, o cuál es la razón victoria-pérdida de los dos equipos? ¿Qué clase de información le ayudaría a decidir cuál equipo es mejor?

¡Disfruten el partido!

Razones y tasas (continuación)

Lección	Objetivo de aprendizaje	Criterios de éxito
3.1 Razones	Comprender el concepto de razones y razones equivalentes.	• Sé escribir e interpretar razones usando la notación y el lenguaje adecuados. • Sé reconocer relaciones multiplicativas en las razones. • Sé describir cómo determinar si las razones son equivalentes. • Sé nombrar razones equivalentes a una razón dada.
3.2 Usar diagramas de cinta	Usar diagramas de cinta para representar y resolver problemas de razones.	• Sé interpretar diagramas de cinta que representan relaciones de razones. • Sé hacer diagramas de cinta para representar relaciones de razones. • Sé hallar el valor de una parte de un diagrama de cinta. • Sé usar diagramas de cinta para resolver problemas de razones.
3.3 Usar tablas de razones	Usar tablas de razones para representar razones equivalentes y resolver problemas de razones.	• Sé usar varias operaciones para crear tablas de razones equivalentes. • Sé usar tablas de razones para resolver problemas de razones. • Sé usar tablas de razones para comparar razones.
3.4 Representar relaciones de razones gráficamente	Representar relaciones de razones en un plano de coordenadas.	• Sé crear y trazar pares ordenados de una relación de razones. • Sé crear gráficas para resolver problemas de razones. • Sé crear gráficas para comparar razones.
3.5 Tasas y tasas unitarias	Comprender el concepto de tasas unitarias y resolver problemas de tasas.	• Sé hallar tasas unitarias. • Sé usar tasas unitarias para resolver problemas de tasas. • Sé usar tasas unitarias para comparar tasas.
3.6 Conversión de medidas	Usar razonamiento de razones para convertir unidades de medida.	• Sé escribir conversiones de operaciones como tasas unitarias. • Sé convertir unidades de medida usando tablas de razones. • Sé convertir unidades de medida usando conversión de factores. • Sé convertir tasas usando conversión de factores.

Lesson 3.1 Cumulative Practice

For use before Lesson 3.1

Write the product as a power.

1. $17 \cdot 17 \cdot 17 \cdot 17 \cdot 17 =$ _____

2. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 =$ _____

Lesson 3.1 Vocabulary Practice

For use before Lesson 3.1

1. Write what you know about this word.

Preview: ratio

Lesson 3.1 Prerequisite Skills Practice

For use before Lesson 3.1

Multiply or divide.

1. 7×6

2. $48 \div 6$

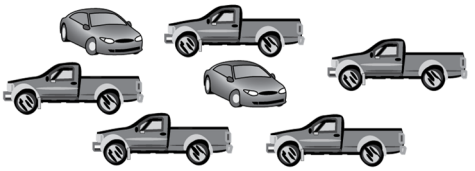
Name _____ Date _____

Lesson 3.1 Extra Practice

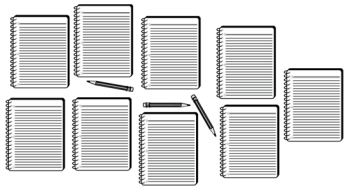
Write the ratio.

1. flies to lizards

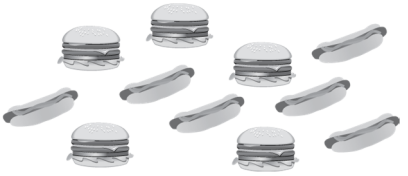
2. cars : trucks



3. notebooks : pencils



4. hamburgers to hot dogs



Write the ratio. Then find and interpret the value of the ratio.

5. tubas : clarinets

6. trumpets : tubas

7. clarinets : tubas

8. trumpets : clarinets

Determine whether the ratios are equivalent.

9. 2 : 3 and 4 : 6

10. 5 : 8 and 8 : 14

11. 9 : 12 and 24 : 18

12. Your friend says that the two ratios are equivalent. Is your friend correct? Explain your reasoning.

$$3 : 5 \xrightarrow{\times 6} 18 : 30 \quad (\times 6)$$

Because you can multiply each number in the first ratio by 6 to obtain the numbers in the second ratio, the ratios are equivalent.

13. Stacia has 28 red and blue marbles. The ratio of red to blue marbles is 1 : 6. How many blue marbles does Stacia have?

14. Kendall reads 8 pages each night. DeSean reads 32 pages every 4 nights. Are Kendall and DeSean reading at the same rate?

15. There are 5 pennies for every 6 quarters in Ahmed's pocket. Could Ahmed have a total of 30 coins in his pocket? Explain.

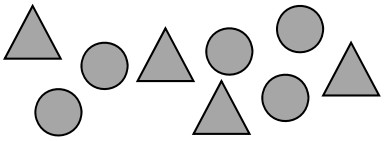
Name _____ Date _____

Lesson 3.1 Reteach

EXAMPLE Writing Ratios

A **ratio** is a comparison of two quantities. The comparison can be part-to-part, part-to-whole, or whole-to-part.

Write the ratio of circles to triangles.



There are two types of shapes: circles and triangles. The part-to-part ratio of circles to triangles is the number of circles compared to the number of triangles.

There are 5 circles and 4 triangles.

▶ So, the ratio of circles to triangles is 5 to 4, or 5 : 4.

The number $\frac{a}{b}$ associated with the ratio $a : b$ is called the **value of the ratio**.

It describes the multiplicative relationship between the quantities in the ratio.

EXAMPLE Writing and Interpreting Ratios

The ratio of apples to oranges in a bowl is 1 : 3. Find and interpret the value of the ratio.

The ratio of apples to oranges is 1 : 3 so the value of the ratio is $\frac{1}{3}$.

▶ So, the number of apples is $\frac{1}{3}$ times the number of oranges.

Two ratios that describe the same relationship are **equivalent ratios**. If both numbers in the first ratio are multiplied by the same number to obtain the numbers in the second ratio, then the ratios are equivalent.

EXAMPLE Determining Whether Ratios Are Equivalent

Determine whether 2 : 5 and 4 : 10 are equivalent ratios.

To get from 2 to 4, you multiply by 2. So, multiply 5 by 2 to get 10.

$$\times 2 \left(2 : 5 \right) \times 2$$
$$4 : 10$$

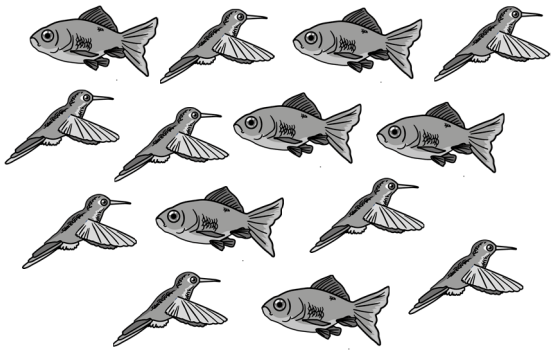
▶ So, the ratios are equivalent.

Name _____ Date _____

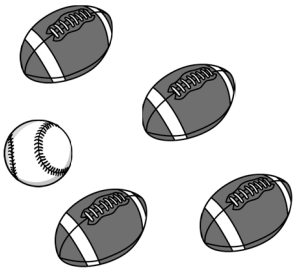
Lesson 3.1 Reteach (continued)

Write the ratio.

1. fish to birds



2. baseballs : footballs



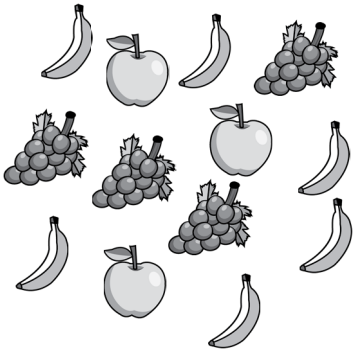
Find and interpret the value of the ratio.

3. apples : grape bunches

4. bananas : apples

5. grape bunches : bananas

6. apples : bananas



Determine whether the ratios are equivalent.

7. 1 : 3 and 5 : 15

8. 2 : 6 and 4 : 12

9. 3 : 9 and 27 : 81

10. 2 : 4 and 3 : 5

11. 4 : 3 and 3 : 4

12. 5 : 1 and 10 : 2

Name_____ Date _____

Lesson 3.1 Enrichment and Extension

Odds

A ratio comparing the number of ways an event can occur (called favorable outcomes) to the number of ways the event cannot occur (unfavorable outcomes) is called the odds of an event. By adding the two parts of the ratio together, you get the total number of possible outcomes.

Example: Find the odds that a coin will land on heads when flipped. Then find the total number of possible outcomes.

When you flip a coin, it can land on either heads or tails.

Heads : Tails	Make a labeled ratio.
1 : 1	Rewrite using numbers.
1 + 1 = 2	Add both parts of the ratio to find the total number of possibilities.

So, the odds that a coin will land on heads when flipped are 1 : 1 and the total number of possible outcomes is 2.

Find the odds of each event happening as well as the total number of possible outcomes.

1. A number cube is rolled, and it lands on 3.
2. A number cube is rolled, and it lands on a multiple of 2.
3. A letter is randomly chosen from the word “mirror,” and you choose an “r.”
4. A letter is randomly chosen from the word “mirror,” and you choose an “x.”
5. A spinner with eight equal sections numbered 1 through 8 is spun, and you get an even number.
6. A bag contains 4 blue marbles, 3 yellow marbles and 6 green marbles. You pick a blue marble out of the bag.
7. A standard deck of playing cards contains 52 cards. There are 13 cards of each suit (hearts, diamonds, clubs and spades). You draw a diamond card.

Name _____ Date _____

3.1 Puzzle Time

Did You Hear About The...

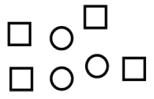
A	B	C	D	E	F
G	H	I	J	K	L

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

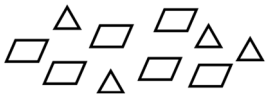
17 to 5 AND
2 : 11 FAST
3 to 7; 3 : 7 THAT
4 to 5; 4 : 5 INTO
75 COW
25 SUNSHINE
3 to 4; 3 : 4 TWO
65 CART
7 to 2 AN
5 to 6; 5 : 6 HORSE
3 : 5 WAS

Write the ratio.

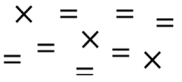
A. circles to squares



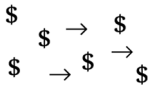
B. triangles to parallelograms



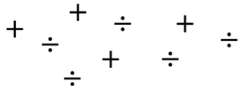
C. multiplication signs to equal signs



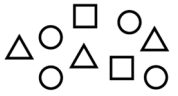
D. dollar signs to arrows



E. addition signs to division signs



F. squares to triangles to circles



Use the figure to write the ratio.

G. diamonds to shapes

H. shapes to squares

I. stars to shapes

J. diamonds to squares

K. stars to triangles

L. diamonds to squares to stars

1 to 6; 1 : 6 MUST
12 HAPPY
2 to 3 to 4; 2 : 3 : 4 EACH
3 : 5 : 7 OXIDENT
4 to 6; 4 : 6 OXEN
7 : 17 IT
6 to 3; 6 : 3 BUMPED
1 to 2; 1 : 2 ROCKS
80 GRASS
3 to 17 OTHER
64 WEATHER

Lesson 3.2 Cumulative Practice

For use before Lesson 3.2

1. Find the LCM of 12 and 9.

The LCM is _____.

2. Find the LCM of 4 and 10.

The LCM is _____.

Lesson 3.2 Vocabulary Practice

For use before Lesson 3.2

1. Write what you know about this phrase.

Review: tape diagram

Lesson 3.2 Prerequisite Skills Practice

For use before Lesson 3.2

Divide.

1. $40 \div 8$

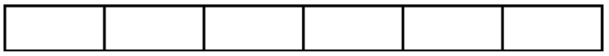
2. $36 \div 3$

Name _____ Date _____

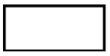
Lesson 3.2 Extra Practice

The tape diagram shows the ratio of bird houses you make to bird houses your friend makes. You and your friend make a total of 45 bird houses. Find how many bird houses you make.

1. You: 

Friend: 

2. You: 

Friend: 

A bag contains quarters and dimes. You are given the number of dimes and the ratio of dimes to quarters. Draw and use a tape diagram to find the number of quarters.

3. 15 dimes; 3 to 2 **4.** 8 dimes; 1 : 4 **5.** 28 dimes; 4 : 3

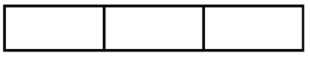
The ratio of Amber's age to her brother Zach's age is 1 : 2. Find the missing age.

6. Amber is 10; Zach is _____ **7.** Zach is 26; Amber is _____

8. Your friend says that there are 8 pieces of yellow chalk. Is your friend correct? Explain your reasoning.

There are 12 pieces of chalk. The tape diagram shows the ratio of chalk that is yellow to chalk that is not yellow.

Yellow chalk 

Not yellow chalk 

9. There is 1 bus for every 32 students on a field trip. There are 96 students on the field trip. How many buses are needed?

10. You spend 90 minutes practicing flip tricks and slides on your skateboard. The ratio of time spent on flip tricks to time spent on slides is 7 : 8. How much time do you spend practicing slides?

11. The ratio of students to teachers at a school is 19 : 1. How many students are there in each total number of people?

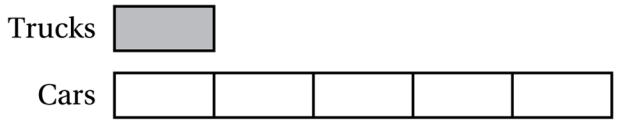
a. 100 people **b.** 280 people **c.** 440 people **d.** 760 people

Name_____ Date_____

Lesson 3.2 Reteach

EXAMPLE Interpreting a Tape Diagram

The tape diagram shows the ratio of trucks to cars in a parking lot. There are 12 trucks in the parking lot. How many cars are there?



Each part of the tape diagram represents the same number of vehicles.
There is 1 part to represent the 12 trucks. So, each part represents 12 vehicles.
There are 5 parts to represent the cars. So, the total number of cars is

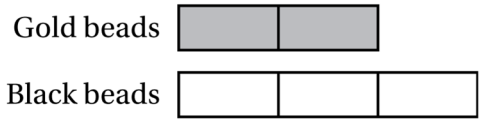
$$5 \times 12 = 60.$$

▶ There are 60 cars in the parking lot.

EXAMPLE Drawing a Tape Diagram

In a necklace kit, there are 2 gold beads for every 3 black beads. There are 36 gold beads. How many black beads are in the kit?

The ratio of gold beads to black beads is 2 : 3. Draw a tape diagram to show the ratio 2 : 3.



There are 36 gold beads represented by 2 parts in the tape diagram. So, divide to find the number of beads in 1 part.

$36 \div 2 = 18$ 1 part represents 18 beads.

There are 3 parts to represent the black beads. So the number of black beads is 3 times the number of beads in 1 part.

$$3 \times 18 = 54$$

▶ There are 54 black beads in the necklace kit.

Name _____ Date _____

Lesson 3.2 **Reteach (continued)**

EXAMPLE Using a Tape Diagram to Solve a Ratio Problem

The ratio of boys to girls in the sixth grade is 4 : 7. There are 88 students in the sixth grade. How many boys and how many girls are there?

Draw a tape diagram to represent a ratio of 4 : 7.

There are 11 parts to represent 88 students. Divide to find the number of students represented by 1 part.

$88 \div 11 = 8$ 1 part represents 8 students.

To find the number of boys and the number of girls, multiply 8 by each number of parts.

$4 \times 8 = 32$ boys

$7 \times 8 = 56$ girls

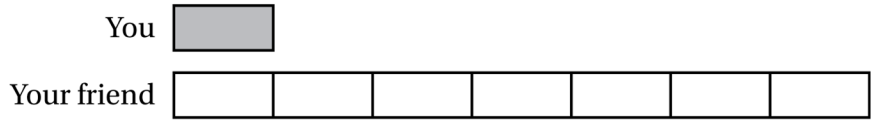
▶ So, there are 32 boys and 56 girls in the sixth grade.

CHECK Verify that the total number of boys and girls is 88.

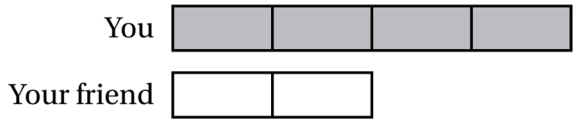
$32 + 56 = 88$ ✓

The tape diagram shows the ratio of the hours of work done by you and a friend. You and your friend worked a total of 24 hours. How many hours did you work?

1.



2.



A box contains green tiles and yellow tiles. The number of yellow tiles and the ratio of yellow tiles to green tiles are given. Draw a tape diagram to find the number of green tiles.

3. 10 yellow; 1 to 3 **4.** 2 yellow; 2 : 5 **5.** 8 yellow; 4 : 3

6. The ratio of the ages (in years) of two teachers is 8 : 9. The sum of their ages is 51. What is the age of each teacher?

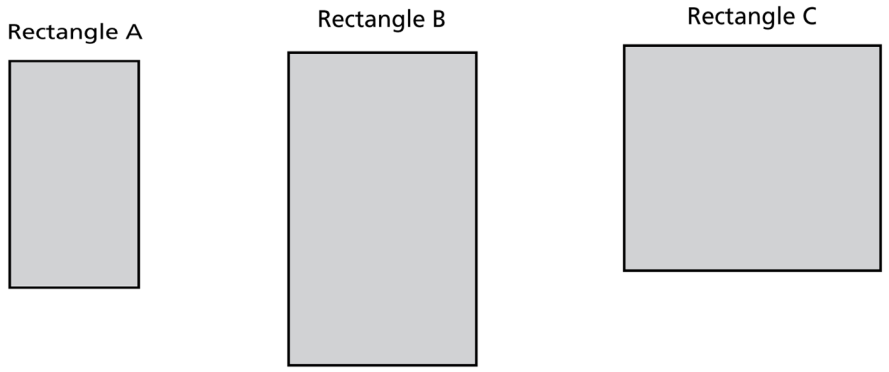
7. There are 84 books on a bookshelf. The ratio of paperbacks to hardcover books is 9 : 5. How many paperbacks and how many hardcover books are there?

Name_____ Date _____

Lesson 3.2 Enrichment and Extension

Golden Ratio

1. Which of the rectangles below do you think is most visually pleasing?



2. In Exercise 1, many people will choose Rectangle B. This rectangle is an example of a *golden rectangle*. The ratio of the length to the width in a golden rectangle is called the *golden ratio*. Use a ruler to approximate the golden ratio.

3. Consider the following pattern, called the *Fibonacci sequence*.

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, . . .

a. Describe the pattern.

b. Find the next three numbers in the pattern.

c. Starting at the third number in the pattern, find the ratio of each number to the previous number.

d. Write each ratio in part (c) as $a : 1$, where a is rounded to the nearest thousandth, if necessary.

e. The ratios are approaching the golden ratio. Make a new approximation of the golden ratio.

4. List several common rectangular objects that are close to the shape of a golden rectangle.

5. Use the Internet or another resource to find three other names for the golden ratio.

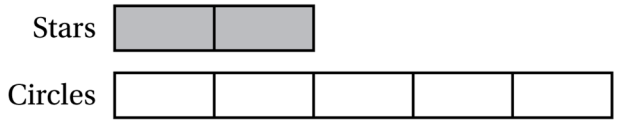
Name _____ Date _____

3.2 Puzzle Time

How Do Cows Count?

Write the letter of each answer in the box containing the exercise number.

Use the tape diagram to find each of the following.



1. number of stars for 35 total shapes

2. total number of shapes for 14 stars

3. ratio of circles to stars

4. ratio of stars to circles

5. number of circles for 63 total shapes

6. total number of shapes for 70 circles

7. ratio of stars to total shapes

8. number of stars for 84 total shapes

9. ratio of total shapes to circles

Use the tape diagram to find each of the following.

10. ratio of sheep to cows

11. number of sheep for 77 cows

12. total number of animals for 56 cows

13. total number of animals for 18 sheep

14. number of sheep for 100 total animals

15. ratio of cows to sheep

16. ratio of cows to total animals

17. ratio of sheep to total animals

18. ratio of total animals to sheep

Answers

A.	33
R.	10
C.	98
Y.	60
S.	5 : 2
H.	45
E.	3 : 10
W.	49
L.	7 : 5
T.	2 : 5
O.	7 : 10
U.	10 : 3
T.	30
E.	24
C.	80
A.	7 : 3
U.	2 : 7
O.	3 : 7

14	5	8	13		7	3	17		11		12	10	2	6	18	9	15	4	16	1

Lesson 3.3 Cumulative Practice

For use before Lesson 3.3

Multiply.

1. $9.7 \times 9.64 =$ _____

2. $5.84 \times 8.12 =$ _____

Lesson 3.3 Vocabulary Practice

For use before Lesson 3.3

1. Write what you know about this phrase.

Preview: ratio table

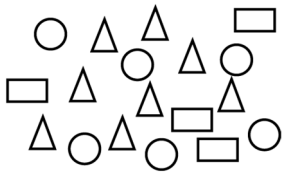
Lesson 3.3 Prerequisite Skills Practice

For use before Lesson 3.3

Write the ratio.

1. circles to triangles

2. triangles to rectangles



Name _____ Date _____

Lesson 3.3 Extra Practice

Find the missing value(s) in the ratio table. Then write the equivalent ratios.

1.

Cars	3	6
Trucks	5	

2.

TVs	2		6
Computers	7	14	

3.

Dogs	4		12
Paws	16	32	48

4.

Apples	5	10		20
Oranges	3		9	12

Complete the ratio table to solve the problem.

5. For every 2 cars you wash, your friend washes 3 cars. You wash a total of 8 cars. How many does your friend wash?

You	Friend
2	3
8	

6. Your closet has 5 shirts for every 2 sweaters. Your closet has 30 shirts. How many sweaters are in your closet?

Shirts	Sweaters
5	2
10	
	10
30	

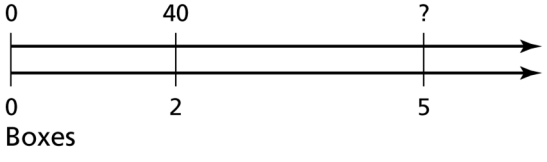
7. Your friend says that there are 36 feet in 12 yards. Is your friend correct? Explain your reasoning.

Yards	Feet
1	3
4	
	30
12	

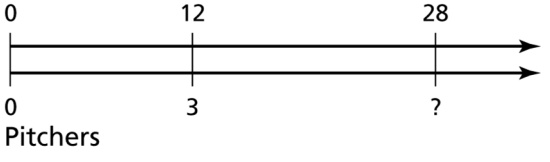
$1 \times 3 = 3$
$4 \times 3 = 12$
$10 \times 3 = 30$
$12 \times 3 = 36$

Find the missing quantity in the double number line.

8.



9.



10. You are making a salad. The ratio of olives to croutons is 5 : 3. You put 12 croutons in your salad. How many olives do you put in your salad?

Name_____ Date_____

Lesson 3.3 Reteach

You can find and organize equivalent ratios in a **ratio table**. You can find equivalent ratios by:

- adding or subtracting quantities in equivalent ratios.
- multiplying or dividing each quantity in a ratio by the same number.

EXAMPLE Completing Ratio Tables

Find the missing values in the ratio table. Then write the equivalent ratios.

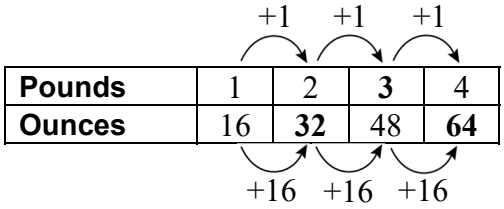
a.

Pounds	1	2		4
Ounces	16		48	

b.

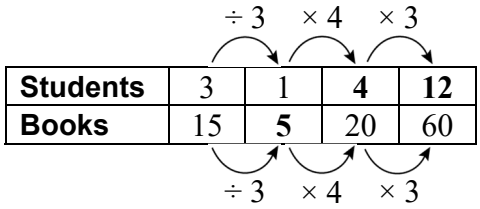
Students	3	1		
Books	15		20	60

a. You can use repeated addition of quantities in the ratio 1 to 16.



▶ The equivalent ratios are 1 : 16, 2 : 32, 3 : 48, and 4 : 64.

b. You can multiply or divide each quantity in any ratio by the same number.



▶ The equivalent ratios are 3 : 15, 1 : 5, 4 : 20, and 12 : 60.

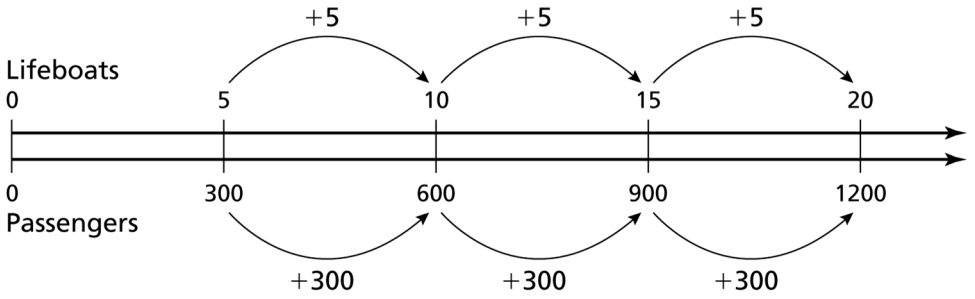
Name _____ Date _____

Lesson 3.3 Reteach (continued)

EXAMPLE Solving a Ratio Problem

On a cruise ship, 5 lifeboats can carry 300 passengers. Use a double number line to find how many lifeboats can carry 1200 passengers.

Draw a double number line. Write values on the number lines by adding quantities in the original ratio of 5 to 300.



▶ You can see that 20 lifeboats can carry 1200 passengers.

Find the missing values in the ratio table. Then write the equivalent ratios.

1.

Teachers	1	2	
Students	16		48

2.

Groups	1	2	3
People		6	

3.

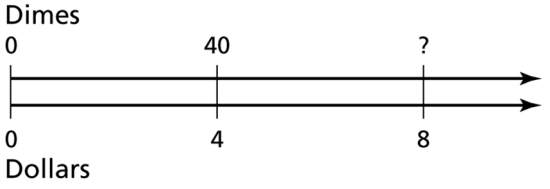
Trumpets	10	5		25
Drums	8		16	

4.

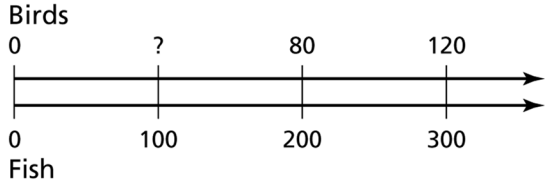
Pens	12		36	
Pencils	16	4		8

Find the missing quantity in the double number line.

5.



6.



Name_____ Date_____

Lesson 3.3 Enrichment and Extension

Finding the Best Buy

Determine which is the best buy.

1.

Peanuts	A	B	C
Cost (dollars)	2.80	6.20	6.99
Size (ounces)	10	20	24

2.

Spaghetti Sauce	A	B	C
Cost (dollars)	2.32	2.72	2.24
Size (ounces)	40	48	32

3.

Hot Dogs	A	B	C
Cost (dollars)	2.99	4.49	3.29
Size (amount)	5	8	6

4.

Laundry Detergent	A	B	C
Cost (dollars)	5.10	7.09	7.94
Size (ounces)	30	42	50

5.

Cooler	A	B	C	D
Cost (dollars)	29.88	18.88	39.88	34.88
Size (quarts)	50	27	70	62

6.

Water	A	B	C	D
Cost (dollars)	2.98	3.28	3.48	3.98
Size (bottles)	12	18	24	28

7. Aisha went to the local gas station to get a gallon of milk. She saw that the store had quart containers of milk for $1.19 while a gallon was $4.66. Aisha bought four quarts instead of the gallon because she thought it would be cheaper for the same amount of milk. Did Aisha save money?

Name _____ Date _____

3.3 Puzzle Time

How Can A Leopard Change His Spots?

Write the letter of each answer in the box containing the exercise number.

Find the missing value(s) in the ratio table.

1.

Butterflies	2	
Flowers	7	14

2.

Nickels	6	12
Dimes	11	

3.

Apples	5		15
Oranges	6	12	

4.

Carrots	8	16	
Cucumbers	3		9

5.

Cats	3		9
Dogs	2	4	

6.

Pens	3	6	
Pencils	4		12

Answers

I. 6, 6

Y. 22

M. 8

V. 4

G. 6, 24

N. 12

O. 10, 18

B. 8, 9

Complete the ratio table to solve the problem.

7. For every 2 laps you swim, your friend swims 3 laps. You swim a total of 8 laps. How many laps does your friend swim?

You	2	8
Friend	3	

8. An amusement park sells 5 bottles of water for every 2 bottles of juice. In one hour, the amusement park sells 20 bottles of water. How many bottles of juice does the amusement park sell?

Water	5	20
Juice	2	

6	**2**		**8**	**3**	**1**	**5**	**7**	**4**

Lesson 3.4 Cumulative Practice

For use before Lesson 3.4

1. A square vegetable garden has side lengths of 11 feet. You plant flowers in the center portion of the garden, a square that has side lengths of 7 feet. You divide the remaining space into 4 equal sections and plant tomatoes, onions, zucchini, and peppers. What is the area of the onion section?

The area of the onion section is _____ square feet.

2. A square vegetable garden has side lengths of 11 feet. You plant flowers in the center portion of the garden, a square that has side lengths of 3 feet. You divide the remaining space into 4 equal sections and plant tomatoes, onions, zucchini, and peppers. What is the area of the pepper section?

The area of the pepper section is _____ square feet.

Lesson 3.4 Vocabulary Practice

For use before Lesson 3.4

1. Write what you know about this phrase.

Review: ordered pair

Lesson 3.4 Prerequisite Skills Practice

For use before Lesson 3.4

Find the missing value(s) in the ratio table.

1.

Cats	4	8	12
Dogs	7		21

2.

Roses	3	6	15
Lilies	5		

Name _____ Date _____

Lesson 3.4 Extra Practice

Represent the ratio relationship using a graph.

1.

Distance (miles)	20	80	120
Fuel (gallons)	1	4	6

2.

Cost (dollars)	2	5	15
Pens	8	20	60

3.

Time (hours)	1	4	10
Pages read	15	60	150

4.

Apples (pounds)	5	15	20
Cost (dollars)	8	24	32

5.

Sheep	4	8	12
Cows	10	20	30

6.

Fish	3	6	9
Water (gallons)	5	10	15

7. You grow 3 centimeters in 2 months.

a. Represent the ratio relationship using a graph.

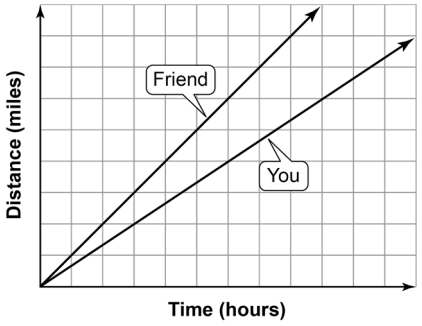
b. At this rate, how much do you grow in 5 months?

8. A fruit punch has a ratio of 2 cups of powder mix for every 5 gallons of water.

a. Represent the ratio relationship using a graph.

b. How many cups of powder mix are used with 9 gallons of water?

9. Just by looking at the graph, determine who is traveling faster. Explain.



10. You read 6 pages every 15 minutes. Your friend reads 8 pages every 18 minutes. Graph each relationship in the same coordinate plane. Who reads faster?

Name_____ Date _____

Lesson 3.4 Reteach

For a ratio of two quantities, you can use equivalent ratios to create ordered pairs. You can use the ordered pairs to sketch a graph that represents the ratio relationship.

The first quantity of each ratio becomes the x-coordinate of an ordered pair, and the second quantity of the ratio becomes the y-coordinate of the ordered pair.

The graph of every ratio relationship starts at (0, 0).

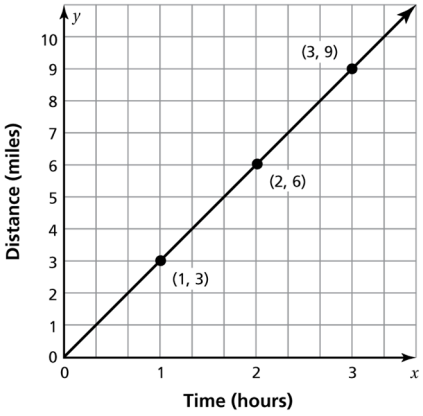
EXAMPLE Graphing Ratio Relationships

Represent the ratio relationship using a graph.

Time (hours)	1	2	3	← x-coordinates
Distance (miles)	3	6	9	← y-coordinates

The ordered pairs for this ratio relationship are (1, 3), (2, 6), and (3, 9).

Plot the ordered pairs in a coordinate plane and draw a line through their points. Start at (0, 0).



Name _____ Date _____

Lesson 3.4 Reteach (continued)

EXAMPLE Using a Graph to Solve a Ratio Problem

You buy 2 pounds of cheese for $7.

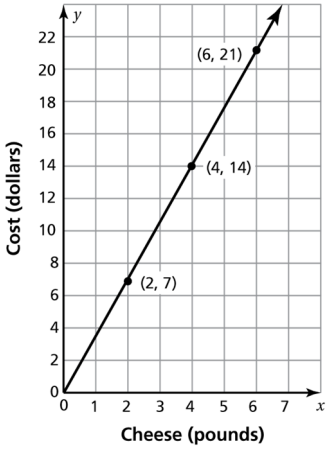
a. Represent the ratio relationship using a graph.

Create a ratio table. Use numbers that are easy to work with.

Cheese (pounds)	2	4	6
Cost (dollars)	7	14	21

Use the values in each column to make ordered pairs of the form (pounds, dollars).

The ordered pairs are (2, 7), (4, 14), and (6, 21). Plot these ordered pairs and draw a line through their points, starting at (0, 0).



b. Use the graph to find the cost of 3 pounds of cheese.

Draw a vertical dashed line at $x = 3$.

Draw a dashed horizontal line. The cost of 3 pounds of cheese is halfway between $7 and $14.

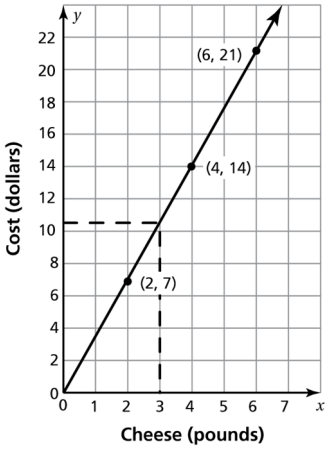
To find this cost, find half of the difference of 14 and 7, and add that number to 7.

Difference: $14 - 7 = 7$

Half of the difference: $7 \div 2 = 3.5$

Add the number to 7: $7 + 3.5 = 10.5$

▶ So, 3 pounds of cheese costs $10.50.



Represent the ratio relationship using a graph.

1.

Distance (feet)	1	2	3	4
Time (seconds)	6	12	18	24

2.

Fabric (yards)	2	4	6	8
Cost (dollars)	10	20	30	40

3. You buy 2 pounds of tomatoes for $5.00.

a. Represent the ratio relationship using a graph.

b. How much do 3 pounds of tomatoes cost?

Name_____ Date _____

Lesson 3.4 Enrichment and Extension

A Smooth Price

A smoothie shop charges $4.80 for a small size 12-ounce smoothie and $6.40 for a large size 16-ounce smoothie. The manager has decided to begin selling a jumbo size 22-ounce smoothie.

Small	Large	Jumbo
12 oz	16 oz	22 oz
$4.80	$6.40	

The manager needs to find a price for the new jumbo size smoothie.

1. How can the manager use ratios to determine an appropriate price for the jumbo size smoothie? Are the small and large smoothies priced in this way? Explain.

2. Determine a price the manager could charge for the jumbo smoothie. Explain how you found your answer.

3. Create a ratio table of the pricing for all three smoothies sizes. Add two more sizes and their costs.

Name _____ Date _____

3.4 Puzzle Time

What Do You Call A Frog With A Cast On Each Of Its Back Legs?

Write the letter of each answer in the box containing the exercise number.

Determine which car gets the better gas mileage.

1.

Car	A	B
Distance (miles)	180	175
Gallons Used	6	7

Y. Car A **Z.** Car B

2.

Car	A	B
Distance (miles)	234	140
Gallons Used	9	5

N. Car A **O.** Car B

3.

Car	A	B
Distance (miles)	400	630
Gallons Used	20	18

T. Car A **U.** Car B

4.

Car	A	B
Distance (miles)	315	228
Gallons Used	15	12

P. Car A **Q.** Car B

Determine which is the better buy.

5.

Apples	A	B
Cost (dollars)	3.75	4.50
Pounds	3	5

M. Brand A **N.** Brand B

6.

Toothpaste	A	B
Cost (dollars)	2.64	3.60
Ounces	6	8

P. Brand A **Q.** Brand B

7. Participant A did 120 jumping jacks in 10 minutes. Participant B did 140 jumping jacks in 14 minutes. Which participant had the greater jumping jack rate?

H. Participant A **I.** Participant B

3	5	7	2	4	6	1

Lesson 3.5 Cumulative Practice

For use before Lesson 3.5

Divide. Write the answer as a fraction or mixed number in simplest form.

1. $1\frac{3}{5} \div 1\frac{1}{7} =$ ____

2. $2\frac{1}{2} \div 1\frac{2}{5} =$ ____

Lesson 3.5 Vocabulary Practice

For use before Lesson 3.5

1. Write what you know about this phrase.

Preview: unit rate

Lesson 3.5 Prerequisite Skills Practice

For use before Lesson 3.5

Fill in the blank so that the ratios are equivalent.

1. 25 : 5 and _____ : 1

2. 64 : 8 and _____ : 1

Name _____ Date _____

Lesson 3.5 Extra Practice

Write a unit rate for the situation.

1. $44 in 4 days
2. 12 haircuts in 4 hours
3. 256 heartbeats in 4 minutes
4. 15 liters in 3 minutes
5. 12 cans for 6 people
6. 27 outs in 9 innings
7. 85 drops in 5 minutes
8. 36 children from 12 families

Find the missing values in the ratio table.

9.

Pounds	10		
Weeks	4	1	7

10.

Tons	5	1	12
Days	3		

Decide whether the rates are equivalent.

11. 17 heartbeats in 15 seconds,
68 heartbeats in 60 seconds
12. 96 miles on 4 gallons,
380 miles on 15 gallons

13. You receive 9 text messages in 12 minutes. What is the rate of text messages per hour?
14. You studied for 14 hours last week. What was your unit rate of hours of study per day?
15. In a walk for charity, you walk at a rate of 100 meters per minute. How long does it take you to walk 2 kilometers?
16. A deli sells a sandwich spread for $6.40 per pound. How much do you have to pay for 24 ounces of the spread?
17. You can buy 3 sandwiches for $4.95 or 4 sandwiches for $6.72. Which is the better buy?
18. You can buy 20 ounces of cereal for $4.40 or 16 ounces of the same brand for $3.68. Which is the better buy?

Name_____ Date_____

Lesson 3.5 Reteach

A **unit rate** compares a quantity to one unit of another quantity.

Some common unit rates are miles per gallon, cost per pound, miles per hour, and earnings per hour.

Equivalent rates have the same unit rate.

To find the unit rate of a ratio $a : b$, divide both a and b by b.

$a : b = \frac{a}{b} : \frac{b}{b}$ Divide both quantities by b.

$= \frac{a}{b} : 1$ Simplify. This is the unit rate.

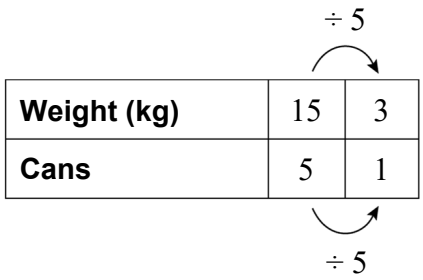
EXAMPLE Finding a Unit Rate

The weight of 5 large cans of spaghetti sauce is 15 kilograms. Find the unit rate of kilograms per can.

The ratio of kilograms to cans is

15 kilograms : 5 cans.

To find the equivalent ratio for 1 can, divide each quantity by 5.



▶ The unit rate is 3 kilograms per can.

Name _____ Date _____

Lesson 3.5 Reteach (continued)

EXAMPLE Using a Unit Rate to Solve a Rate Problem

A hiker walks 20 miles in 8 hours.

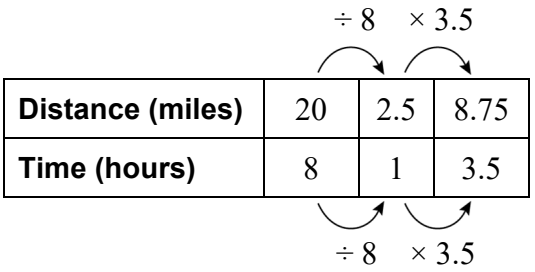
a. How many miles does the hiker walk in 3.5 hours?

The ratio of miles to hours is 20 : 8. You can divide by 8 to find the unit rate of miles per hour.

$20 \div 8 = 2.5$

The hiker walks 2.5 miles per 1 hour. Now, multiply by 3.5 to find the distance traveled in 3.5 hours.

$3.5 \times 2.5 = 8.75$



▶ The hiker walks 8.75 miles in 3.5 hours.

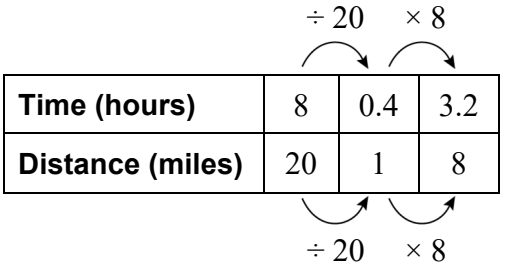
b. How long does it take for the hiker to walk 8 miles?

The ratio of hours to miles is 8 : 20. You can divide by 20 to find the unit rate of hours per mile.

$8 \div 20 = 0.4$

It takes the hiker 0.4 hour to walk 1 mile. Now, multiply by 8 to find the time to walk 8 miles.

$0.4 \times 8 = 3.2$



▶ So, it takes the hiker 3.2 hours to walk 8 miles.

Write a unit rate for the situation.

1. 8 kittens in 4 rooms

2. $96 for 8 hours of work

3. 54 biscuits from 9 batches

4. 2700 revolutions in 75 seconds

5. An airplane flies 585 miles in 1.5 hours.

a. How many miles does the airplane fly in 4.5 hours?

b. How many hours does it take the airplane to fly 195 miles?

Name _____ Date _____

Lesson 3.5 Enrichment and Extension

How much does it cost to travel one mile?

Your aunt and uncle each fill their cars' gas tanks at the gas station whose sign is shown. Your aunt gets 18 gallons of regular unleaded. Her car averages 32 miles per gallon. Your uncle gets 12 gallons of premium unleaded. His car averages 30 miles per gallon.

1. Find your aunt's unit cost for each mile she drives.
2. Find your uncle's unit cost for each mile he drives.
3. Whose vehicle is getting the better value? Explain.
4. Your uncle switches to mid-grade unleaded, and his car still averages about 30 miles per gallon. How does his unit cost change? Is he getting the better value for his vehicle compared to your aunt? Explain.
5. Suppose over time, gas prices decrease to about 80% of their current prices. Does this change your answer to Exercise 3? Explain.
6. The United States uses about 146,000,000,000 gallons of gasoline each year.
   a. How many gallons does the United States use every day?
   b. Use compatible numbers to estimate how many gallons the United States uses every minute.
   c. Use compatible numbers to estimate how many gallons the United States uses every second.

Name _____ Date _____

3.5 Puzzle Time

Where Does An Umpire Like To Sit When He Is Eating Dinner?

Write the letter of each answer in the box containing the exercise number.

Write a rate that represents the situation.

1. 45 meters in 6 seconds
2. 3 meters in 4 seconds
3. 2.80 meters in 5 seconds
4. 12 meters in 3 seconds
5. 35 meters in 20 seconds
6. 10 meters in 60 seconds

Write a unit rate for the situation.

7. $45.00 for 9 pounds
8. $24 for 3 pounds
9. $390 for 6 pounds
10. $42 for 21 pounds
11. $180 for 10 pounds
12. $864 for 8 pounds

Decide whether the rates are equivalent.

13. 9 miles in 3 hours

    27 miles in 6 hours

14. 152 points in 8 games

    171 points in 9 games

Answers

T. $108 per pound

P. 35 meters : 20 seconds

E. 45 meters : 6 seconds

B. 12 meters : 3 seconds

E. $8 per pound

T. 3 meters : 4 seconds

I. 2.80 meters : 5 seconds

A. $18 per pound

L. $5 per pound

D. 10 meters : 60 seconds

H. $65 per pound

N. $2 per pound

E. yes

H. no

4	1	9	3	10	6		12	13	8		5	7	11	2	14

Lesson 3.6 Cumulative Practice

For use before Lesson 3.6

Find the value of the power.

1. $5^4 =$ _____

2. $6^4 =$ _____

Lesson 3.6 Vocabulary Practice

For use before Lesson 3.6

1. Write what you know about this phrase.

Preview: conversion factor

Lesson 3.6 Prerequisite Skills Practice

For use before Lesson 3.6

Copy and complete the statement using <, >, or =.

1. 3 yd ___?___ 21 ft

2. 10 cm ___?___ 1 m

Name _____ Date _____

Lesson 3.6 Extra Practice

Copy and complete the statement. Round to the nearest hundredth, if necessary.

1. 14 qt = ? g

2. 1500 ft = ? yd

3. 500 cm = ? m

4. 9 qt = ? c

5. 10 ft ≈ ? m

6. 2000 m ≈ ? ft

7. 4 qt ≈ ? L

8. 50 g ≈ ? oz

9. 1.4 lb ≈ ? kg

10. A hurricane has a large eye of about 80 miles. Your friend says the eye is about 50 kilometers wide. Is your friend correct? Explain your reasoning.

Copy and complete the statement using < or >.

11. 3 kg ? 100 oz

12. 2 yd ? 200 cm

13. 15 gal ? 50 L

14. 100,000 cm ? 1 mi

Copy and complete the statement. Round to the nearest hundredth, if necessary.

15. 2 in./sec ≈ ? cm/sec

16. 2 ft/day ≈ ? m/day

17. 8 L/h ≈ ? gal/h

18. 80 oz/yr ≈ ? g/yr

19. The maximum sustained winds reached by a hurricane were 230 kilometers per hour.

a. What is this wind speed in miles per hour?

b. What is this wind speed in meters per hour?

c. What is this wind speed in meters per minute?

d. Use the Internet to determine the highest category attained by the hurricane.

20. A book is 15 centimeters long and 6 centimeters wide. What are the length and width of the book in inches? Round your answers to the nearest hundredth.

21. You have a liter bottle of orange juice. You want to divide the juice into one-cup amounts. How many cups of juice can you pour? How much juice will be left over? Explain your answer.

Name _____ Date _____

Lesson 3.6 Reteach

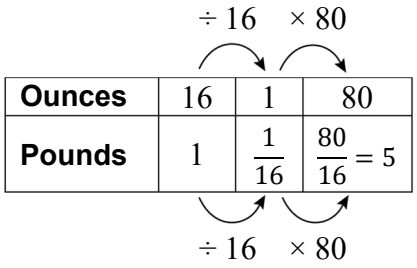
To convert from one unit of measure to another, you can use a unit rate and a ratio table.

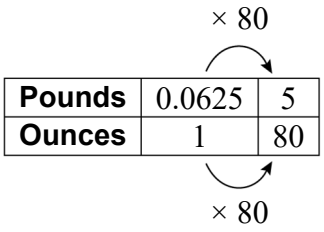
Use a unit rate of both units involved in the conversion to make a ratio table with equivalent ratios.

EXAMPLE Converting Measures within the Same System

Convert 80 ounces to pounds.

There are 16 ounces in 1 pound, and there is 0.0625 pound in 1 ounce. You can use either of these unit rates to make the conversion.





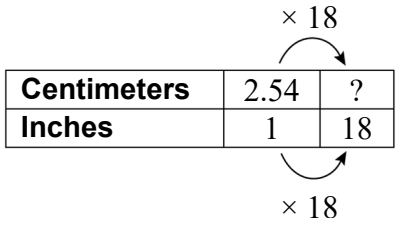
▶ So, 80 ounces is equal to 5 pounds.

Converting measures between the two measurement systems works just like converting within a single system. Determine a unit rate of the two units and create a ratio table.

EXAMPLE Converting Measures Between Systems

Convert 18 inches to centimeters.

There are 2.54 centimeters in 1 inch. Use a ratio table.



$2.54 \times 18 = 45.72$

▶ So, 18 inches is equal to 45.72 centimeters.

Name _____ Date _____

Lesson 3.6 Reteach (continued)

You can also convert measures using conversion factors. A **conversion factor** is a rate in which the two quantities are equal.

Use **unit analysis** to determine which conversion factor to use. You can "cross out" units that appear in both a numerator and a denominator of a product.

EXAMPLE Using Conversion Factors

Convert 2 liters to quarts. Round to the nearest hundredth, if necessary.

There are about 1.06 quarts in 1 liter. The conversion factor from liters to quarts is written as $\frac{1.06\text{ qt}}{1\text{L}}$.

Multiply 2 liters by the conversion factor.

$$2\text{ liters} \approx 2\text{ L} \times \frac{1.06\text{ qt}}{1\text{ L}} = 2.12\text{ qt}$$

Notice that you can cross out the units "liters," and the unit "quarts" remains, so you know that you used the correct conversion factor.

▶ So, there are about 2.12 quarts in 2 liters.

Converting rates is very similar to converting simple units.

EXAMPLE Converting Rates

Convert 300 feet per minute to yards per minute.

There are 3 feet in 1 yard. The conversion factor from feet to yards is written as $\frac{1\text{ yd}}{3\text{ ft}}$. Multiply 300 ft/min by the conversion factor.

$$\frac{300\text{ ft}}{1\text{ min}} = \frac{300\text{ ft}}{1\text{ min}} \times \frac{1\text{ yd}}{3\text{ ft}} = \frac{100\text{ yd}}{1\text{ min}}$$

▶ So, 300 feet per minute is equal to 100 yards per minute.

Copy and complete the statement. Round to the nearest hundredth, if necessary.

1. 9 qt = _____ gal

2. 2 km = _____ m

3. 48 oz = _____ lb

4. 6.3 in. ≈ _____ cm

5. 19.1 oz ≈ _____ g

6. 6.75 L ≈ _____ qt

Copy and complete the statement using < or >.

7. 26 ft _____ 895 cm

8. 7 pt _____ 6 L

9. 360 g ____ 14 oz

Copy and complete the statement.

10. 38 gal/min ≈ _____ L/min

11. 5.3 km/h ≈ _____ mi/h

Name _____ Date _____

Lesson 3.6 Enrichment and Extension

Converting a Rate

Sometimes you have to convert both the numerator and denominator of a rate.

Example: Convert 65 miles per hour to meters per second.

Use 1 mi ≈ 1.61 km, 1000 m = 1 km, 1 h = 60 min, and 1 min = 60 sec.

$$\frac{65 \text{ mi}}{1 \text{ h}} \approx \frac{65 \text{ mi}}{1 \text{ h}} \times \frac{1.61 \text{ km}}{1 \text{ mi}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = \frac{104{,}650 \text{ m}}{3600 \text{ sec}} \approx 29.07 \text{ m/sec}$$

▶ So, 65 miles per hour is about 29.07 meters per second.

Copy and complete each statement. Round to the nearest hundredth, if necessary.

1. 45 mi/h ≈ ___?___ km/min

2. 92 gal/min ≈ ___?___ L/sec

3. 1500 L/h ≈ ___?___ pt/sec

4. 75 m/min ≈ ___?___ mi/h

5. 12.8 in./day ≈ ___?___ cm/h

6. 0.5 kg/day ≈ ___?___ lb/week

7. 35 km/h ≈ ___?___ ft/min

8. 58 L/sec ≈ ___?___ gal/day

9. 17 lb/yr ≈ ___?___ g/day

10. 25 mi/h ≈ ___?___ m/sec

11. A needle palm tree at the park is growing an average of 4.35 centimeters per day. A cabbage palm tree next to it is growing an average of 1.26 inches per day. Which one is growing faster? Explain.

12. Change 30 miles per hour, 50 miles per hour, and 70 miles per hour into miles per minute. Explain why speed limits are posted in miles per hour and not miles per minute or miles per second.

13. Jose wants to buy a filter for his pool. One filter has a flow rate of 75 gallons per minute. Another filter has a flow rate of 2 liters per second.

a. When purchasing a filter for a pool, is it better to have a faster or slower flow rate? Explain.

b. Which filter has the faster flow rate?

Name _____ Date _____

3.6 Puzzle Time

How Do You Fix A Broken Pizza?

Write the letter of each answer in the box containing the exercise number.

Complete the statement. Round to the nearest hundredth, if necessary.

1. 72 in. = ? cm

2. 3 qt ≈ ? L

3. 15 lb ≈ ? kg

4. 120 mi ≈ ? km

5. 7 L ≈ ? qt

6. 75 kg ≈ ? lb

7. 5 km ≈ ? mi

8. 54 cm ≈ ? in.

9. $\frac{24 \text{ in.}}{\text{h}} = \frac{? \text{ cm}}{\text{h}}$

10. $\frac{32 \text{ lb}}{\text{day}} \approx \frac{? \text{ kg}}{\text{day}}$

11. $\frac{52 \text{ L}}{\text{year}} \approx \frac{? \text{ qt}}{\text{year}}$

12. $\frac{7 \text{ km}}{\text{min}} \approx \frac{? \text{ mi}}{\text{min}}$

13. Felicia is 63 inches tall. What is her height in centimeters?

14. Your backpack weighs 6 kilograms. What is its weight in pounds?

15. If the speed limit is 65 miles per hour, how many kilometers per hour can a person drive without speeding?

Answers

P. 160.02

I. 182.88

W. 21.06

T. 13.2

H. 193.2

A. 2.85

T. 14.4

O. 3.1

A. 104.65

S. 165

T. 55.12

O. 7.42

E. 6.75

M. 4.34

T. 60.96

8	1	11	4		14	5	12	2	9	7		13	15	6	10	3