

UNIT 6

Measurement and Geometry

460-461 Marilyn Goddard/Corbis

Chapter 12

Measurement

Chapter 13

Geometry: Angles and
Polygons

Chapter 14

Geometry: Measuring
Area and Volume

In this unit, you will solve problems involving customary and metric measures, angle measure, area, and volume.



INTERDISCIPLINARY PROJECT

Road Trip

Math and Geography Let's hit the road! Come join us on a cross-country trip to see the nation. In preparation, you'll need a map to figure out how far you're traveling. You're also going to need to load up your car with all the necessary travel essentials. Don't overdo it though, there's only so much room in there. Put on your geometry thinking cap and let's get packing!



Log on to msmath1.net/webquest to begin your WebQuest.

Measurement



“What do pumpkins have to do with math?”

A pumpkin pie recipe calls for 15 ounces of pumpkin. *About* how many pies can be made with eight pounds of pumpkin? To estimate, you need to change pounds to ounces. Being able to convert measures of length, weight, and capacity is a useful skill for solving many real-life problems.

You will solve problems by converting customary units in Lessons 12-1 and 12-2.

GETTING STARTED

► Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 12. Refer to the lesson number in parentheses for review.

Vocabulary Review

State whether each sentence is *true* or *false*. If *false*, replace the underlined word to make a true sentence.

1. When adding decimals, you must align the decimal point. (Lesson 3-5)
2. When a decimal between 0 and 1 is divided by a whole number greater than one, the result is a greater number. (Lesson 4-1)

Prerequisite Skills

Add. (Lesson 3-5)

- | | |
|-------------------|--------------------|
| 3. $8.73 + 11.96$ | 4. $54.26 + 21.85$ |
| 5. $3.04 + 9.92$ | 6. $76.38 + 44.15$ |
| 7. $7.9 + 8.62$ | 8. $15.37 + 9.325$ |

Subtract. (Lesson 3-5)

- | | |
|-------------------|---------------------|
| 9. $17.46 - 3.29$ | 10. $68.05 - 24.38$ |
| 11. $9.85 - 2.74$ | 12. $73.91 - 50.68$ |
| 13. $8.4 - 3.26$ | 14. $27 - 8.62$ |

Multiply. (Lesson 4-1)

- | | |
|-----------------------|------------------------|
| 15. 3.8×100 | 16. 5.264×10 |
| 17. 6.75×10 | 18. $8.9 \times 1,000$ |
| 19. 7.18×100 | 20. 24.9×100 |

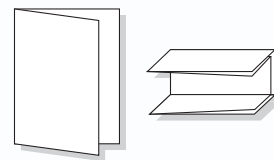
Divide. (Lesson 4-3)

- | | |
|--------------------|----------------------|
| 21. $9.8 \div 100$ | 22. $12.25 \div 10$ |
| 23. $4.5 \div 10$ | 24. $26.97 \div 100$ |

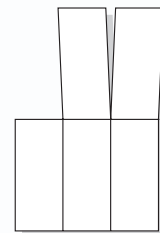
FOLDABLES Study Organizer

Measurement Make this Foldable to help you organize your notes on metric and customary units. Begin with a sheet of 11" by 17" paper.

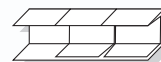
STEP 1 Fold Fold the paper in half along the length. Then fold in thirds along the width.



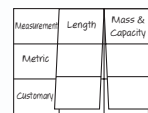
STEP 2 Unfold and Cut Open and cut along the two top folds to make three strips. Cut off the first strip.



STEP 3 Refold Refold the two top strips down and fold the entire booklet in thirds along the length.



STEP 4 Unfold and Label Unfold and draw lines along the folds. Label as shown.



Noteables™ Chapter Notes Each time you find this logo throughout the chapter, use your *Noteables™: Interactive Study Notebook with Foldables™* or your own notebook to take notes. Begin your chapter notes with this Foldable activity.



Readiness To prepare yourself for this chapter with another quiz, visit msmath1.net/chapter_readiness

Area and Perimeter

What You'll LEARN

Explore changes in area and perimeter of rectangles.

Materials

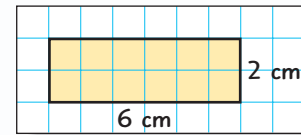
- centimeter grid paper

INVESTIGATE

Work in groups of three.

If you increase the side lengths of a rectangle, how are the area and the perimeter affected? In this lab, you will investigate relationships between the areas and perimeters of original figures and those of the newly created figures.

- STEP 1** On centimeter grid paper, draw and label a rectangle with a length of 6 centimeters and a width of 2 centimeters.



- STEP 2** Find the area and perimeter of this original rectangle. Then record the information in a table like the one shown.

Rectangle	Length (cm)	Width (cm)	Area (sq cm)	Perimeter (cm)
original	6	2		
A	12	4		
B	18	6		
C	24	8		

- STEP 3** Repeat Steps 1 and 2 for rectangles A, B, and C, whose dimensions are shown in the table.

Writing Math

- Describe how the dimensions of rectangles A, B, and C are different from the original rectangle.
- Describe how the area of the original rectangle changed when the length and width were both doubled.
- Describe how the perimeter of the original rectangle changed when the length and width were both doubled.
- Describe how the area and the perimeter of the original rectangle changed when the length and width were both tripled.
- Draw** a rectangle whose length and width are half those of the original rectangle. Describe how the area and perimeter changes.
- Suppose the perimeter of a rectangle is 15 centimeters. **Make a conjecture** about the perimeter of the rectangle if the length and the width are both doubled.

STUDY TIP

Look Back You can review **area** and **perimeter of rectangles** in Lessons 1-8 and 4-5, respectively.

12-1

Length in the Customary System

What You'll LEARN

Change units of length and measure length in the customary system.

NEW Vocabulary

inch
foot
yard
mile

HANDS-ON Mini Lab

Work with a partner.

STEP 1 Using string, measure and cut the lengths of your arm and your shoe.

STEP 2 Use the strings to find the classroom length in *arms* and classroom width in *shoes*. Record the nonstandard measures.

STEP 3 Use a yardstick or tape measure to find the length in yards and width in feet. Record the standard measures.

1. Compare your nonstandard and standard measures with the measures of other groups. Are they similar? Explain.
2. Explain the advantages and the disadvantages of using nonstandard measurement and standard measurement.

Materials

- string
- scissors
- yardstick
- tape measure

Measure	Nonstandard	Standard
classroom length	_____ arms	_____ yards
classroom width	_____ shoes	_____ feet

The most commonly used customary units of length are shown below.

Noteables™

Key Concept: Customary Units of Length

Unit	Model
1 inch (in.)	width of a quarter
1 foot (ft) = 12 in.	length of a large adult foot
1 yard (yd) = 3 ft	length from nose to fingertip
1 mile (mi) = 1,760 yd	10 city blocks

STUDY TIP

Measurement When changing from larger units to smaller units, there will be a greater number of smaller units than larger units.

To change from larger units of length to smaller units, multiply.

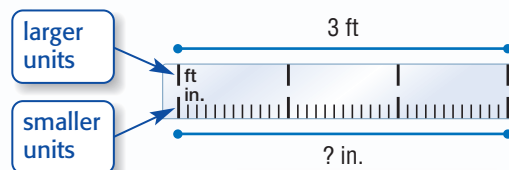
EXAMPLE Change Larger Units to Smaller Units

1 $3 \text{ ft} = \underline{\quad ? \quad} \text{ in.}$

Since 1 foot = 12 inches, multiply by 12.

$$3 \times 12 = 36$$

So, 3 feet = 36 inches.



To change from smaller units to larger units, divide.

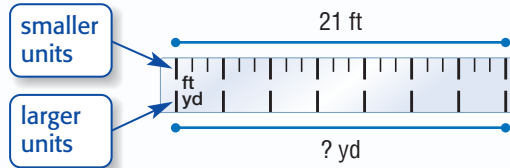
EXAMPLE Change Smaller Units to Larger Units

1 $21 \text{ ft} = \underline{\quad?} \text{ yd}$

Since 3 feet = 1 yard,
divide by 3.

$$21 \div 3 = 7$$

So, 21 feet = 7 yards.



There will be fewer larger units than smaller units.

Your Turn Complete.

- a. $5 \text{ ft} = \underline{\quad?} \text{ in.}$ b. $3 \text{ yd} = \underline{\quad?} \text{ ft}$ c. $2,640 \text{ yd} = \underline{\quad?} \text{ mi}$

Rulers are usually separated into eighths of an inch.

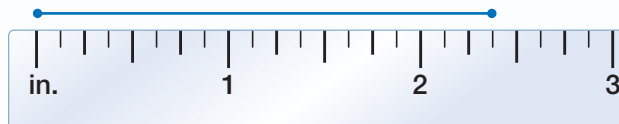


The longest marks on a ruler represent an inch, the next smaller marks represent $\frac{1}{2}$ inch, and so on.

EXAMPLE Draw a Line Segment

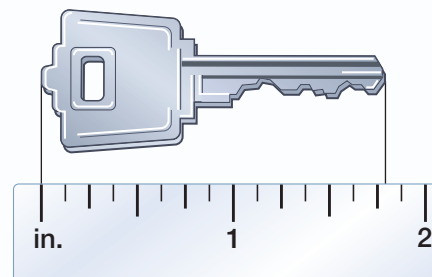
- 1 Draw a line segment measuring $2\frac{3}{8}$ inches.

Draw a line segment from 0 to $2\frac{3}{8}$.



EXAMPLE Measure Length

- 1 **KEYS** Measure the length of the key to the nearest half, fourth, or eighth inch.



The key is between $1\frac{3}{4}$ inches and $1\frac{7}{8}$ inches. It is closer to $1\frac{3}{4}$ inches.

The length of the key is about $1\frac{3}{4}$ inches.

STUDY TIP

Measurement When changing from smaller units to larger units, there will be fewer larger units than smaller units.

Skill and Concept Check

- Writing Math** Describe how you would change 12 feet to yards.
- OPEN ENDED** Draw a segment that is between $1\frac{1}{2}$ inches and $2\frac{1}{4}$ inches long. State the measure of the segment to the nearest fourth inch and eighth inch.

GUIDED PRACTICE

Complete.

3. $4 \text{ yd} = \underline{\quad} \text{ ft}$ 4. $72 \text{ in.} = \underline{\quad} \text{ yd}$ 5. $4 \text{ mi} = \underline{\quad} \text{ yd}$

Draw a line segment of each length.

6. $1\frac{1}{4}$ in. 7. $\frac{5}{8}$ in.

Measure the length of each line segment or object to the nearest half, fourth, or eighth inch.



10. Which is greater: $2\frac{1}{2}$ yards or 8 feet? Explain.

11. **IDENTIFICATION** Measure the length and width of a student ID card or driver's license to the nearest eighth inch.

Practice and Applications

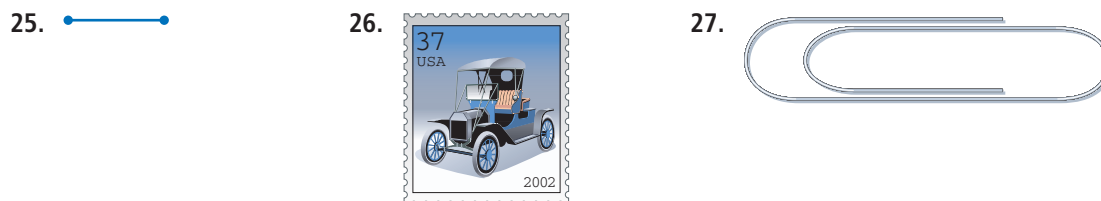
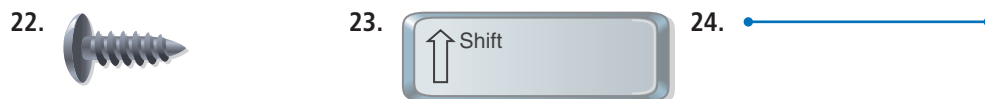
Complete.

12. $5 \text{ yd} = \underline{\quad} \text{ in.}$ 13. $6 \text{ yd} = \underline{\quad} \text{ ft}$ 14. $6\frac{1}{2} \text{ ft} = \underline{\quad} \text{ in.}$
15. $3 \text{ mi} = \underline{\quad} \text{ ft}$ 16. $48 \text{ in.} = \underline{\quad} \text{ ft}$ 17. $10 \text{ ft} = \underline{\quad} \text{ yd}$

Draw a line segment of each length.

18. $2\frac{1}{2}$ in. 19. $3\frac{1}{4}$ in. 20. $\frac{3}{4}$ in. 21. $1\frac{3}{8}$ in.

Measure the length of each line segment or object to the nearest half, fourth, or eighth inch.



HOMWORK HELP

For Exercises	See Examples
12–17	1, 2
18–21	3
22–27	4

Extra Practice
See pages 618, 635.



28. Which is greater: $1\frac{1}{3}$ yards or 45 inches? Explain.
29. Which is greater: 32 inches or $2\frac{1}{2}$ feet? Explain.
30. **TOOLS** Measure the width of the bolt. What size wrench would tighten it: $\frac{1}{2}$ inch, $\frac{5}{8}$ inch, or $\frac{3}{4}$ inch?
31. **MONEY** Measure the length of a dollar bill to the nearest sixteenth inch.
32. **RESEARCH** Estimate the height of an adult giraffe. Then use the Internet or another source to find the actual height.



For Exercises 33–35, estimate the length of each object. Then measure to find the actual length.

33. the length of your bedroom to the nearest yard
34. the width of a computer mouse to the nearest half inch
35. the height of your dresser to the nearest foot
36. **CRITICAL THINKING** How many sixteenth inches are in a foot? How many half inches are in a yard?



EXTENDING THE LESSON The symbol for foot is ' and the symbol for inches is ". You can add and subtract lengths with different units.

Add the feet.	↔	$\begin{array}{r} 7' \ 8'' \\ + 3' \ 6'' \\ \hline 10'14'' \end{array}$	↔	Add the inches.
Since $14'' = 1'2''$, the sum is $10' + 1'2''$ or $11'2''$.				

Add or subtract.

37. $15'7'' + 1'5''$ 38. $6'9'' - 4'3''$ 39. $2 \text{ yd } 2 \text{ ft} + 4 \text{ yd } 2 \text{ ft}$

Spiral Review with Standardized Test Practice

40. **MULTIPLE CHOICE** Choose the greatest measurement.
- A 53 in.
 B $4\frac{5}{7}$ ft
 C $\frac{1}{8}$ ft
 D $\frac{1}{8}$ yd
41. **SHORT RESPONSE** The length of a football field is 100 yards. How many inches is this?
42. A coin is tossed, and the spinner is spun. Find $P(\text{tails and } 4)$.
(Lesson 11-5)
- 
43. Find the probability that a randomly thrown dart will land in the shaded region. (Lesson 11-4)
- 

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Multiply or divide. (Page 590)

44. 4×8 45. 16×5 46. $5,000 \div 2,000$ 47. $400 \div 8$



What You'll LEARN

Use a spreadsheet to compare areas of rectangles with the same perimeter.

Area and Perimeter

A computer spreadsheet is a useful tool for comparing different rectangular areas that have the same perimeter.

ACTIVITY

Suppose 24 sections of fencing, each one foot long, are to be used to enclose a rectangular vegetable garden. What are the dimensions of the garden with the largest possible area?

If w represents the width of the garden, then $12 - w$ represents the length.

Set up the spreadsheet as shown. The possible widths are listed in column A. The spreadsheet calculates the lengths in column B, the perimeters in column C, and the areas in column D.

	A	B	C	D
1	Width + Length	12		
2	Width	Length	Perimeter	Area
3	1	11	24	11
4	2	10	24	20
5	3	9	24	27
6	4	8	24	32
7	5	7	24	35
8	6	6	24	36
9	7	5	24	35
10	8	4	24	32
11	9	3	24	27
12	10	2	24	20
13	11	1	24	11

The spreadsheet evaluates the formula $B1 - A3$.

The spreadsheet evaluates the formula $A9 \times B9$.

EXERCISES

1. Explain why the formula for the length is $12 - w$ instead of $24 - w$.
2. Which garden size results in the largest area?
3. Which cell should you modify to find the largest area that you can enclose with 40 sections of fencing, each 1 foot long?
4. Use the spreadsheet to find the dimensions of the largest area you can enclose with 40, 48, and 60 feet of fencing.
5. **Make a conjecture** about the shape of a rectangular garden when the area is the largest.

Capacity and Weight in the Customary System

What You'll LEARN

Change units of capacity and weight in the customary system.

NEW Vocabulary

fluid ounce
cup
pint
quart
gallon
ounce
pound
ton

Link to READING

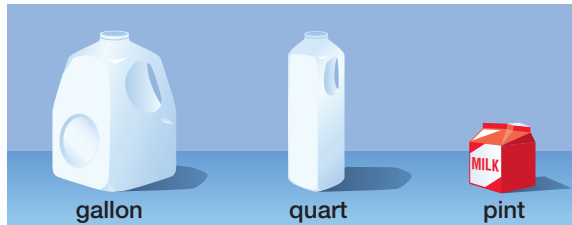
Everyday Meaning of Capacity: the maximum amount that can be contained, as in a theater filled to capacity

READING in the Content Area

For strategies in reading this lesson, visit msmath1.net/reading.

HANDS-ON Mini Lab

Work in groups of 4 or 5.



Materials

- gallon container
- quart container
- pint container
- water

STEP 1

Fill the pint container with water. Then pour the water into the quart container. Repeat until the quart container is full. Record the number of pints needed to fill the quart.

STEP 1

Fill the quart container with water. Then pour the water into the gallon container. Repeat until the gallon container is full. Record the number of quarts needed to fill the gallon.

Complete.

- 1 quart = ? pints
- 2 quarts = ? pints
- 1 gallon = ? quarts
- 1 gallon = ? pints
- What fractional part of 1 gallon would fit in 1 pint?
- How many gallons are equal to 12 quarts? Explain.

The most commonly used customary units of capacity are shown.

Noteables™

Key Concept: Customary Units of Capacity

Unit	Model
1 fluid ounce (fl oz)	2 tablespoons of water
1 cup (c) = 8 fl oz	coffee cup
1 pint (pt) = 2 c	small ice cream container
1 quart (qt) = 2 pt	large measuring cup
1 gallon (gal) = 4 qt	large plastic jug of milk

As with units of length, to change from larger units to smaller units, multiply. To change from smaller units to larger units, divide.

EXAMPLES

Change Units of Capacity

Complete.

1 $3 \text{ qt} = \underline{\quad?} \text{ pt}$

$$3 \times 2 = 6$$

So, 3 quarts = 6 pints.

THINK 1 quart = 2 pints

Multiply to change a larger unit to a smaller unit.

1 $64 \text{ fl oz} = \underline{\quad?} \text{ pt}$

$$64 \div 8 = 8$$

$$8 \div 2 = 4$$

So, 64 fluid ounces = 4 pints.

THINK 8 fluid ounces = 1 cup and 2 cups = 1 pint. You need to divide twice.

Divide to change fluid ounces to cups.
So $64 \text{ fl oz} = 8 \text{ c}$.

Divide to change cups to pints.

The most commonly used customary units of weight are shown below.

Noteables™

Key Concept: Customary Units of Weight

Unit	Model
1 ounce (oz)	pencil
1 pound (lb) = 16 oz	package of notebook paper
1 ton (T) = 2,000 lb	small passenger car

REAL-LIFE MATH

TRUCKS A pickup truck that is said to be “one-and-a-half tons,” means that the maximum amount of weight it can carry is $1\frac{1}{2}$ tons, or 3,000 pounds.

Source: cartalk.cars.com



EXAMPLES

Change Units of Weight

1 **TRUCKS** A truck weighs 7,000 pounds. How many tons is this?

$$7,000 \text{ lb} = \underline{\quad?} \text{ T} \quad \text{THINK } 2,000 \text{ pounds} = 1 \text{ ton}$$

$$7,000 \div 2,000 = 3\frac{1}{2} \quad \text{Divide to change pounds to tons.}$$

So, 7,000 pounds = $3\frac{1}{2}$ tons.

1 **PARTIES** How many 4-ounce party favors can be made with 5 pounds of mixed nuts?

First, find the total number of ounces in 5 pounds.

$$5 \times 16 = 80 \quad \text{Multiply by 16 to change pounds to ounces.}$$

Next, find how many sets of 4 ounces are in 80 ounces.

$$80 \text{ oz} \div 4 \text{ oz} = 20$$

So, 20 party favors can be made with 5 pounds of mixed nuts.

2 **Your Turn** Complete.

a. $4 \text{ pt} = \underline{\quad?} \text{ c}$ b. $32 \text{ fl oz} = \underline{\quad?} \text{ c}$ c. $40 \text{ oz} = \underline{\quad?} \text{ lb}$



Skill and Concept Check

1. **State** the operation that you would use to change pints to quarts.
2. **Writing Math** Explain whether 1 cup of sand and 1 cup of cotton balls would have the same capacity, the same weight, both, or neither.
3. **OPEN ENDED** Without looking at the labels, estimate the weight or capacity of three packaged food items in your kitchen. Then compare your estimate to the actual weight or capacity.

GUIDED PRACTICE

Complete.

4. $7 \text{ pt} = \underline{\quad?} \text{ c}$
5. $24 \text{ qt} = \underline{\quad?} \text{ gal}$
6. $16 \text{ pt} = \underline{\quad?} \text{ gal}$
7. $5 \text{ c} = \underline{\quad?} \text{ fl oz}$
8. $10,000 \text{ lb} = \underline{\quad?} \text{ T}$
9. $3\frac{1}{2} \text{ lb} = \underline{\quad?} \text{ oz}$
10. **OCEAN** Giant clams can weigh as much as $\frac{1}{4}$ ton. How many pounds is this?
11. **LIFE SCIENCE** Owen estimates that the finches eat 8 ounces of birdseed a day at his feeder. If he buys a 10-pound bag of birdseed, about how many days will it last?

Practice and Applications

Complete.

12. $5 \text{ qt} = \underline{\quad?} \text{ pt}$
13. $8 \text{ gal} = \underline{\quad?} \text{ qt}$
14. $24 \text{ fl oz} = \underline{\quad?} \text{ c}$
15. $32 \text{ qt} = \underline{\quad?} \text{ gal}$
16. $6\frac{1}{2} \text{ pt} = \underline{\quad?} \text{ c}$
17. $13 \text{ qt} = \underline{\quad?} \text{ gal}$
18. $9 \text{ gal} = \underline{\quad?} \text{ pt}$
19. $24 \text{ fl oz} = \underline{\quad?} \text{ pt}$
20. $1,500 \text{ lb} = \underline{\quad?} \text{ T}$
21. $112 \text{ oz} = \underline{\quad?} \text{ lb}$
22. $84 \text{ oz} = \underline{\quad?} \text{ lb}$
23. $4\frac{1}{2} \text{ T} = \underline{\quad?} \text{ lb}$

24. How many pounds are in 30 tons?

25. How many gallons equal 8 cups?

26. Which is less: 14 cups or 5 pints? Explain.

27. Which is greater: $3\frac{1}{2}$ pints or 60 fluid ounces? Explain.

Choose the better estimate for each measure.

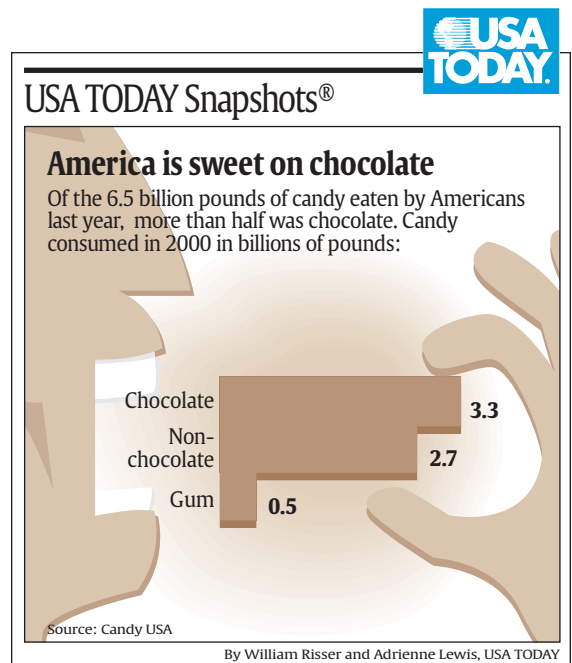
28. the amount of milk in a bowl of cereal: 1 cup or 1 quart
29. the amount of cough syrup in one dosage: 2 fluid ounces or 1 pint
30. the weight of a bag of groceries: 3 ounces or 3 pounds
31. Estimate how many cups of soda are in a 12-ounce can. Then find the actual amount.
32. Estimate the number of pints in a bottle of laundry detergent. Then find the exact number.

HOMWORK HELP

For Exercises	See Examples
12–23	1, 2
24–25, 31–34	3, 4

Extra Practice
See pages 618, 635.

33. **CHOCOLATE** Refer to the graphic at the right. How many tons of chocolate candy did Americans consume in 2000?
34. **BAKING** A pumpkin pie recipe calls for 15 ounces of pumpkin. *About* how many pies can be made with 8 pounds of pumpkin?
35. **WRITE A PROBLEM** Write a problem that can be solved by converting customary units of capacity or weight.
36. **MULTI STEP** Peni has 12 quart jars and 24 pint jars to fill with strawberry jam. If her recipe makes 5 gallons of jam, will she have enough jars? Explain.



MULTI STEP For Exercises 37 and 38, refer to the information below.

During the Ironman Triathlon World Championships, about 25,000 cookies and 250,000 cups of water are given away. Each cup contains 8 fluid ounces, and each cookie weighs 2.5 ounces.

37. About how many gallons of water are given away?
38. About how many pounds of cookies are given away?
39. **CRITICAL THINKING** What number can you divide by to change 375 fluid ounces directly to quarts?

Spiral Review with Standardized Test Practice

40. **MULTIPLE CHOICE** Which measuring tool would you use to find the number of pounds that a can of paint weighs?
- (A) protractor (B) measuring cup
(C) thermometer (D) weight scale
41. **MULTIPLE CHOICE** A can of green beans weighs 13 ounces. How many pounds does a case of 24 cans weigh?
- (F) 1.5 lb (G) 15 lb (H) 19.5 lb (I) 312 lb
42. **MEASUREMENT** Measure the width of your pencil to the nearest eighth inch. (Lesson 12-1)

A coin is tossed, and a number cube is rolled. Find each probability. (Lesson 11-5)

43. $P(\text{heads and } 1)$ 44. $P(\text{tails and } 5 \text{ or } 6)$ 45. $P(\text{heads or tails and odd})$

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Estimate each measure. (Lesson 12-1)

46. the width of a quarter 47. the width of a doorway



What You'll LEARN

Measure in metric units.

Materials

- tape measure

The Metric System**INVESTIGATE** *Work as a class.*

The basic unit of length in the metric system is the *meter*. All other metric units of length are defined in terms of the meter.

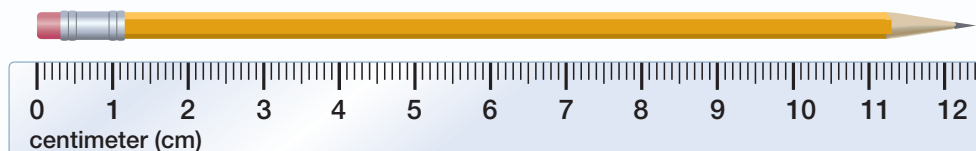
The most commonly used metric units of length are shown in the table.

Metric Unit	Symbol	Meaning
millimeter	mm	thousandth
centimeter	cm	hundredth
meter	m	one
kilometer	km	thousand

A metric ruler or tape measure is easy to read. The ruler below is labeled using *centimeters*.

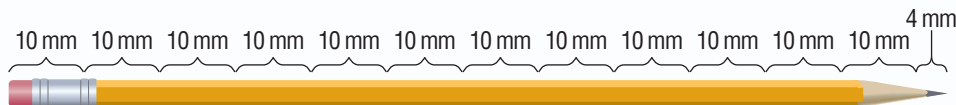


The pencil below is about 12.4 centimeters long.



To read *millimeters*, count each individual unit or mark on the metric ruler.

There are ten millimeter marks for each centimeter mark. The pencil is about 124 millimeters long.



$$124 \text{ mm} = 12.4 \text{ cm}$$

There are 100 centimeters in one meter. Since there are 10 millimeters in one centimeter, there are 10×100 or 1,000 millimeters in one meter.

The pencil is $\frac{124}{1,000}$ of a meter or 0.124 meter long.



$$124 \text{ mm} = 12.4 \text{ cm}$$

$$12.4 \text{ cm} = 0.124 \text{ m}$$

ACTIVITY*Work with a partner.*

Use metric units of length to measure various items.

STEP 1 Copy the table.

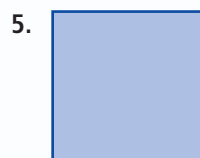
Object	Measure		
	mm	cm	m
length of pencil			
length of sheet of paper			
length of your hand			
width of your little finger			
length of table or desk			
length of chalkboard eraser			
width of door			
height of door			
distance from doorknob to the floor			
length of classroom			

STEP 2 Use a metric ruler or tape measure to measure the objects listed in the table. Complete the table.

Writing Math

- Tell which unit of measure is most appropriate for each item. How did you decide which unit is most appropriate?
- Examine the pattern between the numbers in each column. What relationship do the numbers have to each other?
- Select three objects around your classroom that would be best measured in meters, three objects that would be best measured in centimeters, and three objects that would be best measured in millimeters. Explain your choices.
- Write the name of a common object that you think has a length that corresponds to each length. Explain your choices.
 - 5 centimeters
 - 3 meters
 - 1 meter
 - 75 centimeters

Measure the sides of each rectangle in centimeters. Then find its perimeter and area.



12-3

Length in the Metric System

WHEN am I ever going to use this?

What You'll LEARN

Use metric units of length.

NEW Vocabulary

meter
metric system
millimeter
centimeter
kilometer


Link to READING

Everyday meaning of mill-: one thousand, as a millennium is one thousand years

SCIENCE The table shows the deepest points in several oceans.

1. What unit of measure is used?
2. What is the depth of the deepest point?
3. Use the Internet or another source to find the meaning of meter. Then write a sentence explaining how a meter compares to a yard.

Deepest Ocean Points



Ocean	Point	Depth (m)
Pacific	Mariana Trench	10,924
Atlantic	Puerto Rico Trench	8,648
Indian	Java Trench	7,125

Source: www.geography.about.com

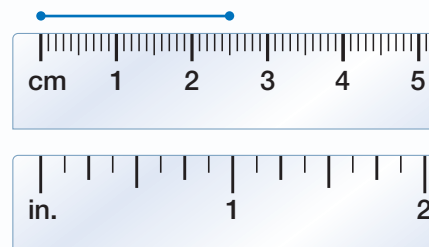
A **meter** is the basic unit of length in the metric system. The **metric system** is a decimal system of weights and measures. The most commonly used metric units of length are shown below.

Noteables™

Key Concept: Metric Units of Length

Unit	Model	Benchmark
1 millimeter (mm)	thickness of a dime	25 mm \approx 1 inch
1 centimeter (cm)	half the width of a penny	2.5 cm \approx 1 inch
1 meter (m)	width of a doorway	1 m \approx 1.1 yard
1 kilometer (km)	six city blocks	6.2 km \approx 1 mile

The segment at the right is 2.5 centimeters or 25 millimeters long. This is about 1 inch in customary units.



EXAMPLE

Use Metric Units of Length

- 1 Write the metric unit of length that you would use to measure the width of a paper clip.

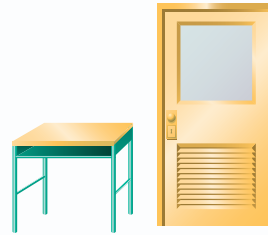
Compare the width of a paper clip to the models described above. The width of a paper clip is greater than the thickness of a dime, but less than half the width of a penny. So, the millimeter is an appropriate unit of measure.

EXAMPLES**Use Metric Units of Length**

Write the metric unit of length that you would use to measure each of the following.

1 height of a desk

Since the height of a desk is close to the width of a doorway, the meter is an appropriate unit of measure.



1 distance across Indiana

Since the distance across Indiana is much greater than 6 city blocks, this is measured in kilometers.



1 width of a floppy disk

Since the width of a floppy disk is greater than half the width of a penny and much less than the width of a doorway, the centimeter is an appropriate unit of measure.

2 **Your Turn** Write the metric unit of length that you would use to measure each of the following.

- a. thickness of a nickel b. height of a cereal box

**EXAMPLE****Estimate Length in Metric Units**

5 **MULTIPLE-CHOICE TEST ITEM** Which is the best estimate for the measurement of the line segment?



- (A) 0.5 km (B) 0.5 m (C) 6.0 cm (D) 6.0 mm

Read the Test Item

You need to determine the best estimate for the measure of the segment.

Solve the Test Item

The segment is much smaller than 0.5 kilometer, or 3 city blocks, so choice A can be eliminated. The segment is also quite a bit smaller than 0.5 meter, or half the width of a doorway, so choice B can also be eliminated.

Two centimeters is about the width of a penny, so 6.0 centimeters is about the width of 3 pennies. This estimate is the most reasonable. The answer is C.

Check The segment is much longer than 6 times the thickness of a dime, so choice D is not correct.

Test-Taking Tip**Eliminate Choices**

Eliminate any answer choices with units that are unreasonably small or large for the given measure.



Skill and Concept Check

- Writing Math** Name the four most commonly used metric units of length and describe an object having each length. Use objects that are different from those given in the lesson.
- OPEN ENDED** Give two examples of items that can be measured with a meterstick and two examples of items that cannot reasonably be measured with a meterstick.
- Which One Doesn't Belong?** Identify the measure that does not have the same characteristic as the other three. Explain your reasoning.

4.3 km

35 mm

23 yd

9.5 cm

GUIDED PRACTICE

Write the metric unit of length that you would use to measure each of the following.

- thickness of a calculator
- distance from home to school
- height of a tree
- width of a computer screen
- About how many centimeters is the thickness of a textbook?

Practice and Applications

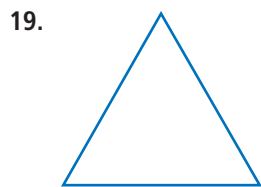
Write the metric unit of length that you would use to measure each of the following.

- thickness of a note pad
- thickness of a watchband
- length of a trombone
- width of a dollar bill
- length of a bracelet
- length of the Mississippi River
- distance from Knoxville, Tennessee, to Asheville, North Carolina
- distance from home plate to first base on a baseball field

Measure each line segment or side of each figure in centimeters and millimeters.

17. 

18. 



- Which customary unit of length is comparable to a meter?
- Is a mile or a foot closer in length to a kilometer?
- Which is greater: 15 millimeters or 3 centimeters? Explain.
- Which is less: 3 feet or 1 meter? Explain.

HOMEWORK HELP

For Exercises	See Examples
9–16	1–4
25–27	5

Extra Practice
See pages 618, 635.

Estimate the length of each of the following. Then measure to find the actual length.

25. CD case 26. chalkboard 27. eraser on end of pencil

28. **MAPS** Use a centimeter ruler to find the distance between Houston and Jacinto City, Texas, on the map at the right.



29. **FENCES** If you were to build a fence around a garden, would you need to be accurate to the nearest kilometer, to the nearest meter, or to the nearest centimeter? Explain.

30. **GEOMETRY** On centimeter grid paper, draw and label a square that has a perimeter of 12 centimeters.

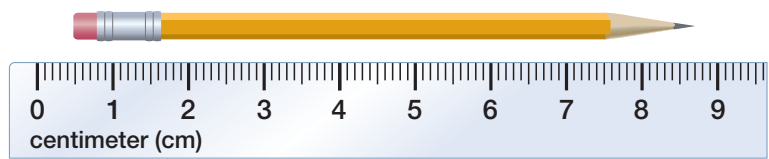
31. **CRITICAL THINKING** Order 4.8 mm, 4.8 m, 4.8 cm, 0.48 m, and 0.048 km from greatest to least measurement.

Spiral Review with Standardized Test Practice

32. **MULTIPLE CHOICE** Which is the *best* estimate for the height of a flagpole?

- (A) 10 km (B) 10 m (C) 10 cm (D) 10 mm

33. **MULTIPLE CHOICE** What is the length of the pencil to the nearest centimeter?



- (F) 9 cm (G) 8 cm (H) 7 cm (I) 6 cm

34. **PAINTING** Painters used 170 gallons of white topcoat to paint the famous Hollywood sign. How many quarts is this? (Lesson 12-2)

Complete. (Lesson 12-1)

35. 4 ft = ? in. 36. ? ft = $\frac{1}{2}$ mi 37. 144 in. = ? yd

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Name an item sold in a grocery store that is measured using each type of unit. (Lesson 12-2)

38. milliliter 39. gram 40. liter

A Follow-Up of Lesson 12-3

Significant Digits

What You'll LEARN

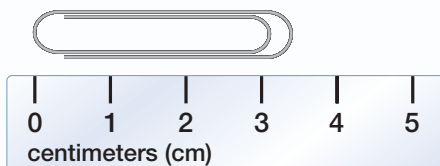
Determine and apply significant digits in a real-life context.

Materials

- centimeter ruler
- meterstick
- yardstick
- tape measure

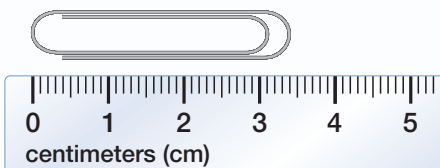
All measurements are approximations. The *precision* of a measurement is the exactness to which a measurement is made. It depends on the smallest unit on the measuring tool.

The smallest unit on the ruler below is 1 centimeter.



The length is *about* 3 centimeters.

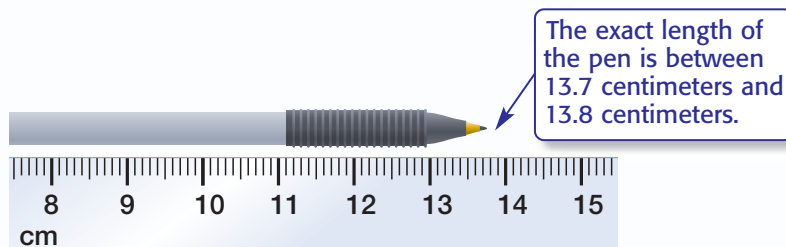
The smallest unit on the ruler below is 1 millimeter, or 0.1 centimeter.



The length is *about* 3.4 centimeters.

Both paper clips have the same length, but the second measurement, 3.4 centimeters, is more precise than the first.

Another method of measuring that is more precise is to use significant digits. *Significant digits* include all of the digits of a measurement that you know for sure, plus one estimated digit. Consider the length of the pen shown below.



estimated digit

13.75 cm ← 4 significant digits

digits known for certain

So, using significant digits, the length of the pen is 13.75 centimeters.

ACTIVITY*Work in groups of three.***STEP 1**

Choose a measuring tool to measure the height of a desk. Find the measure using the smallest unit on your measuring tool and record your measure in a table like the one shown below.

Object	Measure	
	Using Smallest Unit	Using Significant Digits
height of desk		
length of calculator		
length of a pencil		
height of door		
length of classroom		
width of classroom		

STEP 2

Determine the height of the desk using significant digits. Record the measure in your table.

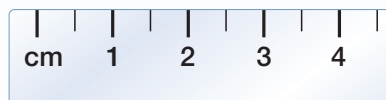
STEP 3

Repeat Steps 1 and 2 for all the objects listed in the table.

Writing Math

Identify the smallest unit of each measuring tool.

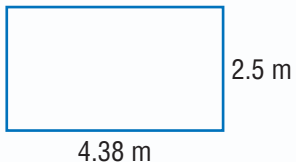
1.



2.



- Explain** how you used significant digits to find the measures.
- Choose** the most precise unit of measurement: inches, feet, or yards. Explain.
- When adding measurements, the sum should have the same precision as the *least precise* measurement. Find the perimeter of the rectangle at the right using significant digits.


- Describe** a real-life situation in which a family member or neighbor used measurement precision. Then describe a real-life situation in which a less precise or estimated measure is sufficient.
- Find the area of your classroom using the precision unit measures from your table and using the significant digit measures. Which area is more precise? Explain.

Mid-Chapter Practice Test

Vocabulary and Concepts

- List four units of length in the customary system. (Lesson 12-1)
- Describe the metric system. (Lesson 12-3)

Skills and Applications

Complete. (Lesson 12-1)

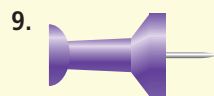
3. $10,560 \text{ ft} = \underline{\quad} \text{ mi}$ 4. $\underline{\quad} \text{ in.} = 2 \text{ yd}$ 5. $18 \text{ ft} = \underline{\quad} \text{ yd}$


Draw a line segment of each length. (Lesson 12-1)

6. $2\frac{1}{2} \text{ in.}$ 7. $\frac{3}{4} \text{ in.}$

Measure the length of each line segment or object to the nearest half, fourth, or eighth inch. (Lesson 12-1)

8. 



10. 

Complete. (Lesson 12-2)

11. $22 \text{ pt} = \underline{\quad} \text{ qt}$ 12. $\underline{\quad} \text{ qt} = 14 \text{ gal}$ 13. $36 \text{ oz} = \underline{\quad} \text{ lb}$
 14. $\underline{\quad} \text{ fl oz} = 5 \text{ c}$ 15. $9 \text{ pt} = \underline{\quad} \text{ c}$ 16. $\underline{\quad} \text{ gal} = 48 \text{ pt}$

17. **ICE CREAM** A container of ice cream contains 20 half-cup servings. How many quarts is this? (Lesson 12-2)
18. Write the metric unit of length that you would use to measure the thickness of a pencil. (Lesson 12-3)

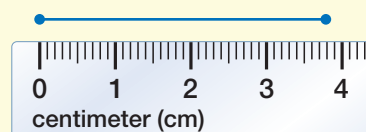
Standardized Test Practice

19. **MULTIPLE CHOICE** How much punch is made with 1 pint of ginger ale, 1 cup of orange juice, and 3 cups of pineapple juice?

- (A) 1 pint (B) 2 pints
 (C) 3 pints (D) 5 pints

20. **SHORT RESPONSE** State the measure of the line segment in centimeters and millimeters.

(Lesson 12-3)



The Game Zone

A Place To Practice Your Math Skills

Math Skill

Using Metric Measures



Mystery Measurements

● GET READY!

Players: two

Materials: 2 metersticks, 12 index cards, scissors

● GET SET!

- Working alone, each player secretly measures the length, width, or depth of six objects in the classroom and records them on a piece of paper. The measures may be in millimeters, centimeters, or meters. This will serve as the answer sheet at the end of the game.
- Each player takes 6 index cards and cuts them in half, making 12 cards.
- For each object, the measurement is recorded on one card. A description of what was measured is recorded on another card. Make sure each measurement is different.

Length
of Math
Book

28.5 cm

● GO!

- Each player shuffles his or her cards.
- Keeping the cards facedown, players exchange cards.
- At the same time, players turn over all the cards given to them.
- Each player attempts to match each object with its measure.
- **Who Wins?** The person with more correct matches after 5 minutes is the winner.

Mass and Capacity in the Metric System

What You'll LEARN

Use metric units of mass and capacity.

NEW Vocabulary

milligram
gram
kilogram
milliliter
liter

HANDS-ON Mini Lab

Work in groups of 2 or 3.

STEP 1 Place the roll of mints on one side of the balance and the paper clips on the other side until the scale balances. How many paper clips were used?

STEP 2 Read the label on the mints to find its mass in grams. Record how many grams are in the roll.

STEP 3 Find the number of paper clips needed to balance 2 pencils of the same size.

1. How does the number of paper clips needed to balance the roll of breath mints compare to the mass of the roll in grams?
2. Estimate the mass of one paper clip.
3. How many paper clips were needed to balance 2 pencils?
4. What is the mass of 1 pencil in grams?

Materials

- balance
- small paper clips
- roll of breath mints
- 2 pencils

The most commonly used metric units of mass are shown below.

Noteables™

Key Concept: Metric Units of Mass

Unit	Model	Benchmark
1 milligram (mg)	grain of salt	1 mg \approx 0.00004 oz
1 gram (g)	small paper clip	1 g \approx 0.04 oz
1 kilogram (kg)	six medium apples	1 kg \approx 2 lb

EXAMPLES

Use Metric Units of Mass

Write the metric unit of mass that you would use to measure each of the following. Then estimate the mass.

- 1 sheet of notebook paper

A sheet of paper has a mass greater than a small paper clip, but less than six apples. So, the gram is the appropriate unit.

Estimate A sheet of paper is a little heavier than a paper clip.

One estimate for the mass of a sheet of paper is about 6 grams.

STUDY TIP

Mass The mass of an object is the amount of material it contains.

STUDY TIP

Capacity Capacity refers to the amount of liquid that can be held in a container.

1 bag of potatoes

A bag of potatoes has a mass greater than six apples. So, the kilogram is the appropriate unit.

Estimate A bag of potatoes is several times heavier than six apples.

One estimate for the mass of a bag of potatoes is about 2 or 3 kilograms.

Your Turn Write the metric unit of mass that you would use to measure each of the following. Then estimate the mass.

- a. tennis ball b. horse c. aspirin

The most commonly used metric units of capacity are shown below.

Noteables™

Key Concept: Metric Units of Capacity

Unit	Model	Benchmark
1 milliliter (mL)	eyedropper	1 mL \approx 0.03 fl oz
1 liter (L)	small pitcher	1 L \approx 1 qt

EXAMPLES Use Metric Units of Capacity

Write the metric unit of capacity that you would use to measure each of the following. Then estimate the capacity.

1 large fishbowl

A large fishbowl has a capacity greater than a small pitcher. So, the liter is the appropriate unit.

Estimate A fishbowl will hold about 2 small pitchers of water.

One estimate for the capacity of a fishbowl is about 2 liters.

1 glass of milk

A glass of milk is greater than an eyedropper and less than a small pitcher. So, the milliliter is the appropriate unit.

Estimate There are 1,000 milliliters in a liter. A small pitcher can fill about 4 glasses.

One estimate for the capacity of a glass of milk is about $1,000 \div 4$ or 250 milliliters.

Your Turn Write the metric unit of capacity that you would use to measure each of the following. Then estimate the capacity.

- d. bathtub e. 10 drops of food coloring

REAL-LIFE MATH

GOLDFISH Most pet goldfish range in length from 2.5 to 10 cm. However, in the wild, they may be up to 40 cm long.

Source: www.factmonster.com



How Does a Zookeeper Use Math?

Zookeepers weigh the appropriate amount of food for their animals' diets.



For more information about a career as a zookeeper, visit msmath1.net/careers



EXAMPLE

Comparing Metric Units

5 ANIMALS The table shows part of the recommended daily diet for a gibbon. Does a gibbon eat more or less than one kilogram of carrots, bananas, and celery each day?

Find the total amount of carrots, bananas, and celery each day.

$$\begin{array}{r}
 \text{carrots} \quad 147 \text{ g} \\
 \text{bananas} \quad 270 \text{ g} \\
 \text{celery} \quad + 210 \text{ g} \\
 \hline
 \text{total} \quad 627 \text{ g}
 \end{array}$$

Daily Diet for a Gibbon	
Food	Amount (g)
lettuce	380
oranges	270
spinach	150
sweet potato	143
bananas	270
carrots	147
celery	210
green beans	210

One kilogram is equal to 1,000 grams. Since 627 is less than 1,000, a gibbon eats less than one kilogram of carrots, bananas, and celery each day.

Skill and Concept Check

- OPEN ENDED** Name an item found at home that has a capacity of about one liter.
- NUMBER SENSE** The mass of a dime is recorded as 4. What metric unit was used to measure the mass? Explain.

GUIDED PRACTICE

Write the metric unit of mass or capacity that you would use to measure each of the following. Then estimate the mass or capacity.

- nickel
- bucket of water
- laptop computer
- juice in a lemon
- light bulb
- can of paint

FOOD For Exercises 9–12, use the list of ingredients for one dark chocolate cake at the right.

- Is the total amount of sugar, chocolate, butter, and flour more or less than one kilogram?
- Write the quantities of ingredients needed for two cakes.
- Is the total amount of sugar, chocolate, butter, and flour for two cakes more or less than one kilogram? Explain.
- Explain why people in the United States may have trouble using this recipe.

Dark Chocolate Cake
6 medium eggs
175 grams sugar
280 grams chocolate
100 grams butter
100 grams flour

Practice and Applications

Write the metric unit of mass or capacity that you would use to measure each of the following. Then estimate the mass or capacity.

13. candy bar
 14. grape
 15. large watermelon
 16. cow
 17. large bowl of punch
 18. cooler of lemonade
 19. canary
 20. shoe
 21. grain of sugar
 22. postage stamp
 23. raindrop
 24. ink in a ballpoint pen
25. **SHOPPING** Your favorite cereal comes in a 1.7-kilogram box or a 39-gram box. Which box is larger? Explain.
26. **SHOPPING** Liquid soap comes in 1.89 liter containers and 221 milliliter containers. Which container is smaller? Explain.
27. **FOOD** Estimate the capacity of a can of cola in metric units. Determine the actual capacity of a can of cola. Compare your estimate with the actual capacity.
28. **MULTI STEP** The doctor told you to take 1,250 milligrams of aspirin for your sprained ankle. According to the bottle at the right, how many tablets should you take?
29. **CRITICAL THINKING** If you filled a 150-milliliter beaker with salt, would its mass be 150 milligrams? Explain.

HOMEWORK HELP

For Exercises	See Examples
13–24	1–4
25–26, 28	5

Extra Practice
See pages 619, 635.



Spiral Review with Standardized Test Practice

30. **MULTIPLE CHOICE** Approximately what is the mass of a bag of flour?
Ⓐ 2 kg Ⓑ 2 mL Ⓒ 2 g Ⓓ 2 L
31. **SHORT RESPONSE** What metric unit would you use to measure the capacity of a tablespoon of water?

Write the metric unit of length that you would use to measure each of the following. (Lesson 12-3)

32. length of a hand
33. thickness of a folder
34. **MEASUREMENT** How many ounces are in $2\frac{1}{2}$ pounds? (Lesson 12-2)

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Multiply or divide. (Lessons 4-1 and 4-3)

35. 2.5×10 36. $2.5 \times 1,000$ 37. $2,500 \div 100$ 38. $2.5 \div 10$



Problem-Solving Strategy

A Follow-Up of Lesson 12-4

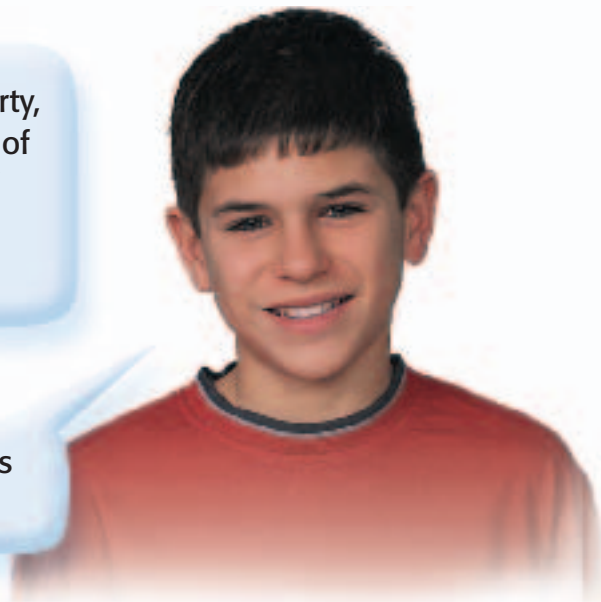
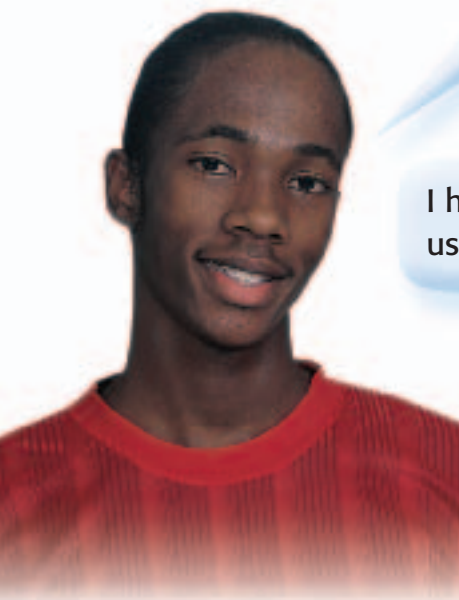
Use Benchmarks

What You'll LEARN

Solve problems using benchmarks.

To make the punch for the party, we need to add one-half liter of juice concentrate to 3 liters of water. But we don't have any metric measuring containers.

I have a clean 2-liter cola bottle. Let's use that as a **benchmark**.



Explore	We need to measure 0.5 liter of concentrate. We have a 2-liter cola bottle.
Plan	We can take the 2-liter bottle and use a marker to visually divide it into four approximately equal sections. Each section will be about 0.5 liter.
Solve	Mark the 2-liter bottle into four sections. Pour the concentrate into the bottle until it reaches the first mark on the bottle.
Examine	Since 4 halves equal 2 wholes, a fourth of the bottle should equal 0.5 liter.



Analyze the Strategy

1. A benchmark is a measurement by which other items can be measured. **Explain** why the 2-liter bottle is a good benchmark to use for measuring the 0.5 liter of concentrate.
2. **Describe** how the students could measure the 3 liters of water for the punch.
3. **Write** a plan to estimate the length of a bracelet in centimeters without using a metric ruler.

Apply the Strategy

Solve. Use the benchmark strategy.

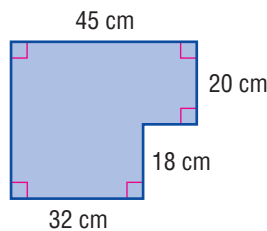
4. **INTERIOR DESIGN** Lucas wants to put a border around his room. He needs to know the approximate length and width of the room in meters. He has some string, and he knows that the distance from the doorknob to the floor is about one meter. Describe a way Lucas could estimate the distances in meters.

5. **PROBABILITY** The students in Mrs. Lightfoot's math class want to determine the probability that a person picked at random from the class is taller than 200 centimeters. They know that the doorway is 3 meters high. Describe a way the students can determine who is taller than 200 centimeters.

Mixed Problem Solving

Solve. Use any strategy.

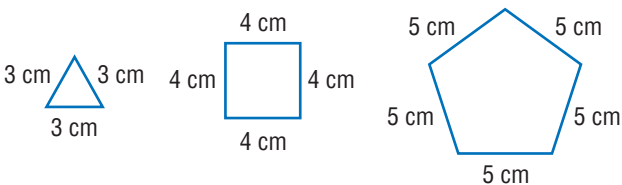
6. **GEOMETRY** Find the area of the figure.



7. **MEASUREMENT** Garcia estimated that he takes 3 steps every 2 meters. How many steps will Garcia take for a distance of 150 meters?

8. **MULTI STEP** The Grayson Middle School softball team won three times as many games as they have lost this season. If they lost 5 games how many games did they play this season?

9. **GEOMETRY** Look at the pattern. What is the perimeter of the next figure in the pattern?



10. **MONEY** Antwon purchased a portable MP3 player for \$129.98, including tax. How much change should he receive from \$150?

11. **NUMBER SENSE** A number multiplied by itself is 676. What is the number?

12. **MEASUREMENT** What is the missing measurement in the pattern?

..., $\frac{?}{4}$ in., $\frac{1}{8}$ in., $\frac{1}{16}$ in., ...

13. **ART** Melissa has a piece of ribbon measuring $8\frac{3}{4}$ yards. How many pieces of ribbon each measuring $1\frac{3}{4}$ yards can be cut from the large piece of ribbon?

14. **BUSINESS** The North Shore Fish Market reported the following sales each day during the first half of April. Which is greater, the mean or the median sales during this time?

April						
		¹	²	³	⁴	⁵
	\$700	\$720	\$790	\$650	\$950	\$1,100
⁷	⁸	⁹	¹⁰	¹¹	¹²	¹³
	\$750	\$900	\$850	\$625	\$930	\$1,030
¹⁴	¹⁵	¹⁶	¹⁷	¹⁸	¹⁹	²⁰
	\$800					
²¹	²²	²³	²⁴	²⁵	²⁶	²⁷

15. **STANDARDIZED TEST PRACTICE**

Katie has three books in her backpack. Which amount best describes the mass of the three books and Katie's backpack?

- (A) 6 g (B) 60 g (C) 6 kg (D) 60 kg

12-5

Changing Metric Units

HANDS-ON Mini Lab

What You'll LEARN

Change units within the metric system.

Link to READING

Everyday Meaning of Cent: one one-hundredth of a dollar, as in 53 cents

Work with a partner.

In the following activity, you will find how many milliliters are in a liter.

STEP 1 Fill an empty soda can with water. Then pour the contents into an empty 2-liter soda bottle, using a funnel.

STEP 2 Repeat Step 1 until the 2-liter bottle is full. Record how many cans it took to fill the bottle.

1. How many cans did it take to fill the 2-liter bottle?
2. If the capacity of a soda can is 355 milliliters, how would you find the number of milliliters in the 2-liter bottle?
3. How many milliliters are in 2 liters?
4. Based on this information, how could you find the number of milliliters in one liter?
5. How many milliliters are in one liter?

Materials

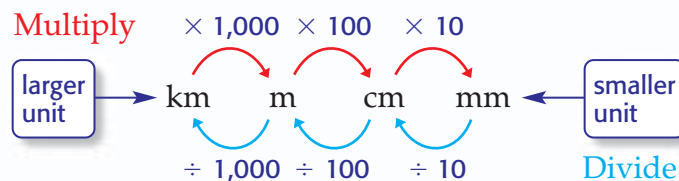
- empty soda can
- empty 2-liter soda bottle
- water
- funnel

To change from one unit to another within the metric system, you either multiply or divide by powers of 10. The chart below shows the relationship between the units in the metric system and the powers of 10.

1,000	100	10	1	0.1	0.01	0.001
thousands	hundreds	tens	ones	tenths	hundredths	thousandths
kilo	hecto	deka	basic unit	deci	centi	milli

Each place value is 10 times the place value to its right.

To change from a larger unit to a smaller unit, you need to multiply. To change from a smaller unit to a larger unit, you need to divide.



STUDY TIP

Multiplying and Dividing by Powers of Ten Remember you can multiply or divide by a power of ten by moving the decimal point.

EXAMPLES

Change Metric Units

Complete.

1 135 g = ? kg

Since 1,000 grams = 1 kilogram, divide by 1,000.

$$135 \div 1,000 = 0.135$$

So, 135 g = 0.135 kg.

Check Since a kilogram is a larger unit than a gram, the number of kilograms should be less than the number of grams. The answer seems reasonable.

2 ? mm = 26.8 cm

Since 1 centimeter = 10 millimeters, multiply by 10.

$$26.8 \times 10 = 268$$

So, 268 mm = 26.8 cm.

Check Since a millimeter is a smaller unit than a centimeter, the number of millimeters should be greater than the number of centimeters. The answer seems reasonable.

3 **Your Turn** Complete.

a. 513 mL = ? L b. 5 cm = ? mm c. ? mg = 8.2 g

Sometimes you will need to change units to solve real-life problems.

REAL-LIFE MATH

TRIATHLONS The triathlon was invented in the early 1970s by the San Diego Track Club. It became an Olympic sport in the Sydney 2000 summer games.

Source: www.triathlon.org



EXAMPLE

Change Units to Solve a Problem

1 **TRIATHLONS** Use the table at the right to determine the total number of meters in the San Diego International Triathlon.

San Diego International Triathlon		
Swim	Bike	Run
1 km	30 km	10 km



Words	Total equals sum of swim, bike, and run times 1,000.
Variable	$m = (s + b + r) \times 1,000$
Equation	$m = (1 + 30 + 10) \times 1,000$

$m = (1 + 30 + 10) \times 1,000$ Write the equation.

$m = 41 \times 1,000$ First, find the sum in the parentheses.

$m = 41,000$ Multiply.

There are 41,000 meters in the San Diego International Triathlon.



Skill and Concept Check

- Writing Math** Explain how to change liters to milliliters.
- OPEN ENDED** Write an equation involving metric units where you would divide by 100 to solve the equation.
- FIND THE ERROR** Julia and Trina are changing 590 centimeters to meters. Who is correct? Explain.

Julia
 $590 \times 100 = 59,000 \text{ m}$

Trina
 $590 \div 100 = 5.9 \text{ m}$

GUIDED PRACTICE

Complete.

- $\underline{\quad ? \quad} \text{ m} = 75 \text{ mm}$
 - $205 \text{ mg} = \underline{\quad ? \quad} \text{ g}$
 - $\underline{\quad ? \quad} \text{ mm} = 3.8 \text{ cm}$
 - $85 \text{ mm} = \underline{\quad ? \quad} \text{ cm}$
 - $0.95 \text{ g} = \underline{\quad ? \quad} \text{ mg}$
 - $0.05 \text{ L} = \underline{\quad ? \quad} \text{ mL}$
10. **SCOOTERS** A scooter goes up to 20 kilometers per hour. How many meters per hour can it travel?

Practice and Applications

Complete.

- $\underline{\quad ? \quad} \text{ L} = 95 \text{ mL}$
- $\underline{\quad ? \quad} \text{ g} = 1,900 \text{ mg}$
- $\underline{\quad ? \quad} \text{ cm} = 52 \text{ mm}$
- $13 \text{ cm} = \underline{\quad ? \quad} \text{ mm}$
- $\underline{\quad ? \quad} \text{ mg} = 8.2 \text{ g}$
- $\underline{\quad ? \quad} \text{ mL} = 23.8 \text{ L}$
- $0.4 \text{ L} = \underline{\quad ? \quad} \text{ mL}$
- $4 \text{ m} = \underline{\quad ? \quad} \text{ cm}$
- $354 \text{ cm} = \underline{\quad ? \quad} \text{ m}$
- $\underline{\quad ? \quad} \text{ m} = 35.6 \text{ cm}$
- $500 \text{ mg} = \underline{\quad ? \quad} \text{ kg}$
- $250 \text{ cm} = \underline{\quad ? \quad} \text{ km}$

- How many centimeters are in 0.82 meter?
- Change 7 milligrams to grams.

25. **EARTH SCIENCE** Earthquakes originate between 5 and 700 kilometers below the surface of Earth. Write these distances in meters.



Data Update What is the depth of the latest earthquake? Visit msmath1.net/data_update to learn more.

BIRDS For Exercises 26 and 27, use the table at the right.

- Write the length and width of a robin's egg in millimeters.
- Which bird has the larger eggs?

Size of Bird Eggs		
Bird	Length	Width
Robin	1.9 cm	1.5 cm
Turtledove	31 mm	23 mm

Source: *Animals as Our Companions*



HOMEWORK HELP

For Exercises	See Examples
11–24, 29	1–2
25, 26	3

Extra Practice
See pages 619, 635.

FOOD For Exercises 28–31, use the table at the right.

28. Find the cost to the nearest tenth of a cent for one milliliter of pancake syrup from the 350-milliliter bottle.
29. Change 1.06 liters to milliliters.
30. Find the cost to the nearest tenth of a cent for one milliliter of pancake syrup from the 1.06-liter bottle.
31. Which bottle of pancake syrup is a better buy?
32. **CRITICAL THINKING** A milliliter of water at 4°C has a mass of 1 gram. What is the mass of 1 liter of water at 4°C?



EXTENDING THE LESSON You can use proportions to change units of measure.

Example 250 mm = ? m

$$\begin{array}{l}
 \text{meters} \rightarrow \frac{1 \text{ m}}{1,000 \text{ mm}} = \frac{x \text{ m}}{250 \text{ mm}} \quad \leftarrow \begin{array}{l} \text{meters} \\ \text{millimeters} \end{array} \\
 1 \times 250 = 1,000 \times x \quad \text{Cross products} \\
 250 = 1,000x \quad \text{Multiply.} \\
 \frac{250}{1,000} = \frac{1,000x}{1,000} \quad \text{Divide.} \\
 0.25 = x \quad \text{Simplify.}
 \end{array}$$

So, 250 millimeters = 0.25 meter.

Write a proportion to solve each problem. Then complete.

33. 0.005 km = ? m 34. ? mL = 0.45 L 35. 263 g = ? kg

Spiral Review with Standardized Test Practice

36. **MULTIPLE CHOICE** Chicago's Buckingham Fountain contains 133 jets that spray approximately 52,990 liters of water into the air every minute. How many milliliters of water is this?
 - (A) 52.99 mL
 - (B) 5,299,000 mL
 - (C) 52,990,000 mL
 - (D) 529,900,000,000 mL
37. **GRID IN** Write 25.9 kilograms in grams.
38. **FOOD** Which is the better estimate for the capacity of a glass of milk, 360 liters or 360 milliliters? (Lesson 12-4)

Find the length of each line segment to the nearest tenth of a centimeter. (Lesson 12-3)



GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Add or subtract. (Lesson 3-5)

41. 3.26 + 4.86 42. 9.32 - 4.78 43. 27.48 + 78.92 44. 7.18 - 2.31



What You'll LEARN

Add and subtract measures of time.

NEW Vocabulary

second
minute
hour

WHEN am I ever going to use this?

MONEY MATTERS Bethany wants to buy a new coat. Her grandfather promises to pay her for each hour she spends doing extra chores. The table shows the amount of time spent on extra chores.

Chore	Time
wash the car	1 h 10 min
fold the laundry	1 h 15 min

1. How long did Bethany take to wash the car?
2. How long did Bethany take to fold laundry?
3. What is the sum of the minutes?
4. What is the sum of the hours?
5. How long did it take to wash the car and fold the laundry?

The most commonly used units of time are shown below.

Noteables™		Key Concept: Units of Time
Unit		Model
1 second (s)		time needed to say 1,001
1 minute (min) = 60 seconds		time for 2 average TV commercials
1 hour (h) = 60 minutes		time for 2 weekly TV sitcoms

To add or subtract measures of time, use the following steps.

Step 1 Add or subtract the seconds.

Step 2 Add or subtract the minutes.

Step 3 Add or subtract the hours.

Rename if necessary in each step.

EXAMPLE Add Units of Time

1 Find the sum of 4 h 20 min 45 s and 2 h 50 min 10 s.

Estimate 4 h 20 min 45 s is about 4 h, and 2 h 50 min 10 s is about 3 h.
 $4 \text{ h} + 3 \text{ h} = 7 \text{ h}$

4 h 20 min 45 s	Add seconds first, then minutes, and finally the hours.
+ 2 h 50 min 10 s	
6 h 70 min 55 s	70 minutes equals 1 hour 10 minutes.

So, the sum is 7 h 10 min 55 s. Compare the answer to the estimate.

EXAMPLE

Subtract Units of Time

1 **OLYMPICS** The table shows the winners of the Women's Marathon in the 1996 and 2000 Summer Olympics. How much faster was Takahashi's time than Roba's time?

Olympic Year	Runner	Time
1996	Fatuma Roba	2 h 26 min 5 s
2000	Naoko Takahashi	2 h 23 min 10 s

Source: *The World Almanac*



REAL-LIFE MATH

OLYMPICS The first women's marathon event of the Summer Olympics took place in 1984.

Source: *The World Almanac*



Estimate Since the numbers are so close, use the minutes.
 $26 \text{ min} - 23 \text{ min} = 3 \text{ min}$

$2 \text{ h } 26 \text{ min } 5 \text{ s}$
 $- 2 \text{ h } 23 \text{ min } 10 \text{ s}$

Since you cannot subtract 10 seconds from 5 seconds, you must rename 26 minutes 5 seconds as 25 minutes 65 seconds.

$$\begin{array}{r} 2 \text{ h } 26 \text{ min } 5 \text{ s} \\ - 2 \text{ h } 23 \text{ min } 10 \text{ s} \\ \hline 2 \text{ h } 25 \text{ min } 65 \text{ s} \\ - 2 \text{ h } 23 \text{ min } 10 \text{ s} \\ \hline 0 \text{ h } 2 \text{ min } 55 \text{ s} \end{array}$$

Takahashi's time was 2 minutes 55 seconds faster than Roba's time. Compared to the estimate, the answer seems reasonable.

Your Turn Add or subtract.

- a. $5 \text{ h } 55 \text{ min} + 6 \text{ h } 17 \text{ min}$ b. $8 \text{ h } 25 \text{ min} - 3 \text{ h } 30 \text{ min}$ c. $5 \text{ h } 15 \text{ min } 10 \text{ s} - 2 \text{ h } 30 \text{ min } 45 \text{ s}$

Sometimes you need to determine the *elapsed time*, which is how much time has passed from beginning to end.

EXAMPLE

Elapsed Time

1 **TRAVEL** A flight leaves Boston at 11:35 A.M. and arrives in Miami at 2:48 P.M. How long is the flight?

You need to find how much time has elapsed.



11:35 A.M. to 12:00 noon is 25 minutes.



12:00 noon to 2:48 P.M. is 2 hours 48 minutes.



The length of the flight is 25 minutes + 2 hours 48 minutes or 2 hours 73 minutes. Now rename 73 minutes as 1 hour 13 minutes.

$$2 \text{ h} + 1 \text{ h } 13 \text{ min} = 3 \text{ h } 13 \text{ min}$$

The length of the flight is 3 hours 13 minutes.



Skill and Concept Check

- Write the number of hours in 330 minutes.
- OPEN ENDED** Name a starting time in the morning and an ending time in the afternoon where the elapsed time is 3 hours 45 minutes.
- Which One Doesn't Belong?** Identify the time that is not the same as the others. Explain your reasoning.

2 h 36 min 16 s

1 h 96 min 16 s

2 h 35 min 76 s

1 h 36 min 76 s

GUIDED PRACTICE

Add or subtract.

- $$\begin{array}{r} 4 \text{ h } 23 \text{ min } 45 \text{ s} \\ + 6 \text{ h } 52 \text{ min } 20 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 17 \text{ min } 15 \text{ s} \\ - 9 \text{ min } 24 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 8 \text{ h } \quad 35 \text{ s} \\ + 7 \text{ h } 29 \text{ min } 54 \text{ s} \\ \hline \end{array}$$

Find each elapsed time.

- 8:25 A.M. to 11:50 A.M.
- 10:15 A.M. to 3:45 P.M.

- TELEVISION** Use the information at the right. How much more time did the average household spend watching television in 2000 than in 1950?

Average Household Time Spent Watching Television	
Year	Time
1950	4 h 35 min
2000	7 h 29 min

Source: Nielsen Media Research

Practice and Applications

Add or subtract.

- $$\begin{array}{r} 15 \text{ min } 45 \text{ s} \\ + 20 \text{ min } 10 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 35 \text{ min } 25 \text{ s} \\ + 17 \text{ min } 30 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 6 \text{ h } 48 \text{ min } 28 \text{ s} \\ - 2 \text{ h } 29 \text{ min } 14 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 2 \text{ h } 57 \text{ min } 42 \text{ s} \\ - 1 \text{ h } 23 \text{ min } 19 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 12 \text{ h } 25 \text{ min} \\ + 19 \text{ h } 53 \text{ min} \\ \hline \end{array}$$
- $$\begin{array}{r} 9 \text{ h } 35 \text{ min} \\ + 2 \text{ h } 59 \text{ min} \\ \hline \end{array}$$
- $$\begin{array}{r} 17 \text{ min } 15 \text{ s} \\ - 9 \text{ min } 24 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 25 \text{ min } 17 \text{ s} \\ - 12 \text{ min } 38 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 12 \text{ h} \quad 45 \text{ s} \\ + 8 \text{ h } 45 \text{ min } 16 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 5 \text{ h} \quad 28 \text{ s} \\ + 3 \text{ h } 8 \text{ min } 40 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 12 \text{ h} \quad 3 \text{ s} \\ - 3 \text{ h } 14 \text{ min } 6 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 5 \text{ h} \\ - 1 \text{ h } 15 \text{ min } 12 \text{ s} \\ \hline \end{array}$$

Find each elapsed time.

- 5:18 P.M. to 9:36 P.M.
- 8:05 A.M. to 11:45 A.M.
- 5:30 P.M. to 3:10 A.M.
- 8:30 A.M. to 10:40 P.M.
- A stopwatch is *always*, *sometimes*, or *never* a good way to measure the length of a movie. Explain.

HOMWORK HELP

For Exercises	See Examples
10–21	1, 2
22–25	3

Extra Practice
See pages 619, 635.

27. **MULTI STEP** The three acts of a play are 28 minutes, 20 minutes, and 14 minutes long. There are 15-minute intermissions between acts. If the play starts at 7:30 P.M., when will it end?
28. **SCHOOL** Estimate the amount of time you need to get dressed for school. Then time yourself. How does your estimate compare with the actual time?
29. **CRITICAL THINKING** A flight from New York City to Los Angeles takes 6 hours. If the plane leaves New York City at 9:15 A.M., at what time will it arrive in Los Angeles? (*Hint*: Remember that there is a time difference.)

EXTENDING THE LESSON

You can use two formulas to change units of temperature.

To change Celsius C to Fahrenheit F , use the formula $F = \frac{9}{5}C + 32$.

Example Change 20°C to Fahrenheit.

$$F = \frac{9}{5}C + 32 \quad \text{Original formula}$$

$$F = \frac{9}{5}(20) + 32 \quad C = 20$$

$$F = 36 + 32 \quad \text{Simplify.}$$

$$F = 68 \quad 20^{\circ}\text{C equals } 68^{\circ}\text{F.}$$

To change Fahrenheit F to Celsius C , use the formula $C = \frac{5}{9}(F - 32)$.

Example Change 50°F to Celsius.

$$C = \frac{5}{9}(F - 32) \quad \text{Original formula}$$

$$C = \frac{5}{9}(50 - 32) \quad F = 50$$

$$C = \frac{5}{9}(18) \quad \text{Simplify.}$$

$$C = 10 \quad 50^{\circ}\text{F equals } 10^{\circ}\text{C.}$$

Complete.

30. $15^{\circ}\text{C} = \underline{\quad?}^{\circ}\text{F}$

31. $0^{\circ}\text{C} = \underline{\quad?}^{\circ}\text{F}$

32. $59^{\circ}\text{F} = \underline{\quad?}^{\circ}\text{C}$

33. $104^{\circ}\text{F} = \underline{\quad?}^{\circ}\text{C}$

Spiral Review with Standardized Test Practice

34. **MULTIPLE CHOICE** The table shows the times for three flights leaving from three different airports in the Washington, D.C., area and traveling to Detroit. Which airport has the shortest travel time to Detroit?

Airport	Departure Time	Arrival Time
WDI	7:31 A.M.	10:05 A.M.
DCA	7:15 A.M.	9:43 A.M.
BWI	7:23 A.M.	9:53 A.M.

(A) WDI

(B) DCA

(C) BWI

(D) All three flights take the same length of time.

35. **SHORT RESPONSE** Suppose Mr. James puts a meat loaf in the oven at 11:49 A.M. It needs to bake for 1 hour and 33 minutes. What time should he take the meat loaf out of the oven?

Complete. (Lesson 12-5)

36. $\underline{\quad?} \text{ L} = 450 \text{ mL}$

37. $6.5 \text{ m} = \underline{\quad?} \text{ cm}$

38. $8,800 \text{ g} = \underline{\quad?} \text{ kg}$

39. **MEASUREMENT** To measure the water in a washing machine, which metric unit of capacity would you use? (Lesson 12-4)



Vocabulary and Concept Check

centimeter (p. 476)
 cup (p. 470)
 fluid ounce (p. 470)
 foot (p. 465)
 gallon (p. 470)
 gram (p. 484)
 hour (p. 494)
 inch (p. 465)
 kilogram (p. 484)

kilometer (p. 476)
 liter (p. 485)
 meter (p. 476)
 metric system (p. 476)
 mile (p. 465)
 milligram (p. 484)
 milliliter (p. 485)
 millimeter (p. 476)

minute (p. 494)
 ounce (p. 471)
 pint (p. 470)
 pound (p. 471)
 quart (p. 470)
 second (p. 494)
 ton (p. 471)
 yard (p. 465)

Choose the correct term or number to complete each sentence.

1. A centimeter equals (one tenth, one hundredth) of a meter.
2. You should (multiply, divide) to change from larger to smaller units.
3. One paper clip has a mass of about one (gram, kilogram).
4. One cup is equal to (8, 16) fluid ounces.
5. To convert from kilograms to grams, multiply by (100, 1,000).
6. The basic unit of capacity in the metric system is the (liter, gram).
7. To convert from 15 yards to feet, you should (multiply, divide) by 3.
8. You should (multiply, divide) to change from ounces to pounds.
9. One centimeter is (longer, shorter) than 1 millimeter.

Lesson-by-Lesson Exercises and Examples

12-1 Length in the Customary System (pp. 465–468)

Complete.

10. $2 \text{ mi} = \underline{\quad} \text{ ft}$ 11. $\underline{\quad} \text{ in.} = 5 \text{ ft}$
 12. $9 \text{ yd} = \underline{\quad} \text{ ft}$ 13. $72 \text{ in.} = \underline{\quad} \text{ yd}$
 14. $\underline{\quad} \text{ in.} = 3 \text{ mi}$ 15. $\underline{\quad} \text{ yd} = 180 \text{ in.}$

Draw a line segment of each length.

16. $2\frac{7}{8} \text{ in.}$ 17. $1\frac{1}{2} \text{ in.}$
 18. $1\frac{5}{8} \text{ in.}$ 19. $3\frac{1}{4} \text{ in.}$

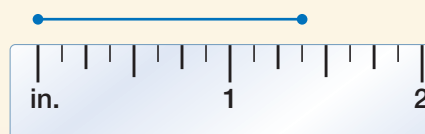
Example 1 Complete $36 \text{ ft} = \underline{\quad} \text{ yd}$.

$36 \div 3 = 12$ Since 1 yard equals 3 feet, divide by 3.

So, $36 \text{ ft} = 12 \text{ yd}$.

Example 2 Draw a line segment measuring $1\frac{3}{8}$ inches.

Draw a line segment from 0 to $1\frac{3}{8}$.



12-2 Capacity and Weight in the Customary System (pp. 470–473)

Complete.

20. 3 pt = $\underline{\quad?}$ fl oz 21. $\underline{\quad?}$ qt = 44 c
22. 5 T = $\underline{\quad?}$ lb 23. 2.75 gal = $\underline{\quad?}$ pt
24. $\underline{\quad?}$ lb = 12 oz 25. $\underline{\quad?}$ pt = 8 qt
26. 64 fl oz = $\underline{\quad?}$ c 27. 3 gal = $\underline{\quad?}$ qt
28. **FOOD** Lauren bought 9 gallons of apple cider for the school party. How many 1-cup servings will she be able to serve?

Example 3 Complete $5 \text{ qt} = \underline{\quad?}$ pt.

THINK 2 pints are in 1 quart.

$$5 \times 2 = 10 \quad \text{Multiply to change a larger unit to a smaller unit.}$$

So, 5 quarts = 10 pints.

12-3 Length in the Metric System (pp. 476–479)

Write the metric unit of length that you would use to measure each of the following.

29. height of your school
30. the length of the state of Florida
31. thickness of slice of bread
32. distance across school gym
33. length of your arm
34. length of a paper clip

Example 4 Write the metric unit of length that you would use to measure the height of a slide on the school playground.

Compare the slide with an item in the table on page 476. The height of a slide is larger than half the width of a penny and smaller than six city blocks. So, you would use the meter to measure the slide.

12-4 Mass and Capacity in the Metric System (pp. 484–487)

Write the metric unit of mass or capacity that you would use to measure each of the following. Then estimate the mass or capacity.

35. a candy apple
36. a pitcher of lemonade
37. a snowflake
38. an automobile
39. a puppy
40. a can of soda
41. **SHOPPING** Your favorite juice comes in 1.5 liter containers and 355 milliliter containers. Which container has less juice?

Example 5 Write the metric unit of mass that you would use to measure a cell phone. Then estimate the mass.

The mass of a cell phone is greater than a paper clip, but less than 6 apples. So, the gram is the appropriate unit.

Estimate There are 1,000 grams in a kilogram. A cell phone is much heavier than a paper clip, but not nearly as heavy as six apples.

One estimate for the mass of a cell phone is about 250 grams.

Mixed Problem SolvingFor mixed problem-solving practice,
see page 635.**12-5 Changing Metric Units** (pp. 490–493)

Complete.

42. $300 \text{ mL} = \underline{\quad?} \text{ L}$
 43. $\underline{\quad?} \text{ g} = 1 \text{ mg}$
 44. $\underline{\quad?} \text{ m} = 0.75 \text{ km}$
 45. $5.02 \text{ kg} = \underline{\quad?} \text{ g}$
 46. $345 \text{ cm} = \underline{\quad?} \text{ m}$
 47. $\underline{\quad?} \text{ m} = 23.6 \text{ mm}$
 48. $5,200 \text{ m} = \underline{\quad?} \text{ km}$
 49. $35 \text{ m} = \underline{\quad?} \text{ cm}$
50. How many centimeters are in 0.74 meter?
51. **PUNCH** Sabrina mixes 6.3 liters of punch. How many milliliters is this?
52. **DISTANCE** Sam's house is 0.6 kilometer from Jose's house. How many meters is this?

Example 6 Complete $9.2 \text{ g} = \underline{\quad?} \text{ mg}$.

To change from grams to milligrams, multiply by 1,000.

$$9.2 \times 1,000 = 9,200$$

So, $9.2 \text{ g} = 9,200 \text{ mg}$.**Example 7** Complete $523 \text{ mm} = \underline{\quad?} \text{ cm}$.

To change from millimeters to centimeters, divide by 10 since 10 millimeters = 1 centimeter.

$$523 \div 10 = 52.3$$

So, $523 \text{ mm} = 52.3 \text{ cm}$.**12-6 Measures of Time** (pp. 494–497)

Add or subtract.

53.
$$\begin{array}{r} 5 \text{ h } 20 \text{ min} \\ + 2 \text{ h } 16 \text{ min} \\ \hline \end{array}$$
54.
$$\begin{array}{r} 7 \text{ h } 45 \text{ min} \\ - 4 \text{ h } 32 \text{ min} \\ \hline \end{array}$$
55.
$$\begin{array}{r} 9 \text{ h } 7 \text{ min} \\ - 8 \text{ h } 7 \text{ min } 8 \text{ s} \\ \hline \end{array}$$
56.
$$\begin{array}{r} 2 \text{ h } 35 \text{ min} \\ + 6 \text{ h } 41 \text{ min} \\ \hline \end{array}$$
57. Find the sum of 7 h 20 min and 2 h 48 min 10 s.
58. What is the sum of 3 h 35 min 40 s and 6 h 50 min 40 s?
59. **MUSIC** Latisha's piano lesson started at 4:45 P.M. and ended at 5:30 P.M. How long was her lesson?
60. **TRAVEL** Aaron flew from Tampa, Florida, to New York City. His plane left Tampa at 6:34 A.M., and the flight took 3 hours 55 minutes. What time did he arrive in New York City?

Example 8 Find the sum of 3 h 50 min and 2 h 15 min.

$$\begin{array}{r} 3 \text{ h } 50 \text{ min} \\ + 2 \text{ h } 15 \text{ min} \\ \hline 5 \text{ h } 65 \text{ min} \end{array}$$

Rename 65 min as 1 h 5 min.

$$5 \text{ h} + 1 \text{ h } 5 \text{ min} = 6 \text{ h } 5 \text{ min}$$

Example 9 Find the difference of 5 h 10 min and 2 h 29 min.

$$\begin{array}{r} 5 \text{ h } 10 \text{ min} \\ - 2 \text{ h } 29 \text{ min} \\ \hline \end{array}$$

You cannot subtract 29 min. from 10 min, so rename 5 h 10 min as 4 h 70 min.

$$\begin{array}{r} 4 \text{ h } 70 \text{ min} \\ - 2 \text{ h } 29 \text{ min} \\ \hline 2 \text{ h } 41 \text{ min} \end{array}$$

Practice Test

Vocabulary and Concepts

- List three commonly used customary units of weight.
- State the meaning of the prefixes kilo-, centi-, and milli-.
- Describe the operation necessary to convert metric units from a prefix of centi- to a prefix of milli-.

Skills and Applications

Complete.

- $48 \text{ in.} = \underline{\quad?} \text{ ft}$
- $2 \text{ yd} = \underline{\quad?} \text{ in.}$
- $\underline{\quad?} \text{ pt} = 6 \text{ qt}$
- $\underline{\quad?} \text{ fl oz} = 3 \text{ c}$
- $48 \text{ c} = \underline{\quad?} \text{ gal}$
- $\underline{\quad?} \text{ yd} = 8 \text{ mi}$
- $328 \text{ mL} = \underline{\quad?} \text{ L}$
- $\underline{\quad?} \text{ mm} = 0.7 \text{ cm}$
- $150 \text{ g} = \underline{\quad?} \text{ kg}$
- $\underline{\quad?} \text{ km} = 57 \text{ m}$
- $10,000 \text{ mg} = \underline{\quad?} \text{ g}$
- $7.1 \text{ L} = \underline{\quad?} \text{ mL}$
- Draw a line segment that is $4\frac{3}{4}$ inches long.
- ICE CREAM** A baseball team orders 5 gallons of ice cream for its end-of-season party. How many cups of ice cream is this?

Write the metric unit of length that you would use to measure each of the following.

- length of a skateboard
- height of a giraffe

Write the metric unit of mass or capacity that you would use to measure each of the following. Then estimate the mass or capacity.

- five \$1 bills
- a bucket of water

Add or subtract.

- $$\begin{array}{r} 7 \text{ h } 20 \text{ min} \\ + 3 \text{ h } 18 \text{ min} \\ \hline \end{array}$$
- $$\begin{array}{r} 19 \text{ min } 30 \text{ s} \\ - 12 \text{ min } 40 \text{ s} \\ \hline \end{array}$$
- $$\begin{array}{r} 7 \text{ h } 20 \text{ min} \\ + 2 \text{ h } 48 \text{ min } 10 \text{ s} \\ \hline \end{array}$$

Standardized Test Practice

- MULTIPLE CHOICE** Determine which container of milk is the best buy by finding the price to the nearest cent for one pint of milk.

- Ⓐ 1 pt Ⓑ 1 qt
Ⓒ 0.5 gal Ⓓ 1 gal

Milk	
Size	Price
0.5 gal	\$1.09
1 qt	\$1.29
1 pt	\$0.75
1 gal	\$2.25



PART 1 Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

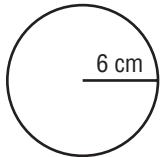
1. The expression $10d$ converts the number of U.S. dollars to the approximate number of Mexican pesos. If d is the number of U.S. dollars, how many Mexican pesos can you get for \$17? (Lesson 1-6)

- (A) 17 pesos (B) 27 pesos
(C) 107 pesos (D) 170 pesos

2. Estimate the sum of three pizzas costing \$9.75, \$10.20, and \$12.66. (Lesson 3-2)

- (F) \$33 (G) \$32
(H) \$31 (I) \$30

3. What is the circumference of the circle? (Lesson 4-6)



- (A) 9.14 cm
(B) 18.84 cm
(C) 37.68 cm
(D) 50.09 cm

4. Which addition sentence describes the model below? (Lesson 8-2)

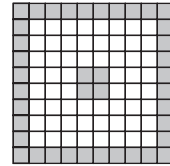


- (F) $6 + (-2) = -4$ (G) $-6 + 4 = -2$
(H) $-2 + 6 = 4$ (I) $-6 + (-4) = 2$

5. Abigail had a collection of 36 CDs. She sold some of them at a yard sale and had 12 left. Use the equation $36 - s = 12$ to determine s , the number of CDs Abigail sold. (Lesson 9-3)

- (A) 3 (B) 12 (C) 18 (D) 24

6. Identify the model at the right as a percent. (Lesson 10-4)



- (F) 30% (G) 40%
(H) 50% (I) 60%

7. Cristóbal paid \$25.88 for shoes that were reduced by 25%. What was the original price? (Lesson 10-7)

- (A) \$29.99 (B) \$30.95
(C) \$34.50 (D) \$44.95

8. Kylie measured four pieces of wood as shown. Which piece was the longest? (Lesson 12-1)

Wood Piece	Measurement
1	2 ft 5 in.
2	36 in.
3	2 ft 3 in.
4	31 in.

- (F) 1 (G) 2 (H) 3 (I) 4

9. How many cups are in 2 gallons? (Lesson 12-2)

- (A) 4 c (B) 8 c (C) 16 c (D) 32 c

10. How many milliliters are equivalent to 3 liters? (Lesson 12-5)

- (F) 30 mL (G) 300 mL
(H) 3,000 mL (I) 30,000 mL

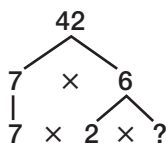
11. It took Pablo 1 hour 40 minutes and 15 seconds to complete a walkathon. It took Set-Su 1 hour 50 minutes and 9 seconds to complete the walkathon. How much longer did Set-Su take to complete the walkathon? (Lesson 12-6)

- (A) 9 min 51 s (B) 9 min 54 s
(C) 10 min 6 s (D) 10 min 54 s

PART 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

12. What number completes the factor tree?
(Lesson 1-3)



13. Samuel, Alexis, Madeline, and Malik each threw one dart at a dartboard. The player closest to the bull's eye wins. Who won?
(Lesson 5-5)

Player	Distance to Bull's Eye
Samuel	$\frac{7}{16}$ in.
Alexis	$\frac{5}{8}$ in.
Madeline	$\frac{1}{4}$ in.
Malik	$\frac{1}{2}$ in.

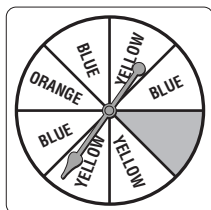
14. Find the next number in the sequence.
 $12, 10\frac{3}{4}, 9\frac{1}{2}, 8\frac{1}{4}, \dots$ (Lesson 7-6)

For Questions 15–17, use the function table at the right.

15. Find a rule for the function table. (Lesson 9-6)
16. Find the output for an input of -3 . (Lesson 9-6)
17. Graph the function. (Lesson 9-7)

x	y
0	0
1	3
2	6
3	9

18. What color should the missing shaded region on the spinner be labeled in order to make the probability of landing on that color $\frac{1}{4}$? (Lesson 11-1)



19. Stadiums that host the World Cup must have soccer fields that are 75 yards wide. How many feet is this? (Lesson 12-1)
20. How many grams are equivalent to 34.7 kilograms? (Lesson 12-5)

PART 3 Extended Response

Record your answers on a sheet of paper. Show your work.

21. Victor tutors younger students at the community center on Saturdays. It takes Victor 20 minutes to get ready and leave the house. The walk to the bus stop is 10 minutes long, and the bus ride to the community center is 40 minutes long. Finally, Victor walks 5 minutes from the bus stop to the community center. (Lesson 12-6)
- If Victor is scheduled to arrive at 3:00 P.M., what is the latest time at which he could start getting ready to leave?
 - Explain the strategy you used to answer part a.
 - Victor has to be home by 7:00 P.M. If it takes him 5 minutes longer to get home, at what time should he leave the community center?
 - How long does Victor spend tutoring on Saturdays?

TEST-TAKING TIP

Question 21 When answering extended response items on standardized tests, make sure you show your work clearly because you may receive points for items that are partially correct.

