13

Geometry: Angles and Polygons

"What do road signs have to do with math?"

Many road signs are geometric in shape. In fact, they are often shaped like squares, rectangles, and triangles. You can use geometric properties to classify the shapes of road signs, determine the types of angles found in road signs, and list the similarities and differences among their shapes.

You will solve problems about road signs in Lessons 13-1 and 13-4.

CONTENTS

▶ Diagnose Readiness

Take this quiz to see if you are ready to begin Chapter 13. Refer to the lesson number in parentheses for review.
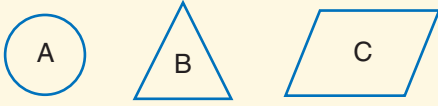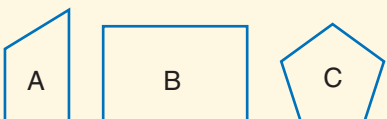
Vocabulary Review

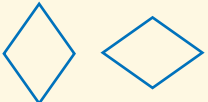**Choose the correct term to complete each sentence.**

1. A rectangle with sides of equal length is a (square, rhombus). (Lesson 1-8)

2. The expression $2\ell + 2w$ can be used to find the (area, perimeter) of a rectangle. (Lesson 4-5)

Prerequisite Skills

Identify which figure *cannot* be folded so that one half matches the other half.

3.

A   B   C

4.

A   B   C

Tell whether each pair of figures has the same size and shape.

5.   6.

Find the length of each line segment in centimeters. (Lesson 12-3)
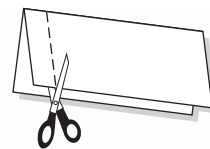
7.

8.

FOLDABLES Study Organizer

Angles and Polygons
Make this Foldable to help you organize information about angles and polygons. Begin with six half-sheets of notebook paper.
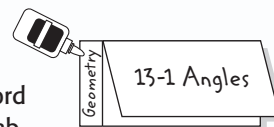
STEP 1 Fold and Cut
Fold a sheet in half lengthwise. Then cut a 1" tab along the left edge through one thickness.
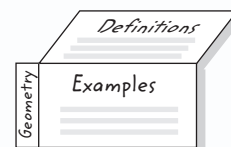
STEP 2 Glue and Label
Glue the 1" tab down. Write the word *Geometry* on this tab and the lesson title on the front tab.
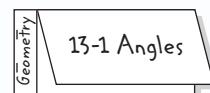
13-1 Angles

STEP 3 Label
Write *Definitions* and *Examples* under the tab.

Definitions
Examples
Geometry

STEP 4 Repeat and Staple
For each lesson, repeat Steps 1–3 using the remaining paper. Staple them to form a booklet.

13-1 Angles

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.

Math Online

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

CONTENTS

Angles

What You'll LEARN

Classify and measure angles.
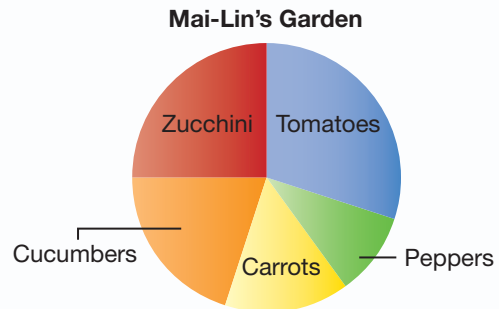
NEW Vocabulary

angle
side
vertex
degree
right angle
acute angle
obtuse angle
straight angle
complementary
supplementary

MATH Symbols
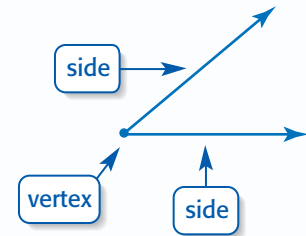
$m\angle A$ measure of angle A

WHEN **am I ever going to use this?**

GARDENING The circle graph shows what Mai-Lin planted in her garden this spring.

Mai-Lin's Garden

1. Mai-Lin planted the most of which food? Explain how you came to this conclusion.
2. Of which did she plant the least?
3. The percents 30%, 25%, 20%, 15%, and 10% correspond to the sections in the graph. Explain how you would match each percent with its corresponding section.

Each section of the circle graph above shows an angle. **Angles** have two **sides** that share a common endpoint called the **vertex** of the angle.
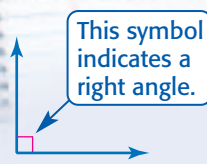

The most common unit of measure for angles is the **degree**. A circle can be separated into 360 equal-sized parts. Each part would make up a one-degree (1°) angle.
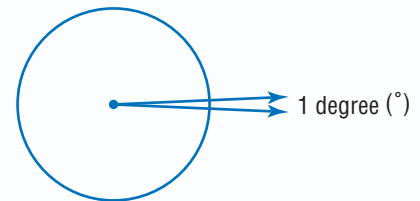
Angles can be classified according to their measure.

Noteables™   **Key Concept: Types of Angles**

This symbol indicates a right angle.
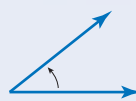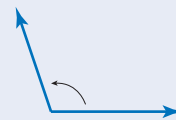
right angle	**acute angle**	**obtuse angle**	**straight angle**
exactly 90°	less than 90°	between 90° and 180°	exactly 180°

READING in the Content Area

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

CONTENTS

EXAMPLES   **Measure Angles**

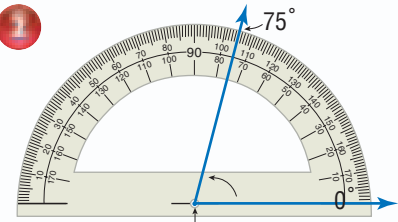**Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*.**

① 150°
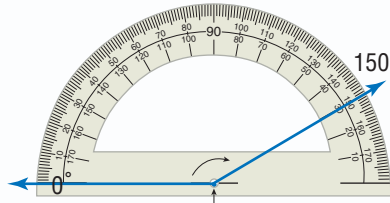
Align the center of the protractor with the vertex of the angle.

② 75°

The angle measures 150°.
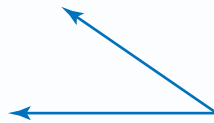It is an obtuse angle.

The angle measures 75°.
It is an acute angle.

Your Turn **Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*.**

a.

b.

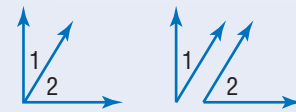Some pairs of angles are **complementary** or **supplementary**.

Noteables   **Key Concept: Pairs of Angles**

Words		Models
Two angles whose sum is 90° are complementary angles.		$m\angle 1 = 30°$, $m\angle 2 = 60°$, $m\angle 1 + m\angle 2 = 90°$
Two angles whose sum is 180° are supplementary angles.		$m\angle 1 = 120°$, $m\angle 2 = 60°$, $m\angle 1 + m\angle 2 = 180°$

READING Math

Notation The notation $m\angle 1$ is read as *the measure of angle 1*.

EXAMPLE   **Find Missing Angle Measures**

② **ALGEBRA** Angles *M* and *N* are supplementary. If $m\angle M = 85°$, what is the measure of $\angle N$?

$m\angle M + m\angle N =$ 180°   Supplementary angles

$85° + m\angle N =$ 180°   Replace $m\angle M$ with 85°.

$\underline{-85°\qquad\qquad = -85°}$ Subtract 85° from each side.

$m\angle N =$ 95°

So, $m\angle N = 95°$.   Since 95° + 85° = 180°, the answer is correct.

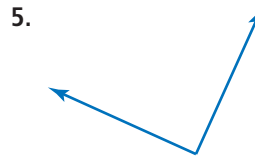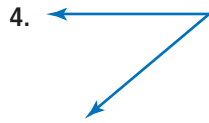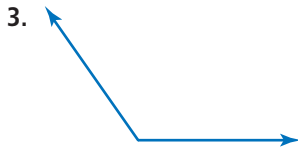**CONTENTS**

1. **OPEN ENDED** Draw an obtuse angle.

2. **FIND THE ERROR** Maria and David are measuring angles. Who is correct? Explain.

Maria
120°

David
60°
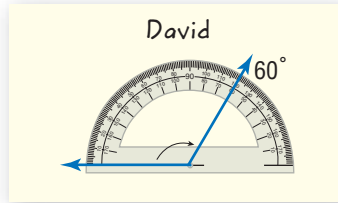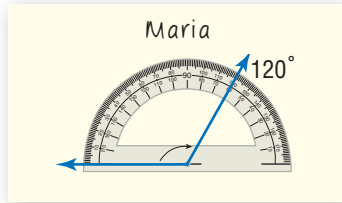
GUIDED PRACTICE

Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*.

3.

4.

5.

6. **ALGEBRA** Angles G and H are complementary. Find $m\angle H$ if $m\angle G = 47°$.

Practice and Applications

Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*.

7.

8.

9.
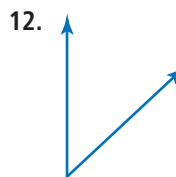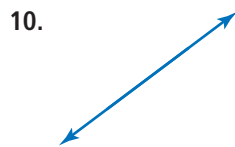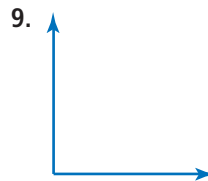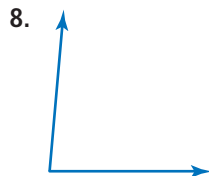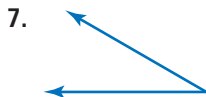
HOMEWORK HELP

For Exercises	See Examples
7–14, 17	1, 2
15–16	3

Extra Practice
See pages 620, 636.

10.

11.

12.

SIGNS Determine what types of angles are found in each road sign.

13.

STOP

14.

YIELD

15. **ALGEBRA** If $m\angle A = 127°$ and $\angle A$ and $\angle B$ are supplementary, what is $m\angle B$?

16. **ALGEBRA** Angles J and K are complementary. Find $m\angle J$ if $m\angle K = 58°$.

CONTENTS

READING For Exercises 17 and 18, use the graphic shown at the right.

17. Find the approximate measure of each angle formed by the sections of the circle graph.

18. Find the sum of the measures of the angles of the circle graph.

19. **CRITICAL THINKING** How would you change the grade of the hill so that it is not so steep?

140°

EXTENDING THE LESSON *Adjacent angles* are angles that share a common side and have the same vertex. *Vertical angles* are nonadjacent angles formed by a pair of lines that intersect.

Adjacent Angles   **Vertical Angles**

2
1

1 2

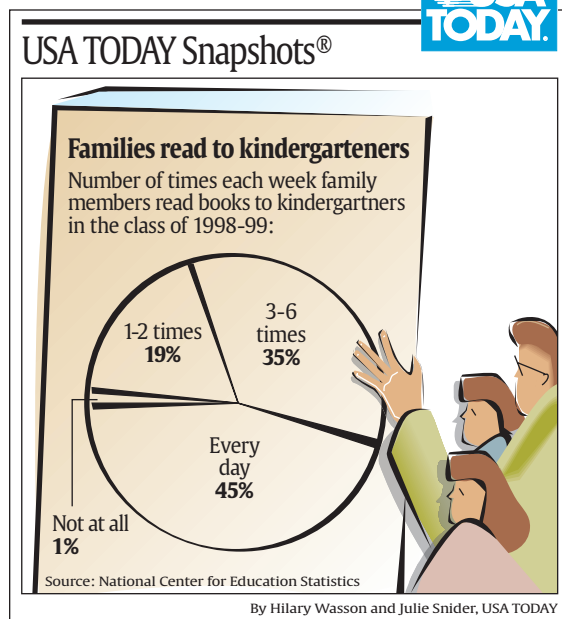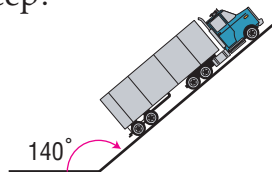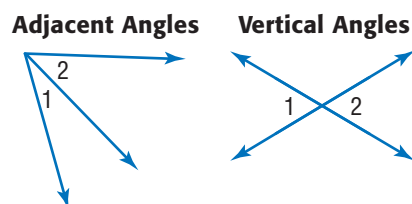20. Draw a different pair of angles that are adjacent and a pair of angles that are vertical angles.

Determine whether ∠1 and ∠2 are *adjacent angles* or *vertical angles*.

21.

2
1

22.

2 1

23.

1
2

24.

1
2

Spiral Review with Standardized Test Practice

25. **SHORT RESPONSE** Give an example of two angle measures in which the angles are supplementary.

26. **MULTIPLE CHOICE** Which term best describes an 89.9° angle?
    Ⓐ acute   Ⓑ right   Ⓒ straight   Ⓓ obtuse

27. Find the sum of 13 h 45 min and 27 h 50 min. (Lesson 12-6)

Complete. (Lesson 12-5)

28. 310 mm = __?__ cm   29. 0.25 km = __?__ m   30. __?__ g = 895 mg

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Use a ruler to draw a diagram that shows how the hands on a clock appear at each time. (Page 591)

31. 9:00   32. 12:10   33. 3:45   34. 2:30

CONTENTS

13-2 Using Angle Measures

HANDS-ON Mini Lab

What You'll LEARN

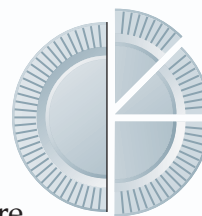Draw angles and estimate measures of angles.

Materials
- paper plate
- ruler
- scissors
- protractor

Work with a partner.

To estimate the measure of an angle, use angles that measure 45°, 90°, and 180°.

STEP 1 Fold a paper plate in half to find the center of the plate.

STEP 1 Cut wedges as shown. Then measure and label each angle.

1. Use the wedges to estimate the measure of each angle shown.
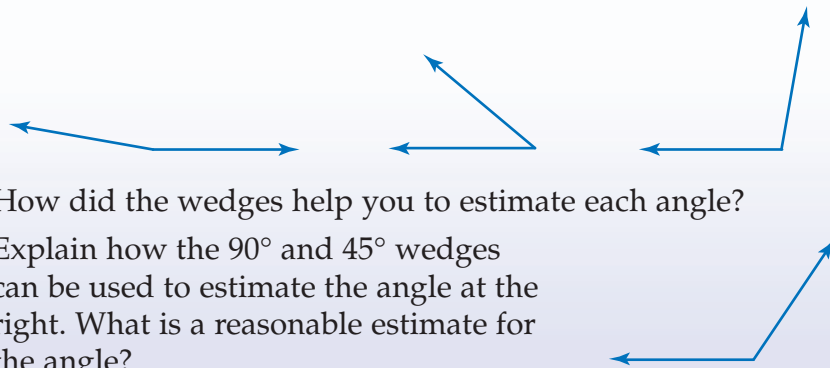
2. How did the wedges help you to estimate each angle?

3. Explain how the 90° and 45° wedges can be used to estimate the angle at the right. What is a reasonable estimate for the angle?

4. How would you estimate the measure of any angle without using the wedges?

To estimate the measure of an angle, compare it to an angle whose measure you know.

EXAMPLE Estimate Angle Measures

Estimate the measure of the angle shown.

Compare the given angle to an angle whose measure you know. The angle is a little less than a 90° angle. So, a reasonable estimate is about 80°.

Your Turn Estimate the measure of each angle.

a.

b.

CONTENTS

A protractor and a *straightedge*, or ruler, can be used to draw angles.
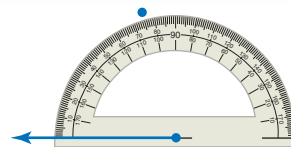
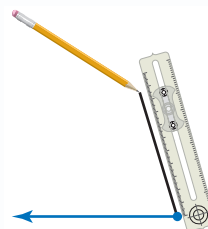**EXAMPLE** **Draw an Angle**

① **Draw a 74° angle.**

Step 1 Draw one side of the angle. Then mark the vertex and draw an arrow.

Step 2 Place the center point of the protractor on the vertex. Align the mark labeled 0 on the protractor with the line. Find 74° on the correct scale and make a pencil mark.

Step 3 Use a straightedge to draw the side that connects the vertex and the pencil mark.

STUDY TIP

Checking Reasonableness
You can check whether you have used the correct scale by comparing your angle with an estimate of its size.

Your Turn Use a protractor and a straightedge to draw angles having the following measurements.

c. 68°   d. 105°   e. 85°

Skill and Concept Check

1. **Writing Math** Explain how you would draw an angle measuring 65°.

2. **OPEN ENDED** Draw an angle whose measure is about 45°.

3. **Which One Doesn't Belong?** Identify the angle that does not measure about 45°. Explain your reasoning.

1   2   3   4
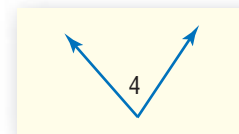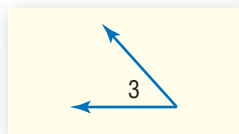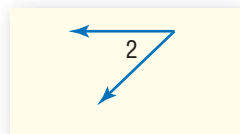
GUIDED PRACTICE

Estimate the measure of each angle.

4.   5.
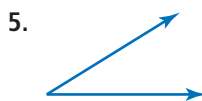
Use a protractor and a straightedge to draw angles having the following measurements.

6. 25°   7. 140°

Practice and Applications

Estimate the measure of each angle.

8.   9.   10.   11.
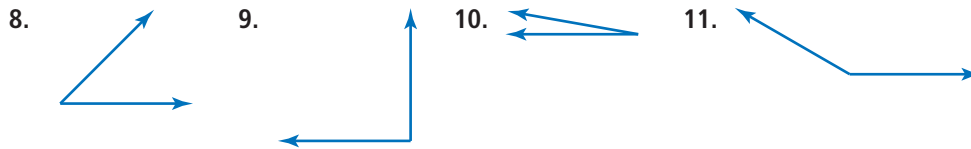
Use a protractor and a straightedge to draw angles having the following measurements.

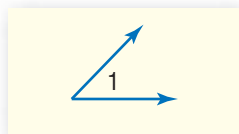**12.** 75°   **13.** 50°   **14.** 45°   **15.** 20°

16. 115°   **17.** 175°   **18.** 133°   **19.** 79°

20. TIME Is the measure of the angle formed by the hands on a clock at 3:20 P.M. greater than, less than, or about equal to 90°? Explain.

21. RESEARCH Use the Internet or another source to find a photo of a humpback whale. Draw an example of the angle formed by the two tail fins. Then give a reasonable estimate for the measure of this angle.
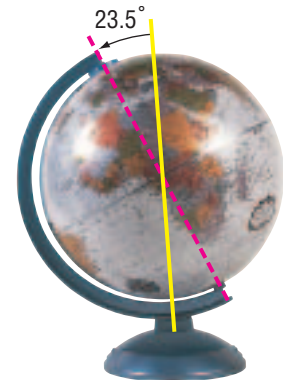
22. SCIENCE Most globes show that Earth's axis inclines 23.5° from vertical. Use the data below to draw diagrams that show the inclination of axis of each planet listed.

Planet	Uranus	Neptune	Pluto	Venus
Inclination of Axis	97.9°	29.6°	122°	177.3°

23. CRITICAL THINKING Describe how the corner of a textbook can be used to estimate the measure of an angle.

Spiral Review with Standardized Test Practice

24. MULTIPLE CHOICE Estimate the measure of the angle shown.

    A 60°   **B** 120°   **C** 90°   **D** 150°

25. SHORT RESPONSE Draw an angle having a measure of 66°.

26. ALGEBRA Angles W and U are supplementary. If $m\angle W = 56°$, what is the measure of $\angle U$? (Lesson 13-1)

Find each elapsed time. (Lesson 12-6)

27. 4:25 P.M. to 10:42 P.M.   **28.** 9:30 P.M. to 2:10 A.M.

GETTING READY FOR THE NEXT LESSON

PREREQUISITE SKILL Find the measure of each line segment in centimeters. What is the length of half of each segment? (Lesson 12-3)

29.   **30.**   **31.**

Construct Congruent Segments and Angles

A **line segment** is a straight path between two endpoints. To indicate line segment JK, write $\overline{JK}$. Line segments that have the same length are called **congruent segments**. In this lab, you will construct congruent segments using a **compass**.
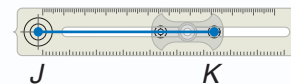
ACTIVITY *Work with a partner.*

1 **STEP 1** Draw $\overline{JK}$. Then use a straightedge to draw a line segment longer than $\overline{JK}$. Label it $\overline{LM}$.

STEP 2 Place the compass at *J* and adjust the compass setting so you can place the pencil tip on *K*. The compass setting equals the length of $\overline{JK}$.

STEP 3 Using this setting, place the compass tip at *L*. Draw an arc to intersect $\overline{LM}$. Label the intersection *P*. $\overline{LP}$ is congruent to $\overline{JK}$.
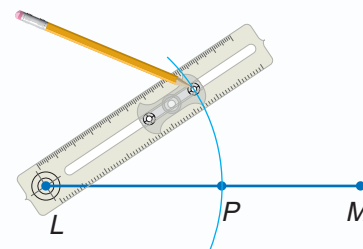
Your Turn Trace each segment. Then construct a segment congruent to it.

a. X Y   b. R S   c. M N

Writing Math

1. Explain, in your own words, how to construct a line segment that is congruent to a given line segment.

2. Find the measure of $\overline{JK}$ above. How does this compare to the measure of $\overline{LP}$?

3. Suppose the length of $\overline{JK}$ is 26 centimeters. If $\overline{JK}$ is separated into two congruent parts, what will be the length of each part? Explain.

CONTENTS

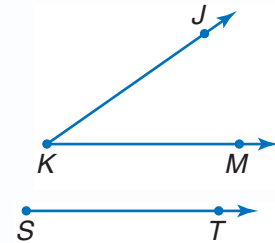The angle in step 1 shown below can be named in two ways, ∠*JKM* and ∠*MKJ*. The vertex is always the middle letter.
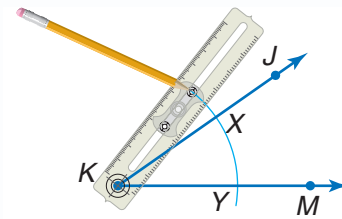
You can also construct congruent angles with a compass.
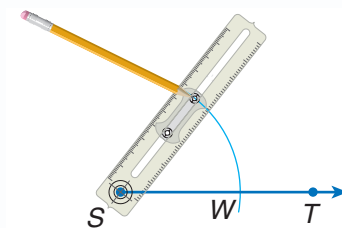
ACTIVITY *Work with a partner.*

① STEP 1 Draw ∠*JKM*. Then use a straightedge to draw $\overrightarrow{ST}$.

STEP 2 Place the tip of the compass at *K*. Draw an arc to intersect both sides of ∠*JKM*. Label the points of intersection *X* and *Y*.

STEP 3 Using this setting, place the compass at point *S*. Draw an arc to intersect $\overrightarrow{ST}$. Label the intersection *W*.

STEP 4 Place the point of the compass on *Y*. Adjust so that the pencil tip is on *X*.
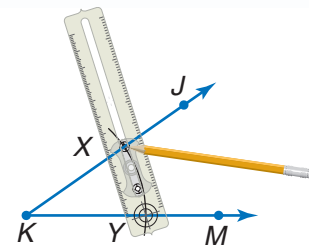
STEP 5 Using this setting, place the compass at *W*. Draw an arc to intersect the arc in Step 3. Label the intersection *U*. Draw $\overrightarrow{SU}$. ∠*JKM* is congruent to ∠*UST*.
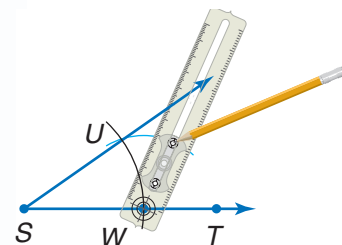
Writing Math

4. Explain the relationship between ∠*JKM* and ∠*UST*.
5. Explain how to construct an angle that is congruent to a 65° angle.

CONTENTS

Bisectors

What You'll LEARN

Bisect line segments and angles.

NEW Vocabulary

bisect
congruent
perpendicular

MATH Symbols

$\cong$ is congruent to
$\overline{AB}$ segment AB

ENGLISH The table lists a few words that contain the prefix *bi-*.

Words that Contain the Prefix *bi-*
bicycle
bimonthly
bilingual
biathlon
binocular

1. Use the Internet or a dictionary to find the meaning of each word.

2. What do the meanings have in common?

3. What does the prefix *bi-* mean?

4. **Make a conjecture** about what it means to bisect something.
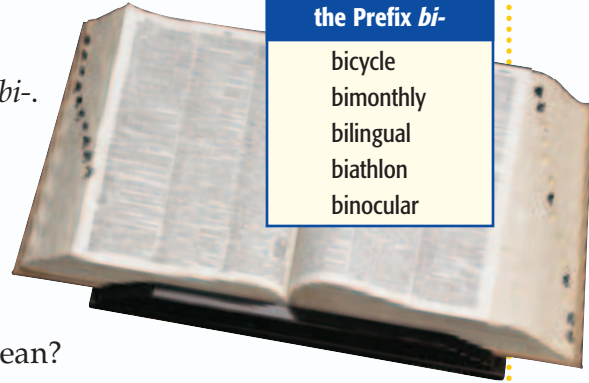
To **bisect** something means to separate it into two equal parts. You can use a straightedge and a compass to bisect a line segment.

EXAMPLE   **Bisect a Line Segment**

1️⃣ **Use a straightedge and a compass to bisect $\overline{AB}$.**

Step 1 Draw $\overline{AB}$.

Step 2 Place the compass at point A. Using a setting greater than one half the length of $\overline{AB}$, draw two arcs as shown.

Step 3 Using the same setting, place the compass at point B. Draw an arc above and below as shown.

The arcs should intersect.

Step 4 Use a straightedge to align the intersections. Draw a segment that intersects $\overline{AB}$. Label the intersection M.
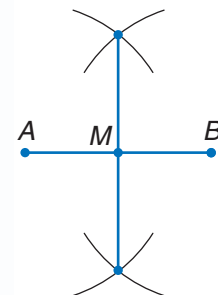
The vertical line segment bisects $\overline{AB}$ at M. The segments $\overline{AM}$ and $\overline{MB}$ are **congruent**. This can be written as $\overline{AM} \cong \overline{MB}$. This means that the measure of $\overline{AM}$ is equal to the measure of $\overline{MB}$. The line segments are also **perpendicular**. That is, they meet at right angles.

CONTENTS

A compass and straightedge can also be used to bisect an angle.

EXAMPLE **Bisect an Angle**

1 Use a straightedge and a compass to bisect ∠MNP.

Step 1 Draw ∠MNP.

Step 2 Place the compass at point N and draw an arc that intersects both sides of the angle. Label the points of intersection X and Y.
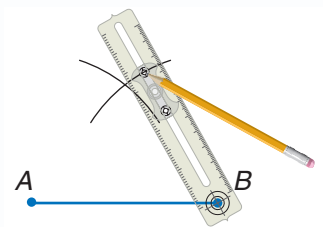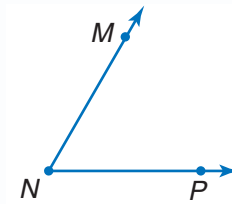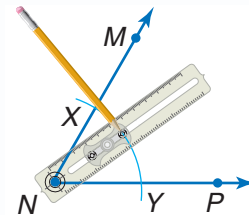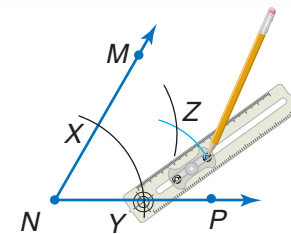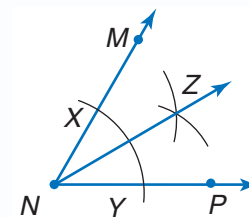
Step 3 With the compass at point X, draw an arc as shown.

Step 4 Using the same setting, place the compass point at Y and draw another arc as shown. Label the intersection Z.

Step 5 Use a straightedge to draw $\overrightarrow{NZ}$.

$\overrightarrow{NZ}$ bisects ∠MNP. Therefore, ∠MNZ and ∠ZNP are congruent. This can be written as ∠MNZ ≅ ∠ZNP.

Your Turn

a. Draw a line segment measuring 6 centimeters. Then use a straightedge and compass to bisect the segment.

b. Draw a 120° angle. Then use a straightedge and a compass to bisect the angle.

Skill and Concept Check

1. **Writing Math** Describe the result of bisecting an angle.

2. **OPEN ENDED** Draw a pair of congruent segments.

GUIDED PRACTICE

Draw each line segment or angle having the given measurement. Then use a straightedge and a compass to bisect the line segment or angle.

3. 3 cm

4. 85°

msmath1.net/extra_examples

CONTENTS

Practice and Applications

Draw each line segment or angle having the given measurement. Then use a straightedge and a compass to bisect the line segment or angle.

5. 2 cm   **6.** $1\frac{1}{2}$ in.   **7.** 60°   **8.** 135°

9. Draw and then bisect a $1\frac{3}{4}$-inch segment. Find the measure of each segment.

10. Draw a 129° angle. Then bisect it. What is the measure of each angle?

For Exercises 11–14, refer to segment $\overline{AF}$. Identify the the point that bisects each given line segment.

A   B   C D   E   F

**11.** $\overline{AC}$ **12.** $\overline{AF}$ **13.** $\overline{CF}$ **14.** $\overline{BF}$

FANS For Exercises 15–17, refer to the fan at the right.

15. Name the side of the fan that appears to bisect the section represented by ∠XVY.

16. Name two other angles and their bisectors.

17. Use a protractor to verify your answers to Exercises 15 and 16. Are the answers reasonable? Explain.

18. CRITICAL THINKING Explain how to construct a line passing through a given point and perpendicular to a given line using a compass and a straightedge.
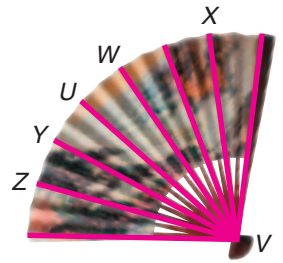
Spiral Review with Standardized Test Practice

19. MULTIPLE CHOICE In the figure shown, which ray appears to bisect ∠DBC?

    Ⓐ $\overrightarrow{BD}$ Ⓑ $\overrightarrow{BA}$ Ⓒ $\overrightarrow{BC}$ Ⓓ $\overrightarrow{BE}$

20. MULTIPLE CHOICE An angle that measures 37° is bisected. What is the measure of each angle?
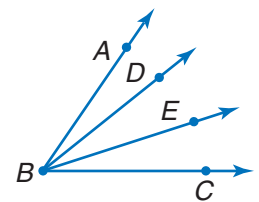
    Ⓕ 17°   Ⓖ 17.5°   Ⓗ 18.5°   Ⓘ 19°

Use a protractor and a straightedge to draw angles having the following measurements. (Lesson 13-2)

21. 75°   **22.** 25°   **23.** 110°

24. ALGEBRA Angles G and H are supplementary angles. If $m\angle G = 115°$, find $m\angle H$. (Lesson 13-1)

GETTING READY FOR THE NEXT LESSON

BASIC SKILL Draw an example of each figure.

25. rectangle   **26.** parallelogram   **27.** triangle

Vocabulary and Concepts

1. **Explain** the difference between acute angles and obtuse angles.
   (Lesson 13-1)

2. **Define** *bisect*. (Lesson 13-3)

Skills and Applications

Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*. (Lesson 13-1)

3.

4.

5. **ALGEBRA** If $m\angle A = 108°$ and $\angle A$ and $\angle B$ are supplementary, find $m\angle B$. (Lesson 13-1)

Use a protractor to draw angles having the following measurements.
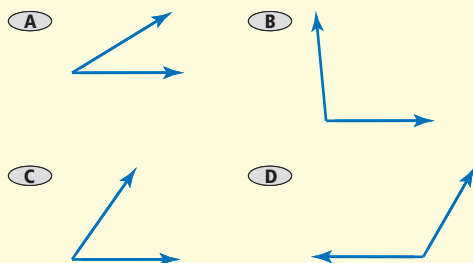(Lesson 13-2)

6. $35°$ 7. $110°$ 8. $80°$

Draw each line segment or angle having the given measurement. Then use a straightedge and a compass to bisect the line segment or angle. (Lesson 13-3)
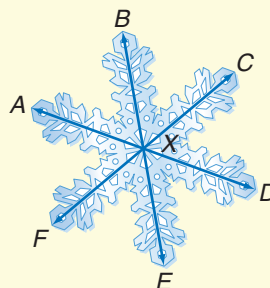
9. $120°$ 10. $30°$ 11. 2.5 in.   12. 3 cm

Standardized Test Practice

13. **MULTIPLE CHOICE** Which angle measures between 45° and 90°?
    (Lesson 13-2)

    Ⓐ   Ⓑ

    Ⓒ   Ⓓ

14. **SHORT RESPONSE** A snowflake is shown. Name an angle and its bisector. (Lesson 13-3)

CONTENTS

Wild Angles

GET READY!

Players: two
Materials: 21 index cards, spinner

5°	5°	10°	10°	15°	15°
20°	20°	25°	25°	30°	30°
35°	35°	40°	40°	45°	45°
50°	50°	55°	55°	60°	60°
65°	65°	70°	70°	75°	75°
80°	80°	85°	85°	90°	90°
Wild	Wild	Wild	Wild	Wild	Wild

GET SET!

- Cut the index cards in half.
- Label the cards and spinner as shown.

GO!

- Shuffle the cards and then deal five cards to each player. Place the remaining cards facedown in a pile.
- A player spins the spinner.
- Using two cards, the player forms a pair whose sum results in the type of angle spun. A wild card represents any angle measure. Each pair is worth 2 points.
- If a pair cannot be formed, the player discards one card and selects another from the facedown pile. If a pair is formed, the player sets aside the two cards and gets 2 points. Then it is the other player's turn. If no pair is formed, it is the other player's turn.
- **Who Wins?** The first player to reach 20 points wins.

John Evans

CONTENTS
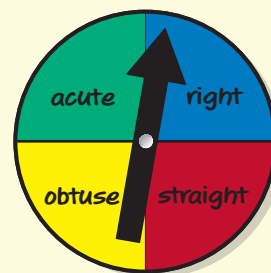
Draw a Diagram

What You'll LEARN

Solve problems by drawing a diagram.

> Hey Shawn, the science club is going to plant cacti in the school courtyard. The courtyard is 46 feet by 60 feet, and each planting bed will be 6 feet across.

> Yes, Margarita, I heard that. The planting beds will be square, and they will be 8 feet apart and 6 feet away from any walls. How many beds can we make?
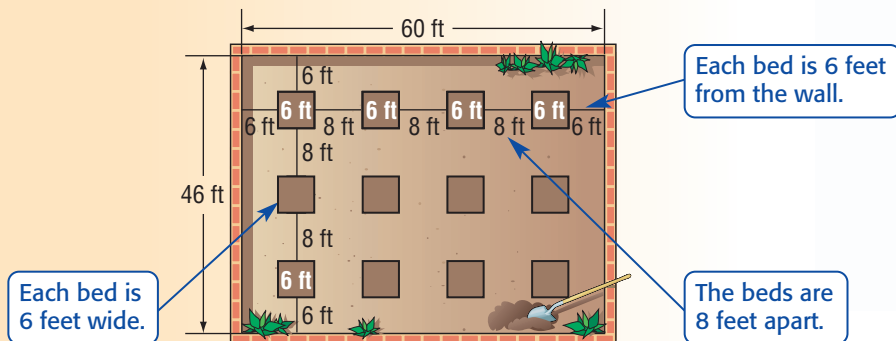
Explore	We know all the dimensions. We need to find how many beds will fit inside of the courtyard.
Plan	Let's draw a diagram to find how many planting beds will fit in the courtyard.
Solve	The diagram shows that 12 cactus beds will fit into the courtyard.
Examine	Make sure the dimensions meet the requirements. The distance across is 46 feet, and the distance down is 60 feet. So the answer is correct.

Apply the Strategy

1. **Explain** why you think the students chose to draw a diagram to solve the problem.

2. **Determine** the number of cactus beds that could be planted if the courtyard measured 74 feet by 88 feet.

3. **Write** a problem that can be solved by making a diagram.

CONTENTS

Solve. Use the draw a diagram strategy.

4. **TRAVEL** Jasmine lives in Glacier and works in Alpine. There is no direct route from Glacier to Alpine, so Jasmine drives through either Elm or Perth. How many different ways can she drive to work?

5. **DECORATING** For the Spring Dance, there are 5 columns arranged in the shape of a pentagon. Large streamers are hung from each column to every other column. How many streamers are there in all?

Mixed Problem Solving

Solve. Use any strategy.

6. **CAMPING** Robin bought a tent for camping. Each of the four sides of the tent needs three stakes to secure it properly to the ground. How many stakes are needed?

BASKETBALL For Exercises 7 and 8, refer to the table.

Game	Tally	Three-Point Shots
1	卌 II	7
2	卌	5
3	卌 IIII	9
4	IIII	4
5	卌 I	6

7. What is the mean number of three-point shots made by the team for games 1–5?

8. What is the median number of three-point shots made for games 1–5?

9. **GEOMETRY** A kite has two pairs of congruent sides. If two sides are 56 centimeters and 34 centimeters, what is the perimeter of the kite?

10. **FOOD** Jesse works at the local sandwich shop. There are 4 different kinds of bread and 6 different kinds of meat to choose from. How many different sandwiches could be made using one kind of bread and two different kinds of meat?

11. **WEATHER** What is the difference between the hottest and coldest temperatures in the world?
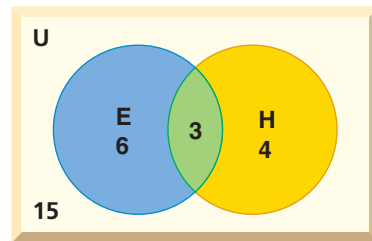
Hottest Temp.	Coldest Temp.
134°F	−128°F

12. **PATTERNS** A number is doubled and then 9 is subtracted. If the result is 15, what was the original number?

13. **STANDARDIZED TEST PRACTICE**
Refer to the Venn diagram.

Ecology Club and Honor Society

U = all students in the class
E = ecology club   H = honor society

Which statement is *not* true?

Ⓐ There are more kids in the honor society than the ecology club.

Ⓑ One fourth of the class is in the honor society.

Ⓒ There are only two more students in the ecology club than the honor society.

Ⓓ 15 students are not in either club.

13-4 Two-Dimensional Figures

What You'll LEARN
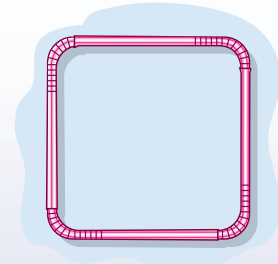
Name two-dimensional figures.

NEW Vocabulary

polygon
triangle
quadrilateral
pentagon
hexagon
heptagon
octagon
regular polygon
scalene triangle
isosceles triangle
equilateral triangle
rectangle
square
parallelogram
rhombus

HANDS-ON Mini Lab

Materials
- six flexible straws
- ruler
- protractor

Work with a partner.

STEP 1 Using four flexible straws, insert an end of one straw into the end of another straw as shown.

STEP 2 Form a square.

1. What is true about the angles and sides of a square?
2. Using two more straws, what changes need to be made to the square to form a rectangle that is not a square?
3. How are rectangles and squares alike? How do they differ?
4. Push on one vertex of the rectangle so it is no longer a rectangle. What is true about the opposite sides?

In geometry, flat figures such as squares or rectangles are *two-dimensional* figures. A **polygon** is a simple, closed, two-dimensional figure formed by three or more sides.

Noteables™   Key Concept: Polygons

triangle (3 sides) **quadrilateral** (4 sides) **pentagon** (5 sides)

hexagon (6 sides) **heptagon** (7 sides) **octagon** (8 sides)

When all of the sides of a polygon are congruent and all of the angles are congruent, the polygon is a **regular polygon**.
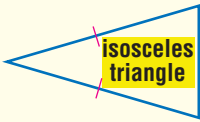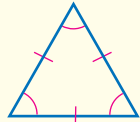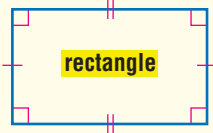
READING Math

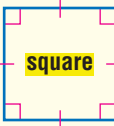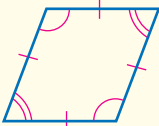**Congruent Markings** The red tick marks show congruent sides. The red arcs show congruent angles.

EXAMPLE Identify a Polygon

Identify the polygon. Then tell if it is a regular polygon.

The polygon has 5 sides. So, it is a pentagon. Since the sides and angles are congruent, it is a regular polygon.

CONTENTS
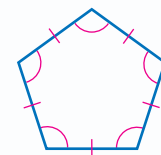
Certain triangles and quadrilaterals have special names.

Figure	Characteristics
scalene triangle	• No sides congruent.
isosceles triangle	• At least two sides congruent.
equilateral triangle	• All sides congruent. • All angles congruent.
rectangle	• Opposite sides congruent. • All angles are right angles. • Opposite sides parallel.
square	• All sides congruent. • All angles are right angles. • Opposite sides parallel.
parallelogram	• Opposite sides congruent. • Opposite sides parallel. • Opposite angles congruent.
rhombus	• All sides congruent. • Opposite sides parallel. • Opposite angles congruent.

STUDY TIP

Parallel Parallel means that if you extend the lengths of the sides, the opposite sides will never meet.

EXAMPLE **Analyze Two-Dimensional Figures**

1 **FLAGS** Many aircraft display the American flag in the shape of a parallelogram to show motion. Identify and describe the similarities and the differences between a rectangle and a parallelogram.

These shapes are alike because they both have four sides, opposite sides parallel, and opposite sides congruent.

They are different because a rectangle has four right angles and a parallelogram does not necessarily have four right angles.
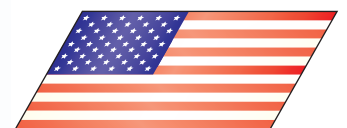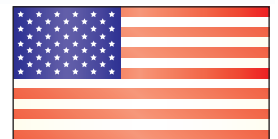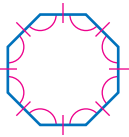
1. **Draw** an example of each polygon listed. Mark any congruent sides, congruent angles, and right angles.

   a. hexagon   **b.** regular octagon   **c.** parallelogram

   d. triangle   **e.** equilateral triangle   **f.** rectangle

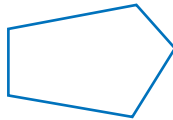2. **OPEN ENDED** Describe two different real-life items that are shaped like a polygon.

GUIDED PRACTICE

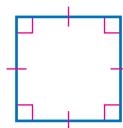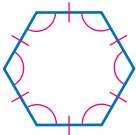**Identify each polygon. Then tell if it is a regular polygon.**

3.   4.   5.

6. **SIGNS** Identify and then describe the similarities and the differences between the shapes of the road signs shown.
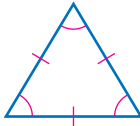
Practice and Applications

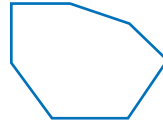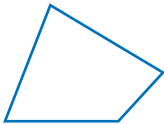**Identify each polygon. Then tell if it is a regular polygon.**

7.   8.   9.

10.   11.   12.

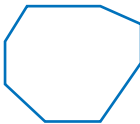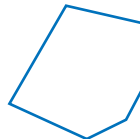| HOMEWORK HELP	
For Exercises	See Examples
7–12, 20	1
17	2

Extra Practice
See pages 621, 636.

13. Draw a quadrilateral that is not a parallelogram.

14. Draw a triangle with only two equal sides. Identify this triangle.

15. Draw a scalene triangle having angle measures 55°, 40°, and 85°.

16. **BIRD HOUSES** The front of a bird house is shaped like a regular pentagon. If the perimeter of the front is 40 inches, how long is each side?

17. Describe the similarities and the differences between a square and a rhombus.

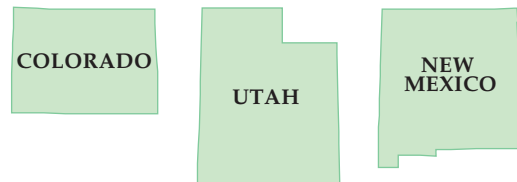**Give a counterexample for each statement.**

18. All parallelograms are rectangles.

19. All quadrilaterals are parallelograms.

CONTENTS

20. GEOGRAPHY Name the polygon formed by the boundaries of each state shown at the right.

21. ALGEBRA The sum of the measures of a regular octagon is 1,080°. Write and solve an equation to find the measure of one of the angles.

COLORADO

UTAH

NEW MEXICO

Tell whether each statement is *sometimes, always,* or *never* true.

22. Parallelograms are squares.

23. A rhombus is a square.

24. A rectangle is a parallelogram.

25. A square is a rhombus.

26. CRITICAL THINKING Explain how to construct the following using a compass and a straightedge.

    a. an equilateral triangle   **b.** an isosceles triangle

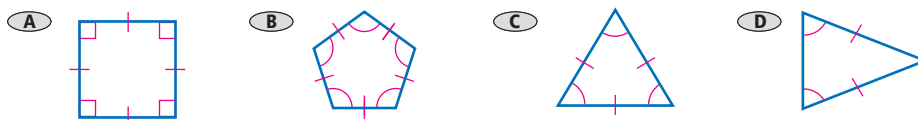**EXTENDING THE LESSON** The sum of the angles of a quadrilateral is 360°.

Find each missing measure.

27.

80°   120°

$x°$ 65°

28.

$x°$ 70°

110°   110°

29.

115°   65°

65° $x°$
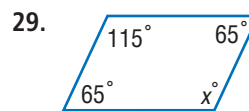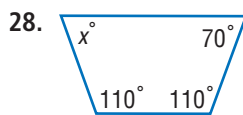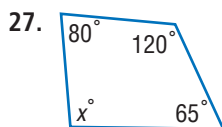
30. Draw a quadrilateral whose angles measure 90°, 70°, 120°, and 80°.

Spiral Review with Standardized Test Practice

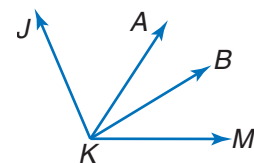**31. MULTIPLE CHOICE** Which polygon is *not* a regular polygon?

  Ⓐ   Ⓑ   Ⓒ   Ⓓ

32. MULTIPLE CHOICE Which is *not* a characteristic of a rectangle?

  Ⓕ All sides are congruent.   Ⓖ All angles are right angles.

  Ⓗ Opposite sides are parallel.   Ⓘ All angles are congruent.

33. Refer to the angles at the right. Identify the ray that bisects ∠*JKM*.
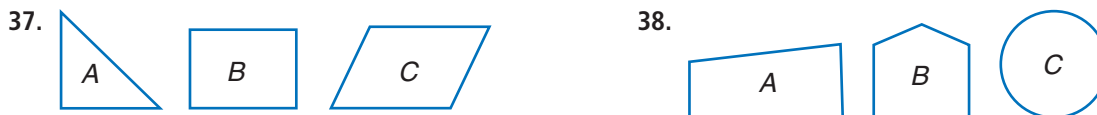(Lesson 13-3)

J   *A*   *B*

K   *M*

Use a protractor to draw angles having the following measurements. Then classify each angle as *acute, right, obtuse,* or *straight*. (Lesson 13-2)

34. 35°   **35.** 100°   **36.** 180°

GETTING READY FOR THE NEXT LESSON

BASIC SKILL Identify which figure *cannot* be folded so that one half matches the other half.

37.

A   B   C

38.

A   B   C

Triangles and Quadrilaterals

There are many different properties and characteristics of triangles and quadrilaterals. In this lab, you will explore these properties and characteristics. Triangle means three angles. Let's first explore how the three angles of a triangle are related.

ACTIVITY *Work with a partner.*

1 **STEP 1** Draw a triangle similar to the one shown below. Then tear off each corner.

STEP 2 Rearrange the torn pieces as shown.

When you arrange the angles, a line is formed.

By extending the line, you find 180° on the protractor.
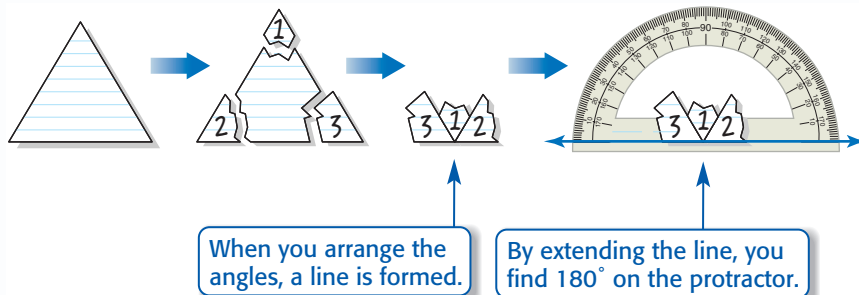
STEP 3 Repeat Steps 1 and 2 with a different triangle.

Therefore, the sum of the measures of the angles of a triangle is 180°.
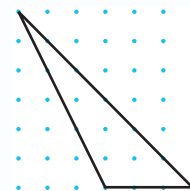
Triangles can be classified according to their angles.

ACTIVITY *Work with a partner.*

1 **STEP 1** Draw the triangle shown at the right on dot paper. Then cut it out.

STEP 2 Draw nine more different triangles on dot paper. Then cut out each triangle.

STEP 3 All triangles have at least two acute angles. The triangle shown above has two acute angles. Since the third angle is obtuse, the triangle is an obtuse triangle. Sort your triangles into three groups, based on the third angle.
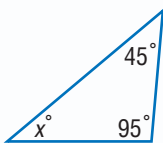
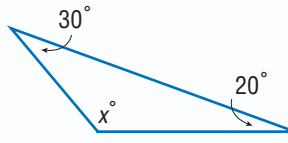**STEP 4** Name the groups *acute*, *right*, and *obtuse*.

CONTENTS

**Find the missing angle measure for each triangle shown.
Then classify each triangle as *acute*, *right*, or *obtuse*.**

a.

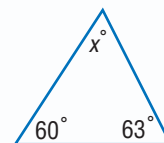$45°$
$x°$ $95°$

b.

$30°$
$20°$
$x°$

c.

$x°$
$60°$ $63°$

In Activity 2, you classified triangles by their angles. Now you will
classify quadrilaterals by their *sides* and *angles*.

ACTIVITY   *Work with a partner.*

3

STEP 1 Draw the two quadrilaterals shown on
dot paper. Then cut them out.

STEP 2 Draw nine more different quadrilaterals
on dot paper. Then cut out each
quadrilateral.

STEP 3 The first quadrilateral shown can be
classified as a quadrilateral with four right
angles. Sort your quadrilaterals into three
groups, based on any characteristic. Write
a description of the quadrilaterals in each
group.
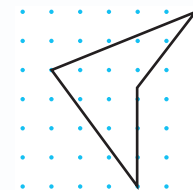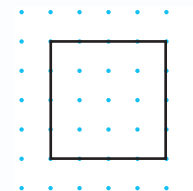
Writing Math

1. If a triangle has angles with measures $45°$, $35°$, and $100°$, what
type of triangle is it? Explain.

2. Is the statement *All rectangles are parallelograms, but not all
parallelograms are rectangles* true or false? Explain.

3. Tell why a triangle must always have at least two acute angles.
Include drawings in your explanation.

4. Two different quadrilaterals each have four congruent sides.
However, one has four 90° angles, and the other has no
90° angles. Draw the figures and compare them using the
given characteristics.

What You'll LEARN

Describe and define lines of symmetry.

NEW Vocabulary

line symmetry
line of symmetry
rotational symmetry

HANDS-ON Mini Lab

Materials
- tracing paper

Work with a partner.

A butterfly, a dragonfly, and a lobster have a common characteristic that relates to math.

STEP 1 Trace the outline of each figure.

STEP 2 Draw a line down the center of each figure.

1. Compare the left side of the figure to the right side.
2. Draw another figure that has the same characteristic as a butterfly, a dragonfly, and a lobster.

When two halves of a figure match, the figure is said to have **line symmetry**. The line that separates the figure into two matching halves is called a **line of symmetry**.
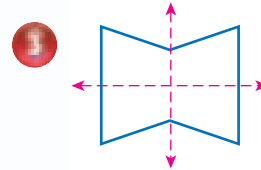
EXAMPLES Draw Lines of Symmetry

Draw all lines of symmetry for each figure.
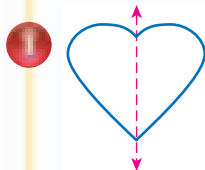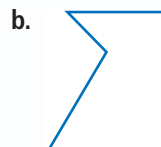
① This figure has 1 line of symmetry.

② The letter J has no lines of symmetry.

③ This hexagon has 2 lines of symmetry.

Your Turn Trace each figure. Then draw all lines of symmetry.

a.

b.

c.

CONTENTS

EXAMPLE **Identify Line Symmetry**

MULTIPLE-CHOICE TEST ITEM

The Navy signal flag for the number 5 is shown. How many lines of symmetry does this flag have?

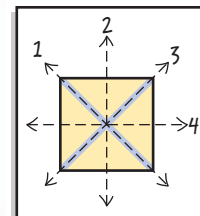Ⓐ 2   Ⓑ 4   Ⓒ 8   Ⓓ none

Read the Test Item You need to find all of the lines of symmetry for the flag.

Solve the Test Item Draw all lines of symmetry. It is a good idea to number each line so that you do not count a line twice.
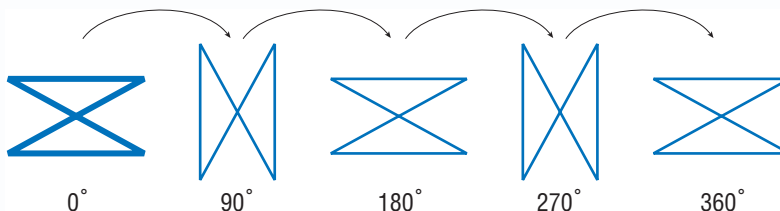
There are 4 lines of symmetry.

The answer is B.

Some figures can be turned or rotated less than 360° about a fixed point so that the figure looks exactly as it did before being turned. These figures are said to have **rotational symmetry**.
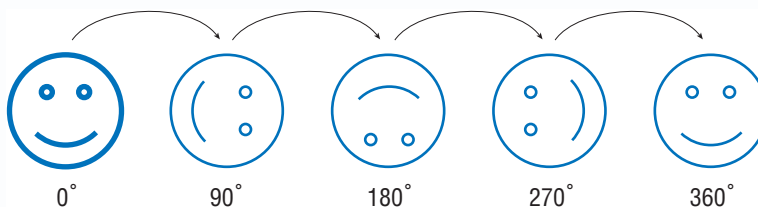
EXAMPLES **Identify Rotational Symmetry**

Tell whether each figure has rotational symmetry.

5

0°   90°   180°   270°   360°

When the figure is rotated 180°, the figure looks as it did before it was rotated. So, the figure has rotational symmetry.

6

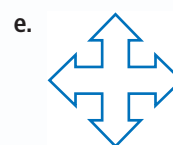0°   90°   180°   270°   360°

The figure appears as it did before being rotated only after being rotated 360°. So, it does *not* have rotational symmetry.
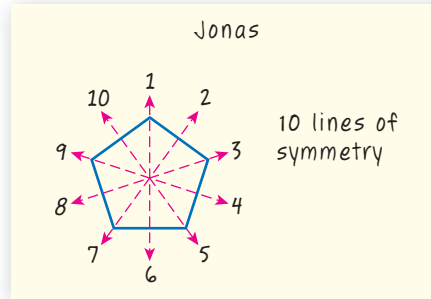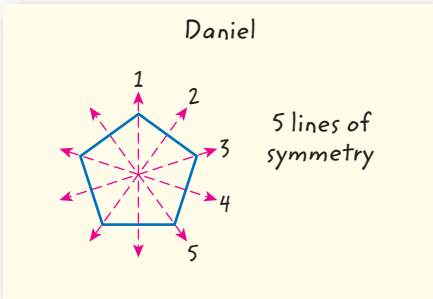
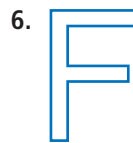**Your Turn** Tell whether each figure has rotational symmetry. Write *yes* or *no*.
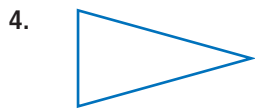
d.

e.

1. **Writing Math** Describe line symmetry and rotational symmetry.

2. **OPEN ENDED** Draw a figure that has rotational symmetry.

3. **FIND THE ERROR** Daniel and Jonas are finding the lines of symmetry for a regular pentagon. Who is correct? Explain.

Daniel

5 lines of symmetry

Jonas

10 lines of symmetry

GUIDED PRACTICE

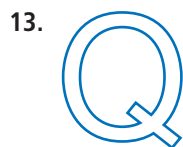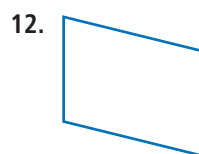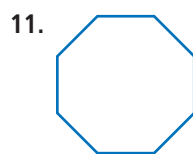**Trace each figure. Then draw all lines of symmetry.**

4.

5.

6.

Tell whether each figure has rotational symmetry. Write *yes* or *no*.

7.

8.

9.

Practice and Applications

Trace each figure. Then draw all lines of symmetry.

10.

11.

12.

13.

14.

15.
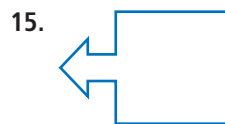
16. **MUSIC** How many lines of symmetry does a violin have?

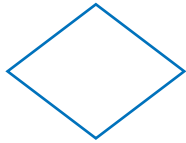17. **DECORATING** Find the number of lines of symmetry for a square picture frame.

CONTENTS
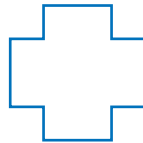
Tell whether each figure has rotational symmetry. Write *yes* or *no*.
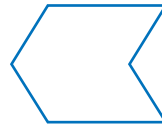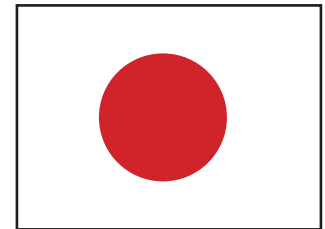
18.

19.

20.

21.

22.

23.

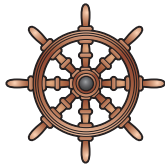24. **SCIENCE** Does a four-leaf clover have rotational symmetry?

25. **FLAGS** The flag of Japan is shown. How many lines of symmetry does the flag have?

Data Update What U.S. state flags have line symmetry? Visit msmath1.net/data_update to learn more.

26. **CRITICAL THINKING** Which figures below have both line and rotational symmetry?

a.

b.

c.

d.

Spiral Review with Standardized Test Practice

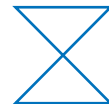27. **MULTIPLE CHOICE** Which figure does *not* have line symmetry?

A   B   C   D

28. **SHORT RESPONSE** What capital letters of the alphabet have rotational symmetry?

29. **FOOD** Identify the shape of the front of a cereal box. Tell if it is a regular polygon. (Lesson 13-4)

30. Draw a 6-centimeter line segment. Then use a straightedge and a compass to bisect the line segment. (Lesson 13-3)

GETTING READY FOR THE NEXT LESSON

BASIC SKILL Tell whether each pair of figures have the same size and shape.

31.

32.

33.

Transformations

What You'll LEARN

Investigate transformations.

Materials

- grid paper
- pattern blocks
- geomirror
- colored pencils

A **transformation** is a movement of a figure. The three types of transformations are a **translation** (slide), a **reflection** (flip), and a **rotation** (turn).

In a translation, a figure is slid horizontally, vertically, or both.
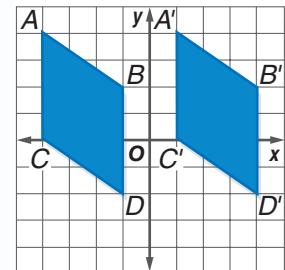
ACTIVITY *Work with a partner.*

1 Perform a translation of a figure on a coordinate grid.

STEP 1 Trace a parallelogram-shaped pattern block onto the coordinate grid. Label the vertices *ABCD*.
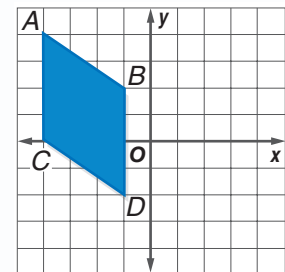
STEP 2 Slide the pattern block over 5 units to the right.

STEP 3 Trace the figure in its new position. Label the vertices *A'*, *B'*, *C'*, and *D'*.

Parallelogram *A'B'C'D'* is the image of parallelogram *ABCD* after a translation 5 units right.

READING Math

Notation The notation *A'* is read *A prime*. This notation is used to name a point after a translation.

In a reflection, a figure is flipped over a line.

ACTIVITY *Work with a partner.*

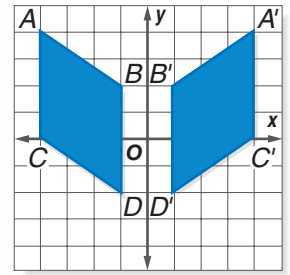**1** Perform a reflection of a figure on a coordinate grid.

STEP 1 Trace a parallelogram-shaped pattern block as shown. Label the vertices *A*, *B*, *C*, and *D*.

STEP 2 Place a geomirror on the *y*-axis.

CONTENTS
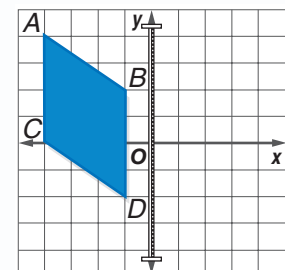
STEP 3 Trace the reflection of the parallelogram. Label the vertices A', B', C', and D'.

Parallelogram $A'B'C'D'$ is the image of parallelogram $ABCD$ reflected over the y-axis.

In a rotation, a figure is rotated about a point.

ACTIVITY *Work with a partner.*

1 **Perform a rotation of a figure on a coordinate grid.**

STEP 1 Trace a parallelogram-shaped pattern block onto the coordinate grid as shown. Label the vertices A, B, C, and D.

STEP 2 Rotate the figure 90° clockwise, using the origin as the point of rotation.

STEP 3 Trace the rotation of the figure. Label the vertices A', B', C', and D'.
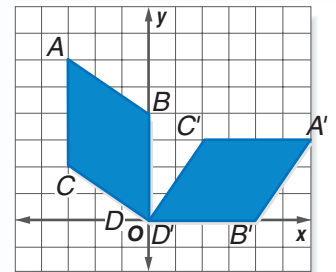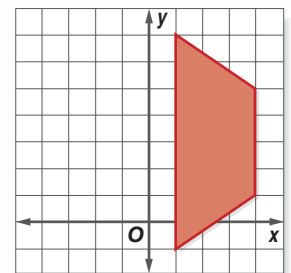
Parallelogram $A'B'C'D'$ is the image of parallelogram $ABCD$ rotated 90° clockwise about the origin.

Your Turn

Using the pattern block shown, perform each transformation described on a coordinate grid.

a. a translation 5 units left

b. a reflection across the y-axis

c. a 90° rotation counterclockwise

Writing Math

1. A square is transformed across the y-axis. How could this transformation be interpreted as a slide, a flip, and a turn?

2. **GRAPHIC DESIGN** Abby is creating a new company logo. She first draws a rectangle with vertices at (3, 2), (7, 2), (3, 8), and (7, 8). How did Abby transform the first rectangle to draw the second rectangle with vertices at (8, 2), (12, 2), (8, 8), and (12, 8)?

CONTENTS

Similar and Congruent Figures

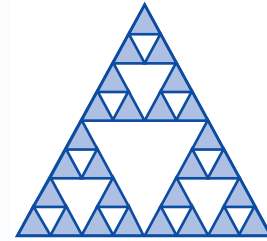Determine congruence and similarity.

NEW Vocabulary

similar figures
congruent figures
corresponding parts

Link to READING

*similar*: nearly, but not exactly, the same or alike.

WHEN am I ever going to use this?

PATTERNS The triangle at the right is called *Sierpinski's triangle*. Notice how the pattern is made up of various equilateral triangles.
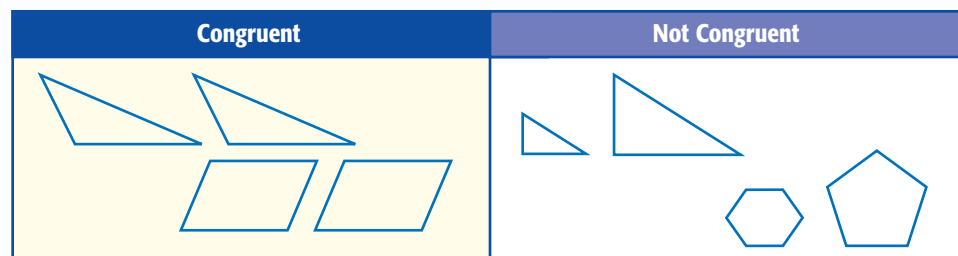
1. How many different-sized triangles are in the pattern?

2. Compare the size and shape of these triangles.

Figures that have the same shape but not necessarily the same size are called **similar figures**. Here are some examples.
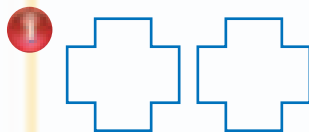
Similar	Not Similar
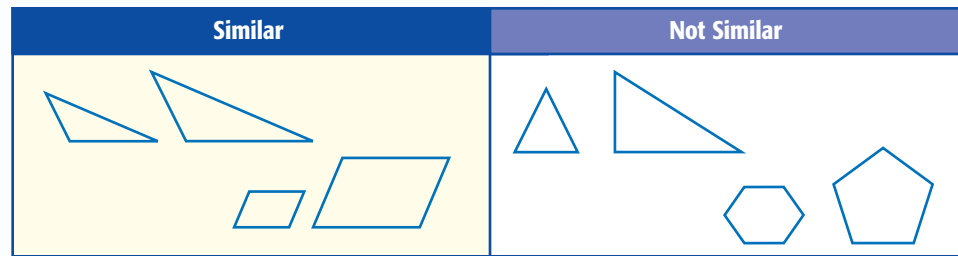
Figures that have the same size and shape are **congruent figures**. Consider the following.

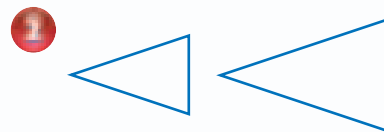| Congruent	Not Congruent

EXAMPLES **Identify Similar and Congruent Figures**

Tell whether each pair of figures is *similar*, *congruent*, or *neither*.

1

The figures have the same size and shape. They are congruent.

2

The figures have the same shape but not the same size. They are similar.

CONTENTS

● **Your Turn** Tell whether each pair of figures is *similar, congruent,* or *neither.*

a.

b.

c.

The parts of congruent figures that "match" are called **corresponding parts**.

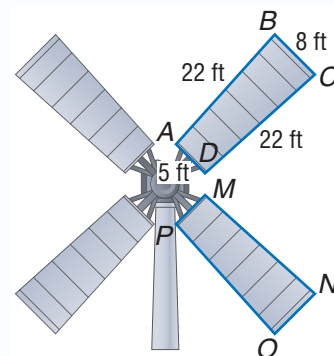**EXAMPLES** **Apply Similarity and Congruence**

WINDMILLS The arms of the windmill shown have congruent quadrilaterals.

① What side of quadrilateral *ABCD* corresponds to side $\overline{MP}$?

Side $\overline{AD}$ corresponds to side $\overline{MP}$.

② What is the perimeter of quadrilateral *MNOP*?

The perimeter of quadrilateral *ABCD* is $5 + 22 + 8 + 22$, or 57 feet. Since the quadrilaterals are congruent, they have the same size and shape. So, the perimeter of quadrilateral *MNOP* is 57 feet.
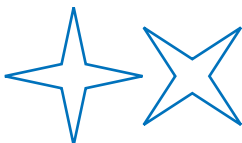
Skill and Concept Check

1. **Writing Math** Describe similarity and congruence.

2. **Draw** two figures that are congruent and two figures that are not congruent.

3. **OPEN ENDED** Draw a pair of similar triangles and a pair of congruent quadrilaterals.
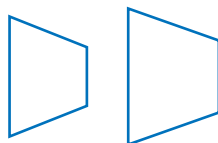
GUIDED PRACTICE

Tell whether each pair of figures is *congruent, similar,* or *neither.*
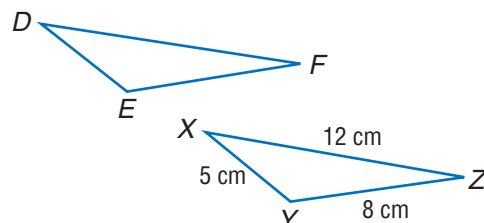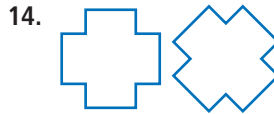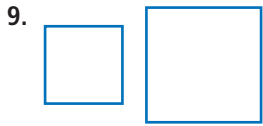
4.

5.

6.

For Exercises 7 and 8, use the figures shown at the right. Triangle *DEF* and △*XYZ* are congruent triangles.

7. What side of △*DEF* corresponds to side $\overline{XZ}$?

8. Find the measure of side $\overline{EF}$.

CONTENTS

Practice and Applications

Tell whether each pair of figures is *congruent, similar,* or *neither*.

9.

10.

11.

12.

13.

14.

15. STATUES Are a model of the Statue of Liberty and the actual Statue of Liberty similar figures? Explain.

16. Describe a transformation or a series of motions that will show that the two shapes shown on the coordinate system are congruent.
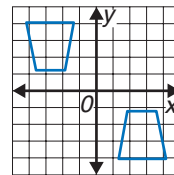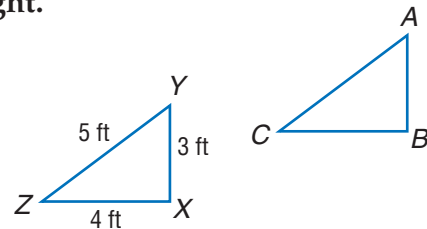
For Exercises 17–20, use the congruent triangles at the right.

17. What side of $\triangle ABC$ corresponds to side $\overline{YZ}$?

18. Name the side of $\triangle XYZ$ that corresponds to side $\overline{AB}$.

19. What is the measure of side $\overline{AC}$?

20. Find the perimeter of $\triangle ABC$.

CRITICAL THINKING Tell whether each statement is *sometimes, always,* or *never* true. Explain your reasoning.

21. All rectangles are similar.

22. All squares are similar.

Spiral Review with Standardized Test Practice

23. MULTIPLE CHOICE Which polygons are congruent?

A

B

C

D

24. SHORT RESPONSE Draw two similar triangles in which the size of one is twice the size of the other.

Draw all lines of symmetry for each figure. (Lesson 13-5)

25. square

26. regular pentagon

27. equilateral triangle

28. WINDOWS A window is shaped like a regular hexagon. If the perimeter of the window is 54 inches, how long is each side?
(Lesson 13-4)

msmath1.net/self_check_quiz

CONTENTS

Tessellations

A pattern formed by repeating figures that fit together without gaps or overlaps is a **tessellation**. Tessellations are formed using slides, flips, or turns of congruent figures.
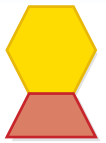
What You'll LEARN

Create tessellations using pattern blocks.

Materials

• pattern blocks
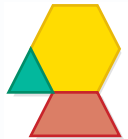
ACTIVITY   *Work with a partner.*

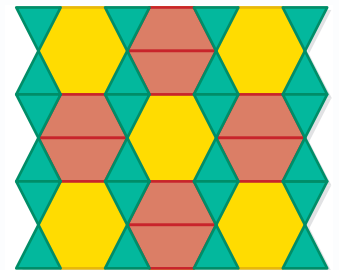**STEP 1** Select the three pattern blocks shown.

STEP 2 Choose one of the blocks and trace it on your paper. Choose a second block that will fit next to the first without any gaps or overlaps and trace it.

STEP 3 Trace the third pattern block into the tessellation.

STEP 4 Continue the tessellation by expanding the pattern.

Your Turn

Create a tessellation using the pattern blocks shown.

a.   b.   c.

Writing Math

1. **Tell** if a tessellation can be created using a square and an equilateral triangle. Justify your answer with a drawing.

2. What is the sum of the measures of the angles where the vertices of the figures meet? Is this true for all tessellations?

3. Name two figures that cannot be used to create a tessellation. Use a drawing to justify your answer.

CONTENTS

Vocabulary and Concept Check

acute angle (p. 506)
angle (p. 506)
bisect (p. 515)
complementary (p. 507)
congruent (p. 515)
congruent figures (p. 534)
corresponding parts (p. 535)
degree (p. 506)
equilateral triangle (p. 523)
heptagon (p. 522)
hexagon (p. 522)
isosceles triangle (p. 523)

line of symmetry (p. 528)
line symmetry (p. 528)
obtuse angle (p. 506)
octagon (p. 522)
parallelogram (p. 523)
pentagon (p. 522)
perpendicular (p. 515)
polygon (p. 522)
quadrilateral (p. 522)
rectangle (p. 523)
regular polygon (p. 522)

rhombus (p. 523)
right angle (p. 506)
rotational symmetry (p. 529)
scalene triangle (p. 523)
side (p. 506)
similar figures (p. 534)
square (p. 523)
straight angle (p. 506)
supplementary (p. 507)
triangle (p. 522)
vertex (p. 506)

Choose the letter of the term that best matches each phrase.

1. a six-sided figure
2. a polygon with all sides and all angles congruent
3. a ruler or any object with a straight side
4. the point where two edges of a polygon intersect
5. the most common unit of measure for an angle
6. an angle whose measure is between 0° and 90°
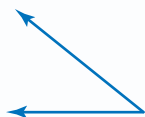7. an angle whose measure is between 90° and 180°

a. regular polygon
b. vertex
c. straightedge
d. acute angle
e. obtuse angle
f. degree
g. hexagon

Lesson-by-Lesson Exercises and Examples

13-1 Angles (pp. 506–509)

Use a protractor to find the measure of each angle. Then classify each angle as *acute*, *obtuse*, *right*, or *straight*.
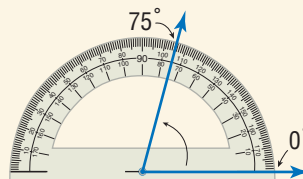
8.   9.

10. **ALGEBRA** Angles M and N are supplementary. If $m\angle M = 68°$, find $m\angle N$.

Example 1   Use a protractor to find the measure of the angle. Then classify the angle as *acute*, *obtuse*, *right*, or *straight*.

75°
90
0°

The angle measures 75°. Since it is less than 90°, it is an acute angle.

CONTENTS

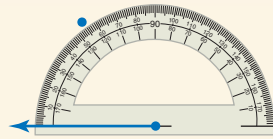## 13-2 Using Angle Measures (pp. 510–512)

Use a protractor and a straightedge to draw angles having the following measurements.

11. 36°   **12.** 127°
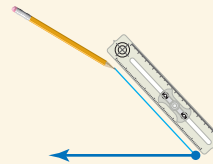**13.** 180°   **14.** 90°

Estimate the measure of each angle.

15.   **16.**

Example 2 Use a protractor and a straightedge to draw a 47° angle.

Draw one side of the angle. Align the center of the protractor and the 0° with the line. Find 47°. Make a mark.

Draw the other side of the angle.
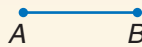
13-3 Bisectors (pp. 515–517)

Draw each line segment or angle having the given measure. Then use a straightedge and a compass to bisect the line segment or angle.

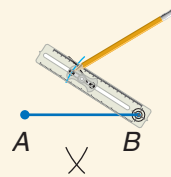**17.** 2 cm   **18.** 2 in.
19. 100°   **20.** 65°

21. TOOLS A rake is shown. Identify the segment that bisects ∠CXD.
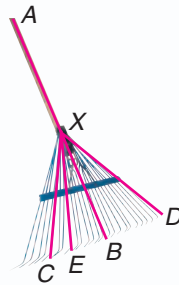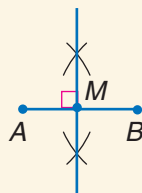
Example 3 Use a straightedge and a compass to bisect $\overline{AB}$.

Draw the segment.

$A \qquad B$

Place the compass at A. Using a setting greater than one half the length of $\overline{AB}$, draw two arcs as shown. Using the same setting, place the compass at B. Draw two arcs as shown.
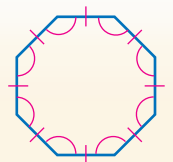
Use a straightedge to align the intersections. Draw a segment that intersects $\overline{AB}$. Label the intersection.

13-4 Two-Dimensional Figures (pp. 522–525)

Identify each polygon. Then tell if it is a regular polygon.

22.   **23.**
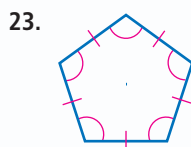
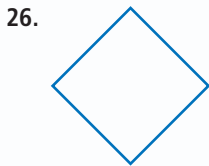**Example 4** Identify the polygon shown. Then tell if the polygon is a regular polygon.

The polygon has eight sides. So, it is an octagon. Since the sides and angles are congruent, it is a regular polygon.

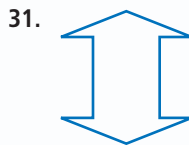**13-5** **Lines of Symmetry** (pp. 528–531)

Trace each figure. Then draw all lines of symmetry.

24.

25.

26.

27.

Tell whether each figure has rotational symmetry. Write *yes* or *no*.
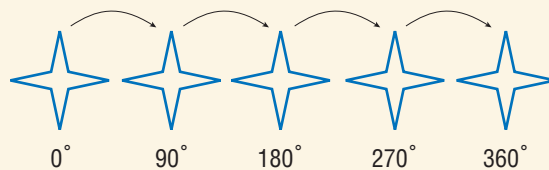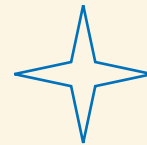
28.

29.

30.

31.

Example 5 Draw all lines of symmetry for the figure shown.
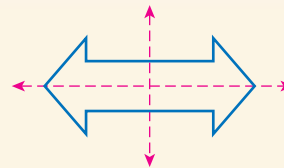
This figure has 2 lines of symmetry.

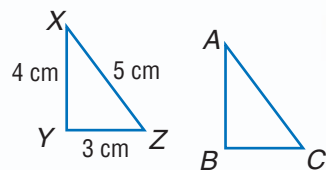**Example 6** Tell whether the figure shown has rotational symmetry.

0°   90°   180°   270°   360°

When the figure is rotated less than 360°, it looks as it did before it was rotated. So, the figure has rotational symmetry.

13-6 **Similar and Congruent Figures** (pp. 534–536)

The triangles shown are congruent.

X 4 cm 5 cm *A*
Y 3 cm *Z* *B* *C*

32. What side of △*XYZ* corresponds to side $\overline{AC}$?

33. Find the measure of $\overline{CB}$.

34. Tell whether the pair of figures shown at the right is *congruent*, *similar*, or *neither*.

Example 7 The figures shown are congruent. What side of quadrilateral *RSTU* corresponds to $\overline{MN}$?

M *N* *P* *O* *R* *S* *U* *T*
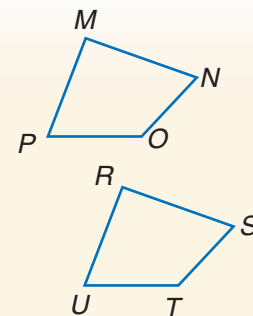
The parts of congruent figures that match are corresponding parts. In the figures, $\overline{RS}$ corresponds to $\overline{MN}$.

CONTENTS

Practice Test

Vocabulary and Concepts

1. **Define** *polygon*.
2. **Explain** the difference between similar figure and congruent figures.

Skills and Applications

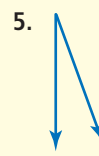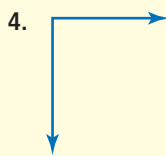**Use a protractor to find the measure of each angle. Then classify each angle as *acute, obtuse, right,* or *straight*.**

3.

4.

5.

6. **ALGEBRA** Angles G and H are complementary angles. If $m\angle G = 37°$, find $m\angle H$.

Use a protractor and a straightedge to draw angles having the following measurements.

7. $25°$

8. $135°$

9. Draw a line segment that measures 4 centimeters. Then use a straightedge and a compass to bisect the line segment.

Identify each polygon. Then tell if it is a regular polygon.

10.

11.

12.
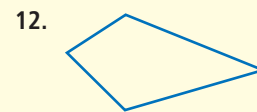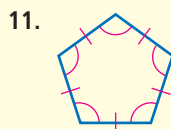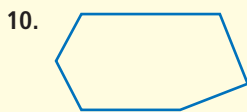
13. **SAFETY** The traffic sign shown warns motorists of a slow-moving vehicle. How many lines of symmetry does the sign have?

Tell whether each pair of figures is *congruent, similar,* or *neither*.

14.

15.
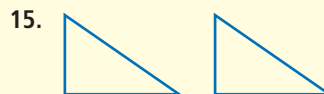
Standardized Test Practice

16. **SHORT RESPONSE** Triangle DEF and $\triangle MNP$ are congruent triangles. What is the perimeter of $\triangle MNP$?

D, 6 ft, 10 ft, E, 8 ft, F, N, P, M

CONTENTS

PART 1 Multiple Choice

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

1. Justin buys 5 balloons and a pack of gum. Theo buys 7 balloons. Which expression could be used to find the total amount they spent? (Lesson 4-1)

Item	Cost
Balloon	$0.10
Pack of gum	$0.25

 Ⓐ $0.10(5 + 7) + $0.25

 Ⓑ $0.10 + (5)(7) + $0.25

 Ⓒ $0.10(5) + $0.25(7)

 Ⓓ ($0.10 + $0.25)(5 + 7)

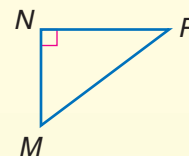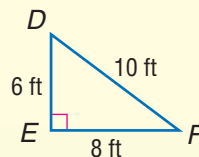2. Find $6\frac{5}{6} - 2\frac{1}{3}$. (Lesson 6-5)

 Ⓕ $3\frac{5}{6}$ Ⓖ $4\frac{5}{18}$

 Ⓗ $4\frac{1}{2}$ Ⓘ $4\frac{2}{3}$

3. Which fraction comes next in the pattern below? (Lesson 7-6)

$$\frac{405}{243}, \frac{135}{81}, \frac{45}{27}, \frac{15}{9}, ?$$

 Ⓐ $\frac{5}{3}$ Ⓑ $\frac{6}{3}$

 Ⓒ $\frac{8}{3}$ Ⓓ $\frac{15}{4}$

4. What type of figure is formed if the points at $(-2, 2)$, $(2, 2)$, $(0, -2)$, $(-4, -2)$, and $(-2, 2)$ are connected in order? (Lesson 8-6)

 Ⓕ triangle

 Ⓖ pentagon

 Ⓗ trapezoid

 Ⓘ parallelogram

5. Which ratio compares the shaded part of the rectangle to the part that is not shaded? (Lesson 10-1)

 Ⓐ $\frac{2}{5}$ Ⓑ $\frac{4}{5}$ Ⓒ $\frac{4}{10}$ Ⓓ $\frac{2}{3}$

6. The table shows the contents of two bags containing red and blue gumballs. If one gumball is taken from each bag, find the probability that two red gumballs are taken. (Lesson 11-5)

 Ⓕ $\frac{1}{8}$ Ⓖ $\frac{1}{4}$

 Ⓗ $\frac{3}{8}$ Ⓘ $\frac{3}{5}$

Bag	Red	Blue
1st	2	2
2nd	1	3

7. Which line is a line of symmetry in the figure? (Lesson 13-5)
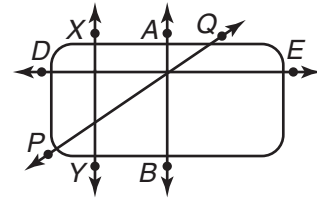
 Ⓐ $\overleftrightarrow{PQ}$ Ⓑ $\overleftrightarrow{DE}$ Ⓒ $\overleftrightarrow{AB}$ Ⓓ $\overleftrightarrow{XY}$

8. Which triangle appears to be congruent to $\triangle NOP$? (Lesson 13-6)

 Ⓕ   Ⓖ

 Ⓗ   Ⓘ
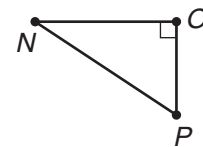
TEST-TAKING TIP

Question 7 To check that you have chosen the correct line of symmetry, pretend that the line is a fold in the page. The images on each side of the fold should be identical.

CONTENTS

PART 2   Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a piece of paper.
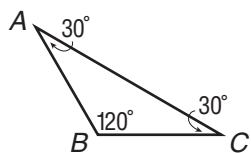
9. Write $\frac{75}{100}$ as a decimal. **(Lesson 5-7)**

10. What is the value of $-81 \div (-3)$? **(Lesson 8-5)**

11. Refer to the table. What is the function rule for these x- and y-values? **(Lesson 9-6)**

| x	0	1	2	3	4
y	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2

12. A zookeeper wants to weigh a donkey. What is the most appropriate metric unit for the zookeeper to use when measuring the mass of the donkey? **(Lesson 12-4)**

13. What types of angles are in $\triangle ABC$? **(Lesson 13-1)**

14. Draw a pair of angles that are complementary. **(Lesson 13-1)**

15. The shaded area below represents the students in the sixth grade who like jazz music. Is the measure of the angle of the shaded area closer to 30° or 60°? **(Lesson 13-2)**

Sixth Graders Who Like Jazz
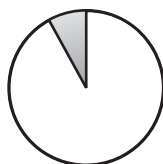
16. What is the name for a 6-sided polygon? **(Lesson 13-4)**

17. Which two-dimensional shape makes up the surface of the box shown below? **(Lesson 13-4)**

18. How many lines of symmetry does the leaf have? **(Lesson 13-5)**

PART 3   Extended Response

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

19. Kelsey is designing a decorative border for her bedroom. The design will repeat and is made up of different geometric shapes.

  a. The first figure she draws meets the following criteria.

  - a polygon
  - has exactly 2 lines of symmetry
  - not a quadrilateral

  Draw a possible figure. **(Lesson 13-5)**

  b. The next figure drawn meets the criteria listed below.

  - a polygon
  - no lines of symmetry
  - has an obtuse angle

  Draw the possible figure. **(Lesson 13-5)**

  c. The characteristics of the third figure drawn are listed below.

  - two similar polygons
  - one positioned inside the other

  Draw the possible figure. **(Lesson 13-6)**