

13-1

Angles (pages 506–509)

The lines that form the **edges** of a box meet at a point called the **vertex**. Two lines that meet at a vertex form an **angle**. Angles are measured in **degrees**, or parts of a circle. A circle contains 360 degrees. You can measure the degrees in an angle with a **protractor**.

Classifying Angles	<ul style="list-style-type: none"> • Acute angles measure between 0° and 90°. • Obtuse angles measure between 90° and 180°. • Right angles measure 90°. • Complementary angles are two angles whose measures add to 90°. • Supplementary angles are two angles whose measures add to 180°.
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EXAMPLES

A An angle measures 179° .
Is it acute, right, or obtuse?
This angle measures between 90° and 180° , so it is obtuse.

B Angles F and G are complementary angles. Find $m\angle G$ if $m\angle F$ is 31° .
 $m\angle G + m\angle F = 90^\circ$
 $m\angle G + 31^\circ = 90^\circ$
 $m\angle G = 59^\circ \quad 59 + 31 = 90$

Try These Together

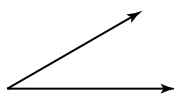
1. An angle measures 29° . Is it acute, right, or obtuse?
HINT: Is 29° less than 90° ?

2. Angles K and L are supplementary angles. Find $m\angle K$ if $m\angle L$ is 42° .
HINT: What is the sum of $m\angle K$ and $m\angle L$?

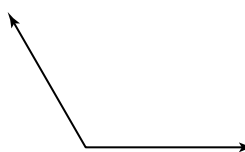
PRACTICE

Use a protractor to find the measure of each angle.

3.



4.



Classify each angle measure as acute, right, or obtuse.

5. 45°

6. 100°

7. 90°

8. 20°

9. **Architecture** An architect is designing a building. A corner in a hallway has an angle that measures 135° . Is the angle *acute*, *right*, or *obtuse*?



10. **Standardized Test Practice** Angle P and angle Q are complementary. Find $m\angle P$ if $m\angle Q$ is 45° .

A 55°

B 45°

C 135°

D 145°

Answers: 1. acute 2. 138° 3. 30° 4. 120° 5. acute 6. obtuse 7. right 8. acute 9. obtuse 10. B

13-2

Using Angle Measures (pages 510–512)

You can use a protractor and a **straightedge**—a ruler or any object with a straight side—to draw an angle with a measure of a certain number of degrees. You can also estimate the measure of an angle.

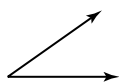
Estimating the Measure of an Angle	Estimate the measure of an angle by comparing it to a right angle (90°), half of a right angle (45°), one third of a right angle (30°), or two thirds of a right angle (60°). You can also compare an angle to a straight angle (180°).
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EXAMPLES

A Use two pencils to show an angle of about 35° .

Think: How does 35° compare to 90° ?

Hold the pencils to show an angle a little more than one third of a right angle and a little less than half of a right angle.



B Is this angle greater than, less than, or about equal to 125° ?



The angle shown is just a little less than 180° so it is greater than 125° .

Try These Together

1. Use a straightedge to draw an angle that you estimate to be about 22° .

HINT: What is half of 45° ?

2. Use a straightedge to draw an angle that you estimate to be about 135° .

HINT: Notice that 135° is 90° plus 45° .

PRACTICE

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

3. 80°

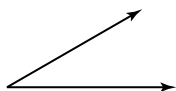
4. 145°

5. 45°

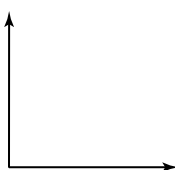
6. 110°

Estimate the measure of each angle.

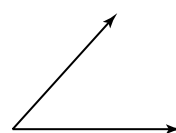
7.



8.



9.



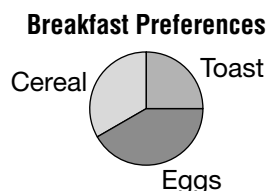
10. Standardized Test Practice The circle graph shows what people prefer to eat for breakfast. Which of the following shows the order of breakfasts from most-preferred to least-preferred?

A eggs, toast, cereal

B cereal, eggs, toast

C toast, eggs, cereal

D eggs, cereal, toast



Answers: 1–2. Use a protractor to see how close your estimates are. **3–6.** See Answer Key. **7–9.** Sample answers are given. **7.** about 30° **8.** about 90° **9.** about 45° **10.** D

13-3

Bisectors (pages 515–517)

When you **bisect** a geometric figure, you divide it into two congruent parts. A line segment is the **perpendicular bisector** of another line segment when it bisects the segment at a right angle. You can use a straightedge and a compass to bisect a line segment or an angle.

Constructing Bisectors	<ul style="list-style-type: none"> From each end of a line segment, use the same compass setting to draw arcs above and below the line segment. Join the points where the arcs intersect to draw the perpendicular bisector of the segment. From the vertex of an angle, draw an arc that intersects the sides of the angle. From these two points of intersection, draw equal arcs inside the angle. Join the points where the arcs intersect to the vertex to make a ray that bisects the angle.
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EXAMPLES

A When you draw a ray to bisect an angle of 56° , what is the measure of each angle formed?

Bisect means to divide into two equal parts, so each angle is one half of 56° , or 28° .

B When you draw the ray that bisects a right angle, are the two angles that result supplementary or complementary?

Since the two angles total 90° , they are complementary.

Try These Together

1. Draw a rectangle that is *not* a square. Draw the two diagonals that connect the opposite corners. Do the diagonals appear to bisect each other?

HINT: For each diagonal, compare the lengths of the two parts formed by the point where the diagonals intersect.

2. Draw a rectangle that is *not* a square. Draw the two diagonals that connect the opposite corners. Is one diagonal the perpendicular bisector of the other?

HINT: Measure the angles formed where the diagonals intersect to see if they are 90° .

PRACTICE

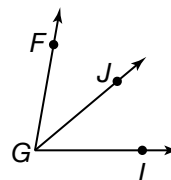
Draw each line segment or angle having the given measurement. Then use a straightedge and a compass to bisect the line segment or angle.

3. 90° 4. 4 cm 5. 68° 6. 3 in. 7. 124°



8. Standardized Test Practice Angle FGI has been bisected by \overrightarrow{GJ} . If $m\angle FGI$ is 80° , what is the measure of each angle formed ($\angle FGJ$ and $\angle JGI$)?

- A** 60° **B** 30° **C** 50° **D** 40°



Answers: 1. yes 2. no 3–7. See Answer Key. 8. D


13-4

Two-Dimensional Figures (pages 522–525)

A polygon with all the sides and angles congruent is called a **regular polygon**. A regular triangle (3 sides) is also called an **equilateral triangle**. In a regular quadrilateral (4 sides), also called a square, the opposite sides are **parallel**. Parallel lines will never meet, no matter how far they are extended.

Identifying Polygons	A triangle has 3 sides.	A quadrilateral has 4 sides.
	A pentagon has 5 sides.	A hexagon has 6 sides.
	An octagon has 8 sides.	A decagon has 10 sides.

EXAMPLES

A Is this figure a quadrilateral?
Is it a parallelogram? 

Yes, it has 4 sides so it is a quadrilateral. Yes, the opposite sides are parallel, so it is a parallelogram.

B In the figure for Example A, are all the angles congruent? Are the sides? Is this figure a regular polygon?

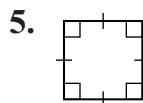
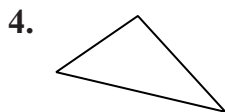
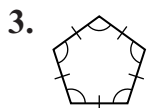
Yes, all the angles are right angles so they are congruent. No, the length is greater than the width, so the sides are not congruent and it is not a regular polygon.

Try These Together


- How many congruent angles does a regular decagon have?
HINT: What does “regular” mean? How many sides does a decagon have? Think of the word “decimal” to help you remember the sides of a “decagon.”
- What do you know about a figure if you know that it is a regular hexagon?
HINT: How many sides does it have? What is true of all the sides and all the angles?

PRACTICE

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



6. How many sides does a regular octagon have?

 **7. Standardized Test Practice** Embry’s father is building a storage shed in their backyard. The floor will be the shape of a square. If the perimeter of the floor is 40 feet, how long is each side?

- A** 20 feet **B** 15 feet **C** 10 feet **D** 30 feet

Answers: 1. 10 2. It has 6 congruent sides and 6 congruent angles. 3. pentagon; regular 4. triangle; not regular 5. square; regular 6. 8 7. C

13-5

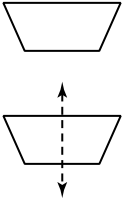
Lines of Symmetry (pages 528–531)

When a figure has a **line of symmetry** (or more than one), you can fold the figure along this line so that the two halves match. Figures that can be turned or rotated less than 360° about a fixed point and still look exactly the same have **rotational symmetry**.

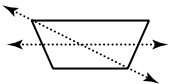
Finding Lines of Symmetry	To look for lines of symmetry, imagine folding the figure in half vertically, horizontally, and diagonally. When the two halves match exactly, then the fold line is a line of symmetry.
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EXAMPLES

A Draw a line of symmetry for the figure at the right.
Think about folding the figure along a line to see if the two halves match.



B Does the figure in Example A have more than one line of symmetry?
No. If you draw a diagonal and fold the figure along it, the two halves do not match. The same is true for a line halfway up the figure.



Try These Together

<p>1. How many lines of symmetry does an equilateral triangle have? <i>HINT: Sketch the triangle and think about folding it.</i></p>	<p>2. Do a rectangle (that is not a square) and a square have the same number of lines of symmetry? <i>HINT: Look at the diagonals to see if they are lines of symmetry.</i></p>
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PRACTICE

Draw all lines of symmetry in each figure.


3.  4.  5.  6. 

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

7.  8. 

 **9. Standardized Test Practice** How many lines of symmetry does this shell have?

A 1 **B** 2 **C** 3 **D** 4



Answers: 1. 3 2. no 3-6. See Answer Key. 7. no 8. yes 9. A

13-6

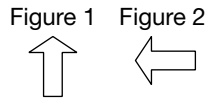
Similar and Congruent Figures (pages 534–536)

You can compare figures that look alike in two different ways.

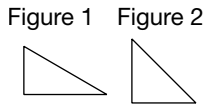
Comparing Figures for Size and Shape	Two figures that have the same shape and angles but are different in size are called similar figures . Figures that are exactly the same size and shape are called congruent figures .
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EXAMPLES

A Is Figure 1 similar or congruent to Figure 2?
 Although the two figures are turned differently, they are exactly the same size and shape, so they are congruent figures.

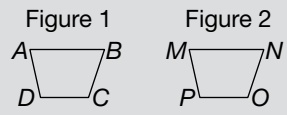


B Is Figure 1 similar or congruent to Figure 2?
 Although the figures are both right triangles, they are not the same size and they are not the same shape, so they are neither similar nor congruent.



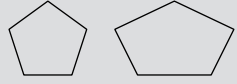
Try These Together

1. Figure 1 is congruent to Figure 2. Which side of Figure 1 corresponds to side \overline{MN} of Figure 2?



HINT: Find the side that is in the matching position.

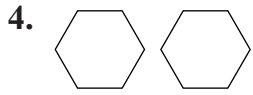
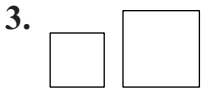
2. Is this pair of polygons congruent, similar, or neither?



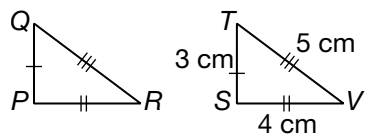
HINT: Are the figures the same shape? Are they the same size? Are the corresponding angles equal?

PRACTICE

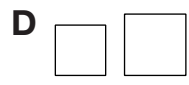
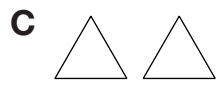
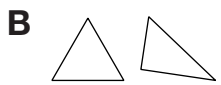
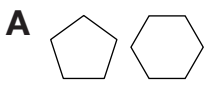
Tell whether each pair of figures is congruent, similar, or neither.



5. $\triangle PQR$ is congruent to $\triangle STV$.
 a. What side corresponds to side \overline{TV} ?
 b. What is the measure of side \overline{PR} ?



6. **Standardized Test Practice** Which two figures are congruent?



Answers: 1. \overline{AB} 2. neither 3. similar 4. congruent 5a. \overline{QR} 5b. 4 cm 6. C

