7.4 Quadrilaterals

**Essential Question** How can you classify quadrilaterals?

Quad means *four* and *lateral* means *side*. So, *quadrilateral* means a polygon with *four* sides.

<table>
<thead>
<tr>
<th>Quadrilaterals</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Quadrilateral Images]</td>
</tr>
</tbody>
</table>

**ACTIVITY: Using Descriptions to Form Quadrilaterals**

Work with a partner. Use a geoboard to form a quadrilateral that fits the given description. Record your results on geoboard dot paper.

a. Form a quadrilateral with exactly one pair of parallel sides.

![Geoboard Quadrilateral] (The top and bottom sides are parallel.)

b. Form a quadrilateral with four congruent sides and four right angles.

c. Form a quadrilateral with four right angles that is *not* a square.

d. Form a quadrilateral with four congruent sides that is *not* a square.

e. Form a quadrilateral with two pairs of congruent adjacent sides and whose opposite sides are *not* congruent.

f. Form a quadrilateral with congruent and parallel opposite sides that is *not* a rectangle.

**ACTIVITY: Naming Quadrilaterals**

Work with a partner. Match the names *square, rectangle, rhombus, parallelogram, trapezoid, and kite* with your 6 drawings in Activity 1.

Geometry

In this lesson, you will

- understand that the sum of the angle measures of any quadrilateral is 360°.
- find missing angle measures in quadrilaterals.
- construct quadrilaterals.
**ACTIVITY: Forming Quadrilaterals**

Work with a partner. Form each quadrilateral on your geoboard. Then move only one vertex to create the new type of quadrilateral. Record your results on geoboard dot paper.

a. Trapezoid ➔ Kite

b. Kite ➔ Rhombus (*not* a square)

**ACTIVITY: Using Technology to Draw Quadrilaterals**

Work with a partner. Use geometry software to draw a quadrilateral that fits the given description.

a. a square with a side length of 3 units
b. a rectangle with a width of 2 units and a length of 5 units
c. a parallelogram with side lengths of 6 units and 1 unit
d. a rhombus with a side length of 4 units

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**What Is Your Answer?**

5. **REASONING** Measure the angles of each quadrilateral you formed in Activity 1. Record your results in a table. Include the sum of the angle measures. Then describe the pattern in the table and write a conclusion based on the pattern.

6. **IN YOUR OWN WORDS** How can you classify quadrilaterals? Explain using properties of sides and angles.

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**Practice**

Use what you learned about quadrilaterals to complete Exercises 4–6 on page 296.
A quadrilateral is a polygon with four sides. The diagram shows properties of different types of quadrilaterals and how they are related. When identifying a quadrilateral, use the name that is most specific.

**EXAMPLE 1**  
Classifying Quadrilaterals

**Study Tip**  
In Example 1(a), the square is also a parallelogram, a rectangle, and a rhombus. Square is the most specific name.

**Classify the quadrilateral.**

**a.**

The quadrilateral has four congruent sides and four right angles.  
So, the quadrilateral is a square.

**b.**

The quadrilateral has two pairs of congruent adjacent sides and opposite sides that are not congruent.  
So, the quadrilateral is a kite.

**On Your Own**

Classify the quadrilateral.

1.  
2.  
3.
Key Idea

Sum of the Angle Measures of a Quadrilateral

Words  The sum of the angle measures of a quadrilateral is 360°.

Algebra  \( w + x + y + z = 360 \)

Example 2 Finding an Angle Measure of a Quadrilateral

Find the value of \( x \).

\[
70 + 75 + 115 + x = 360
\]

Write an equation.

\[
260 + x = 360
\]

Combine like terms.

\[
-260 - 260
\]

Subtraction Property of Equality

\[
x = 100
\]

Simplify.

The value of \( x \) is 100.

Example 3 Constructing a Quadrilateral

Draw a parallelogram with a 60° angle and a 120° angle.

Step 1: Draw a line.

Step 2: Draw a 60° angle and a 120° angle that each have one side on the line.

Step 3: Draw the remaining side. Make sure that both pairs of opposite sides are parallel and congruent.

On Your Own

Find the value of \( x \).

4. \[
100^\circ + 80^\circ + x^\circ = 360^\circ
\]

5. \[
81^\circ + 124^\circ + x^\circ = 360^\circ
\]

6. Draw a right trapezoid whose parallel sides have lengths of 3 centimeters and 5 centimeters.

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7.4 Exercises

**Vocabulary and Concept Check**

1. **VOCABULARY** Which statements are true?
   
   a. All squares are rectangles.  
   b. All squares are parallelograms.  
   c. All rectangles are parallelograms.  
   d. All squares are rhombuses.  
   e. All rhombuses are parallelograms.

2. **REASONING** Name two types of quadrilaterals with four right angles.

3. **WHICH ONE DOESN’T BELONG?** Which type of quadrilateral does not belong with the other three? Explain your reasoning.
   - rectangle
   - parallelogram
   - square
   - kite

**Practice and Problem Solving**

Classify the quadrilateral.

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

Find the value of $x$.

10.  
11.  
12.  

13. **KITE MAKING** What is the measure of the angle at the tail end of the kite?

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Draw a quadrilateral with the given description.

14. a trapezoid with a pair of congruent, nonparallel sides
15. a rhombus with 3-centimeter sides and two 100° angles
16. a parallelogram with a 45° angle and a 135° angle
17. a parallelogram with a 75° angle and a 4-centimeter side

Copy and complete using always, sometimes, or never.

18. A square is ? a rectangle.
19. A square is ? a rhombus.
20. A rhombus is ? a square.
21. A parallelogram is ? a trapezoid.
22. A trapezoid is ? a kite.
23. A rhombus is ? a rectangle.

24. **DOOR** The dashed line shows how you cut the bottom of a rectangular door so it opens more easily.
   a. Identify the new shape of the door. Explain.
   b. What is the new angle at the bottom left side of the door? Explain.

25. **VENN DIAGRAM** The diagram shows that some quadrilaterals are trapezoids, and all trapezoids are quadrilaterals. Copy the diagram. Fill in the names of the types of quadrilaterals to show their relationships.

26. **Structure** Consider the parallelogram.
   a. Find the values of $x$ and $y$.
   b. Make a conjecture about opposite angles in a parallelogram.
   c. In polygons, consecutive interior angles share a common side. Make a conjecture about consecutive interior angles in a parallelogram.

27. Write the ratio as a fraction in simplest form. *(Section 5.1)*
   27. 3 turnovers : 12 assists
   28. 18 girls to 27 boys
   29. 42 pens : 35 pencils
   30. **MULTIPLE CHOICE** Computer sales decreased from 40 to 32. What is the percent of decrease? *(Section 6.5)*

   A 8%  B 20%  C 25%  D 80%