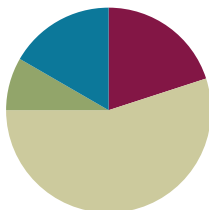# Lesson 15

Objective: Classify quadrilaterals based on parallel and perpendicular lines and the presence or absence of angles of a specified size.

Suggested Lesson Structure

■ Fluency Practice   (12 minutes)
■ Application Problem   (5 minutes)
■ Concept Development   (33 minutes)
■ Student Debrief   (10 minutes)
   Total Time   **(60 minutes)**

Fluency Practice (12 minutes)

▪ Add and Subtract **4.NBT.4**   (4 minutes)
▪ Classify the Triangle **4.G.2**   (3 minutes)
▪ Find the Unknown Angle **4.MD.5**   (5 minutes)

Add and Subtract (4 minutes)

Materials: (S) Personal white boards

Note: This concept reviews the year-long Grade 4 fluency standard for adding and subtracting using the standard algorithm.

   T: (Write 543 thousands 178 ones.) On your boards, write this number in standard form.

   S: (Write 543,178.)

   T: (Write 134 thousands 153 ones.) Add this number to 543,178 using the standard algorithm.

   S: (Write 543,178 + 134,153 = 677,331 using the standard algorithm.)

Continue the process for 481,737 + 253,675.

   T: (Write 817 thousands 560 ones.) On your boards, write this number in standard form.

   S: (Write 817,560.)

   T: (Write 426 thousands 145 ones.) Subtract this number from 817,560 using the standard algorithm.

   S: (Write 817,560 – 426,145 = 391,415 using the standard algorithm.)

Continue the process for 673,172 – 143,818 and 600,000 – 426,521.

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Classify the Triangle (3 minutes)

Materials: (S) Personal white boards

Note: This fluency reviews G4–M4–Lesson 13.

- T: (Project triangle.) Is the triangle equilateral, scalene, or isosceles?
- S: Equilateral.
- T: Why?
- S: Because all the sides and angles are the same.
- T: Is it acute, right, or obtuse?
- S: Acute.
- T: Why?
- S: Because all the angles are less than 90°.
- T: (Project triangle.) Say the measure of the largest angle.
- S: 130°.
- T: Is the triangle equilateral, scalene, or isosceles?
- S: Scalene.
- T: Why?
- S: Because all the sides are different.
- T: Is the triangle acute, right, or obtuse?
- S: Obtuse.
- T: Why?
- S: Because it has an angle greater than 90°.
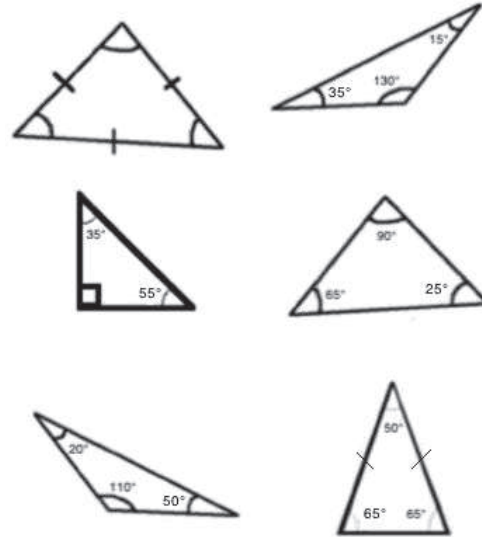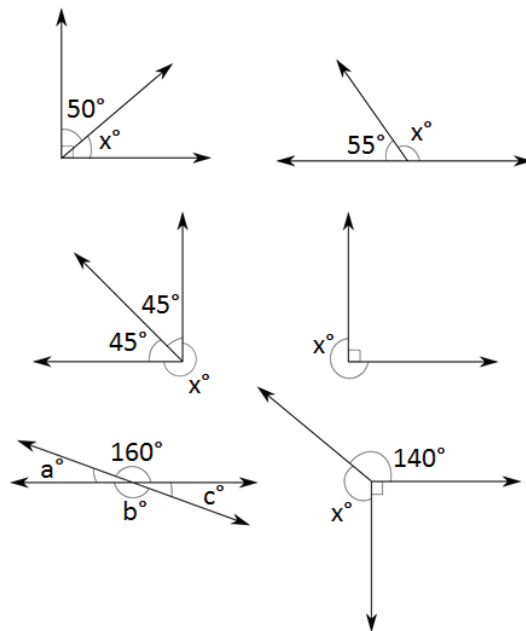
Continue the process for the other triangles.

Find the Unknown Angle (5 minutes)

Materials: (S) Personal white boards

Note: This fluency reviews G4–M4–Lesson 10.

- T: (Project first unknown angle problem. Run finger over the larger angle.) This is a right angle. On your boards, write a number sentence to find the measure of $\angle x$.
- S: (Write $90 - 50 = x$. Below it, write $x° = 40°$.)

Continue with the remaining unknown angle problems.

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Application Problem (5 minutes)

a. On grid paper, draw two perpendicular line segments, each measuring 4 units, which extend from a point V. Identify the segments as $\overline{SV}$ and $\overline{UV}$. Draw $\overline{SU}$. What did you construct? Classify it.
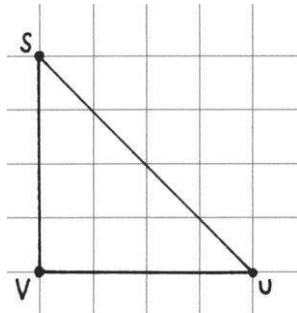
I constructed a triangle — ∆SUV.
It is a right and isosceles triangle.

b. Imagine $\overline{SU}$ is a line of symmetry. Construct the other half of the figure. What figure did you construct? How can you tell?
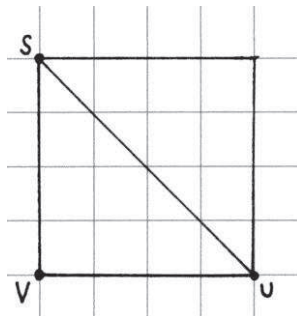
This is a square. I know because each side is 4 units long and it has 4 right angles.

Note: This Application Problem reviews segments and points from G4–M4–Lesson 1, perpendicular lines from G4–M4–Lesson 3, lines of symmetry from G4–M4–Lesson 12, classifying triangles from G4–M4–Lesson 13, and constructing triangles from G4–M4–Lesson 14. It also links knowledge of the attributes of a square from previous grades, bridging to this lesson's objective of classifying quadrilaterals.

Concept Development (33 minutes)

Materials: (T) Problem Set, ruler, right angle template
(S) Problem Set, ruler, right angle template

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Provide alternatives to constructing polygons with pencil and paper to students working below grade level and others. For example, tactile learners may use geoboards, while others may benefit from using a virtual geoboard, such as that found at the following link (which can be enlarged and made tactile using a Smart Board):

http://www.mathplayground.com/geoboard.html

Alternatively, you may provide grid paper to ease the task of drawing.

Problem 1: Construct and define trapezoids.

> T: What do you know about quadrilaterals?
>
> S: They have four straight sides. → They can be shapes like a square or a rectangle.
>
> T: Use your Problem Set, Problem 1 to construct a quadrilateral with at least one set of parallel sides.
>
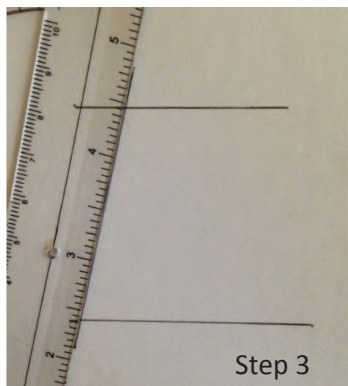> > Step 1. Draw a straight, horizontal segment.
> >
> > Step 2. Use your right angle template and ruler to draw a segment parallel to that segment.
> >
> > Step 3. Draw a third segment that crosses both.
> >
> > Step 4. Draw a fourth different segment that crosses both but does not cross the third segment.

MP.5
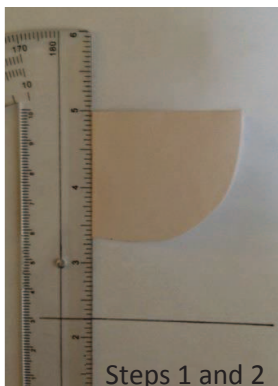
Steps 1 and 2   Step 3   Step 4
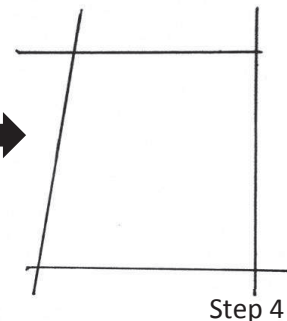
> T: Compare your quadrilateral with your group looking at angle size and side length.
>
> S: The sides of mine are all different lengths. → Mine has two obtuse angles and two acute angles. → Mine looks more like a rectangle. → Mine has two right angles, an acute angle, and an obtuse angle. → Mine has angles of different sizes. One set of opposite sides look equal. → Yes, but we all have shapes with one set of parallel sides.
>
> T: All of our quadrilaterals have at least one set of parallel sides, which means all of our quadrilaterals are trapezoids. However, some of your trapezoids might have other familiar names, like *rectangle*.
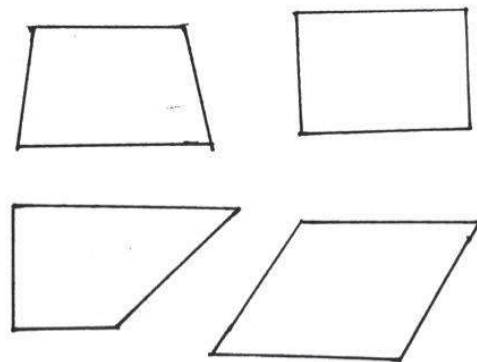
Other possible trapezoids

Be sure that the students identify the pair of parallel sides in a square, a rectangle, a non rectilinear parallelogram, and rhombus.

> T: Construct two more trapezoids for Problem 1. Ask your partners for suggestions on how they constructed their trapezoids as you construct a new one.

Allow time for students to construct two more trapezoids.

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Problem 2: Construct and define parallelograms.

T: Under Problem 2, let's construct a quadrilateral with two sets of parallel sides. Start by drawing one set of parallel segments, the same way you did in Problem 1.

1.   Draw a straight, horizontal segment.
2.   Use your right angle template and ruler to draw a segment parallel to that segment.
3.   Draw a third segment that crosses both.
4.   Draw a fourth different segment that is parallel to the third segment using your ruler and right angle template that crosses the first two segments.
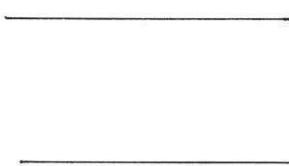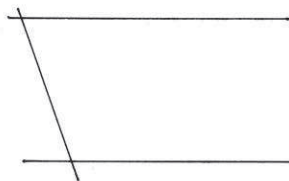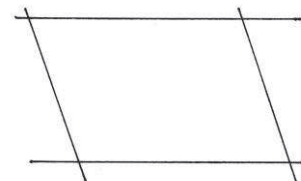
|		
Steps 1 and 2	Step 3	Step 4

T: Verify both sets of lines are parallel. Compare your quadrilateral with your group.

Students discuss similar and contrasting features of their figures.

T: Are all of these shapes drawn in Problem 2 trapezoids?

S: They don't look like the trapezoid I drew. → Yeah, this one looks like mine from Problem 1. → A trapezoid has to have at least one set of parallel sides. Mine has two! → So these must be trapezoids if they all have one pair of parallel sides.

T: All of the trapezoids we constructed for Problem 2 have two sets of parallel sides. We call quadrilaterals with two pairs of parallel sides parallelograms. Again, I see some figures that I might give another name too, but all of the shapes we've constructed are parallelograms. Record the word *parallelogram* for Problem 2. Construct two more parallelograms for Problem 2. Ask your partners for suggestions on how they constructed their parallelograms, or construct a new one.
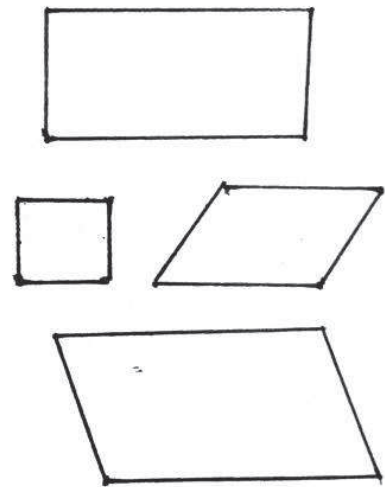
Other possible parallelograms

T: Did anyone draw the same quadrilateral in Problem 1 and in Problem 2?

S: Yes, I drew a parallelogram in Problem 1. So a parallelogram has two names?

T: A trapezoid must have at least one set of parallel sides. A parallelogram is a special trapezoid. It has two sets of parallel sides. To be specific, we call the quadrilaterals in Problem 2 parallelograms.

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Problem 3: Construct and define rectangles.

T: For Problem 3 we need to make a parallelogram with four right angles. What do we call two lines that intersect at a right angle?

S: Perpendicular lines.

T: (Guide students through the process of drawing the parallelogram.)

Step 1.   Draw a straight, horizontal segment.

Step 2.   Use your right angle template and ruler to draw a segment parallel to that segment.

Step 3.   Draw a third segment with a right angle, perpendicular to the base line.

Step 4.   Draw a fourth segment that is also perpendicular to the first segment.
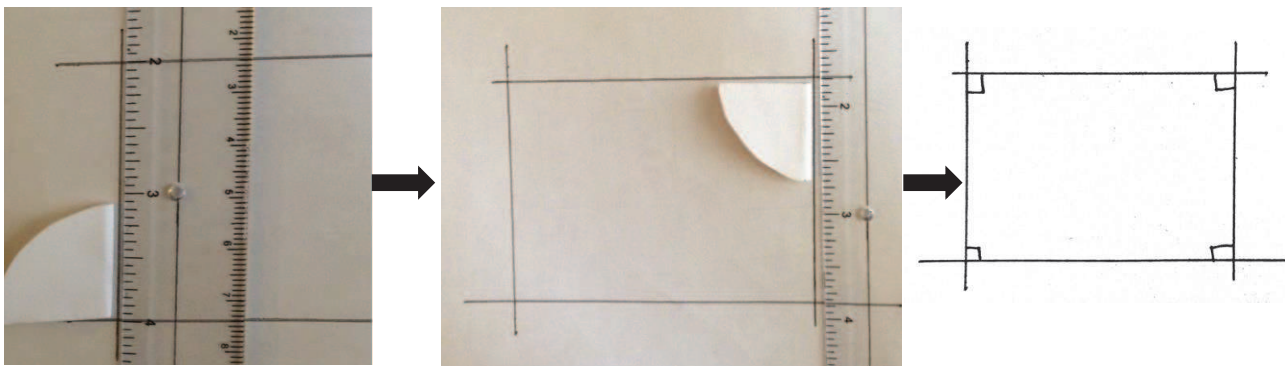
Steps 1,2, and 3

Step 4

T: Compare your quadrilateral with those of your group looking at angle measure and side length.

S: The fourth segment is parallel to the third one. → It has two sets of parallel sides. That means it is a parallelogram. → Mine has four right angles. → The opposite sides are the same length. → It looks like a rectangle. → Mine looks like a square.

T: These quadrilaterals all have two sets of parallel sides, so they are parallelograms and trapezoids. However, our figures have another special attribute--four right angles, so they are also rectangles.

T: Construct two more rectangles for Problem 3. (A square is a special rectangle so at least one should be evidenced in the examples.)

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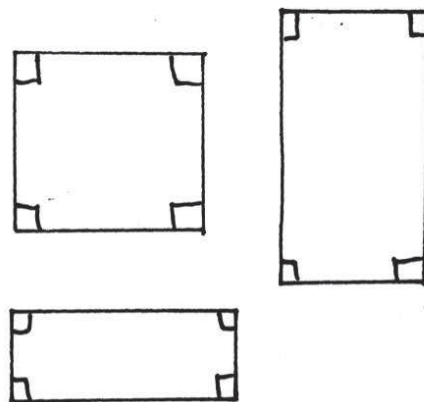
Problem 4: Construct and define squares.

T: Problem 4 requires us to draw a rectangle with sides that are all the same length. Discuss with your group how you might do that.

S: Draw each side the same length. → We can draw the parallel sides, then 1 of the perpendicular sides. Then we will have to measure some sides.

T: (Guide students through the process of drawing the rectangle.)

1. Draw a straight, horizontal segment.

2. Use your right angle template and ruler to draw a segment parallel to that segment.

3. Draw a third segment with a right angle, perpendicular to the base line.

4. Measure the length of the third side and mark the same length on both the first segments. Start the measurement at the third side.

5. Draw a fourth segment perpendicular to the first segment through those marks.

> **NOTES ON MULTIPLE MEANS OF REPRESENTATION:**
>
> Support math language acquisition for English language learners and others. Post on the word wall and have students add to their personal math dictionaries *quadrilateral, parallelogram,* and *trapezoid* and corresponding pictures. Guide student connections amongst the quadrilaterals using graphic organizers, such as a Venn Diagram. Teach the etymology or meaningful word parts, if helpful. Offer or facilitate student-made mnemonic devices. Challenge students working above grade level to research connections between similar words, such as *trapeze* and *trapezoid,* and *quarter* and *quadrilateral.*
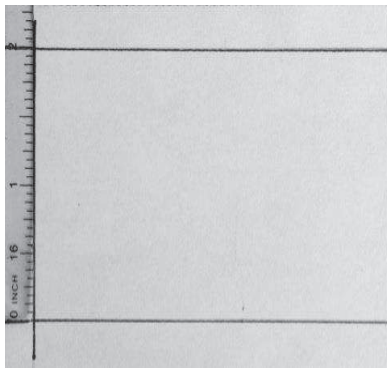
Steps 1, 2, and 3
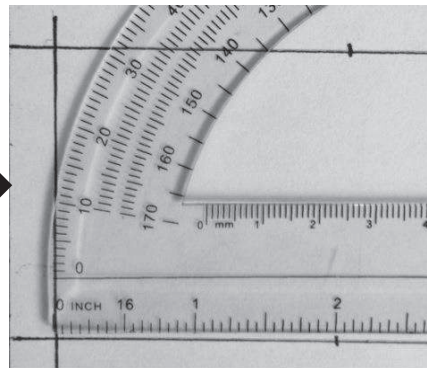
Step 4
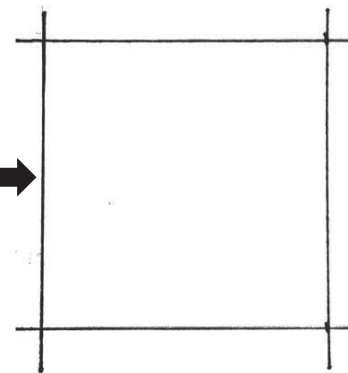
Step 5

S: We made a square!

T: Yes, a square is a special rectangle and has all sides the same length. Construct two more squares.

S: If a square is a rectangle, then a square can also be a parallelogram. → And a trapezoid!

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Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Classify quadrilaterals based on parallel and perpendicular lines and the presence or absence of angles of a specified size.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.
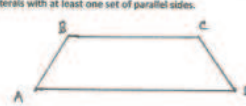
You may choose to use any combination of the questions below to lead the discussion.
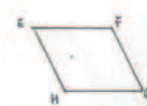
- For Problem 6, what makes a square different from a rectangle? Why is it important to define a square as a rectangle with four equal length sides, and not as a quadrilateral with four equal length sides?

- What are some attributes that every square has in common. How is a square a special case of a rectangle, a parallelogram, and a trapezoid?

- If your teacher asked you to draw a trapezoid and you drew a parallelogram, explain to your teacher why a parallelogram is also a trapezoid.

- Can a trapezoid be defined as a square? What attributes of a square are not present in a trapezoid? Why does it only work in the reverse: a square is also a trapezoid? What attributes of a trapezoid are present in a square?
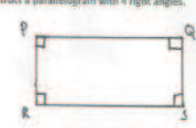
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- ▪ We have seen today that a figure can belong to different categories. That is often true in life. For example, consider the following words: woman, mother, sister, and aunt. A woman can be a mother, but only is a mother if she has children. A woman isn't a sister unless she has a sister or a brother. Each classification has a defining attribute. A mother, sister, and aunt are all women just as a parallelogram, rectangle, and square are all trapezoids and, ultimately, all quadrilaterals. Talk to your partner about the following set of words: clothes, pants, and jeans.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students' understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.

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Name _____   Date _____

Construct the figures with given attributes. Name the shape you created. Be as specific as possible. Use extra blank paper as needed.

1. Construct quadrilaterals with at least one set of parallel sides.

2. Construct a quadrilateral with two sets of parallel sides.

3. Construct a parallelogram with four right angles.
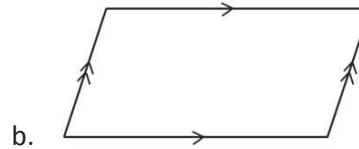
4. Construct a rectangle with all sides the same length.

5. Use the word bank to name each shape, being as specific as possible.

parallelogram	trapezoid	rectangle	square

a.
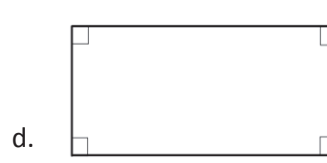
_____

b.

_____

c.

_____

d.

_____
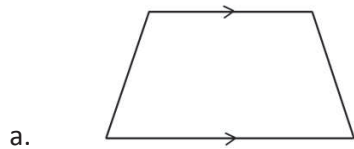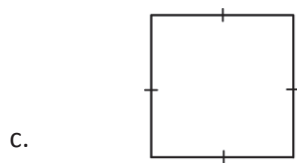
6. Explain the attribute that makes a square a special rectangle.

7. Explain the attribute that makes a rectangle a special parallelogram.

8. Explain the attribute that makes a parallelogram a special trapezoid.

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Name _____   Date _____

1. In the space below, draw a parallelogram.

2. Explain why a rectangle is a special parallelogram.

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Name _____ Date _____

1. Use the word bank to name each shape, being as specific as possible.
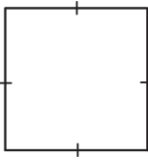
| parallelogram | trapezoid | rectangle | square |

a.

_____

b.

_____

c.

_____

d.

_____

2. Explain the attribute that makes a square a special rectangle.

3. Explain the attribute that makes a rectangle a special parallelogram.

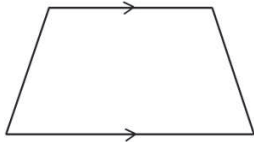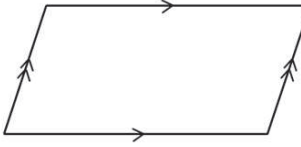4. Explain the attribute that makes a parallelogram a special trapezoid.

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5. Construct the following figures based on the given attributes.
    Give a name to the figure you construct. Be as specific as possible.

    a. A quadrilateral with four sides the same length and four right angles.

    b. A quadrilateral with two sets of parallel sides.

    c. A trapezoid with only one pair of parallel sides.

    d. A parallelogram with four right angles.

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