Applications

For Exercises 1–4, follow these directions. Use the given side lengths.

- If possible, build a triangle with the side lengths. Sketch your triangle.
- Tell whether your triangle is the only one that is possible. Explain.
- If a triangle is not possible, explain why.

1. 5, 5, 3

2. 8, 8, 8

3. 7, 8, 15

4. 5, 6, 10

5. From Exercises 1–4, which sets of side lengths can make each of the following shapes?

a. an equilateral triangle (all three sides are equal length)

b. an isosceles triangle (two sides are equal length)

c. a scalene triangle (no two sides are equal length)

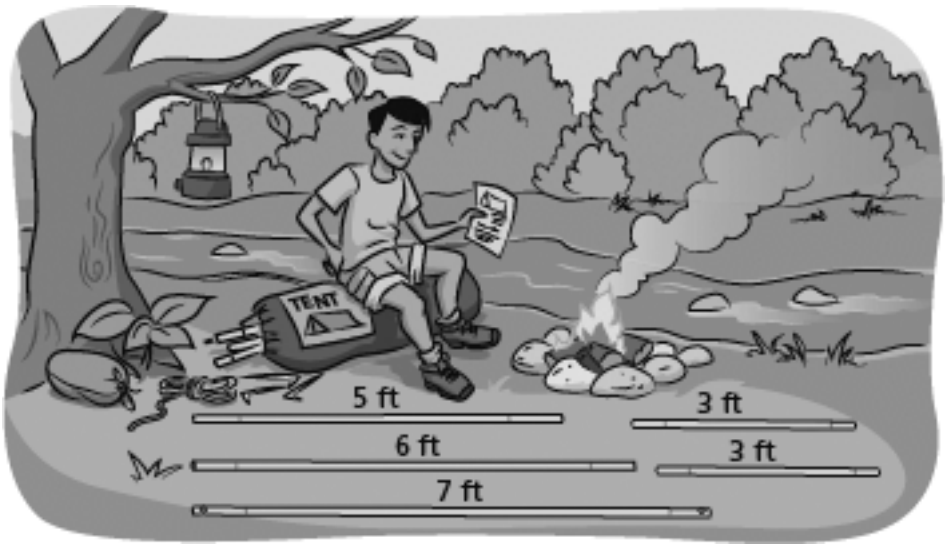
d. a triangle with at least two angles of the same measure

For Exercises 6 and 7, draw the polygons described to help you answer the questions.

6. Suppose you want to build a triangle with three angles measuring 60°. What do you think must be true of the side lengths? What kind of triangle is this?

7. Suppose you want to build a triangle with only two angles the same size. What do you think must be true of the side lengths? What kind of triangle is this?

8. Giraldo is building a tent. He has two 3-foot poles. He also has a 5-foot pole, a 6-foot pole, and a 7-foot pole. He wants to make a triangular-shaped doorframe for the tent using the 3-foot poles and one other pole. Which of the other poles could be used for the base of the door?



9. Which of these descriptions of a triangle ABC are directions that can be followed to draw exactly one shape?

a. $\overline{AB} = 2.5\text{in.}, \overline{AC} = 2\text{ in.}, \text{Đ}B = 40°$

b. $\overline{AB} = 2.5\text{in.}, \overline{AC} = 1\text{ in.}, \text{Đ}A = 40°$

c. $\overline{AB} = 2.5\text{in.}, \text{Đ}B = 60°, \text{Đ}A = 40°$

d. $\overline{AB} = 2.5\text{in.}, \text{Đ}B = 60°, \text{Đ}A = 130°$

For Exercises 10–13, follow these directions. Use the given side lengths.

- If possible, build a quadrilateral with the side lengths. Sketch your quadrilateral.
- Tell whether your quadrilateral is the only one that is possible. Explain.
- If a quadrilateral is not possible, explain why.

10. 5, 5, 8, 8

11. 5, 5, 6, 14

12. 8, 8, 8, 8

13. 4, 3, 5, 14

14. From Exercises 10–13, which sets of side lengths can make each of the following shapes?

a. a square

b. a quadrilateral with all angles the same size

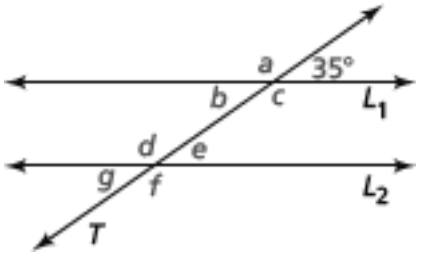
c. a parallelogram

d. a quadrilateral that is not a parallelogram

15. A quadrilateral with four equal sides is called a *rhombus*. Which set(s) of side lengths from Exercises 10–13 can make a rhombus?

16. A quadrilateral with just one pair of parallel sides is called a *trapezoid*. Which sets of side lengths from Exercises 10–13 can make a trapezoid?

17. In the diagram below, line T is a transversal to parallel lines L_1 and L_2.



a. Find the degree measures of angles labeled a–g.

b. Name the pairs of opposite or vertical angles in the figure.

18. Which of these shapes have reflectional symmetry? Which of these shapes have rotational symmetry?

Multiple Choice For Exercises 19–22, choose the symmetry or symmetries of each shape.

19. rhombus (four equal sides)

A. rotation **B.** reflection **C.** both A and B **D.** none

20. regular pentagon

F. rotation **G.** reflection **H.** both F and G **J.** none

21. square

A. rotation **B.** reflection **C.** both A and B **D.** none

22. parallelogram (not a rhombus or a rectangle)

F. rotation **G.** reflection **H.** both F and G **J.** none

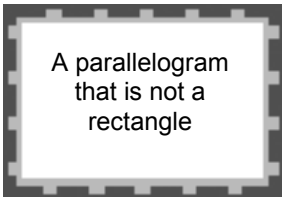
For Exercises 23 and 24, draw the polygons described to help you answer the questions.

23. To build a square, what must be true of the side lengths?

24. Suppose you want to build a rectangle that is not a square. What must be true of the side lengths?

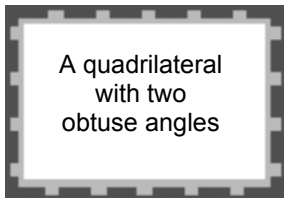
25. Li Mei builds a quadrilateral with sides that are each five inches long. To help stabilize the quadrilateral, she wants to insert a ten-inch diagonal. Will that work? Explain.

26. You are playing the Quadrilateral Game. The shape currently on the geoboard is a square. Your team rolls the number cubes and gets the result to the right:



Your team needs to match this description. What is the minimum number of corners your team needs to move?

27. Suppose you are playing the Quadrilateral Game. The shape currently on the geoboard is a parallelogram but not a rectangle. Your team rolls the number cubes and gets the result to the right. :

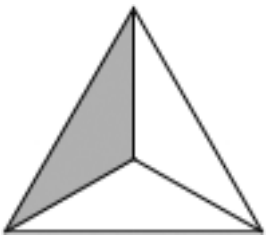


Your team needs to match this description. What is the minimum number of corners your team needs to move?

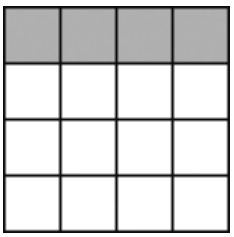
Connections

28. Multiple Choice Which of the following shaded regions is *not* a representation of $\frac{4}{12}$?

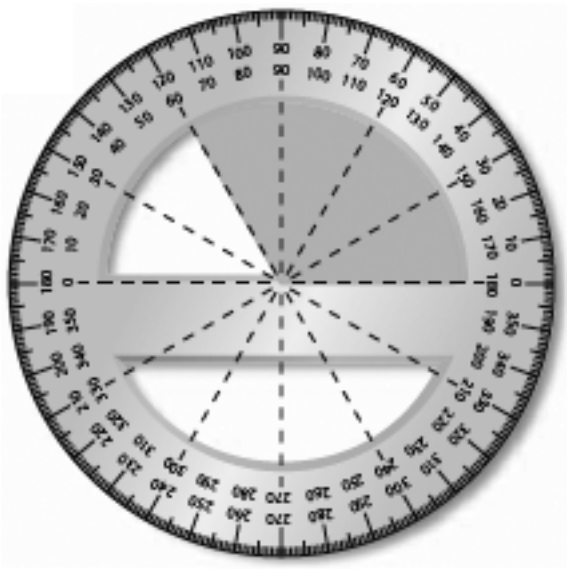
A.



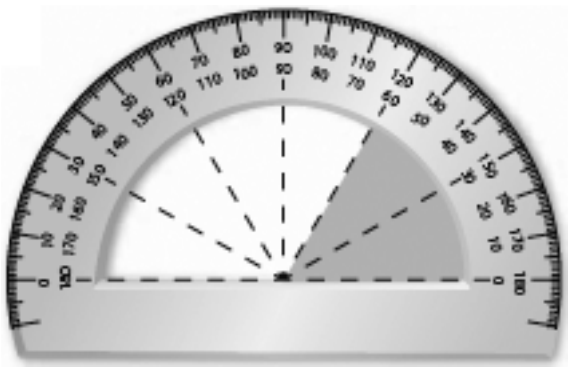
B.



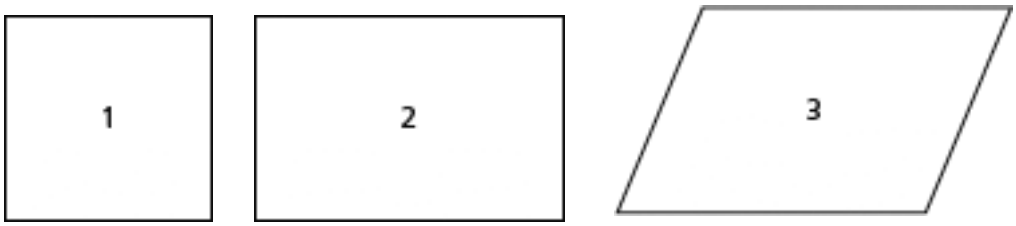
C.



D.



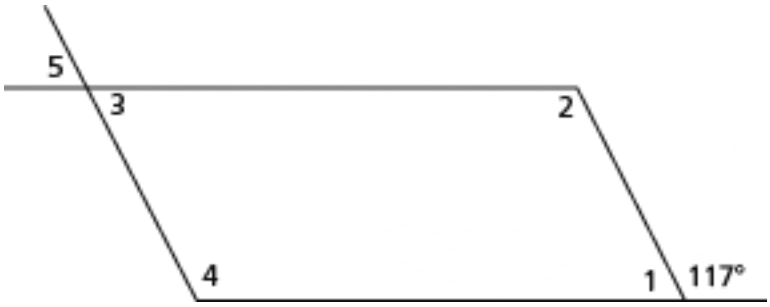
29. Compare the three quadrilaterals below.



a. How are all three quadrilaterals alike?

b. How does each quadrilateral differ from the other two?

30. In the parallelogram, find the measure of each numbered angle.



31. Think about your polystrip experiments with triangles and quadrilaterals. What explanations can you now give for the common use of triangular shapes in structures like bridges and towers for transmitting radio and television signals?

32. Below is a rug design from the Southwest United States.

a. Name some of the polygons in the rug.

b. Describe the symmetries of the design.

33. Here are three state flags.

a. Describe the lines of symmetry in each whole flag.

b. Do any of the shapes or designs within the flags have rotational symmetry? If so, which ones?

c. Design your own flag. Your flag should have at least one line of symmetry. Your flag should also include three shapes that have rotational symmetry. List the shapes in your flag that have rotational symmetry.

34. **Multiple Choice** A triangle has a base of 4 and an area of 72. Which of the following is true?

F. These properties do not make a triangle.

G. These properties make a unique triangle.

H. There are at least two different triangles with these properties.

J. The height of the triangle is 18.

35. Multiple Choice Which of the following could *not* be the dimensions of a parallelogram with an area of 18?

A. base = 18, height = 1

B. base = 9, height = 3

C. base = 6, height = 3

D. base = 2, height = 9

For Exercises 36–37, use these quilt patterns.

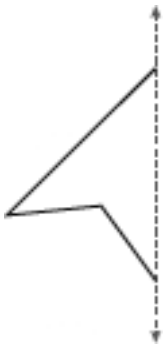
Pattern A

Pattern B

36. Name some of the polygons in each quilt pattern.

37. Describe the symmetries of each quilt pattern.

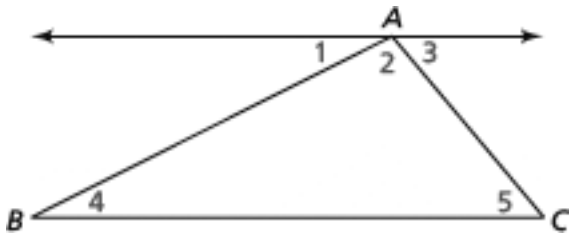
38. Half of the figure is hidden.



The vertical line is a line of symmetry for the complete figure. Copy the part of the figure shown. Then, draw the missing half.

Extensions

39. In the triangle *ABC*, a line has been drawn through vertex *A*, parallel to side *BC*.



a. What is the sum of the measures of angles 1, 2, and 3?

b. Explain why angle 1 has the same measure as angle 4 and why angle 3 has the same measure as angle 5.

c. How can you use the results of parts (a) and (b) to show that the angle sum of a triangle is 180°?

40. In parts (a)–(c), explore properties of pentagons by using polystrips or making sketches. Use your results to answer the following questions.

a. If you choose five numbers as side lengths, can you always build a pentagon? Explain.

b. Can you make two or more different pentagons from the same set of side lengths?

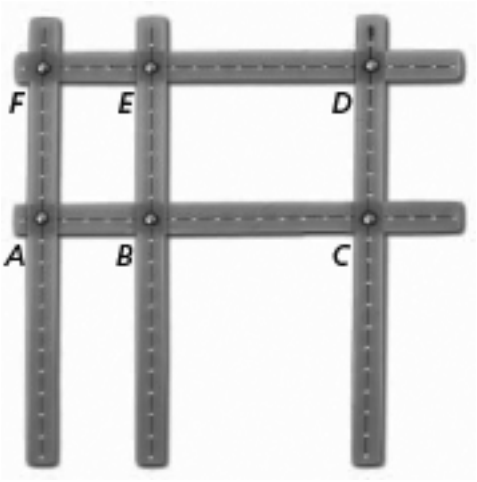
c. Can you find side lengths for a pentagon that will tile a surface? Explain why or why not.

41. Refer to the *Did You Know?* after Problem 3.3.

a. Make a model that illustrates Grashof's principle using polystrips. Describe the motion of your model.

b. How can your model be used to make a stirring mechanism? A windshield wiper?

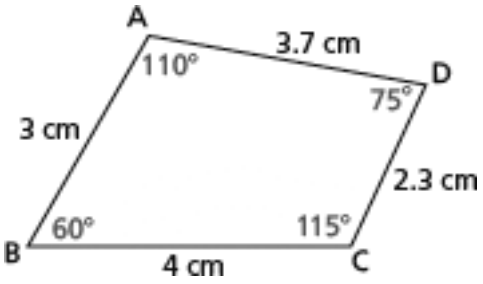
42. Build the figure below from polystrips. The vertical sides are all the same length. The distance from B to C equals the distance from E to D. The distance from B to C is twice the distance from A to B.



a. Experiment with holding various strips fixed (one at a time) and moving the other strips. In each case, tell which strip you held fixed, and describe the motion of the other strips.

b. Fix a strip between points F and B and then try to move strip CD. What happens? Explain why this occurs.

43. The drawing below shows a quadrilateral with measures of all angles and sides. Suppose you wanted to text a friend giving directions for drawing an exact copy of it.



Which of the following short messages give enough information to draw a quadrilateral that has the same size and shape as $ABCD$ above?

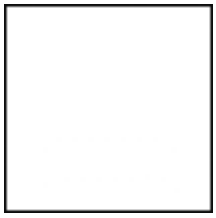
a. $\overline{AB}$ = 3 cm, $\overline{BC}$ = 4 cm, $\overline{CD}$ = 2.3 cm

b. $\overline{AB}$ = 3 cm, ÐB = 60°, $\overline{BC}$ = 4 cm, ÐC = 115°, Ð A = 110°

c. $\overline{AB}$ = 3 cm, ÐB = 60°, $\overline{BC}$ = 4 cm, ÐC = 115°, $\overline{CD}$ = 2.3 cm

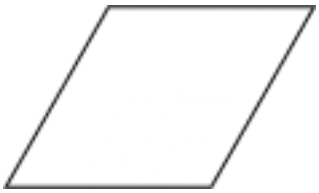
44. In parts (a)–(d), write the shortest possible message that tells how to draw each quadrilateral so that it will have the same size and shape as those below.

a.

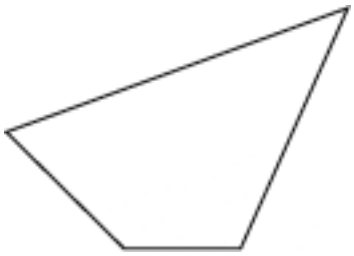


b.

c.



d.



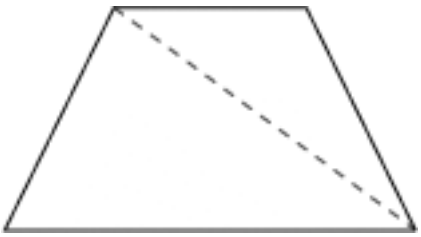
e. What is the minimum information about a quadrilateral that will allow you to draw an exact copy?

For Exercises 45–49, one diagonal of each quadrilateral has been drawn. Complete parts (a) and (b) for each quadrilateral.

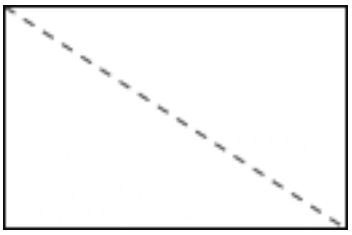
a. Is the given diagonal a line of symmetry? Why or why not?

b. Does the figure have any other lines of symmetry? If so, copy the figure and sketch the symmetry lines.

45.



46.



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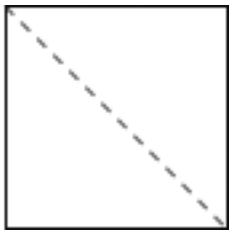

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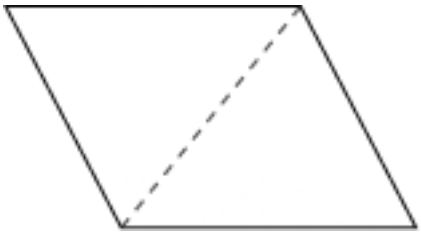

48.