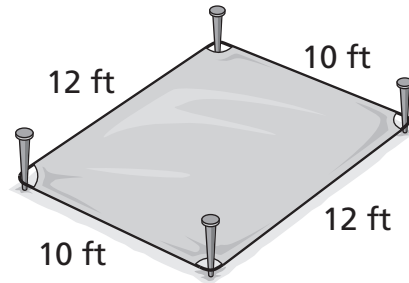


## 7.2 Start Thinking

A scout is working on a construction project that involves building a 10-foot by 12-foot storage shed. He lays out a footprint of the building on the site using tent stakes and string, as shown in the diagram. The scout is certain of the measure of each side but does not have the proper tools to determine if the angles in each corner are right angles.



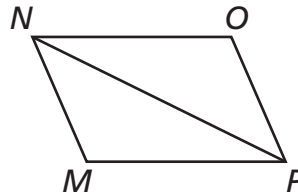
Can the conclusion be made that the sides are definitely parallel? Consider how the scout could determine if the corner angles are right angles, by just using a tape measure.

## 7.2 Warm Up

Write a two-column proof.

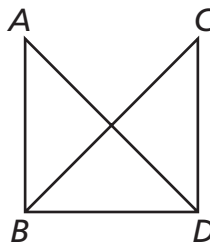
1. **Given:**  $\overline{MN} \cong \overline{PO}$ ,  $\overline{NO} \cong \overline{MP}$

**Prove:**  $\triangle PMN \cong \triangle NOP$



2. **Given:**  $\overline{AB} \cong \overline{CD}$ ,  $\overline{AB} \perp \overline{BD}$ ,  
 $\overline{CD} \perp \overline{BD}$

**Prove:**  $\overline{AD} \cong \overline{BC}$



## 7.2 Cumulative Review Warm Up

Solve the equation. Justify each step.

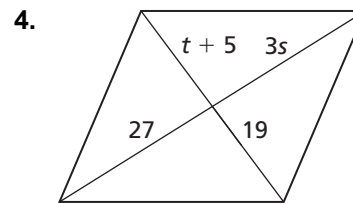
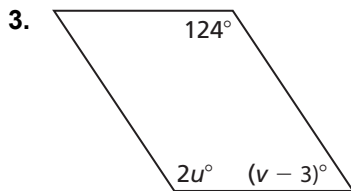
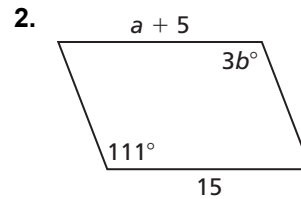
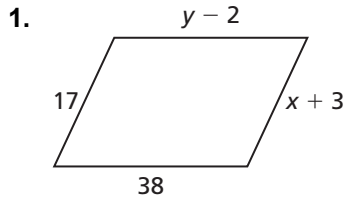
1.  $2x - 8 = 5 + 4x$

2.  $\frac{1}{2}(3x + 8) = 2x - 3$

3.  $\frac{11 - x}{5} = 9 - 7x$

## 7.2 Practice A

In Exercises 1–4, find the value of each variable in the parallelogram.



5. Find the coordinates of the intersection of the diagonals of the parallelogram with vertices  $(-2, -1)$ ,  $(1, 3)$ ,  $(6, 3)$ , and  $(3, -1)$ .

In Exercises 6 and 7, three vertices of parallelogram  $ABCD$  are given. Find the remaining vertex.

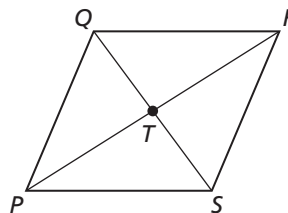
6.  $A(-2, 0)$ ,  $B(-2, -2)$ ,  $D(2, 2)$

7.  $A(-1, -3)$ ,  $C(1, 2)$ ,  $D(-1, -2)$

8. The measure of one interior angle of a parallelogram is  $30^\circ$  more than two times the measure of another angle. Find the measure of each angle of the parallelogram.
9. Your friend claims that you can prove that two parallelograms are congruent by proving that they have two pairs of congruent opposite angles. Is your friend correct? Explain your reasoning.
10. Use the diagram to write a two-column proof.

**Given:**  $PQRS$  is a parallelogram.

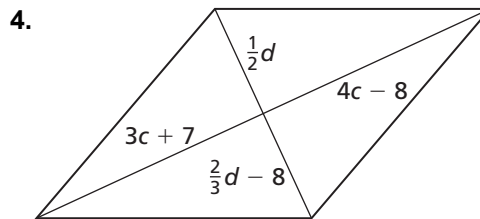
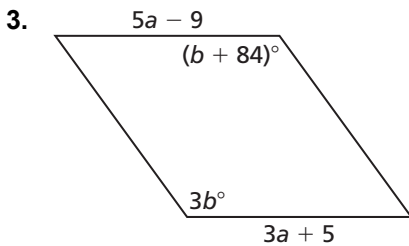
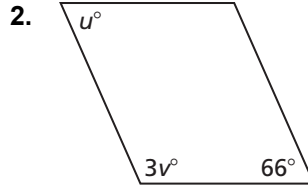
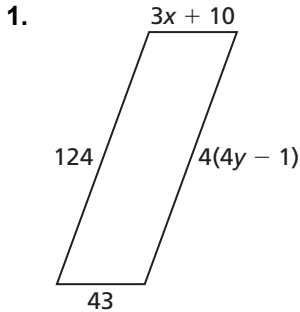
**Prove:**  $\triangle PQT \cong \triangle RST$



# 7.2

## Practice B

In Exercises 1–4, find the value of each variable in the parallelogram.



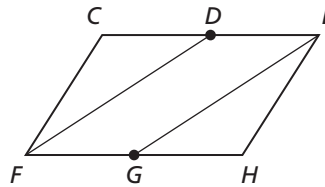
5. Find the coordinates of the intersection of the diagonals of the parallelogram with vertices  $(-2, -4)$ ,  $(-4, 4)$ ,  $(2, 12)$ , and  $(4, 4)$ .

6. Three vertices of parallelogram  $ABCD$  are  $A(1, 5)$ ,  $B(1, 1)$ , and  $D(2, 2)$ . Find the coordinates of the remaining vertex.

7. Use the diagram to write a two-column proof.

**Given:**  $CEHF$  is a parallelogram.  
 $D$  bisects  $\overline{CE}$  and  $G$  bisects  $\overline{FH}$ .

**Prove:**  $\triangle CDF \cong \triangle HGE$



8. State whether each statement is *always*, *sometimes*, or *never* true for a parallelogram. Explain your reasoning.

- The opposite sides are congruent.
- All four sides are congruent.
- The diagonals are congruent.
- The opposite angles are congruent.
- The adjacent angles are congruent.
- The adjacent angles are complementary.

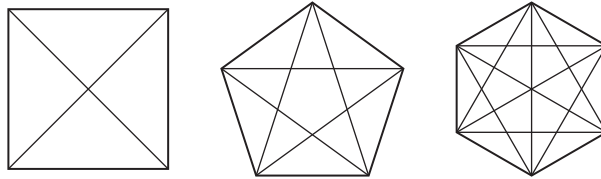
## 7.2 Enrichment and Extension

### Properties of Parallelograms and Diagonals

The given coordinates represent three vertices of a parallelogram. Write the coordinates of each other point that could be the fourth vertex.

1.  $A(-5, -1), B(2, -1), C(-2, -7)$
2.  $A(2, 5), B(-1, 2), C(5, 1)$
3.  $A(a, b), B(a + 2, b), C(a + 4, b + 3)$
4.  $A(a, b), B(a^2, b), C(a^2, b^2)$

A *diagonal* is a line that connects one vertex of a polygon to a nonadjacent vertex. You can see from the picture below the diagonals drawn in a square, pentagon, and hexagon.



5. Complete the chart to the right to show the number of diagonals in each polygon.
6. Write a formula to find the number of diagonals in any  $n$ -gon.
7. How many diagonals does a decagon have? 13-gon?
8. If a polygon has 189 diagonals, how many sides does the polygon have?

Number of sides ( $n$ )	Number of diagonals ( $d$ )
3	
4	
5	
6	
7	

9. There are six people in a tennis tournament who will play in *round-robin*, in which everyone has to play everyone else.
  - a. Draw a diagram that would represent this situation.
  - b. How many games will be played in this tennis tournament?
  - c. Write a simplified equation for the number of games played in round-robin play with  $n$  players.

# 7.2 Puzzle Time

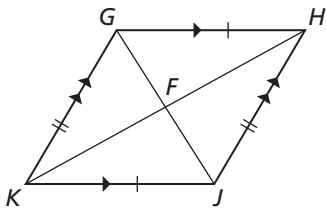
## Where Did Columbus Land When He Found America?

Write the letter of each answer in the box containing the exercise number.

**Complete the sentence.**

1. A \_\_\_\_\_ is a quadrilateral with both pairs of opposite sides parallel.
2. If a \_\_\_\_\_ is a parallelogram, then its opposite sides are congruent.
3. If a quadrilateral is a parallelogram, then its consecutive angles are \_\_\_\_\_.
4. If a quadrilateral is a parallelogram, then its diagonals \_\_\_\_\_ each other.
5. If a quadrilateral is a parallelogram, then its opposite angles are \_\_\_\_\_.

**Use the diagram.**



6.  $KG = 17, KJ = 14$ . Find  $GH$ .
7.  $m\angle GKH = 86^\circ, m\angle GHJ = (x + 6)^\circ$ . Find  $x$ .
8.  $KH = 20$ . Find  $KF$ .
9.  $m\angle HJK = 82^\circ$ . Find  $m\angle GKH$ .
10.  $m\angle HJK = 82^\circ$ . Find  $m\angle HGK$ .

**Answers**

T. bisect	A. $42^\circ$
D. 40	E. parallelogram
L. acute	H. $82^\circ$
M. 17	O. supplementary
C. $98^\circ$	D. intersect
E. $108^\circ$	A. quadrilateral
H. congruent	B. 14
T. $110^\circ$	R. triangle
E. 10	C. polygon
S. complementary	
N. 80	

3	7		4	10	1		6	8	2	9	5
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