

Choose a word from the word bank to complete each sentence. Words will be used more than once.

1. A quadrilateral with two pairs of parallel sides is a 11-gram
2. The opposite sides of a parallelogram are 11-gram
3. The opposite angles of a parallelogram are 11-gram
4. The consecutive angles of a parallelogram are suppl.
5. The diagonals of a parallelogram bisect each other.

parallelogram  
congruent  
supplementary  
bisect

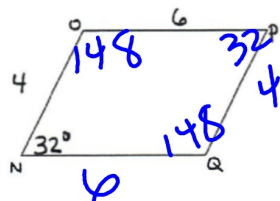
Use parallelogram MATH to answer #6-8.



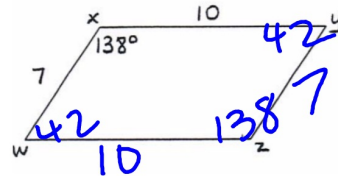
6. Name **two pairs** of congruent angles.  $\angle M \cong \angle T$  and  $\angle H \cong \angle A$
7. Name **four pairs** of supplementary angles.  $\angle M \angle H$ ,  $\angle M \angle A$ ,  $\angle T \angle A$ , and  $\angle T \angle H$
8. Name **two pairs** of congruent segments.  $MA \cong HT$  and  $MH \cong AT$

Find the missing angles and sides. Label them **ON THE PICTURES**.

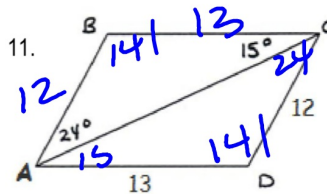
9.



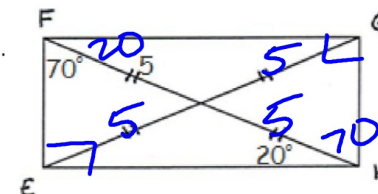
10.



11.



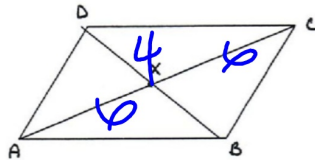
12.



Use parallelogram ABCD to answer the following questions.

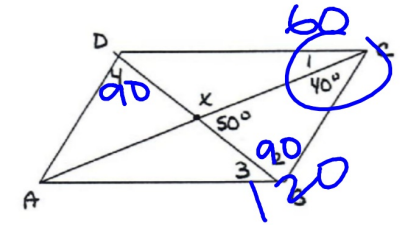
13. If  $DX = 4$  and  $AX = 6$  find:

$BX = \underline{4}$        $BD = \underline{8}$   
 $XC = \underline{4}$        $AC = \underline{12}$

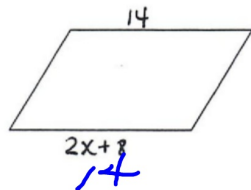


14. If  $m\angle ABC = 120^\circ$ , find:

$m\angle ADC = \underline{120}$        $m\angle DAB = \underline{60}$   
 $m\angle 1 = \underline{20}$        $m\angle 2 = \underline{90}$   
 $m\angle 3 = \underline{70}$        $m\angle 4 = \underline{90}$



15.



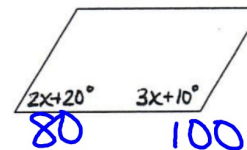
$2x + 8 = 14$   
 $2x = 6$   
 $x = 3$

Relationship: congruent or supplementary

Equation:

$x = \underline{\hspace{2cm}}$

16.



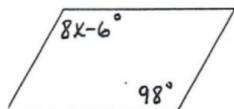
$5x + 30 = 180$   
 $5x = 150$   
 $x = 30$

Relationship: congruent or supplementary

Equation:

$x = \underline{\hspace{2cm}}$

17.



$$8x - 6 = 98$$

$$8x = 104$$

$$x = 13$$

Relationship: congruent or supplementary

Equation:

 $x =$  \_\_\_\_\_

## H. Geometry

## 6-4: Proving a Quadrilateral is a Parallelogram

Date: \_\_\_\_\_

Objective: I can use the properties of parallel lines, diagonals, and triangles to investigate parallelograms.

Do "Explore and Reason" below.

Sketch and name each quadrilateral. Mark any congruent sides and angles in your diagrams.

	Parallel Sides	Congruent Sides
Quadrilateral 1	0 pairs	consecutive pairs
Quadrilateral 2	1 pair	exactly 1 nonparallel pair
Quadrilateral 3	2 pairs	2 opposite pairs

Quadrilateral 1	Quadrilateral 2	Quadrilateral 3
This is a(n) <u>Kite</u>	This is a(n) <u>isos trapezoid</u>	This is a(n) <u>ll-gram</u>

What properties of a quadrilateral do you think will prove a quadrilateral is a parallelogram?

Both pairs of opp (ll) sides  $\cong$  & opp  $\angle$ s  $\cong$

B. Measure the diagonals of each quadrilateral. How are the diagonals in Quadrilateral 1 related to each other? Quadrilateral 2? Quadrilateral 3?

Quad 1 - diag. are  $\perp$  (create  $90^\circ \angle$ s)  
 Quad 2 - diag. are  $\cong$ .  
 Quad 3 - diag. bisect each other

## EXPLORE &amp; REASON

Sketch the quadrilaterals as described in the table. Include the diagonals.

	Parallel Sides	Congruent Sides
Quadrilateral 1	0 pairs	2 consecutive pairs
Quadrilateral 2	1 pair	exactly 1 non-parallel pair
Quadrilateral 3	2 pairs	2 opposite pairs

A. Measure the angles of each quadrilateral. How are the angle measures in Quadrilateral 1 related to each other? Quadrilateral 2? Quadrilateral 3?

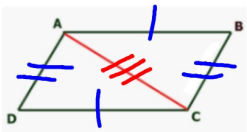
Quad 1 - (kite) one pair of  $\cong \angle$ s  
 Quad 2 - (isos trap) base  $\angle$ s are  $\cong$   
 Quad 3 - (ll-gram) both pairs of opp  $\angle$ s  $\cong$  SSII suppl

- C. **Communicate Precisely** Compare the relationships among the angles and diagonals of Quadrilateral 3 to the other two quadrilaterals. Are there any relationships that make Quadrilateral 3 unique? © MP.6

All have at least one pair of  $\cong \angle$ s.  
 only quad 3 has  
 - two pairs of opp  $\angle$ s  $\cong$   
 - diag. bisect each other.

Fill in the essential question for this section: Which PROP determine whether a quadr. is a ll-gram

**Example 1:** In quadrilateral ABCD,  $\overline{AC}$  is a diagonal,  $\overline{AB} \cong \overline{CD}$ , and  $\overline{AD} \cong \overline{BC}$ . Is ABCD a parallelogram? Explain.



No either diag.  
 forms two  $\Delta$ s  
 that are  $\cong$  by SSS

- \*Does it matter which diagonal is constructed?
- \*What conclusion can be drawn from this example?

yes, this is a ll-gram  
 b/c opp sides are  $\cong$

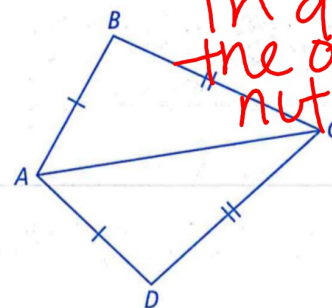
Do Try It 1 and Habits of Mind, page 148 in your student companion.

## HABITS OF MIND

**Use Appropriate Tools** How might a geoboard be helpful in comparing quadrilaterals? © MP.5

### EXAMPLE 1 Try It! Investigate Sides to Confirm a Parallelogram

1. Explain why you cannot conclude that ABCD is a parallelogram.



In quad ABCD  
 the opp sides are  
 not  $\cong$ .



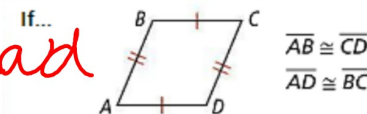
## HABITS OF MIND

**Use Structure** Suppose a scalene triangle is reflected across its longest side, does the triangle combined with its image to form a parallelogram? Explain. © MP.7

NO, the resulting figure is a kite

## Theorem 6-11 (converse of theorem 6-7):

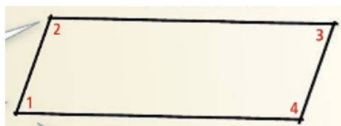
If both pairs of opp sides of a quad are  $\cong$  then, the quadrilateral is a parallelogram.



Then... ABCD is a parallelogram.

## Example 2:

A) Teo sketches a design of a parallelogram-shaped building. If  $\angle 1$  is supplementary to  $\angle 2$  and  $\angle 4$ , is his design a parallelogram?



B. Teo sketches a second design in which  $\angle 1$  is congruent to  $\angle 3$ , and  $\angle 2$  is congruent to  $\angle 4$ . Is that design a parallelogram?

yes this is a 11-gram b/c  $\angle 1$  is suppl to  $\angle 2$  &  $\angle 4$ , these are SSI  $\angle$ s.  
yes, b/c opp  $\angle$ s are  $\cong$ .

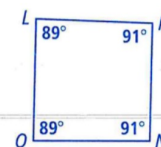
Do Try It 2, page 148 in your student companion.

## EXAMPLE 2 Try It! Explore Angle Measures to Confirm a Parallelogram

2. a. Is DEFG a parallelogram? Explain.

Since this is a quad the int  $\angle$  measure add up to 360  
opp  $\angle$ s  $\cong$  SSI  
 $\angle$ s suppl  
... DEFG 11-gram  
 $\angle D = 27^\circ$

b. Is LMNO a parallelogram? Explain.

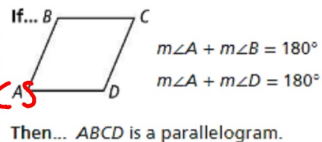


NO, LMNO is not a 11-gram b/c opp  $\angle$ s are not  $\cong$  SSI are not suppl

These examples lead us to two more theorems.

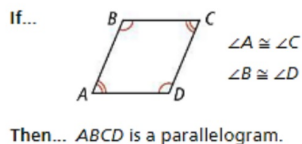
**Theorem 6-12 (converse of theorem 6-8)**

If *an angle of a quad is suppl to both of its ss* then the quadrilateral is a parallelogram.



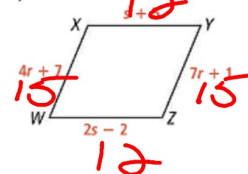
**Theorem 6-13 (converse of theorem 6-9)**

If *both pairs of opp. ∠s of a quad are ≅* then, the quadrilateral is a parallelogram.



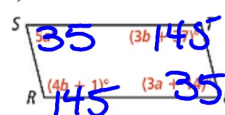
**Example 3:** Find values to make parallelogram.

A) For what values of  $r$  and  $s$  is WXYZ a parallelogram?



$$\begin{aligned} 4r + 7 &= 7r + 1 \\ 5 + 5 &= 2s - 2 \\ 5 &= s - 2 \\ s &= 7 \end{aligned}$$

B) For what values of  $a$  and  $b$  is RSTU a parallelogram? Which angle relationship is best to use and why?



$$\begin{aligned} 5a &= 3a + 14 \\ 2a &= 14 \\ a &= 7 \end{aligned}$$

$$\begin{aligned} 4b + 1 &= 3b + 37 \\ b &= 36 \end{aligned}$$

Do Try It 3 and Habits of Mind, page 149 in your student companion.