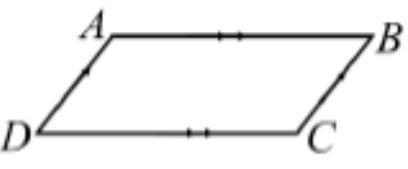
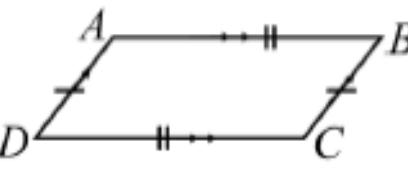
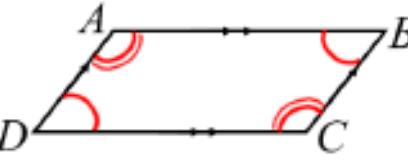
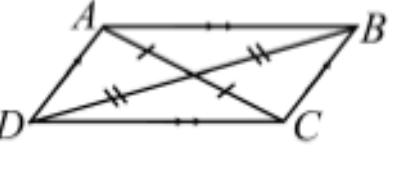
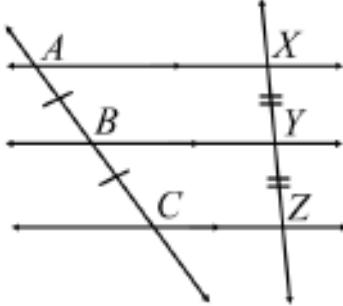


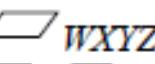
# Properties of Parallelograms

SOL. G.9 (2016)

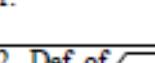
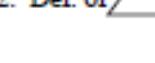
Definition of Parallelogram	
<b>A quadrilateral with two pairs of opposite parallel sides.</b> $\overline{AB} \parallel \overline{DC}$ $\overline{AD} \parallel \overline{BC}$	
Properties of Parallelograms	
<b>If a quadrilateral is a parallelogram, then opposite sides are congruent.</b> $\overline{AB} \cong \overline{DC}$ $\overline{AD} \cong \overline{BC}$	
<b>If a quadrilateral is a parallelogram, then opposite angles are congruent.</b> $\angle A \cong \angle C$ $\angle B \cong \angle D$	
<b>If a quadrilateral is a parallelogram, then its consecutive angles are supplementary.</b> $m\angle A + m\angle B = 180$ $m\angle B + m\angle C = 180$ $m\angle C + m\angle D = 180$ $m\angle D + m\angle A = 180$	
<b>If a quadrilateral is a parallelogram, then the diagonals bisect each other.</b> $\overline{IM} \cong \overline{MK}$ $\overline{LM} \cong \overline{MJ}$	
<b>If three or more parallel lines cut off congruent segments on one transversal, then they cut off congruent segments on every transversal.</b>	

## Practice

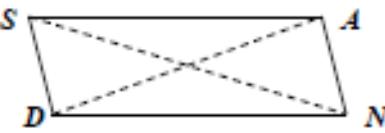
Complete the two-column proof.

1. Given:   
 Prove:  $\overline{WX} \cong \overline{YZ}$



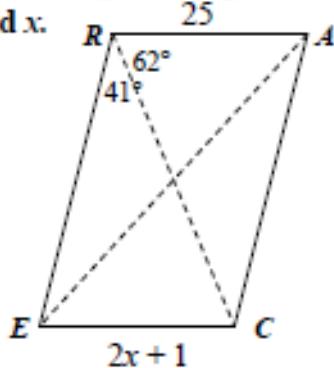
Statements	Reasons
1. 	1.
2.	2. Def. of 
3. Draw $\overline{ZX}$ .	3. Diagonal of $\overline{WXYZ}$
4. $\angle ZXY \cong \angle WZX$	4.
$\angle YZX \cong \angle WXZ$	
5.	5. Reflexive Property
6. $\triangle WZX \cong \triangle YXZ$	6.
7.	7.

Complete each statement about parallelogram SAND. Justify each answer.



2.  $\overline{SD} \parallel \underline{\hspace{2cm}}$
3.  $\angle AND \cong \underline{\hspace{2cm}}$
4.  $\angle SND \cong \underline{\hspace{2cm}}$

**Example 1:** Quadrilateral  $RACE$  is a parallelogram. Find  $m\angle ACE$ ,  $m\angle RAC$ , and  $x$ .



$$m\angle ERA = 41 + 62$$

$$m\angle ERA = 103^\circ$$

$$\angle ACE \cong \angle ERA$$

$$\text{m}\angle ACE = 103^\circ$$

$$m\angle ERA + m\angle RAC = 180$$

$$103 + m\angle RAC = 180$$

$$\text{m}\angle RAC = 77^\circ$$

$$\overline{RA} \cong \overline{EC}$$

$$25 = 2x + 1$$

$$24 = 2x$$

$$x = 12$$

**Example 2:** Find the coordinates of the intersection of the diagonals of parallelogram  $LAKE$  with vertices  $L(0, 5)$ ,  $A(3, 3)$ ,  $K(7, 4)$ , and  $E(4, 6)$ .

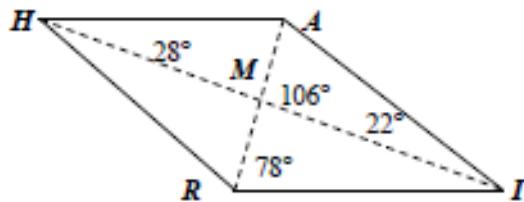
$$\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

$$\left( \frac{0+7}{2}, \frac{5+4}{2} \right) = (3.5, 4.5)$$

$$\left( \frac{3+4}{2}, \frac{3+6}{2} \right) = (3.5, 4.5)$$

$$(3.5, 4.5)$$

Use parallelogram  $HAIR$  to find each measure or value if  $HA = 15$ ,  $AM = 4.5$ ,  $RI = 3x - 9$ , and  $RM = 10 - 11y$ .



1. Angle  $ERA$  is the sum of angles  $ARC$  and  $CRE$ .

5.  $m\angle AIR$

2. Opposite angles of a parallelogram are congruent.

6.  $m\angle HRI$

3. Consecutive sides of a parallelogram are supplementary.

7.  $x$

4. Opposite sides of a parallelogram are congruent.  
5. Substitute and solve.

8.  $y$

9. Find the coordinates of the intersection of the diagonals of parallelogram  $TIME$  with vertices  $T(-4, 8)$ ,  $I(-2, 3)$ ,  $M(3, 5)$ ,  $E(1, 10)$ .