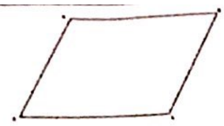
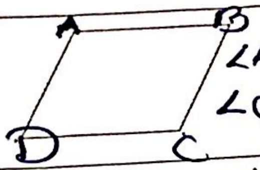
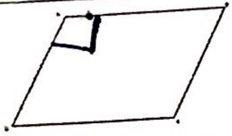
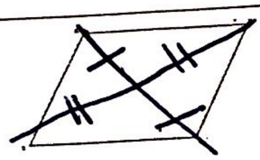
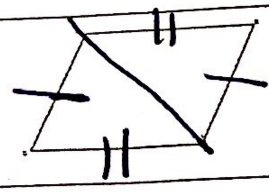
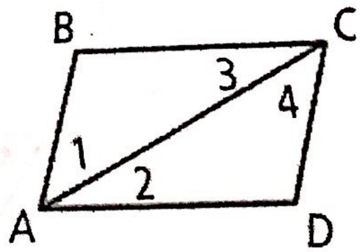
Sides	A **parallelogram** is a quadrilateral with both pairs of opposite sides parallel.	
	If a quadrilateral is a parallelogram, the 2 pairs of opposite sides are congruent.	
Angles	If a quadrilateral is a parallelogram, the 2 pairs of opposite angles are congruent.	
	If a quadrilateral is a parallelogram, the consecutive angles are supplementary.	 $\angle A + \angle B = 180$ $\angle C + \angle D = 180$
	If a quadrilateral is a parallelogram and one angle is a right angle, then all angles are right angles.	
Diagonals	If a quadrilateral is a parallelogram, the diagonals bisect each other.	
	If a quadrilateral is a parallelogram, the diagonals form two congruent triangles.	

Example 1: Given: ▱ABCD is a parallelogram.
Prove: AB = CD and BC = DA.



Statement	Reason
1. ABCD is a parallelogram	1. Given
2. AB // BC	2. Definition of a parallelogram
3. <1 = <4, <3 = <2	3. Alt. int. ∠'s Thm
AC = AC	4. Reflexive Prop
5. $\Delta ABC = \Delta CDA$	5. Def. Parallelogram
6. AB = CD and BC = DA	6. CPCTC

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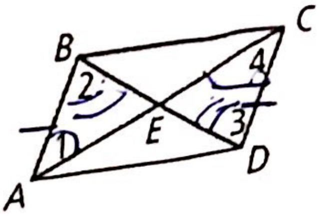
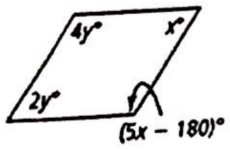


Example 2: Given: ▱ABCD is a parallelogram.
Prove: AC and BD bisect each other at E.

Statement	Reason
1. ABCD is a parallelogram	1. Given
2. AB ∥ DC	2. Def. parallelogram
3. ∠1 = ∠4, ∠2 = ∠3	3. Alt. int ∠'s Thm
4. AB = DC	4. Prop. of parallelogram
5. △ABE ≅ △CDE	5. ASA
6. AE = CE, BE = DE	6. CPTC
7. AC and BD bisect each other at E.	7. Definition of bisector

Example 3: For what values of x and y must each figure be a parallelogram?

a)



$x+5x-180=180$

$6x-180=180$

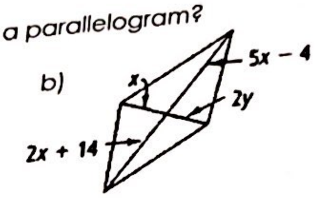
$6x=360$

$\boxed{x=60°}$

$6y=180$

$\boxed{y=30°}$

b)



$2x+14=5x-4$

$14=3x-4$

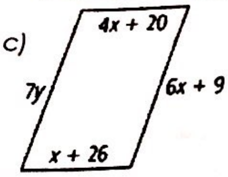
$18=3x$

$\boxed{6=x}$

$6=2y$

$\boxed{3=y}$

c)



$4x+20=x+26$

$3x=6$

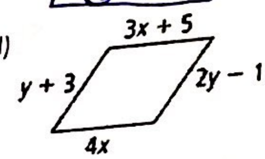
$\boxed{x=2}$

$6(2)+9=7y$

$21=7y$

$\boxed{3=y}$

d)



$4x=3x+5$

$\boxed{x=5}$

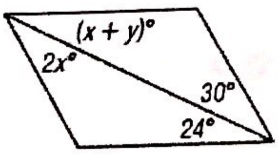
$y+3=2y-1$

$3=2y-1$

$4=2y$

$\boxed{2=y}$

e)



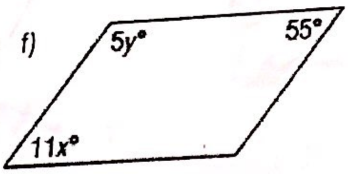
$2x=30$

$x=15$

$15+y=24$

$\boxed{y=9}$

f)



$5y+55=180$

$5y=125$

$\boxed{y=25}$

$11x=55$

$\boxed{x=5}$

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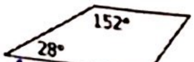
5.3 Proving Parallelograms Practice

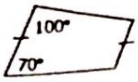
Determine if each quadrilateral is a parallelogram. Explain why or why it does not work.

1) 

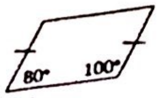
~~Ye~~ ~~Diagonals~~ ~~No Kite~~

2) 

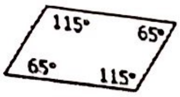
No trap

3) 

NO

4) 

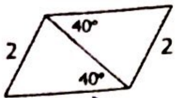
yes

5) 

yes

6) 

NO

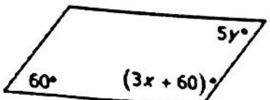
7) 

NO

8) 

yes

Find the value of x and y that ensure each quadrilateral is a parallelogram.

9) 

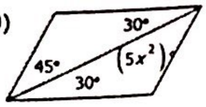
$5y = 60$

$\boxed{y = 12}$

$120 = 3x + 60$

$3x = 60$

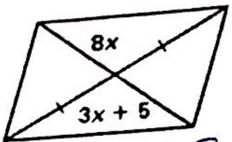
$\boxed{x = 20}$

10) 

$5x^2 = 45$

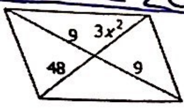
$x = 9$

$\boxed{x = 3}$

11) 

$8x = 3x + 5$

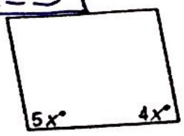
$5x = 5$ $x = 1$

12) 

$48 = 3x^2$

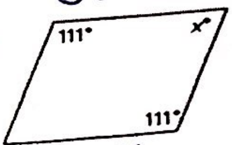
$16 = x^2$

$\boxed{4 = x}$

13) 

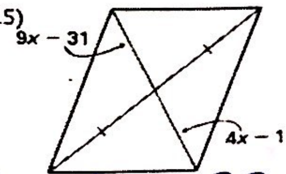
$9x = 180$

$\boxed{x = 20}$

14) 

$180 - 111$

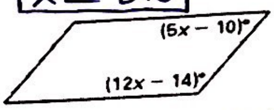
$\boxed{69}$

15) 

~~5x = 32~~

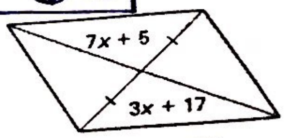
$5x = 30$

$\boxed{x = 6}$

16) 

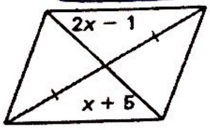
$17x - 24 = 180$

$\boxed{x = 12}$

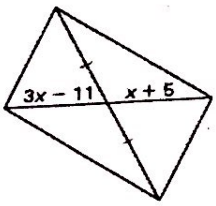
17) 

$4x = 12$

$\boxed{x = 3}$

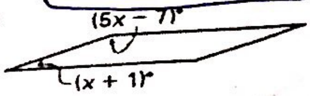
18) 

$x = 6$

19) 

$2x = 16$

$\boxed{x = 8}$

20) 

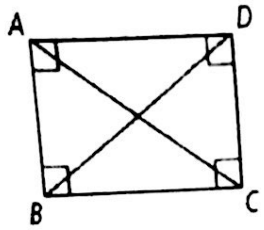
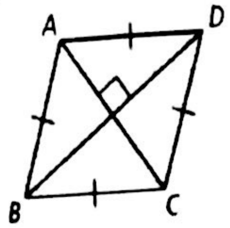
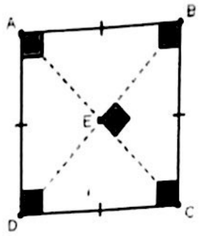
$6x - 6 = 180$

$6x = 186$

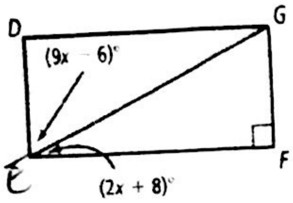
$\boxed{x = 31}$

5.4 Quadrilaterals

SWBAT use the properties of quadrilaterals to solve for unknowns.

Rectangle	Rhombus	Square
…ctangle is a parallelogram with four right angles.	A **rhombus** is a parallelogram with four congruent sides.	A **square** is a parallelogram with four congruent sides and four right angles.
…ctangle has all the properties of a parallelogram PLUS: • 4 right angles • Diagonals are congruent	A **rhombus** has all the properties of a parallelogram PLUS: • 4 congruent sides • Diagonals bisect angles • Diagonals are perpendicular	A **square** has all the properties of a parallelogram PLUS: • All the properties of a rectangle • All the properties of a rhombus
		

Example 1: Solve for x and the measure of each angle if ▭DGFE is a rectangle.



$9x-6+2x+8=90$

$11x+2=90$

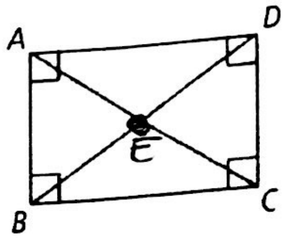
$11x=88$

$\boxed{x=8}$

$\angle DEG=66$

$\angle GEF=24$

Example 2: ▭ABCD is a rectangle whose diagonals intersect at point E.



a) If AE = 36 and CE = 2x − 4, find x.

$36=2x-4$

$40=2x$

$\boxed{20=x}$

b) If BE = 6y + 2 and CE = 4y + 6, find y.

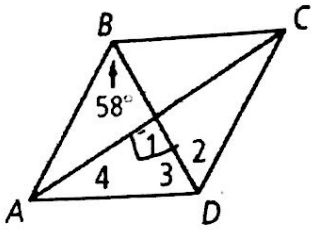
$6y+2=4y+6$

$2y+2=6$

$2y=4$

$\boxed{y=2}$

Example 3: Using the diagram to the right to answer the following if ▭ABCD is a rhombus.



a) Find the m∠1.

90°

b) Find the m∠2.

58°

diag

c) Find the m∠3.

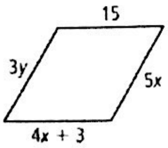
58°

d) Find the m∠4.

32°

Example 4: Solve for each variable if the following are rhombi.

a)



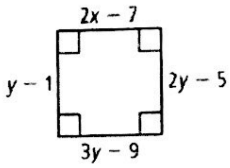
$15=4x+3$

$12=4x$

$\boxed{3=x}$

$\boxed{y=5}$

b)



$2y-5=y-1$

$\boxed{y=4}$

$3(4)-9=2x-7$

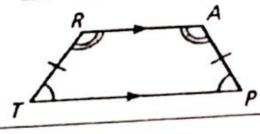
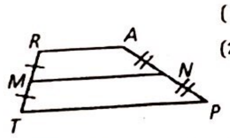
$3=2x-7$

$10=2x$

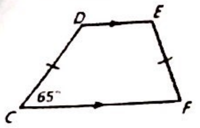
$\boxed{x=5}$

Trapezoid

A **trapezoid** is a quadrilateral with exactly one pair of parallel sides, called bases, and two nonparallel sides, called *legs*.

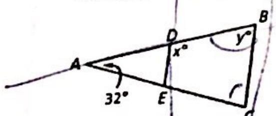
Isosceles Trapezoids	Trapezoid Midsegment
An **isosceles trapezoid** is a trapezoid with congruent legs.	The **median** (also called the midsegment) of a trapezoid is a segment that connects the midpoint of one leg to the midpoint of the other leg.
A trapezoid is isosceles if there is only: • One set of parallel sides • Base angles are congruent • Legs are congruent • Diagonals are congruent • Opposite angles are supplementary $\angle T \cong \angle P$, $\angle R \cong \angle A$ 	**Theorem:** If a quadrilateral is a trapezoid, then a) the midsegment is parallel to the bases and b) the length of the midsegment is half the sum of the lengths of the bases (1) $\overline{MN} \parallel \overline{TP}$, $\overline{MN} \parallel \overline{RA}$, and (2) $MN = \frac{1}{2}(TP + RA)$ 

Example 5: CDEP is an isosceles trapezoid and m<C = 65. What are m<D, m<E, and m<F?



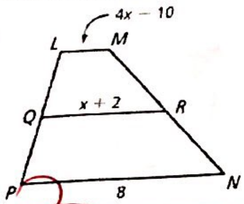
$\angle D = 115^\circ$
$\angle E = 115^\circ$
$\angle F = 65$

Example 6: What are the values of x and y in the isosceles triangle below if DE | | DC?



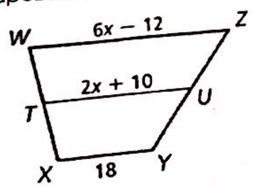
$y = 74^\circ$
$x = 106$

Example 7: QR is the midsegment of trapezoid LMNP. What is x and the length of LM?



$x + 2 = \frac{1}{2}(4x - 2)$
$x + 2 = 2x - 1$
$\boxed{3 = x}$ $LM = 2$

You Try! TU is the midsegment of trapezoid WXYZ. What is x and the length of TU?

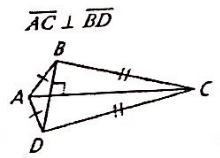
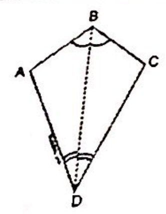
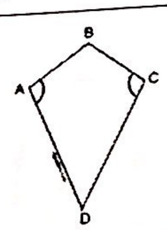
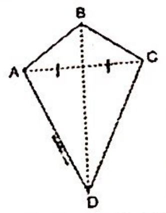


$2x + 10 = \frac{1}{2}(6x - 12 + 18)$
$2x + 10 = \frac{1}{2}(6x + 6)$
$2x + 10 = 3x + 3$
$\boxed{7 = x}$

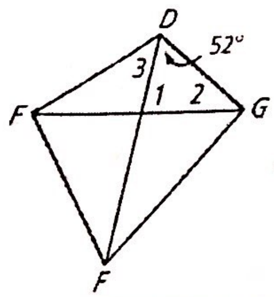
Kite

A **kite** is a quadrilateral with two pairs of adjacent, congruent sides.

If a quadrilateral is a kite, then:

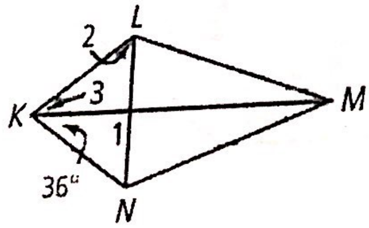
Its diagonals are perpendicular.	Its diagonals bisect the opposite angles.	One pair of opposite angles are congruent.	One diagonal bisects the other.
$\overline{AC} \perp \overline{BD}$ 			

Example 4: Quadrilateral DEFG is a kite. What are m<1, m<2, and m<3?



$\angle 1 = 90$
$\angle 2 = 38$
$\angle 3 = 52$

You Try! Quadrilateral KLMN is a kite. What are m<1, m<2, and m<3?



$\angle 1 = 90^\circ$
$\angle 2 = 54$
$\angle 3 = 36$