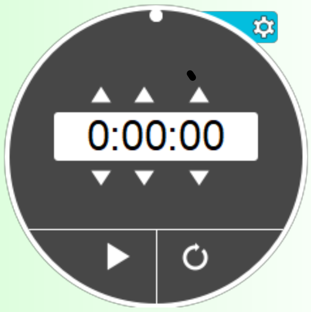
Different types of 4-sided polygons
How many can you come up with?



1. Quadrilateral
2. Kite
3. Trapezoid
4. Isosceles Trapezoid

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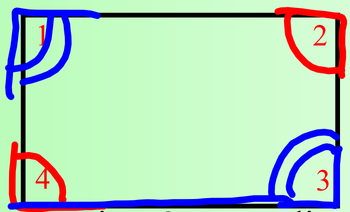
5. Parallelogram
6. Rhombus
7. Rectangle
8. Square



Diagonal = Segment connecting 2 non-adjacent vertices

2 diagonals

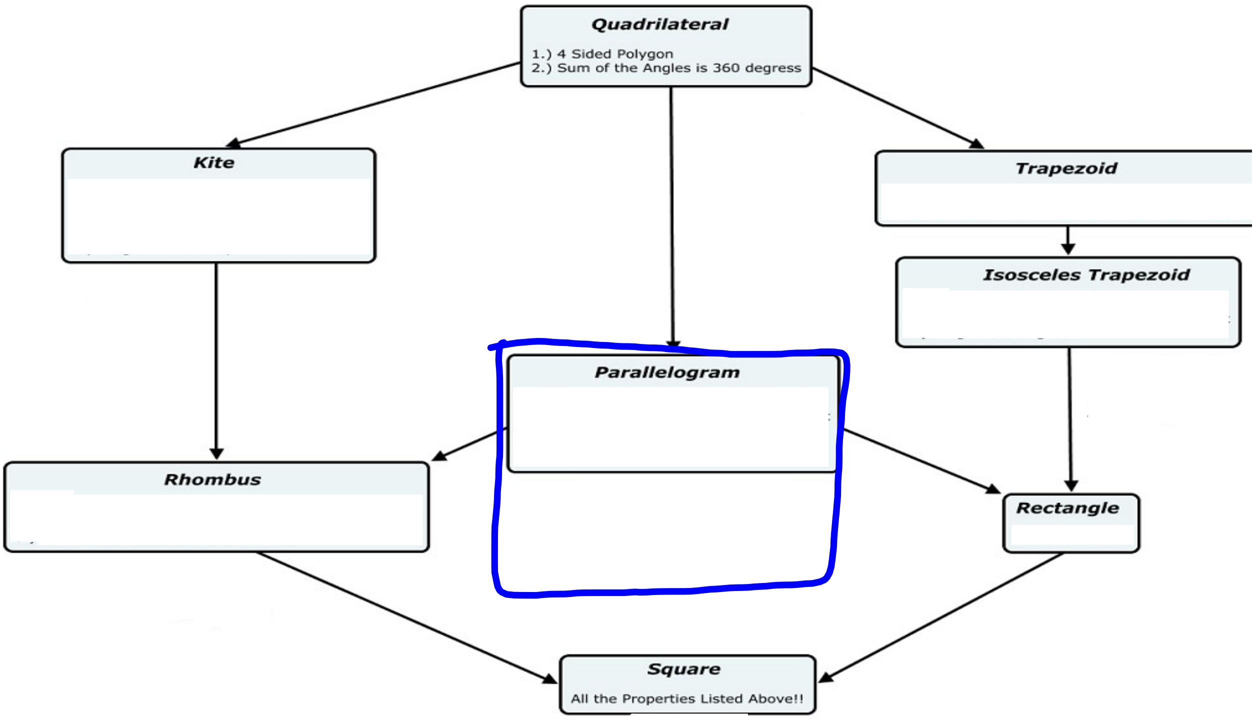
Opposite Angles = Angles across from each other in a quadrilateral. They do not share any common sides.

1 and 3, 2 and 4

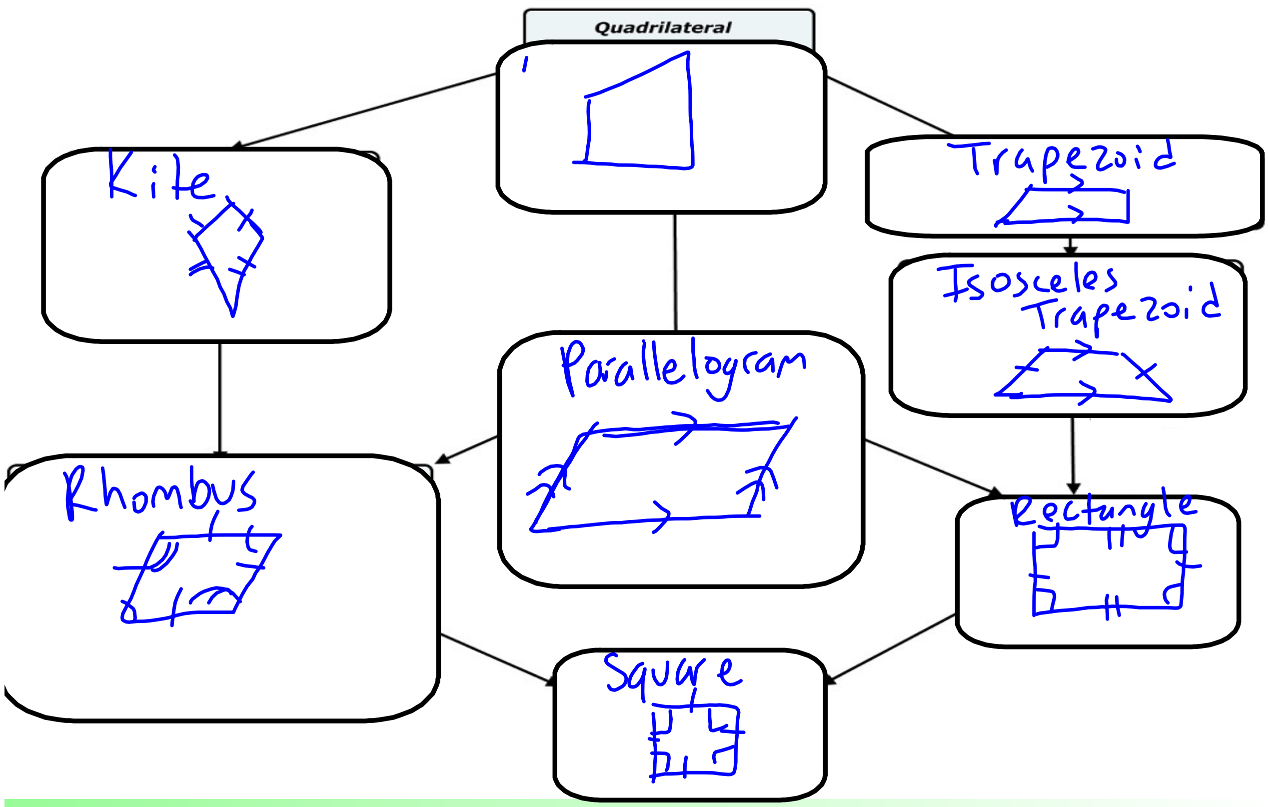
Consecutive Angles = Angles next to each other in a quadrilateral. They share one common side.

1 and 2, 2 and 3, 3 and 4, 4 and 1

Properties of Quadrilaterals



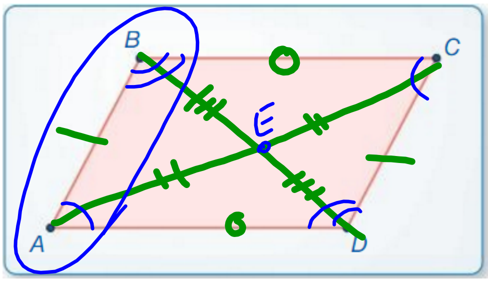
Properties of Quadrilaterals



Parallelogram Properties Exploration (Activities - Parallelogram Exploration Image - Student Copy)

- Using a ruler, measure the lengths of all 4 sides.
- Using a protractor, measure all 4 angles.
- Draw the 2 diagonals, labeling the point of intersection as E. Now use a ruler to measure the distance from E to each of the 4 vertices.

Questions to discuss in your groups:



1.) What did you observe about the sides?

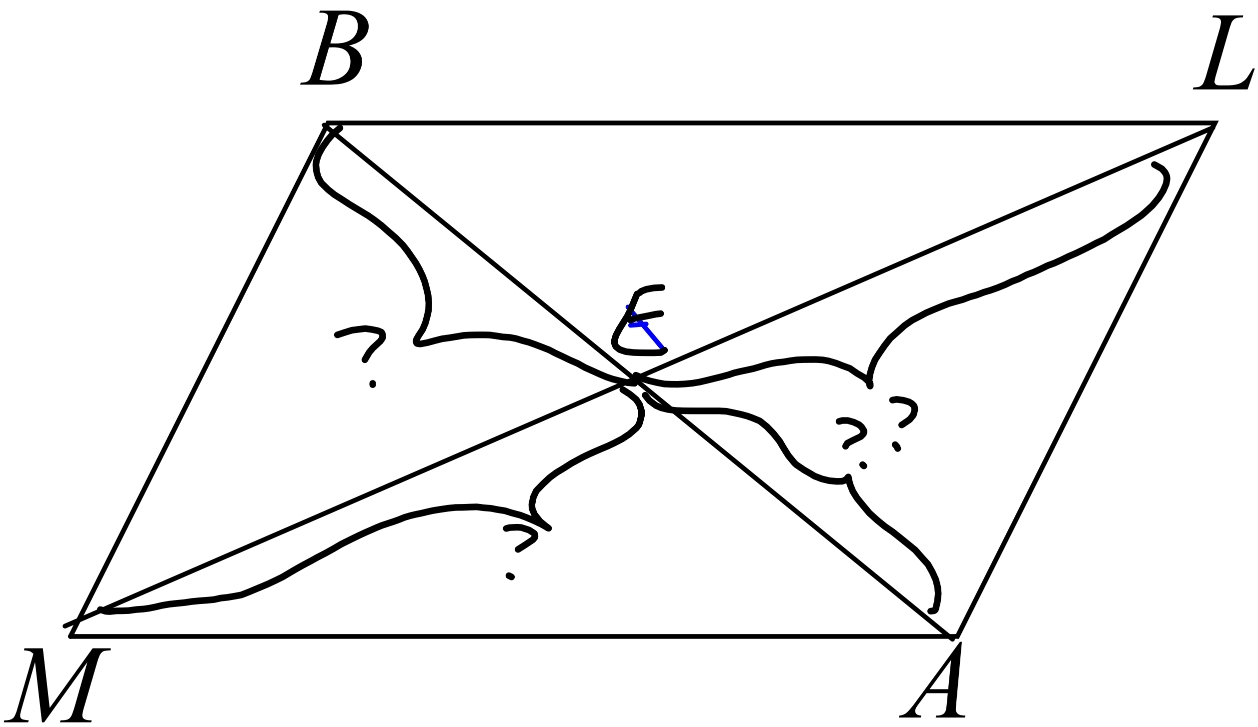
opposite sides equal

2.) What did you observe about the angles?

opposite angles equal

3.) What did you observe about the diagonals?

diagonals cut in half



Parallelogram

1.) [illegible]
2.) [illegible]
3.) [illegible] — equal
4.) [illegible]
5.) [illegible]

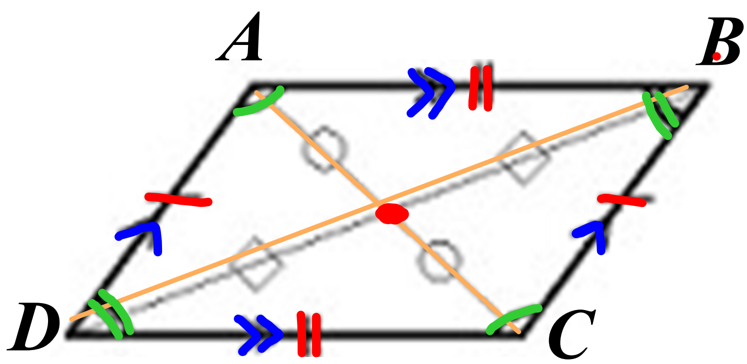
cut into 2 equal parts

adds up to 180

Parallelogram

1.) Both Pairs of Opposite Sides Parallel
2.) Both Pairs of Opposite Sides Congruent
3.) Opposite Angles Congruent
4.) Consecutive Angles Supplementary
5.) Diagonals Bisect Each Other

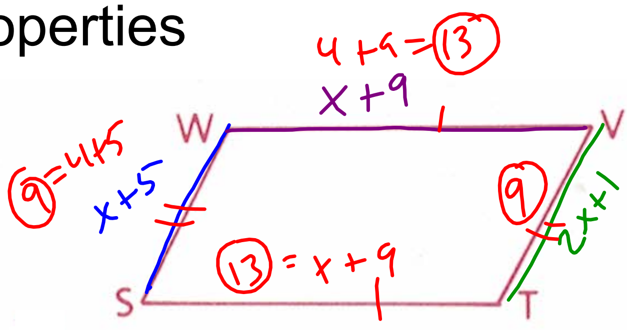
SIDES
ANGLES
DIAGONALS



Using Parallelogram Properties

1. Given: ▱ WSTV,
   WS = x + 5,
   WV = x + 9,
   VT = 2x + 1

   Find the perimeter of WSTV.



- distance around an object
- add up all the sides = P

$WS = VT$

$x+5 = 2x+1$

$-x \quad -x$

$5 = x+1$

$-1 \quad -1$

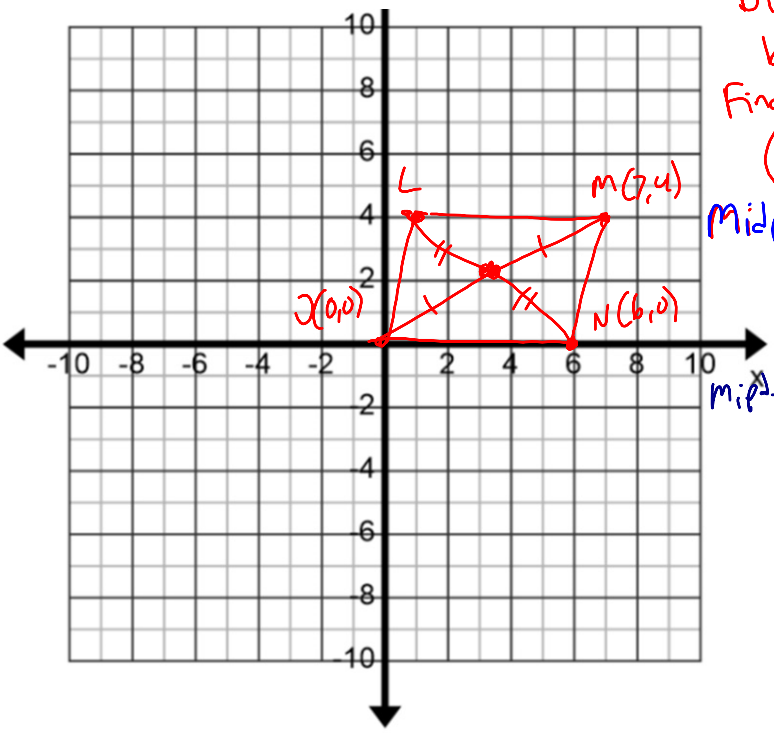
$4 = x$

$P = 9 + 13 + 9 + 13$

$\boxed{P = 44 \text{ units}}$

2. **EXAMPLE** **Using Parallelograms in the Coordinate Plane**

Find the coordinates of the intersection of the diagonals of ▱*LMNO* with vertices *L*(1, 4), *M*(7, 4), *N*(6, 0), and *O*(0, 0).



Diagonals bisect each other

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

$\text{Midpt}_{MO}: \left(\frac{7+0}{2}, \frac{4+0}{2}\right)$

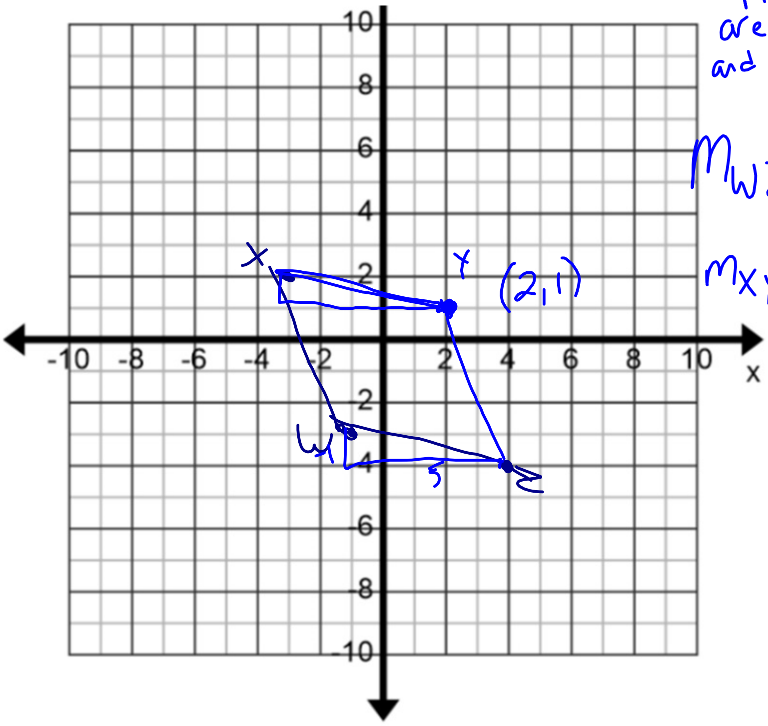
$(3.5, 2)$

$\text{midpt}_{NL}: \left(\frac{1+6}{2}, \frac{4+0}{2}\right)$

$(3.5, 2)$

3. EXAMPLE Using Parallelograms in the Coordinate Plane

Three vertices of ▱$WXYZ$ are $W(-1, -3)$, $X(-3, 2)$, and $Z(4, -4)$. Find the coordinates of vertex Y.



opposite sides are parallel and have the same slope

$m_{WZ} = \frac{rise}{run} = \frac{-1}{5}$

$m_{XY} = \frac{-1}{5}$

In Exercises 9–16, find the indicated measure in ▱$LMNQ$. Explain your reasoning.

9. LM 13

10. LP

11. LQ

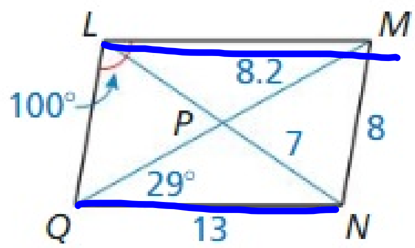
12. MQ

13. $m\angle LMN$

14. $m\angle NQL$

15. $m\angle MNQ$

16. $m\angle LMQ$



In Exercises 9–16, find the indicated measure in ▱*LMNQ*. Explain your reasoning.

9. $LM = 13$

10. $LP = 7$

11. $LQ = 8$

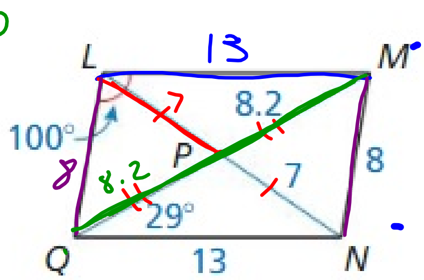
12. $MQ = 16.4$

13. $m\angle LMN$ $180 - 100$ $= 80°$

14. $m\angle NQL = 80°$

15. $m\angle MNQ = 100°$

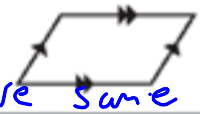
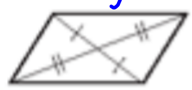
16. $m\angle LMQ = 29°$



Parallel sides
alt. int angles ≅

Homework
7.2 p.372 #4,6,8,9-20

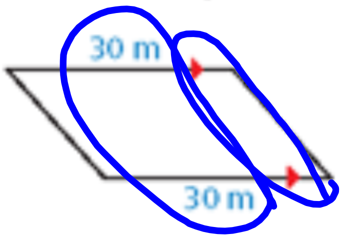
Ways to Prove a Quadrilateral Is a Parallelogram

1.	Show that both pairs of opposite sides are parallel (definition) Show slopes are same	
2.	Show that both pairs of opposite sides are congruent (parallelogram opposite sides converse) show lengths are equal	
3.	Show that both pairs of opposite angles are congruent (parallelogram Opposite Angles Converse)	
4.	Show that one pair of opposite sides are both congruent and parallel (Opposite sides parallel congruent theorem) pick one set of sides find slope + lenghts	
5.	Show that the diagonals bisect each other (parallelgoram diagonals Converse)	

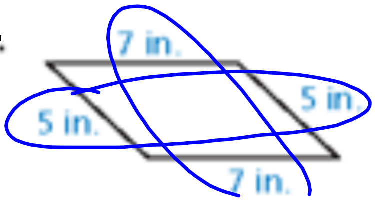
Show midpoint for the diagonals is the same

Proving it's a Parallelogram

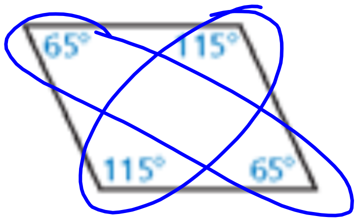
State the theorem you can use to show that the quadrilateral is a parallelogram.

4. 

Opposite sides are parallel and congruent Theorem

5. 

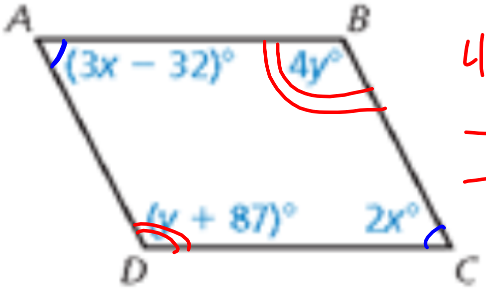
Parallelogram opposite sides congruent converse

6. 

Opposite angles Congruent Converse Thm

7.

For what values of x and y is quadrilateral $ABCD$ a parallelogram? Explain your reasoning.



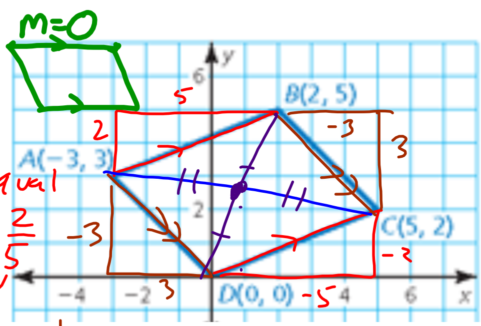
$$3x - 32 = 2x$$
$$-3x \qquad -3x$$
$$-32 = -x$$
$$\frac{-32}{-1} = \frac{-x}{-1}$$
$$\boxed{32 = x}$$

$$4y = y + 87$$
$$-y \quad -y$$
$$3y = 87$$
$$\frac{3y}{3} = \frac{87}{3}$$
$$\boxed{y = 29}$$

If $x=32$ and $y=29$, then Opposite angles are congruent and this is a parallelogram.

8.

Show that quadrilateral $ABCD$ is a parallelogram.



Method 1

Find opposite slopes are equal

$m_{AB} = \frac{rise}{run} = \frac{2}{5}$ $\qquad m_{DC} = \frac{-2}{-5} = \frac{2}{5}$

$m_{AD} = \frac{rise}{run} = \frac{-3}{3} = -1$ $\qquad m_{BC} = \frac{3}{-3} = -1$

Since opposite sides have the same slope, they are parallel and this is a parallelogram

Method 2

Show midpoints of diagonals are the same

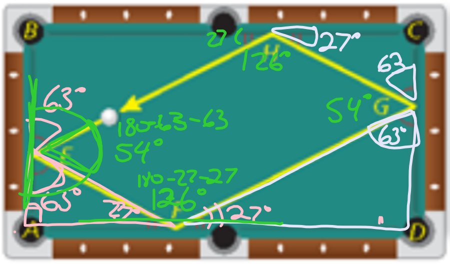
$Midpt_{AC}\left(\frac{-3+5}{2}, \frac{3+2}{2}\right)$ $\qquad Midpt_{BD}\left(\frac{2+0}{2}, \frac{5+0}{2}\right)$

$(1, 2.5)$ $\qquad (1, 2.5)$

Since both diagonals are broken up into 2 equal parts by the same point they bisect each other, and this is a parallelogram

9. **MODELING WITH MATHEMATICS** You shoot a pool ball, and it rolls back to where it started, as shown in the diagram. The ball bounces off each wall at the same angle at which it hits the wall.

90-63
27°



a. The ball hits the first wall at an angle of 63°. So $m\angle AEF = m\angle BEH = 63°$. What is $m\angle AFE$? Explain your reasoning. 90=63+m<AFE → $\boxed{\text{m<AFE=27°}}$

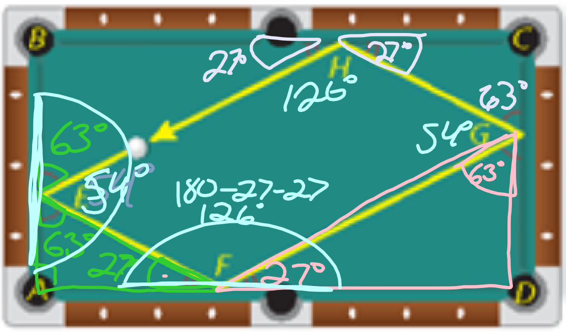
b. Explain why $m\angle FGD = 63°$. If m<AFE=27° and the ball bounces of at the same angle, then m<DFG=27° and 90=27+m<FGD → m<FGD=63°

c. What is $m\angle GHC$? $m\angle EHB$? m<GHC=m<EHB=27°

d. Is quadrilateral *EFGH* a parallelogram? Explain your reasoning. Quadrilateral EFGH is a parallelogram because <E≅<G, they are the missing angle to the straight lines created by the same 2 adjacent angles and <F ≅ <H for the same reason. So both pairs of opposite angles are congruent ∴ EFGH is a parallelogram.

9. **MODELING WITH MATHEMATICS** You shoot a pool ball, and it rolls back to where it started, as shown in the diagram. The ball bounces off each wall at the same angle at which it hits the wall.

180
-63
-63
54



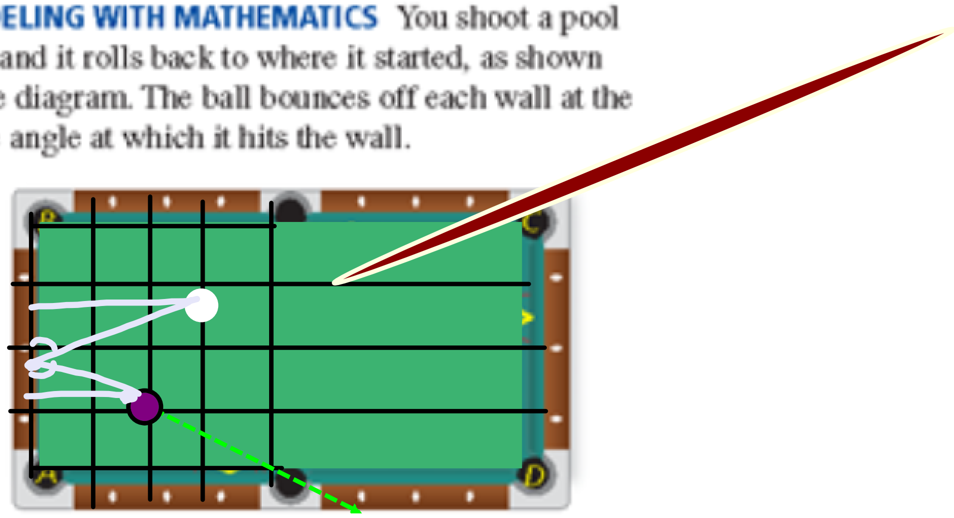
a. The ball hits the first wall at an angle of 63°. So $m\angle AEF = m\angle BEH = 63°$. What is $m\angle AFE$? Explain your reasoning. m<AFE=27° b/c 63+90+27=180

b. Explain why $m\angle FGD = 63°$. b/c one angle in the right triangle is 27°

c. What is $m\angle GHC$? $m\angle EHB$?

d. Is quadrilateral *EFGH* a parallelogram? Explain your reasoning.

9. **MODELING WITH MATHEMATICS** You shoot a pool ball, and it rolls back to where it started, as shown in the diagram. The ball bounces off each wall at the same angle at which it hits the wall.

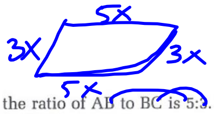


How can you hit the cue ball so that the purple ball will go into a pocket?

Homework
Day 1: 7.2 p.372 #4,6,8,9-20, (Assigned)

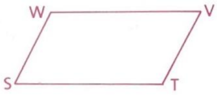
Day 2: 7.3 pg. 381 # 3-16 (Assigned)

Day 3:
7.2 pg. 372 # 28-30 (Assigned)
#32,34,40,42,45 (Extra Challenge)
7.2 pg. 381 # 17-20 (Assigned)
#21-24, 29 (Extra Challenge)



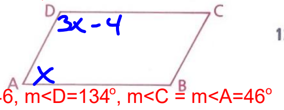
Unit 05 - Section 04

1 Given: ▱ WSTV,
WS = x + 5,
WV = x + 9,
VT = 2x + 1
Find the perimeter of WSTV.



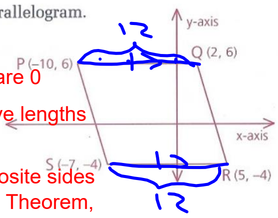
WS= VT .... x = 4, P=44 units

2 Given: ▱ ABCD,
∠A = (x)°,
∠D = (3x − 4)°
Find: m∠D and m∠C



m<D + m<A = 180 .... x= 46, m<D=134°, m<C = m<A=46°

5 Show that PQRS is a parallelogram.



PQ // SR both slopes are 0

and PQ = SR both have lengths of 12 units

By Parallelogram Opposite sides parallel and congruent Theorem, PQRS is a parallelogram

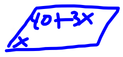
$$3x - 4 + x = 180$$
$$4x - 4 = 180$$
$$+4 \quad +4$$
$$\frac{4x}{4} = \frac{184}{4}$$
$$x = 46$$

8 In ▱ ABCD, the ratio of AB to BC is 5:3. If the perimeter of ABCD is 32, find AB. 5x + 3x + 5x + 3x = 32

x= 2 ... AB = 10

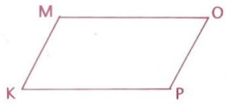
10 The measure of one angle of a parallelogram is 40 more than 3 times another. Find the measure of each angle.
(40 + 3x) + (x) = 180 ... x=35° and 145°

12 Given: Quadrilateral PQRS,
P = (−10, 7), Q = (4, 3),
R = (−2, −5), S = (−16, 1)



a Prove that quadrilateral PQRS is not a parallelogram.
b Prove that the quadrilateral formed by joining consecutive midpoints of the sides of PQRS is a parallelogram.

19 Given: ▱ KMOP,
∠M = (x + 3y)°,
∠O = (x − 4)°,
∠P = (4y − 8)°
Find: m∠K



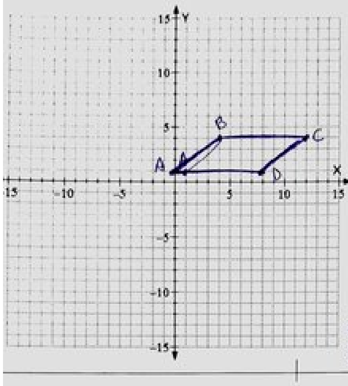
(x + 3y) + (x - 4) = 180 --> 2x + 3y = 184

x + 3y = 4y - 8 --> x - y = -8

x = 32 y = 40 m<K = 28°

eometry Name: ____________
hapter 7 Parallelogram Coordinate Proofs (7.3 #17-20 and 7.2 #27-30) Period: _____

17. $A(0, 1), B(4, 4), C(12, 4), D(8, 1)$



Prove it's a parallelogram by showing that one pair of opposite sides are parallel and congruent.

Slope of BC: $m = \frac{0}{8} = 0$

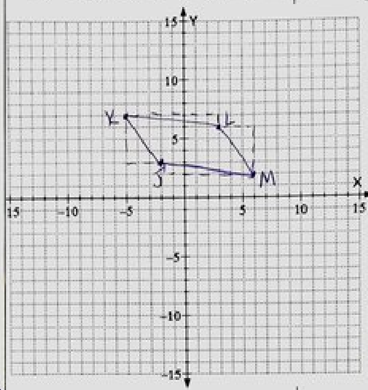
Slope of AD: $m = 0$

Length of BC: 8 units

Length of AD: 8 units

Reasoning as a sentence: Since the slopes of BC and AD are the same, and the lengths are both 8 units, the pair of opposite sides are both parallel and congruent, so by the Parallelogram opposite sides congruent parallel Theorem, ABCD is a parallelogram

9. $J(-2, 3), K(-5, 7), L(3, 6), M(6, 2)$



Prove it's a Parallelogram by showing that both pairs of opposite sides are parallel.

Slope of JK: $m = \frac{-4}{3}$

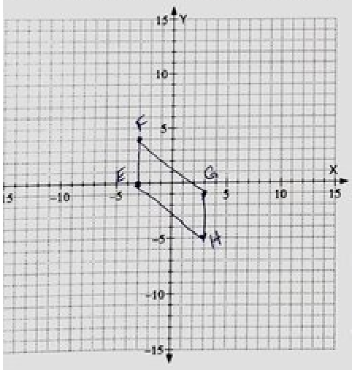
Slope of LM: $m = \frac{4}{-3}$

Slope of KL: $m = \frac{1}{-8}$

Slope of JM: $m = \frac{-1}{8}$

Reasoning as a sentence: Since both pairs of opposite sides have the same slope, th are parallel. $\overline{JK} \parallel \overline{LM}$ and $\overline{KL}$ so by definition of a parallelog JKLM is a parallelogram.

8. $E(-3, 0), F(-3, 4), G(3, -1), H(3, -5)$



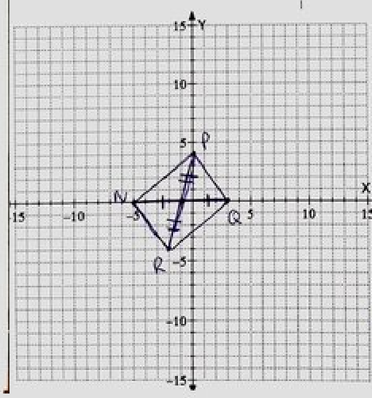
Prove it's a Parallelogram:

Slope of EF = undefined
Slope of GH = undefined

length of EF = 4
length of GH = 4

Reasoning as a sentence: Since EF = GH and both have slopes that are undefined, by the Parallelogram Opposite sides parallel and congruent Theorem, EFGH is a parallelogram

0. $N(-5, 0), P(0, 4), Q(3, 0), R(-2, -4)$



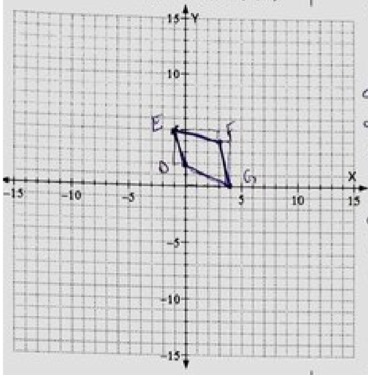
Prove it's a Parallelogram by showing that the diagonals bisect each other
Midpoint $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

Midpoint of NQ:
N(-5,0) Q(3,0)
Midpt NQ : $\left(\frac{-5+3}{2}, \frac{0+0}{2}\right)$
(-1, 0)

Midpoint of PR:
P(0,4) R(-2,-4)
Midpt PR : $\left(\frac{0+-2}{2}, \frac{4+-4}{2}\right)$
(-1, 0)

Reasoning as a sentence: Since the midpoint for both diagonals PR and NQ ~~is~~ the both diagonals are bisected ~~at~~ the point where they cross. So, by the Parallelogram Diagonals Converse Theorem, NPQR is a Parallelogram.

27. D(0,2), E(-1,5), F(3,4), G(4,0)



Prove it's a Parallelogram by showing that both pairs of opposite sides are congruent

$distance = \sqrt{rise^2 + run^2}$

Length of DE: $d = \sqrt{3^2 + 1^2}$, $d = \sqrt{9+1}$, $d = \sqrt{10}$

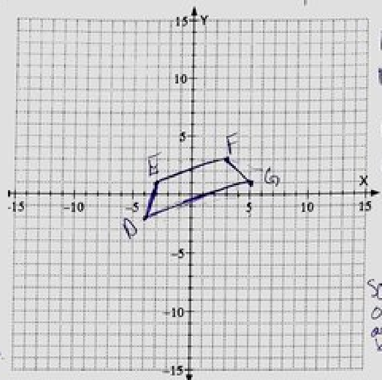
Length FG: $d = \sqrt{4^2 + 1^2}$, $d = \sqrt{16+1}$, $d = \sqrt{17}$

Length of EF: $d = \sqrt{1^2 + 4^2}$, $d = \sqrt{1+16}$, $d = \sqrt{17}$

Length of DG: $d = \sqrt{2^2 + 4^2}$, $d = \sqrt{4+16}$, $d = \sqrt{20}$

Reasoning as a sentence:
Since opposite sides are not congruent $DE \neq FG$ and $EF \neq DG$, this DEFG cannot be a paralelogram.

29. D(-4,-2), E(-3,1), F(3,3), G(5,1)



Prove it's a Parallelogram.

$m_{EF} = \frac{2}{6} = \frac{1}{3}$

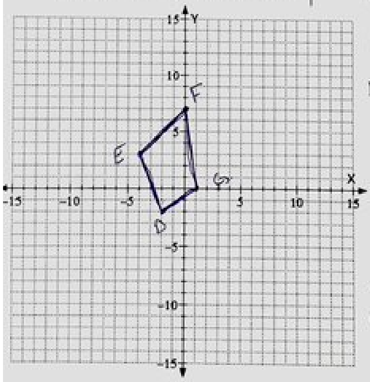
$m_{DG} = \frac{3}{9} = \frac{1}{3}$

$m_{DF} = \frac{3}{1} = 3$

$m_{FG} = \frac{2}{-2} = -1$

Reasoning as a sentence:
Since only one pair of opposite sides are parallel and not both, This cannot be a parallelogram by defin

28. D(-2,-2), E(-4,3), F(0,7), G(1,0)



Prove it's a Parallelogram.

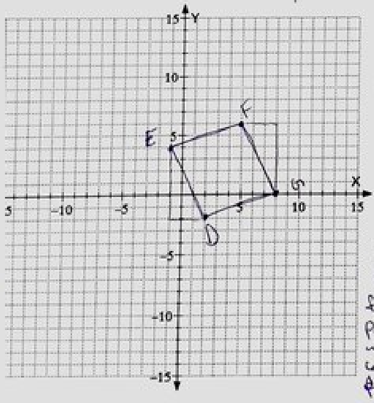
$m_{EF} = \frac{4}{4} = 1 \neq m_{DG} = \frac{2}{3}$

$m_{FG} = \frac{7}{-1} = -7 \neq m_{ED} = \frac{5}{-2}$

Reasoning as a sentence:
Since opposite sides have different slopes they are not parallel, so by definition DEFG cannot be a parallelogram

30. $E(-1, 4)$, $F(5, 6)$, $G(8, 0)$

Three vertices of ▱DEFG are given, determine the coordinates of the fourth vertex.



Missing Point D

$m_{FG} = m_{ED}$

$m_{FG} = \frac{6}{-3} = \frac{-6}{3} = m_{ED}$

$FG = \sqrt{6^2 + 3^2} = ED$

D (2,-2)

Reasoning as a sentence:
Point D must be at (2 for DEFG to be a parallelogram because this would create a parallel and congruent set of sides. So b Parallelogram Congruent Parall Theorem DEFG is a paral