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Objectives

After studying this section, you will be able to

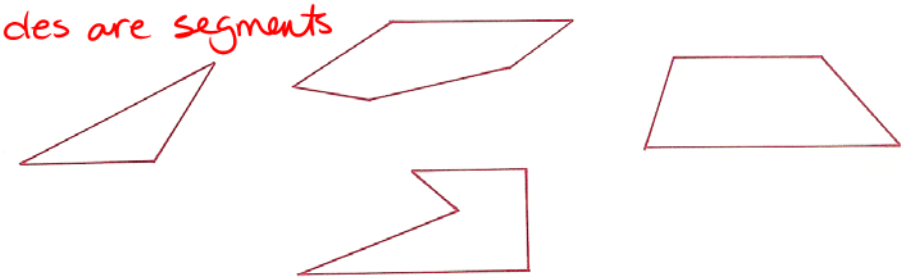
- Recognize polygons
- Understand how polygons are named
- Recognize convex polygons
- Recognize diagonals of polygons
- Identify special types of quadrilaterals

5.4 Notes

Polygons

Polygons are plane figures. The following are examples of polygons.

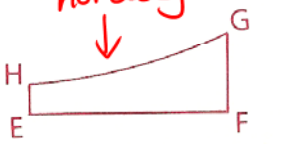
sides are segments



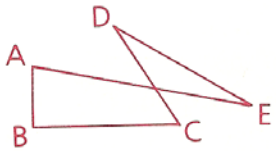
The following are examples of figures that are not polygons.

not a seg ∴ not a poly

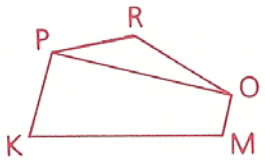
EFGH is not a polygon, because a polygon consists entirely of segments.



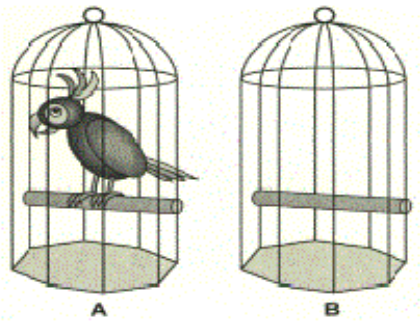
ABCDE is not a polygon. In a polygon, consecutive sides intersect only at endpoints. Nonconsecutive sides do not intersect.



PKMO, PKMOR, and POR are polygons, but PKMOPRO is not, because each vertex must belong to exactly two sides. (Vertex P belongs to three sides in PKMOPRO.)



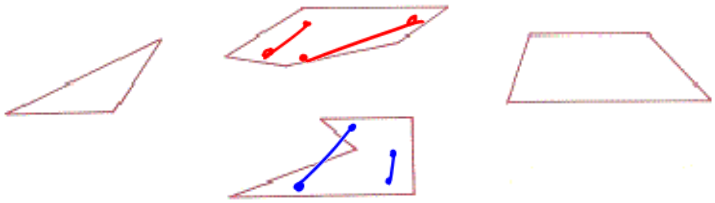
Q: What is a polygon?



WA: It's when your parrot has escaped.

RA: Closed shape w/ seg's as sides.

Polygons are plane figures. The following are examples of polygons.



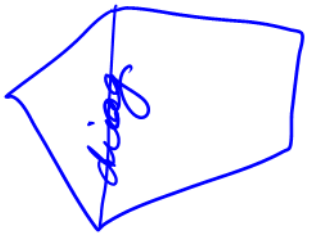
Convex join any 2 pts or segs stays on int

Concave any 2 pts seg may leave poly

Convex Polygons

Many of the polygons you encounter in your geometry studies will be ***convex.***

Definition A ***convex polygon*** is a polygon in which each interior angle has a measure less than 180.



Diagonals of Polygons

In the two following figures, the dashed segments are ***diagonals*** of the polygons.

Definition A ***diagonal*** of a polygon is any segment that connects two nonconsecutive (nonadjacent) vertices of the polygon.

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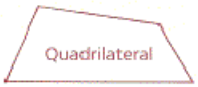
Quadrilaterals

A ***quadrilateral*** is a four-sided polygon.

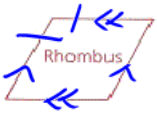


The following are special quadrilaterals.

A ***parallelogram*** is a quadrilateral in which both pairs of opposite sides are parallel.

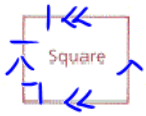
A ***rectangle*** is a parallelogram in which at least one angle is a right angle.

A ***rhombus*** is a parallelogram in which at least two consecutive sides are congruent.



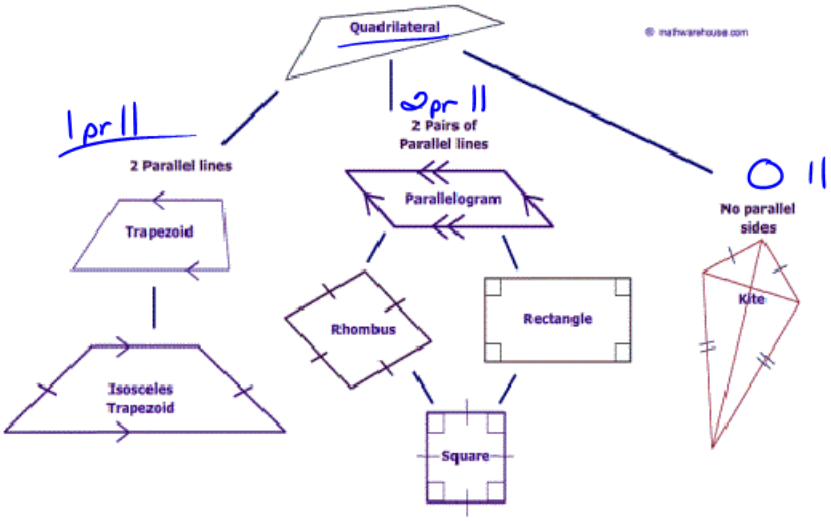
A ***kite*** is a quadrilateral in which two *disjoint* pairs of consecutive sides are congruent.

A ***square*** is a parallelogram that is both a rectangle and a rhombus.



A ***trapezoid*** is a quadrilateral with exactly one pair of parallel sides. The parallel sides are called *bases* of the trapezoid.

An ***isosceles trapezoid*** is a trapezoid in which the nonparallel sides (legs) are congruent. In the figure, ∠A and ∠B are called the ***lower base angles,*** and ∠C and ∠D are called the ***upper base angles***.



5.5 Notes

The properties of the quadrilaterals are noted in the ASN.

The Four Types of Symmetry in the Plane

Rotation

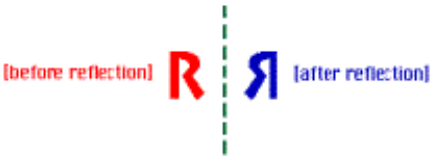
To rotate an object means to turn it around. Every rotation has a center and an angle.

Translation

To translate an object means to move it without rotating or reflecting it. Every translation has a direction and a distance.

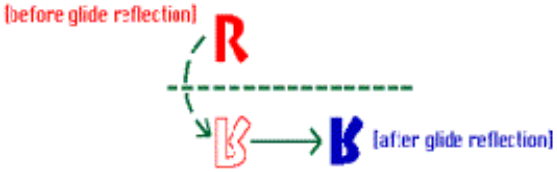
Reflection

To reflect an object means to produce its mirror image. Every reflection has a mirror line. A reflection of an "R" is a backwards "R".



Glide Reflection

A glide reflection combines a reflection with a translation along the direction of the mirror line. Glide reflections are the only type of symmetry that involve more than one step.



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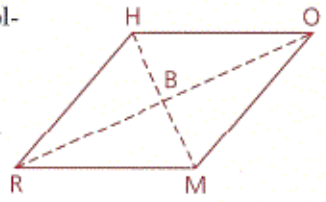
5.4 Examples

Problem Set A

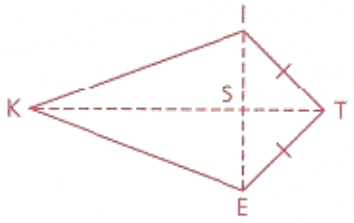
A computer and exploratory geometry software may be used for problems 1–5.

1 Examine the rhombus. Which of the following statements appear to be true?



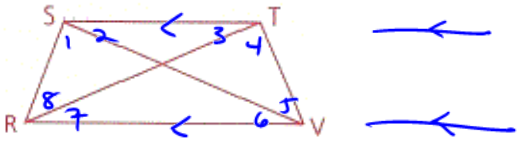
a. All four sides are congruent.
b. The diagonals are perpendicular.
c. The diagonals bisect the angles.
d. The diagonals bisect each other.
e. The diagonals are congruent.

3 Examine the kite. Which of the following statements appear to be true?



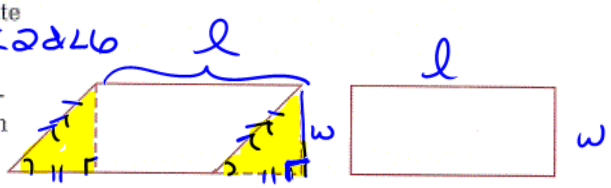
a. The opposite sides are congruent. F
b. Opposite sides are parallel. F
c. The diagonals bisect the angles. F
d. The diagonals bisect each other. F
e. The diagonals are congruent. F
f. The diagonals are perpendicular.

7 In the isosceles trapezoid shown, $\overline{ST} \parallel \overline{RV}$.



Name: a. The bases $\overline{RV}$ & $\overline{ST}$
b. The diagonals $\overline{RT}$ & $\overline{SV}$
c. The legs $\overline{SR}$ & $\overline{TV}$
d. The lower base angles ∠SRV & ∠TVR
e. The upper base angles ∠RST & ∠VTS
f. All pairs of congruent alternate interior angles ∠3 & ∠7, ∠2 & ∠6

10 Using the diagram, explain how the formula for the area of a parallelogram can be the same as that for the area of a rectangle.



Area Rect: $l \cdot w$ = A parallelogram

21. How many diagonals does a n-sided polygon have?

Polygon Drawing	Number of sides = n	Number of diagonals	1st change: Difference in diagonal count	2nd change: Difference in the difference	Attempted formulas:	How many vertices does the polygon have?	How many diagonals meet at one vertex of the polygon
	3		- -	- -			
	4			- -			
	5						
	6						
	7						
	8						
	n						

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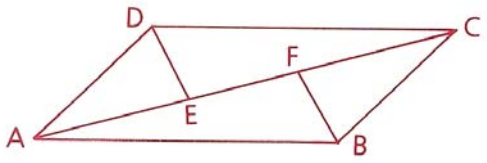
5.5 Examples

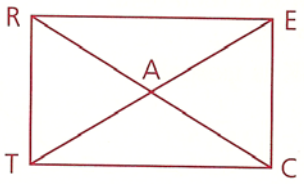
4 Given: $\square ABCD$, $\overline{AE} \cong \overline{CF}$

Conclusion: $\overline{DE} \cong \overline{BF}$



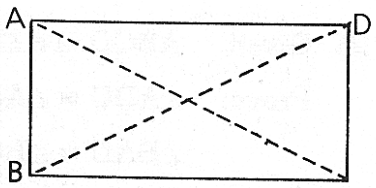
12 Given: RECT is a rectangle.
$RA = 43x$,
$AC = 214x - 742$

Find: The length of $\overline{ET}$ to the nearest tenth



15 Given: ABCD is a $\square$.

Prove: $\overline{AC} \cong \overline{BD}$



1 ABCD is a $\square$.	1 Given
2 ABCD is a $\square$.	2
3 $\angle C$ is a rt $\angle$.	3
4 $\overline{AD} \parallel \overline{BC}$	4
5 $\angle D$ is a rt $\angle$.	5
6 $\angle C \cong \angle D$	6
7 $\overline{AD} \cong \overline{BC}$	7
8 $\overline{DC} \cong \overline{DC}$	8
9 $\triangle ACD \cong \triangle BDC$	9
10 $\overline{AC} \cong \overline{BD}$	10

AMDG

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5.4 Homework

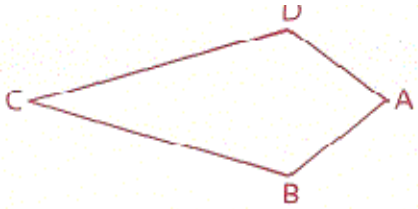
6 **a** Draw an equilateral quadrilateral that is not equiangular.
b Draw an equiangular quadrilateral that is not equilateral.

8. Examine each statement below. If the statement is always true, check the Always column; if it's sometimes true, check sometimes; and if it's never true, check never.	Always	Some times	Never
a. A square is a rhombus.			
b. A rhombus is a square.			
c. A kite is a parallelogram.			
d. A rectangle is a polygon.			
e. A polygon has the same number of vertices as sides.			
f. A parallelogram has three diagonals.			
g. A trapezoid has three bases.			

9 Why is a circle not a polygon?

12 Find the area of a square whose perimeter is 65 feet.

16 Given: ABCD is a kite.
$AB = x + 3$,
$BC = x + 4$,
$CD = 2x - 1$,
$AD = 3x - y$

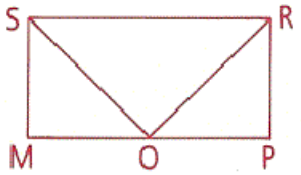


a Solve for x and y.
b What is the perimeter of the kite?
c Is it possible for $\overline{AC}$ to be 19 units long? Why or why not?

5.5 Homework

3 Given: Rectangle MPRS, $\overline{MO} \cong \overline{PO}$

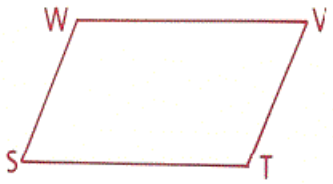
Prove: $\triangle ROS$ is isosceles.



Statements	Reasons
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.

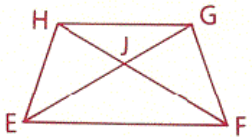
5 Given: $\square$ WSTV,
$WS = x + 5$,
$WV = x + 9$,
$VT = 2x + 1$

Find the perimeter of WSTV.



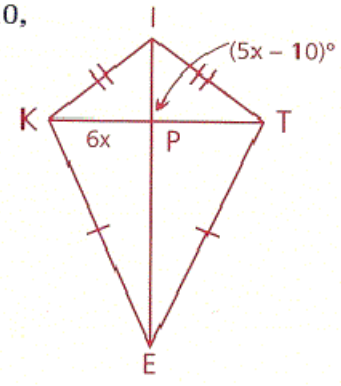
7 Given: EFGH is an isosceles trapezoid, with legs $\overline{HE}$ and $\overline{GF}$.
$EJ = x + 5$,
$JG = 2x - 1$,
$HF = 13$

Find: EJ, JG, and HJ



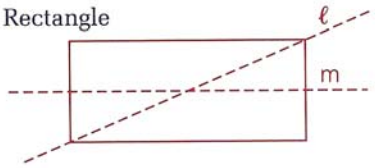
11 Given: $m\angle IPT = 5x - 10$,
$KP = 6x$

Find: KT

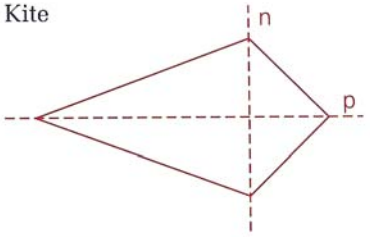


13 Which of the dotted lines represent an *axis of symmetry* of the figure? (One side of a figure is a reflection of the other side over an axis of symmetry.)

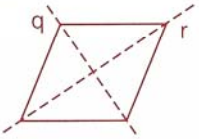
a Rectangle



b Kite

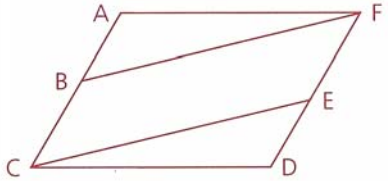


c Rhombus



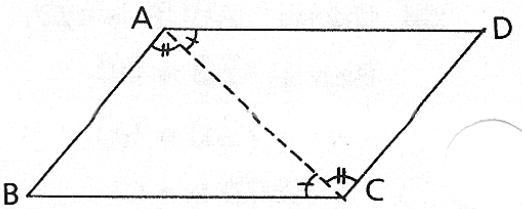
14 Given: $\angle AFB \cong \angle DCE$,
$\triangle AFB \ncong \triangle DCE$

Prove: ACDF is not a parallelogram.



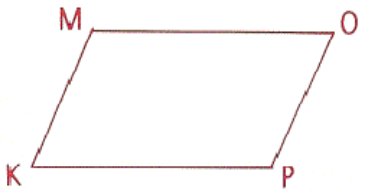
14 Given: ABCD is a $\square$.

Prove: $\overline{AB} \cong \overline{DC}, \overline{AD} \cong \overline{BC}$

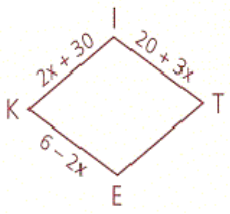


1 ABCD is a $\square$.	1 Given
2 Draw $\overline{AC}$	2 Two pts determine a line.
3 $\overline{AB} \parallel \overline{DC}$	3
4 $\overline{AD} \parallel \overline{BC}$	4
5 $\angle BAC \cong \angle ACD$	5
6 $\angle ACB \cong \angle DAC$	6
7 $\overline{AC} \cong \overline{AC}$	7 Reflexive prop
8 $\triangle ADC \cong \triangle CBA$	8 ASA
9 $\overline{AB} \cong \overline{DC}$	9 CPCTC
10 $\overline{AD} \cong \overline{BC}$	10 CPCTC

19 Given: $\square$ KMOP,
$\angle M = (x + 3y)°$,
$\angle O = (x - 4)°$,
$\angle P = (4y - 8)°$
Find: $m\angle K$



21 An author wrote a problem involving kite KITE but forgot to say which pairs of sides were congruent. Work the problem twice to see which pairs of sides are congruent.



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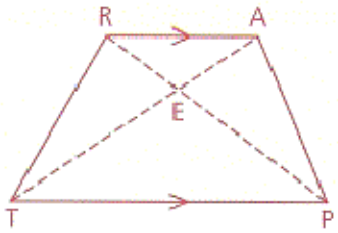
5.4 Class Work

Circle the statements that appear to be true.

2 Examine the isosceles trapezoid. Which of the following statements appear to be true?

a The opposite sides are congruent.
b Opposite sides are parallel.
c The diagonals bisect the angles.
d The diagonals bisect each other.
e The diagonals are congruent.



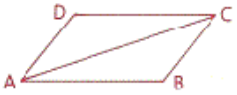
11. Find the sum of the measure of the angles of a polygon.

Polygon Drawing	Number of sides = n	Number of triangles that can be drawn from ONE vertex.	Sum of angles of the polygon
	3		
	4		
	5		
	6		
	7		
	8		
	n		

5.5 Class Work

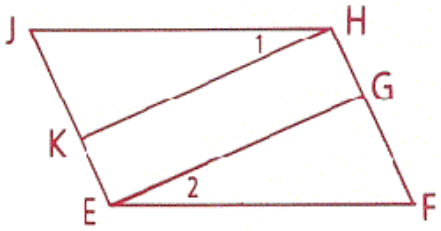
Problem Set A

1 Given: ▱ ABCD (ABCD is a ▱)
Conclusion: △ABC ≅ △CDA



Statements	Reasons
1.	1.
2.	2.
3.	3.
4.	4.

2 Given: ▱ EFHJ,
$\angle 1 \cong \angle 2$
Conclusion: $\overline{KH} \cong \overline{EG}$



Supply each missing reason.

1 ▱ EFHJ	1 _____
2 $\angle J \cong \angle F$	2 _____
3 $\overline{JH} \cong \overline{EF}$	3 _____
4 $\angle 1 \cong \angle 2$	4 _____
5 $\triangle KJH \cong \triangle GFE$	5 _____
6 $\overline{KH} \cong \overline{EG}$	6 _____

6 Given: ▱ ABCD,
$\angle A = (x)°$,
$\angle D = (3x - 4)°$
Find: $m\angle D$ and $m\angle C$