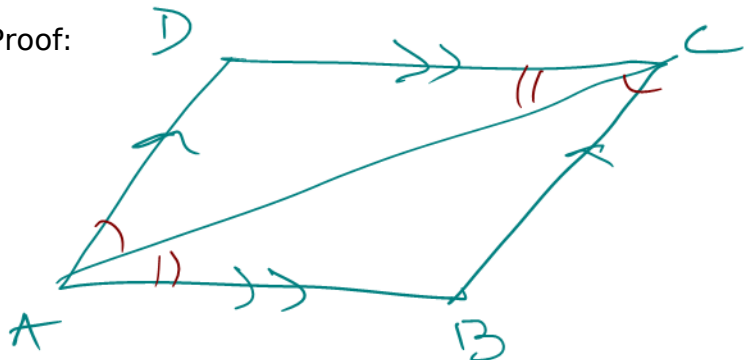


**Class Notes
Section 4.1
Parallelograms**

Defn - a parallelogram is a quadrilateral in which both pairs of opposite sides are parallel.

Thm - A diagonal of a parallelogram separates it into two congruent triangles.

Proof:



$\angle DAC \cong \angle ACB$
 $\angle CAB \cong \angle ACB$
 $AC \cong AC$ Reflexive
 $\therefore \triangle ADC \cong \triangle CAB$ ASA

$\angle A \cong \angle C, \angle B \cong \angle D$

Corollary - The opposite angles of a parallelogram are congruent.

Corollary - The opposite sides of a parallelogram are congruent.

Corollary - The diagonals of a parallelogram bisect each other.

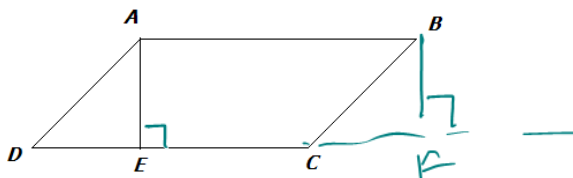
Corollary - Two consecutive angles of a parallelogram are supplementary.

$m\angle A + m\angle D = 180$ $m\angle D + m\angle C = 180$

Thm - Two parallel lines are everywhere equidistant.

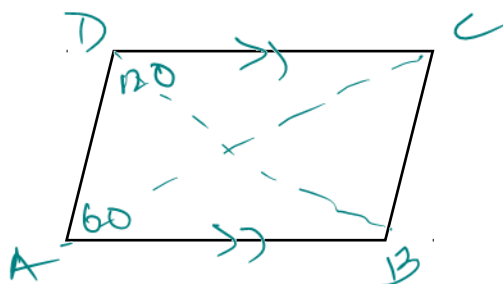
$m\angle C + m\angle B = 180$
 $m\angle A + m\angle B = 180$

Defn - An **altitude** of a parallelogram is a line segment from one vertex that is perpendicular to a non adjacent side (or an extension of that side).



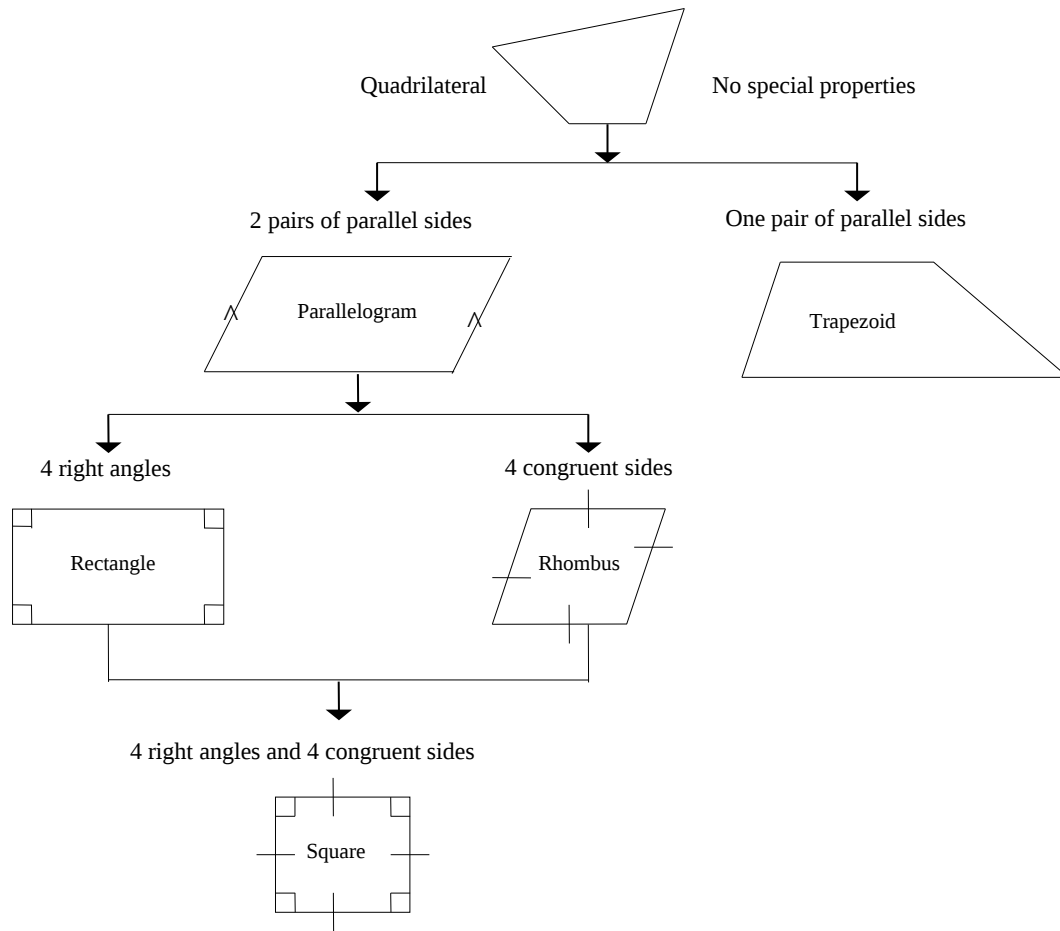
$AE = BF$

Thm - in a parallelogram with unequal pairs of consecutive angles, the longer diagonal lies opposite the obtuse angle.



$AC > BD$

As seen in the flow chart below, a rectangle, a rhombus, and a square are all parallelograms.

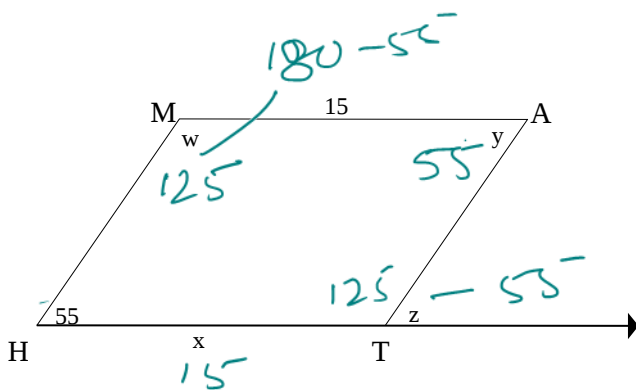


“RULES” of parallelograms:

- 1) Opposite sides of a parallelogram are congruent.
- 2) Opposite angles of a parallelogram are congruent.
- 3) Consecutive angles in a parallelogram are supplementary.
- 4) The diagonals of a parallelogram bisect each other.

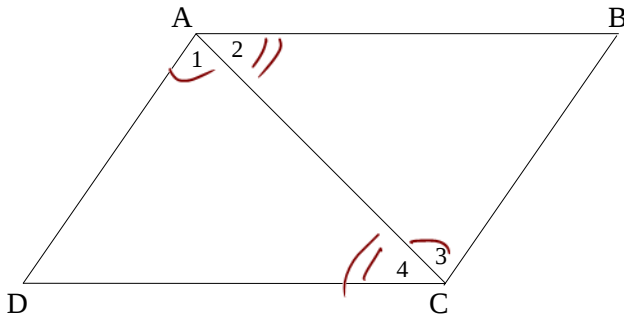
Example 1:

MATH is a parallelogram. Find the values of w , x , y , and z .



Example 2:

If $\angle 1 \cong \angle 3$ and $\angle 2 \cong \angle 4$, is quadrilateral ABCD a parallelogram?

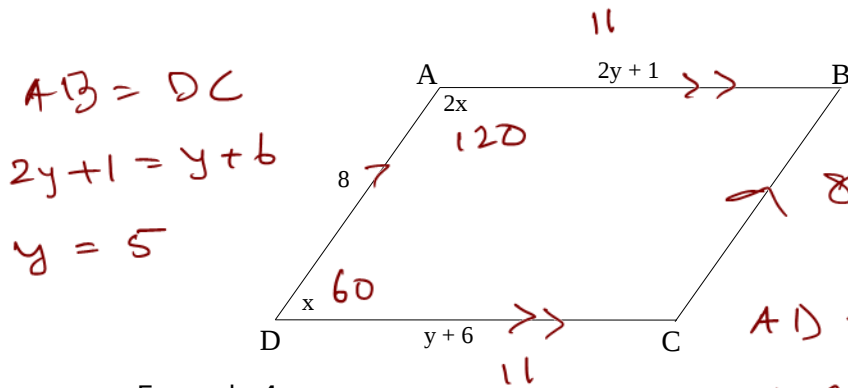


Yes because a diagonal separates a quad into 2 \cong Δ s
 Here $\Delta ADC \cong \Delta CBA$ (ASA)

$\therefore \square ABCD$ is a \parallel gram

Example 3:

Find the measure of each angle and side in parallelogram ABCD below.



$$2x + x = 180$$

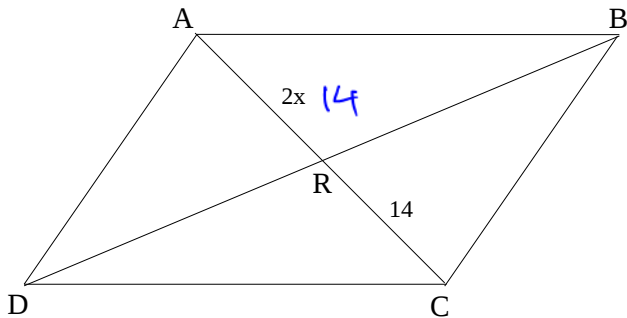
$$3x = 180$$

$$x = 60$$

$$AD = BC$$

$$\therefore BC = 8$$

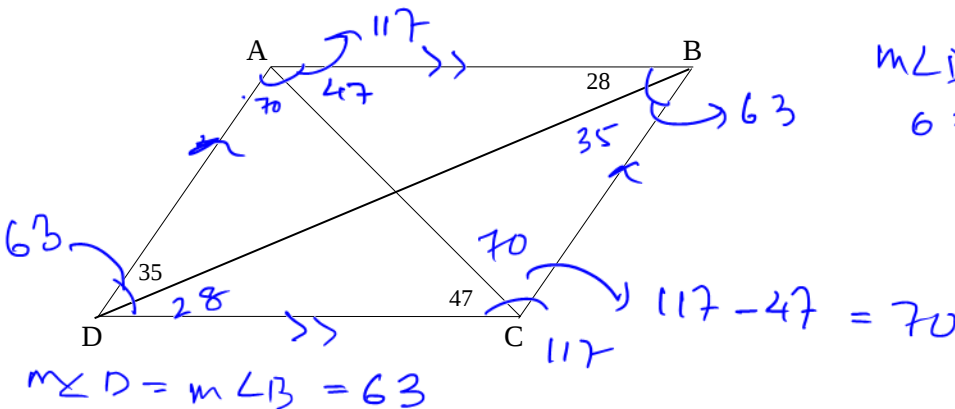
Example 4:



\overline{AC} & \overline{BD}
 Diagonals ~~are~~ intersect at R. Find the measure of: \overline{AC}
 =
 Diagonals bisect each other
 $\therefore AR = RC$
 $2x = 14$
 $x = 7$
 $\therefore AC = 28$

Example 5:

Find the measure of each angle in parallelogram ABCD below.



$$m\angle D + m\angle C = 180$$

$$63 + m\angle C = 180$$

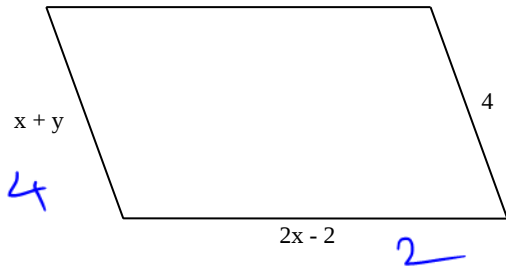
$$m\angle C = 180 - 63$$

$$= 117$$

$$m\angle D = m\angle B = 63$$

Example 6: Find $x = \underline{2}$
 $y = \underline{2}$

$x + y = 4$ $2x - 2 = y$ (ii)
 $y = 4 - x$ (i)
 substituting (i) in (ii) we get



$2x - 2 = 4 - x$
 $3x = 6$
 $x = 2$

$y = 4 - x$
 $= 4 - 2$
 $= 2$

Methods might be used to prove that a quadrilateral is a parallelogram.

1. If both pairs of opposite sides of a quadrilateral are parallel, then the quadrilateral is a parallelogram.
2. If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.
3. If one pair of opposite sides of a quadrilateral are both parallel and congruent, then the quadrilateral is a parallelogram.
4. If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram.
5. If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

6. Diagonals cuts the quad into 2 \cong Δ s

Example 7: State whether or not you can conclude that the figure is a parallelogram, based on the given information.

- a. $AB \cong CD$ and $AD \cong BC$ T(R2)
- b. $AB \parallel CD$ and $AD \parallel BC$ T(R1)
- c. $AB \cong CD$ and $AB \parallel CD$ T(R3)
- d. $AD \cong BC$ and $AB \parallel CD$ F
- e. $AE = AC$ and $BE = BD$
- f. $AB = BC = CD = AD$
- g. $m\angle ADC = m\angle ABC$ and $m\angle BAD = m\angle BCD$

