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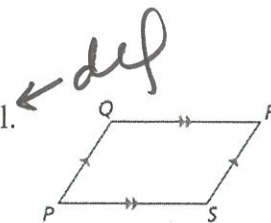
Date:

Period: 4

Properties of Parallelograms

Lesson Objective | WBAT prove and apply properties of parallelograms

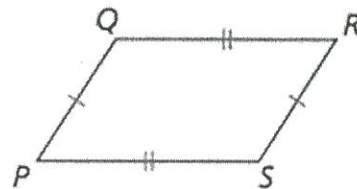
Parallelogram: A parallelogram is a quadrilateral with both pairs of opposite sides parallel.



The theorems below describe other properties of parallelograms.

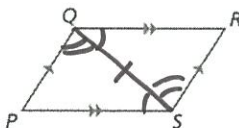
Parallelogram Opposite Sides Theorem

If a quadrilateral is a parallelogram, then the opposite sides are congruent.



PROOF: **Given**: PQRS is a parallelogram

Prove: $\overline{PQ} \cong \overline{RS}$ and $\overline{QR} \cong \overline{SP}$



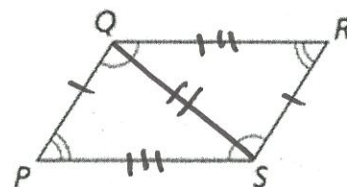
Statements

Reasons

- | | |
|---|---|
| ① PQRS is a // - gram | ① given |
| ② draw Draw $\overline{QS}$ | ② Thru any 2 points there is one line |
| ③ $\overline{QS} \cong \overline{SQ}$ | ③ reflex. prop $\cong$ |
| ④ $\overline{QR} \parallel \overline{PS}$, $\overline{PQ} \parallel \overline{RS}$ | ④ def of // - gram |
| ⑤ $\angle RQS \cong \angle PSQ$, $\angle PQS \cong \angle RSQ$ | ⑤ $\parallel \rightarrow$ alt - int. $\angle s \cong$ |
| ⑥ $\triangle RQS \cong \triangle PSQ$ | ⑥ ASA $\cong$ |
| ⑦ $\overline{PQ} \cong \overline{RS}$, $\overline{QR} \cong \overline{SP}$ | ⑦ CPCTC |

Parallelogram Opposite Angles Theorem

If a quadrilateral is a parallelogram, then its opposite angles are congruent.



PROOF: **Given**: PQRS is a parallelogram

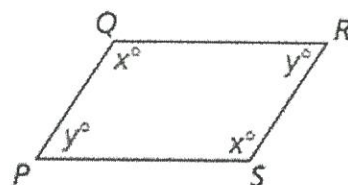
Prove: $\angle P \cong \angle R$ and $\angle Q \cong \angle S$

proof on next page

Statements	Reasons
① PQRS is a -gram	① given
② Draw $\overline{QS}$	② Thru 2 points is one line
③ $\overline{QS} \cong \overline{SQ}$	③ reflex. prop. $\cong$
④ $\overline{QR} \cong \overline{SP}$, $\overline{PQ} \cong \overline{RS}$	④ -gram $\rightarrow$ opp. sides $\cong$
⑤ $\triangle PQS \cong \triangle RSQ$	⑤ SSS $\cong$
⑥ $\angle P \cong \angle R$	⑥ CPCTC
⑦ Draw $\overline{PR}$	⑦ Thru 2 points is one line
⑧ $\overline{PR} \cong \overline{RP}$	⑧ reflex. prop. $\cong$
⑨ $\triangle PQR \cong \triangle RSP$	⑨ SSS $\cong$
⑩ $\angle Q \cong \angle S$	⑩ CPCTC

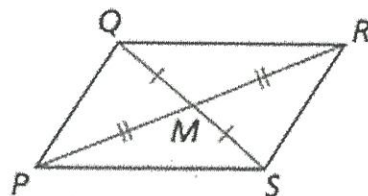
Parallelogram Consecutive Angles Theorem

If a quadrilateral is a parallelogram, then its consecutive angles are supplementary.

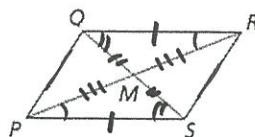


Parallelogram Diagonals Theorem

If a quadrilateral is a parallelogram, then its diagonals bisect each other.



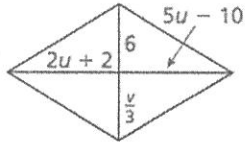
PROOF: **Given:** PQRS is a parallelogram
 Diagonals $\overline{PR}$ and $\overline{QS}$ intersect at M
Prove: M bisects $\overline{PR}$ and $\overline{QS}$



Statements	Reasons
① PQRS is a -gram	① given
② $\overline{QR} \parallel \overline{PS}$	② -gram $\rightarrow$ opp. sides $\parallel$
③ $\overline{QR} \cong \overline{SP}$	③ -gram $\rightarrow$ opp. sides $\cong$
④ $\angle QRM \cong \angle SPM$, $\angle RQM \cong \angle PSM$	④ $\parallel \rightarrow$ alt. int. $\angle$ s $\cong$
⑤ $\triangle QMR \cong \triangle SMP$	⑤ ASA $\cong$
⑥ $\overline{MR} \cong \overline{MP}$, $\overline{MQ} \cong \overline{MS}$	⑥ CPCTC
⑦ M bisects $\overline{PR}$ and $\overline{QS}$	⑦ def. of seg. bisector

Example:

1. Find the values of u and v .



$$2u+2=5u-10$$

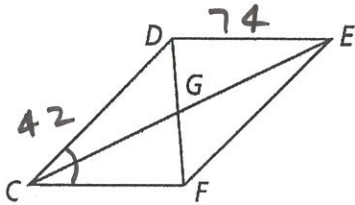
$$12=3u$$

$$u=4$$

$$v = \frac{v}{3}$$

$$v=18$$

2. In parallelogram CDEF, $DE = 74\text{mm}$, $DG = 31\text{mm}$, and $m\angle FCD = 42^\circ$. Answer the following questions and give reasons for each answer.



- a. Find CF

$$74\text{mm}$$

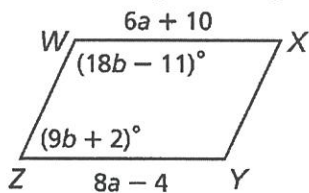
- b. Find $m\angle EFC$

$$138^\circ$$

- c. Find DF

$$62\text{mm}$$

3. WXYZ is a parallelogram.



- a. Find YZ

$$YZ=52$$

$$6a+10=8a-4$$

$$14=2a$$

$$7=a$$

- b. Find $m\angle Z$

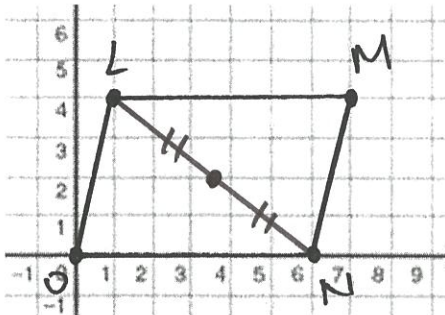
$$m\angle Z=105^\circ$$

$$18b-11+9b+2=180$$

$$27b=189$$

$$b=7$$

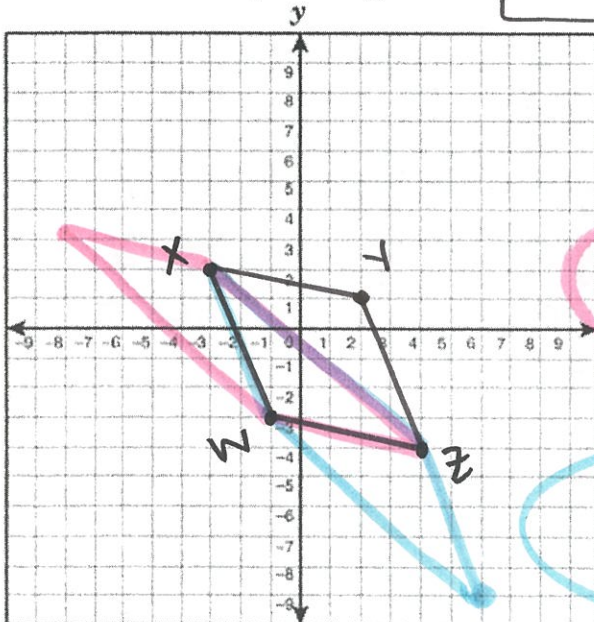
4. Find the coordinates of the intersection of the diagonals of parallelogram LMNO.



$$\text{mdpt LN} = \left(\frac{1+6}{2}, \frac{0+4}{2} \right)$$

$$= \left(\frac{7}{2}, \frac{4}{2} \right) = \left(\frac{7}{2}, 2 \right)$$

5. Three vertices of parallelogram WXYZ are shown. Find the coordinates of the fourth vertex, Y.



$$Y(2, 1)$$

*the name of the

$$WXYZ$$

$$Y(-8, 3)$$

$$WXYZ$$

$$Y(6, -9)$$