

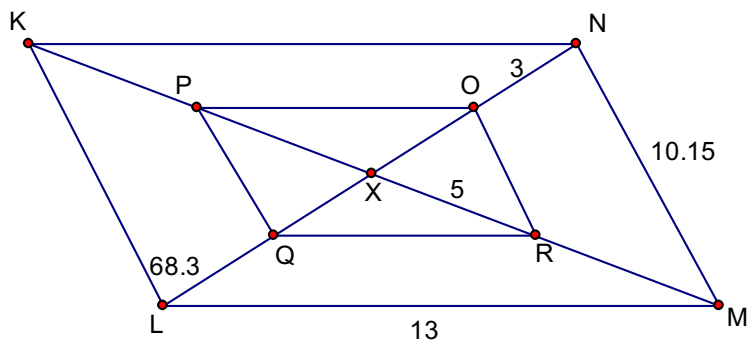
7-1: Properties of Parallelograms

A **parallelogram** is a quadrilateral whose opposite sides are parallel.

The following theorems apply to all parallelograms:

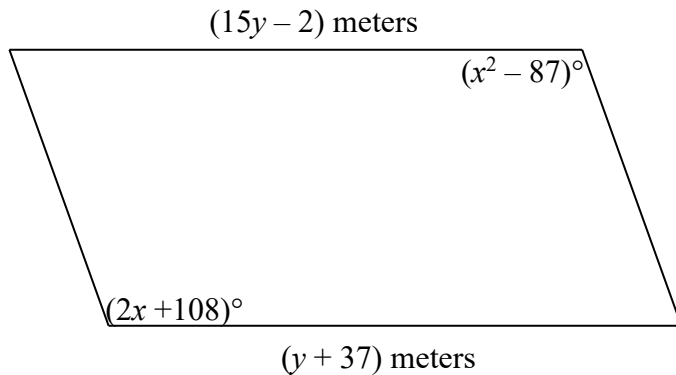
- If a quadrilateral is a parallelogram, then its **opposite sides** are **congruent**.
- If a quadrilateral is a parallelogram, then its **opposite angles** are **congruent**.
- If a quadrilateral is a parallelogram, then its **consecutive (or same-side interior) angles** are **supplementary**.
- If a quadrilateral is a parallelogram, then its **diagonals bisect each other**.

EX 1) In parallelogram $KLMN$ below, points O, P, Q, R are midpoints of \overline{KN} , \overline{KL} , \overline{LN} , and \overline{LM} , $\angle NKL = 61^\circ$ and $\angle NLK = 68.3^\circ$. Find the indicated measures.



- | | | |
|------------------|------------------|------------------------|
| a) KN | b) PX | c) KL |
| d) XN | e) LN | f) KP |
| g) KR | h) $m\angle MNL$ | i) $m\angle NLM$ |
| j) $m\angle NML$ | k) $m\angle XQP$ | l) Perimeter of $KLMN$ |

EX 2) Solve for x and y in the parallelogram below.



7-2: Properties of Parallelograms

In order to prove that a quadrilateral is a parallelogram, you can show that *both* pairs of opposite sides are parallel (since this is the definition of a parallelogram).

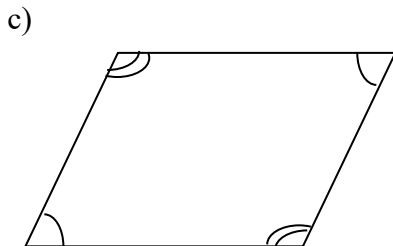
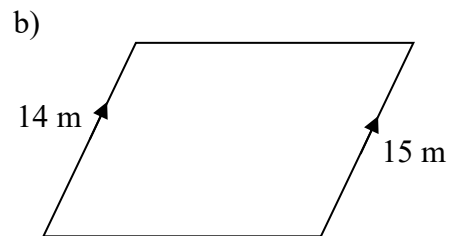
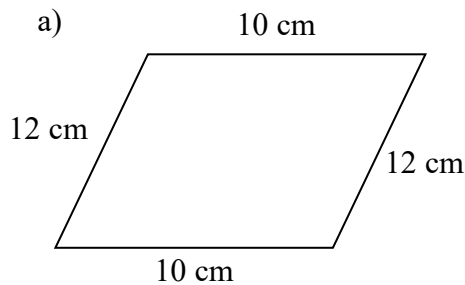
In addition, you can prove a quadrilateral is a parallelogram any of the following ways:

- If the **opposite sides** of a quadrilateral are **congruent**, then it is a parallelogram.
- If the **opposite angles** of a quadrilateral are **congruent**, then it is a parallelogram.
- If the **consecutive angles** of a quadrilateral are **supplementary**, then it is a parallelogram.
- If the **diagonals** of a quadrilateral **bisect each other**, then it is a parallelogram.
- If *one* pair of **opposite sides** are **parallel** and **congruent**, then the quadrilateral is a parallelogram.

Note that these are the converses of the theorem in 6-2 (with the exception of the last statement).

(page 413 has a good summary for recognizing what is a parallelogram)

EX 3) For each of the figures below, which **MUST** be parallelograms. If it is a parallelogram, write the reason why it is. If it is not, explain why not.



EX 4) Prove that quadrilateral $ABCD$ below is a parallelogram. There are 3 different ways to attack this coordinate proof, so find one that works best for you.

- Method 1: Show that opposite sides are parallel (have the same slope).
- Method 2: Show that opposite sides are congruent (have the same length).
- Method 3: Show that *one* pair of opposite sides is congruent and parallel.

