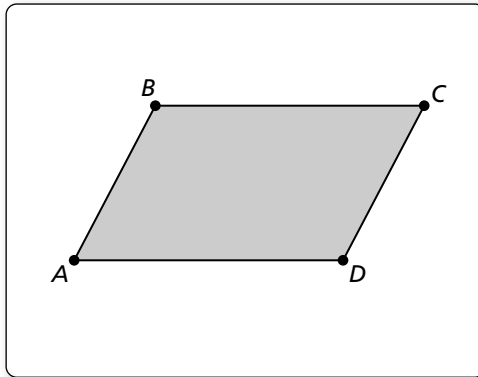


6.4**Properties of Parallelograms**

For use with Exploration 6.4

Essential Question What are the properties of parallelograms?**1 EXPLORATION:** Discovering Properties of ParallelogramsGo to *BigIdeasMath.com* for an interactive tool to investigate this exploration.**Work with a partner.** Use dynamic geometry software.

- a. Construct any parallelogram and label it $ABCD$. Explain your process.

Sample

- b. Find the angle measures of the parallelogram. What do you observe?
- c. Find the side lengths of the parallelogram. What do you observe?
- d. Repeat parts (a)–(c) for several other parallelograms. Use your results to write conjectures about the angle measures and side lengths of a parallelogram.

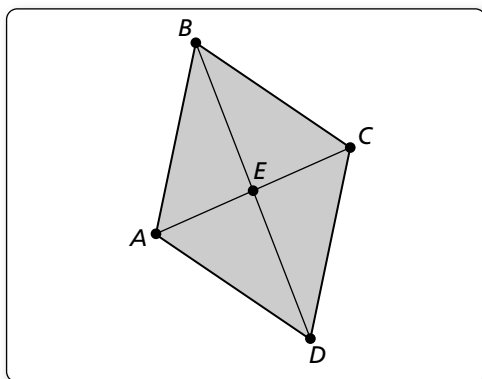
6.4 Properties of Parallelograms (continued)**2** **EXPLORATION:** Discovering a Property of Parallelograms

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use dynamic geometry software.

- Construct any parallelogram and label it $ABCD$.
- Draw the two diagonals of the parallelogram. Label the point of intersection E .

Sample



- Find the segment lengths AE , BE , CE , and DE . What do you observe?
- Repeat parts (a)–(c) for several other parallelograms. Use your results to write a conjecture about the diagonals of a parallelogram.

Communicate Your Answer

- What are the properties of parallelograms?

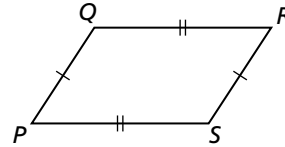
6.4**Practice**

For use after Lesson 6.4

Theorems**Parallelogram Opposite Sides Theorem**

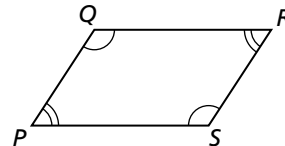
If a quadrilateral is a parallelogram, then its opposite sides are congruent.

If $PQRS$ is a parallelogram, then $\overline{PQ} \cong \overline{RS}$
and $\overline{QR} \cong \overline{SP}$.

**Notes:****Parallelogram Opposite Angles Theorem**

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

If $PQRS$ is a parallelogram, then $\angle P \cong \angle R$
and $\angle Q \cong \angle S$.

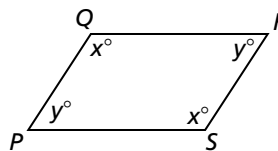
**Notes:**

6.4 Practice (continued)

Parallelogram Consecutive Angles Theorem

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

If $PQRS$ is a parallelogram, then $x^\circ + y^\circ = 180^\circ$.

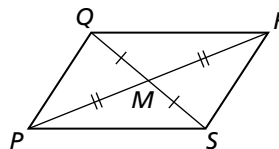


Notes:

Parallelogram Diagonals Theorem

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

If $PQRS$ is a parallelogram, then $\overline{QM} \cong \overline{SM}$ and $\overline{PM} \cong \overline{RM}$.



Notes:

Worked-Out Examples

Example #1

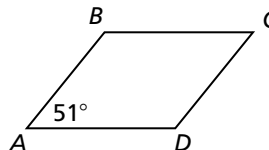
Find the measure of the indicated angle in the parallelogram.

Find $m\angle B$.

$$m\angle A + m\angle B = 180^\circ$$

$$51^\circ + m\angle B = 180^\circ$$

$$m\angle B = 129^\circ$$



Example #2

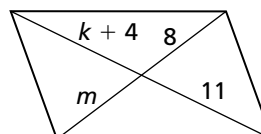
Find the value of each variable in the parallelogram.

$$k + 4 = 11$$

$$k = 7$$

$$m = 8$$

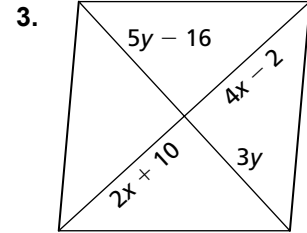
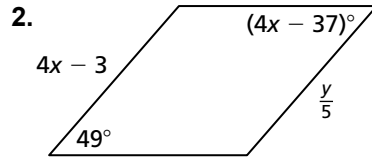
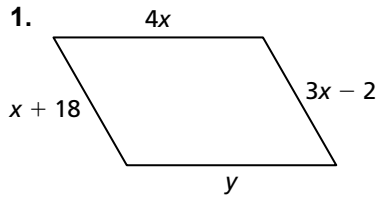
So, $k = 7$ and $m = 8$.



6.4 Practice (continued)

Practice A

In Exercises 1–3, find the value of each variable in the parallelogram.



In Exercises 4–11, find the indicated measure in $\square MNOP$. Explain your reasoning.

4. PO

5. OQ

6. NO

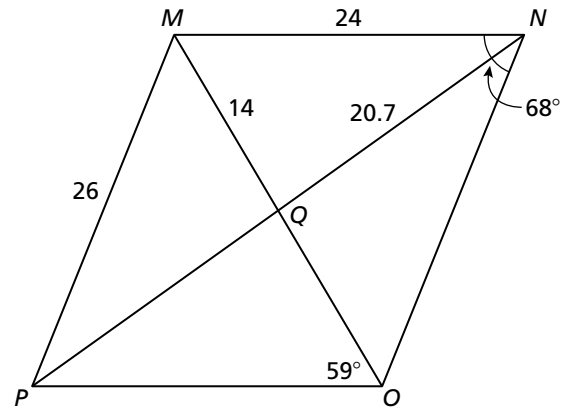
7. PQ

8. $m\angle PMN$

9. $m\angle NOP$

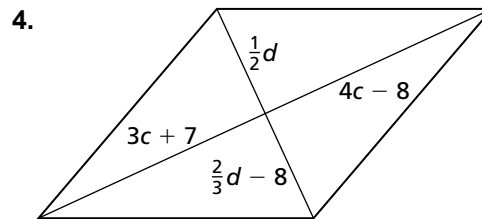
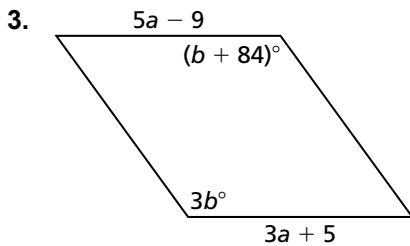
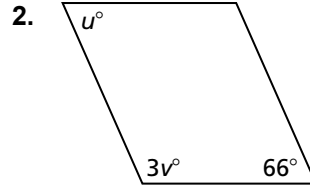
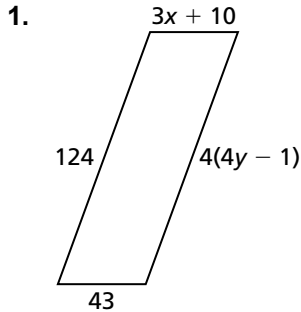
10. $m\angle OPM$

11. $m\angle NMO$



Practice B

In Exercises 1–4, find the value of each variable in the parallelogram.



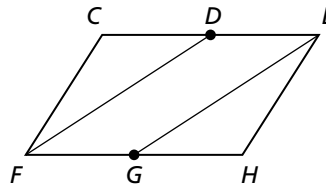
5. Find the coordinates of the intersection of the diagonals of the parallelogram with vertices $(-2, -4)$, $(-4, 4)$, $(2, 12)$, and $(4, 4)$.

6. Three vertices of $\square ABCD$ are $A(1, 5)$, $B(1, 1)$, and $D(2, 2)$. Find the coordinates of the remaining vertex.

7. Use the diagram to write a two-column proof.

Given $CEHF$ is a parallelogram.
 D bisects \overline{CE} and G bisects \overline{FH} .

Prove $\triangle CDF \cong \triangle HGE$



8. State whether each statement is *always*, *sometimes*, or *never* true for a parallelogram. Explain your reasoning.

- The opposite sides are congruent.
- All four sides are congruent.
- The diagonals are congruent.
- The opposite angles are congruent.
- The adjacent angles are congruent.
- The adjacent angles are complementary.