Mini-Lesson 6.1
Polygons

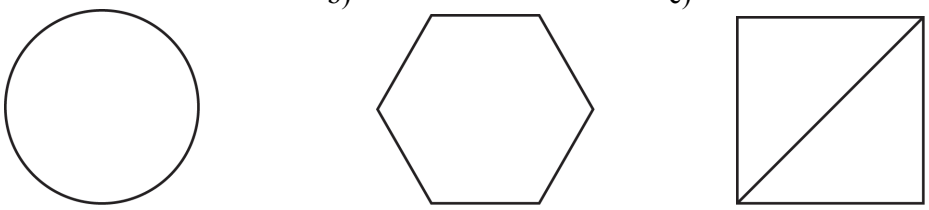
Learning Objectives:

1. Define and name polygons.
2. Find the sum of the measures of the interior angles of a quadrilateral.
3. Key vocabulary: *polygon, vertex, n-gon, concave polygon, convex polygon, quadrilateral, regular polygon, diagonal, equilateral polygon, equiangular polygon*

Key Examples:

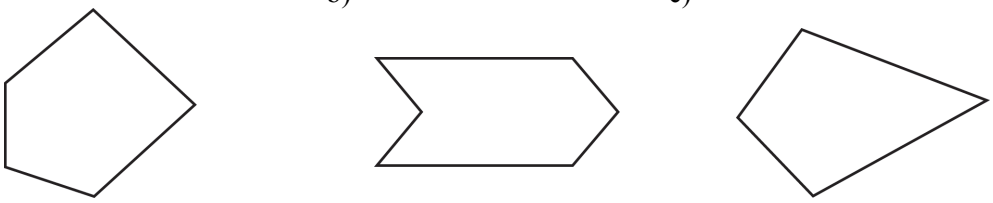
1. Identify the polygons. If not a polygon, state why.

a) b) c)



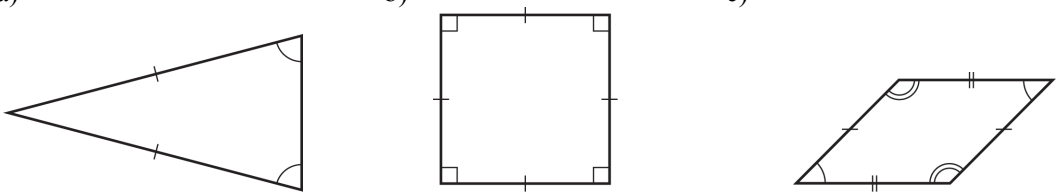
2. Name the polygon according to the number of sides. Then identify whether it is convex or concave.

a) b) c)

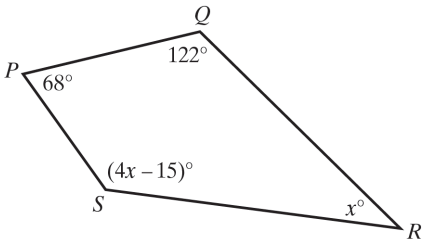


3. Determine if each polygon is regular or not. Explain your reasoning.

a) b) c)



4. Find x, and then $m\angle R$ and $m\angle S$.



Answers: 1) Figure b) is a polygon. Figure a) is not a polygon because it is not formed by line segments. Figure c) is not a polygon because there is a side that intersects more than two other sides. 2a) convex pentagon 2b) concave hexagon 2c) convex quadrilateral 3) *See Additional Answers at end of Mini-Lessons.* 4) $x = 37$, $m\angle R = 37°$, $m\angle S = 133°$

Mini-Lesson 6.1

Polygons

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PowerPoints, Section 6.1

Teaching Notes:

- To help students learn the names of polygons with various numbers of sides, ask the class for other words that have the same prefixes, such as *tricycle, quadrant, octave,* and *decade.*
- If students are confused by the definition of a *concave polygon,* try one of more of these alternate definitions and illustrate with examples:

  (Informal) A concave polygon has one of more vertices that point inward.

  A concave polygon has at least one segment connecting two nonadjacent vertices that lies outside the polygon. (Such a segment may be called a *diagonal,* though the textbook only defines "diagonal" for a convex polygon.)

  A concave polygon has at least one interior angle that measures more than 180°. (This definition requires explaining that angles can measure greater than 180°, which has not been discussed in the textbook.)

ERROR PREVENTION

- Some students may confuse the concepts of *equilateral* and *equiangular,* or think they have the same meaning. Explain the origin of the these words: "equi-lateral" means "equal sides," while "equi-angular" means "equal angles." Illustrate with examples the fact that, except for triangles, a polygon may be equilateral, but not equiangular, or equiangular, but not equilateral.

Closure Questions:

- What is an easy way to remember the sum of the measures of the interior angles of any convex quadrilateral?

  The sum of the measures of the interior angles of any convex quadrilateral is 360° because a diagonal of the quadrilateral divides it into two triangles, each of which has an angle sum of 180°.

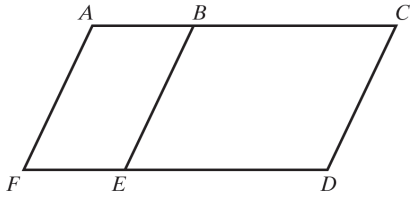
Mini-Lesson 6.2
Parallelograms

Learning Objectives:

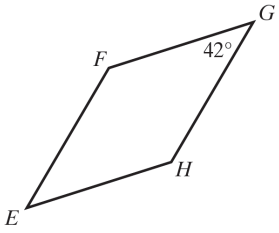
1. Use relationships among sides and angles of parallelograms.
2. Use relationships among consecutive angles and diagonals of parallelograms.
3. Key vocabulary: *parallelogram, opposite sides, opposite angles, consecutive angles*

Key Examples:

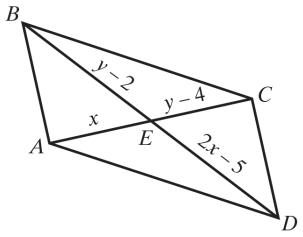
1. **Given:** $\square ABEF$ and $\square BCDE$
   Prove: $\angle A \cong \angle D$



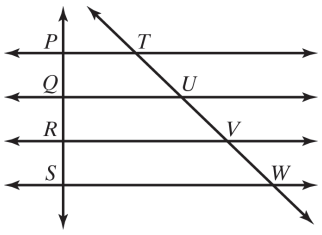
2. A design for tiling a kitchen floor uses tiles in the shape of a parallelogram. The figure represents one tile. What is $m\angle H$?



3. Find the values of x and y in $\square ABCD$. What are AC and BD?



4. In the figure, if $\overleftrightarrow{PT} \parallel \overleftrightarrow{QU} \parallel \overleftrightarrow{RV} \parallel \overleftrightarrow{SW}$, $PQ = QR = RS = 5$, and $TW = 21$, what is UV?



Answers: 1) *See Additional Answers at end of Mini-Lessons.* 2) 138° 3) $x = 7$, $y = 11$, $AC = 14$, $BD = 18$ 4) 7

Mini-Lesson 6.2

Parallelograms

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Video Organizer Section 6.2 (MML)

PowerPoints, Section 6.2

Teaching Notes:

- In the figure used in Example 1, (the proof of Theorem 6.2-1), some students may not see the pairs of alternate interior angles. Redraw the figure with all four sides and the diagonal extended outside the parallelogram. Then ask students to identify the alternate interior angles formed by the diagonal as a transversal to each pair of parallel sides.
- When discussing Theorem 6.2-4, emphasize that when we say that the diagonals of a parallelogram bisect each other, it does not mean that the diagonals are necessarily congruent. In Section 6.4, students will learn that the diagonals of a parallelogram are congruent if and only if the parallelogram is a rectangle.

ERROR PREVENTION

- Because the theorems about transversals involve a transversal that intersects two or more parallel lines, many students think that the term *transversal* only applies when the lines are parallel. To clear up this misunderstanding, sketch several examples of one of more transversals that intersect two or more nonparallel lines.

Closure Questions:

- If consecutive angles of a parallelogram are congruent, what can you conclude about the parallelogram? Explain your reasoning.

  The parallelogram must be a rectangle. Consecutive angles of a parallelogram are supplementary. If two angles are both congruent and supplementary, they must both be right angles, so the parallelogram will have four right angles, which makes it a rectangle.

Mini-Lesson 6.3

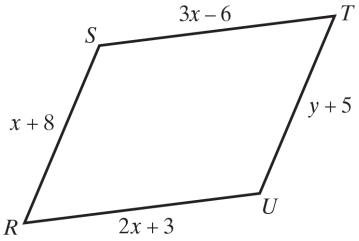
Proving That a Quadrilateral Is a Parallelogram

Learning Objectives:

1. Determine whether a quadrilateral is a parallelogram.
2. Use coordinate geometry with parallelograms.

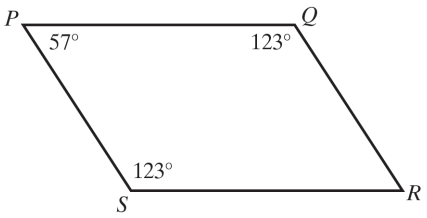
Key Examples:

1. For what values of x and y must $RSTU$ be a parallelogram?

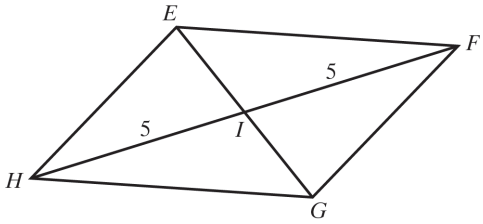


2. Can you prove that the quadrilateral is a parallelogram based on the given information? Explain why or why not.

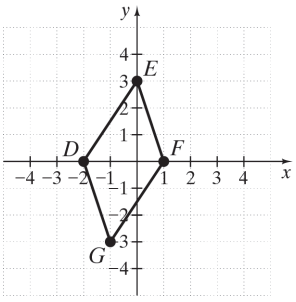
a)



b)



3. Show that a quadrilateral with vertices $D(-2, 0)$, $E(0, 3)$, $F(1, 0)$, and $G(-1, -3)$ is a parallelogram.



Answers: 1) $x = 9$, $y = 12$ 2a) Yes; $\angle P$ is supplementary to both of its consecutive angles, so $PQRS$ is a parallelogram by Theorem 3.6-3. 2b) No; Theorem 6.3-4 says that if the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram, but the figure only shows that one of the diagonals, $\overline{HF}$, is bisected. 3) *See Additional Answers at end of Mini-Lessons.*

Mini-Lesson 6.3

Proving That a Quadrilateral Is a Parallelogram

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PowerPoints, Section 6.3

Teaching Notes:

- When reviewing the Distance, Midpoint, and Slope Formulas (see the Helpful Hint on p.270 of the textbook), ask students to write each formula in symbols and then state the formula in words. In addition, provide practice problems that involve using each of these formulas with the same pair of points before discussing Example 4.
- The first four theorems in this section are the converses of the first four theorems in Section 6.3. Ask students to combine each pair of converses to write biconditional statements.

ERROR PREVENTION

- If students make errors in calculating slopes, remind them that the coordinates of the two points must be written in the same order in numerator and denominator.

Closure Questions:

- What are 6 ways to prove that a quadrilateral is a parallelogram?

  1. Both pairs of opposite sides are parallel. (definition of parallelogram).
  2. Both pairs of opposite sides are congruent.
  3. An angle is supplementary to both of its consecutive angles.
  4. Both pairs of opposite angles are congruent.
  5. The diagonals bisect each other.
  6. One pair of opposite sides is congruent and parallel.

Mini-Lesson 6.4

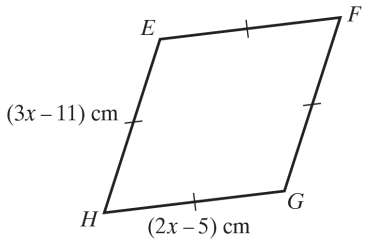
Rhombuses, Rectangles, and Squares

Learning Objectives:

1. Define and classify special types of parallelograms
2. Use properties of diagonals of rhombuses, rectangles, and squares.
3. Use properties of diagonals to form rhombuses, rectangles, and squares.
4. Key vocabulary: *rhombus, rectangle, square*

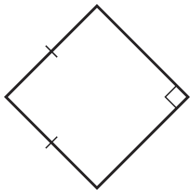
Key Examples:

1. The figure shown is a rhombus.
   a) Find the value of x.
   b) Find the measure of each side.

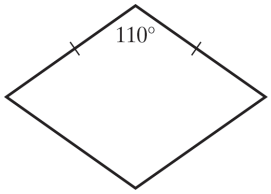


2. Identify each parallelogram as a rhombus, a rectangle, or a square. Be as precise as possible.

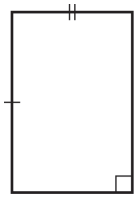
a)



b)

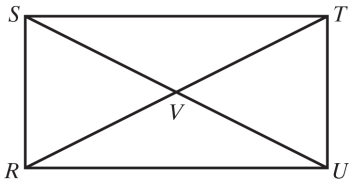


c)

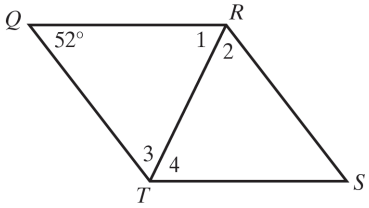


3. The diagonals of a certain parallelogram are perpendicular and congruent. What can you conclude about the parallelogram? Explain your reasoning.

4. a) If $RT = 7x - 32$ and $SU = 3x + 4$, what are the diagonals of rectangle $RSTU$?
   b) What type of triangle is SVR?



5. What are the measures of the numbered angles in rhombus $QRST$?



Answers: 1a) $x = 6$ 1b) $EF = FG = GH = HE = 7$ cm 2a) square 2b) rhombus 2c) rectangle 3) *See Additional Answers at end of Mini-Lessons*. 4a) $RT = SU = 31$ 4b) isosceles triangle 5) $m\angle 1 = m\angle 2 = m\angle 3 = m\angle 4 = 64°$ 6) $y = 5$

Mini-Lesson 6.4

Rhombuses, Rectangles, and Squares

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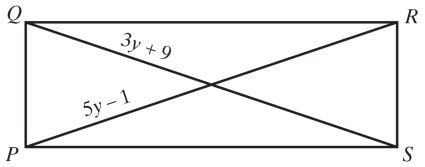
PowerPoints, Section 6.4

6. For what value of y is $PQRS$ a rectangle?



Teaching Notes:

- Both the Venn diagram and the flow chart on p.275 in the textbook can be helpful in understanding the relationships among the types of quadrilaterals that have been introduced so far in this chapter. Present both diagrams and then ask students which one they like better and why.

ERROR PREVENTION

- Because of the diagrams that are typically drawn, some students think of rectangles, rhombuses, and squares as three distinct types of quadrilaterals. They may think that a rectangle must have long and short sides (length and width) and that a rhombus must be "slanted" (have non-right angles). To convince them that a square is both a rectangle and a rhombus, review the definitions of these two types of parallelograms and also refer to the Venn diagram on p.275.

Closure Questions:

- What is the common name for a "rectangular rhombus?

  a square

- In what type of parallelogram do congruent diagonals bisect each other?

  a square

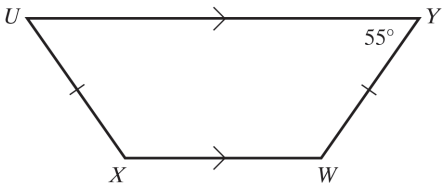
Mini-Lesson 6.5
Trapezoids and Kites

Learning Objectives:

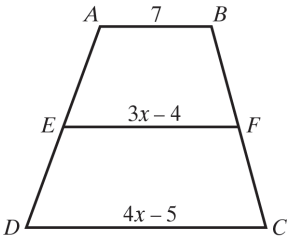
1. Use properties of trapezoids.
2. Use properties of kites.
3. Key vocabulary: *trapezoid, base, leg, base angle, isosceles trapezoid, midsegment of a trapezoid, kite*

Key Examples:

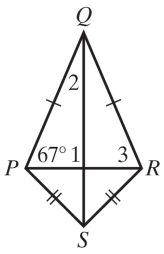
1. *UVWX* is an isosceles trapezoid. Calculate $m\angle U$, $m\angle W$, and $m\angle X$.



2. $\overline{EF}$ is the midsegment of trapezoid *ABCD*. What is *EF*?



3. Quadrilateral *PQRS* is a kite. What are $m\angle 1$, $m\angle 2$, and $m\angle 3$?



Answers: 1) $m\angle U = 55°$, $m\angle W = m\angle X = 125°$ 2) 11 3) $m\angle 1 = 90°$, $m\angle 2 = 23°$, $m\angle 3 = 67°$

Mini-Lesson 6.5

Trapezoids and Kites

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PowerPoints, Section 6.5

Teaching Notes:

- Use the flow chart in the Helpful Hint on p.285 of the textbook to bring together all the types of quadrilaterals that have been discussed in this chapter. Show students how this is an extended version of the flowchart in Section 6.4 (p.275), with trapezoids and kites added to the earlier diagram.
- Emphasize that the Trapezoid Midsegment Theorem is true whether or not the trapezoid is an isosceles trapezoid.

ERROR PREVENTION

- Students may be confused by the use of the terms *bases, legs,* and *base angles* for a trapezoid because these terms have been used earlier to describe isosceles triangles. To help them see the similarities and differences, draw an isosceles triangle and an isosceles trapezoid side-by-side and ask students to identify these parts in each figure.

Closure Questions:

- In what type of trapezoid are the two legs congruent to each other and the two base angles congruent?

  an isosceles trapezoid

- What do the diagonals of an isosceles trapezoid and a rectangle have in common?

  The diagonals are congruent.

- What do the diagonals of a kite and a rhombus have in common?

  The diagonals are perpendicular.