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6.3 Angles of Polygons
For use with Exploration 6.3

Essential Question What is the sum of the measures of the interior angles of a polygon?

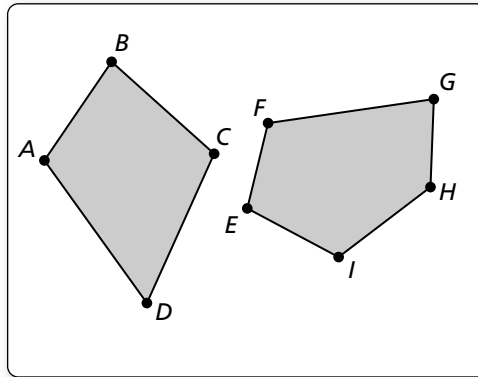**1 EXPLORATION:** The Sum of the Angle Measures of a Polygon

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

Work with a partner. Use dynamic geometry software.

a. Draw a quadrilateral and a pentagon. Find the sum of the measures of the interior angles of each polygon.
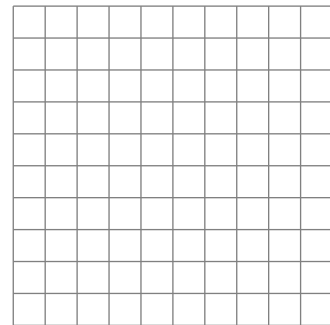
Sample

b. Draw other polygons and find the sums of the measures of their interior angles. Record your results in the table below.

Number of sides, *n*	3	4	5	6	7	8	9
Sum of angle measures, *S*							

c. Plot the data from your table in a coordinate plane.

d. Write a function that fits the data. Explain what the function represents.

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2 **EXPLORATION:** Measure of One Angle in a Regular Polygon

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

Work with a partner.

a. Use the function you found in Exploration 1 to write a new function that gives the measure of one interior angle in a regular polygon with n sides.

b. Use the function in part (a) to find the measure of one interior angle of a regular pentagon. Use dynamic geometry software to check your result by constructing a regular pentagon and finding the measure of one of its interior angles.

c. Copy your table from Exploration 1 and add a row for the measure of one interior angle in a regular polygon with n sides. Complete the table. Use dynamic geometry software to check your results.

Number of sides, n	3	4	5	6	7	8	9
Sum of angle measures, S							
Measure of one interior angle							

Communicate Your Answer

3. What is the sum of the measures of the interior angles of a polygon?

4. Find the measure of one interior angle in a regular dodecagon (a polygon with 12 sides).
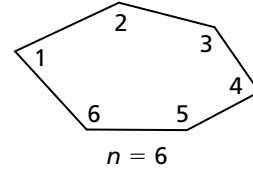
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Theorems

Polygon Interior Angles Theorem

The sum of the measures of the interior angles
of a convex n-gon is $(n - 2) \bullet 180°$.

$$m\angle 1 + m\angle 2 + \cdots + m\angle n = (n - 2) \bullet 180°$$

n = 6

Notes:

Corollary to the Polygon Interior Angles Theorem

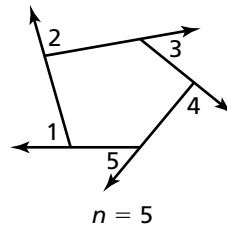The sum of the measures of the interior angles of a quadrilateral is $360°$.

Notes:

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Polygon Exterior Angles Theorem

The sum of the measures of the exterior angles of a
convex polygon, one angle at each vertex, is $360°$.

$$m\angle 1 + m\angle 2 + \cdots + m\angle n = 360°$$
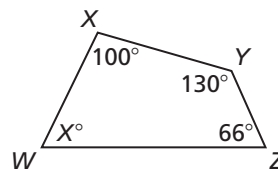
Notes:

$n = 5$

Worked-Out Examples

Example #1

Find the value of *x*.

XYZW is a quadrilateral, therefore the sum of the measures
of the interior angles is $(4 - 2) \cdot 180° = 360°$.

$100° + 130° + 66° + x° = 360°$

$\qquad\qquad 296 + x = 360$

$\qquad\qquad\qquad\quad x = 64$

Example #2

Find the measures of $\angle X$ and $\angle Y$.

The polygon has 6 sides, therefore the sum of the measures
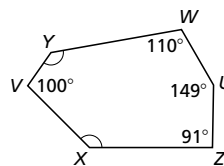of the interior angles is $(6 - 2) \cdot 180° = 720°$.

$100° + x° + 110° + 149° + 91° + x° = 720°$

$\qquad\qquad\qquad 2x + 450 = 720$

$\qquad\qquad\qquad\qquad 2x = 270$

$\qquad\qquad\qquad\qquad\quad x = 135$

$m\angle X = m\angle Y = 135°$
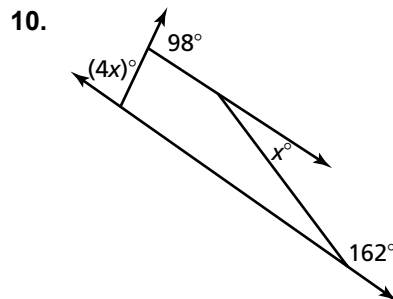
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Practice A

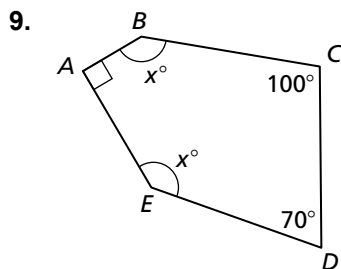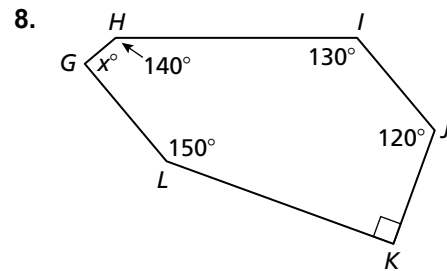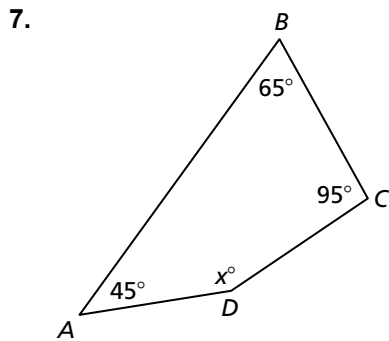**In Exercises 1–3, find the sum of the measures of the interior angles of the indicated convex polygon.**

1. octagon   **2.** 15-gon   **3.** 24-gon

In Exercises 4–6, the sum of the measures of the interior angles of a convex polygon is given. Classify the polygon by the number of sides.
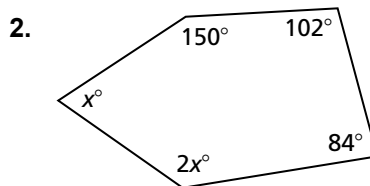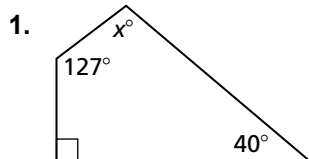
4. 900°   **5.** 1620°   **6.** 2880°
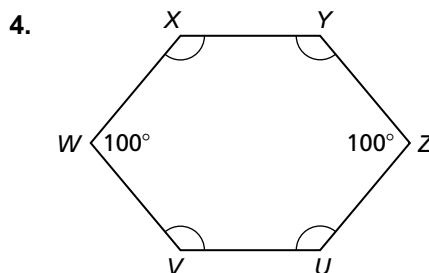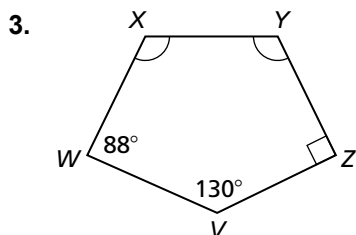
In Exercises 7–10, find the value of *x*.

7.

8.

9.

10.

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Practice B

In Exercises 1 and 2, find the value of *x*.

1.

x°
127°
40°

2.

150° 102°
x°
2*x*° 84°

In Exercises 3 and 4, find the measures of ∠*X* and ∠*Y*.

3.

X   Y
88°
W   Z
130°
V

4.

X   Y
W ⟨100°   100°⟩ Z
V   U

In Exercises 5 and 6, find the value of *x.*

5.

x°
86°
70°
x°
92°

6.

x°
(*x* + 30)°
x°
x°
x°
x°
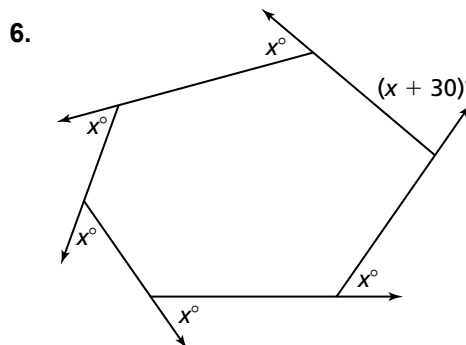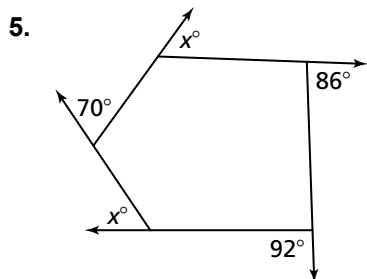
7. Find the measure of each interior angle and each exterior angle of a regular 24-gon.

8. Each exterior angle of a regular polygon has a measure of 18°. Find the number of sides of the regular polygon.

9. A polygon has two pairs of complementary interior angles and three sets of supplementary interior angles. The sum of the remaining interior angles is 1440°. How many sides does the polygon have? Explain.

10. The figure shows interior angle measures of the kite.

    a. Find the sum of the measures of the interior angles of the convex polygon.

    b. Find the value of *x*.

x° 110°
x° 110°