

## Lesson 7.1 Angles of Polygons

Wednesday, February 22, 2023 6:55 PM

Click Link Below for Interactive Pear Deck Powerpoint

<https://app.peardeck.com/student/tvyzrggka>



Lesson 7.1  
Angles Of



# Lesson 7.1 Angles of Polygons

## Content Objective

Students use theorems about the interior and exterior angles of polygons to solve problems and then prove these theorems.

## MA.912.GR.1.3

Prove relationships and theorems about triangles.

Solve mathematical and real-world problems involving postulates, relationships and theorems of triangles.



Copyright © McGraw Hill

This material may be reproduced for licensed classroom only and may not be further reproduced or distributed.

## Learn

### Interior Angles of Polygons

#### Polygon Interior Angles Sum Theorem

The sum of the interior angle measures of an  $n$ -sided polygon is  $180^\circ(n-2)$ .

**Angles in polygons**

We can work out the **angle sum of any polygon** by splitting it into triangles. Remember that the angles in a triangle =  $180^\circ$ .

3 Triangle	Quadrilateral	5 Pentagon	6 Hexagon	7 Heptagon	8 Octagon	$20 = 18 \times 10$ D
$1 \times 180^\circ = 180^\circ$	$2 \times 180^\circ = 360^\circ$	$3 \times 180^\circ = 540^\circ$	$4 \times 180^\circ = 720^\circ$	$5 \times 180^\circ = 900^\circ$	$6 \times 180^\circ = 1080^\circ$	$7 \times 180^\circ = 1260^\circ$

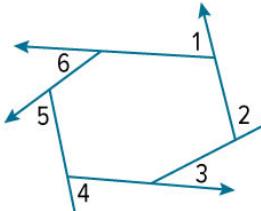
If the polygon has  $n$  sides, there will be  $(n - 2)$  triangles inside.

## Learn

### Exterior Angles of Polygons



### Polygon Exterior Angles Sum Theorem

<b>Words</b>	The sum of the exterior angle measures of a convex polygon, one angle at each vertex, is 360°.
<b>Example</b>	$m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 + m\angle 5 + m\angle 6 = 360^\circ$ 

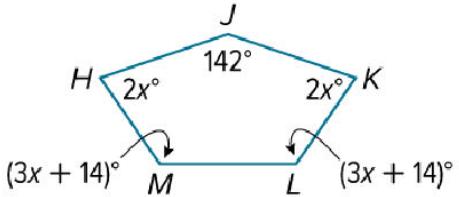
### Example 1

Find the Interior Angles Sum of a Polygon

$$2x + 142 + 2x +$$

Find the measure of each interior angle of pentagon  $HJKLM$ .

$$\begin{aligned} & 180(n-2) \\ & 180(5-2) \\ & 180(3) \\ & 540 \end{aligned}$$



$$\begin{aligned} 10x + 170 &= 540 \\ -170 & \\ 10x &= 370 \\ x &= \end{aligned}$$

### Example 1

Find the Interior Angles Sum of a Polygon



## Step 1 Find the sum.

A pentagon has 5 sides. Use the Polygon Interior Angles Sum Theorem to find the sum of its interior angle measures.

$$m\angle H + m\angle J + m\angle K + m\angle L + m\angle M$$

$$= 180(n - 2)$$

Polygon Interior Angles Sum Thm.

$$= 180^\circ (5-2)$$

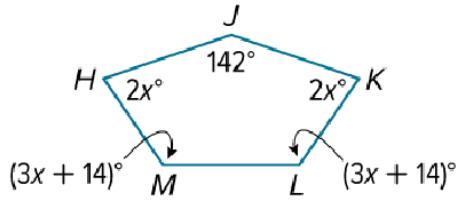
Substitute.

$$= 180 (3)$$

$$= 540^\circ$$

Solve.

McGraw Hill | Angles of Polygons



This material may be reproduced for licensed classroom only and may not be further reproduced or distributed.

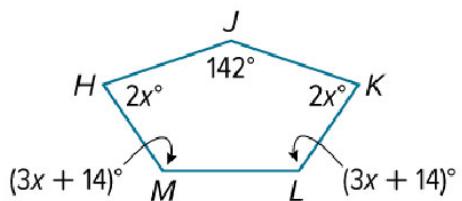
## Example 1

Find the Interior Angles Sum of a Polygon



## Step 2 Find the value of x.

Use the sum of the interior angle measures to determine the value of x.



$$2x^\circ + 2x^\circ + (3x + 14)^\circ + (3x + 14)^\circ + 142^\circ = 540^\circ \text{ Write an equation.}$$

$$x = 37 \text{ Solve.}$$

McGraw Hill | Angles of Polygons

This material may be reproduced for licensed classroom only and may not be further reproduced or distributed.

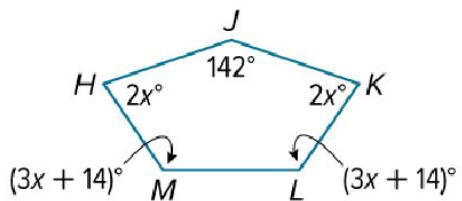
## Example 1

Find the Interior Angles Sum of a Polygon



## Step 3 Find the measure of each angle.

Use the value of x to find the measure of each angle.



$$m\angle J = 142^\circ \quad m\angle K = 2(37)^\circ \text{ or } 74^\circ \quad m\angle L = [3(37) + 14]^\circ \text{ or } 125^\circ$$

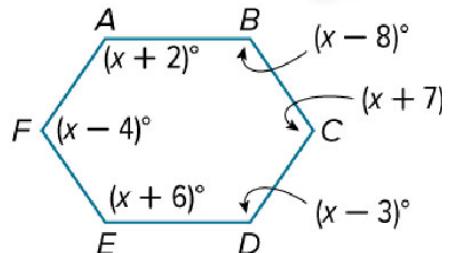
$$m\angle M = [3(37) + 14]^\circ \text{ or } 125^\circ \quad m\angle H = 2x^\circ = 2(37)^\circ \text{ or } 74^\circ$$

### Example 1

Find the Interior Angles Sum of a Polygon

#### Check

Find the measure of all the angles.



### Example 2

Identify the Polygon Given the Sum of the Interior Angle Measures



Let  $n$  = the number of sides in the polygon. If the sum of the interior angle measures is  $1440^\circ$ , what kind of polygon is it? By the Polygon Interior Angles Sum Theorem, the sum of the interior angle measures can also be expressed as  $180^\circ(n-2)$ .

$$1440 = 180(n - 2)$$

$$1440 = 180n - 360$$

$$\underline{+360} \quad \underline{+360}$$

$$1800 = 180n$$

$$\frac{1800}{180} = \frac{180n}{180}$$

$$10 = n$$

The polygon has 10 sides, so it is a regular decagon.

## Example 2: Check

Identify the Polygon Given the Sum of the Interior Angle Measures

Let  $n$  = the number of sides in the polygon. If the sum of the interior angle measures is  $1080^\circ$ , what kind of polygon is it?

## Example 3

Identify the Polygon Given the Interior Angle Measure

The measure of an interior angle of a regular polygon is  $150^\circ$ .

Find the number of sides in the polygon.

Let  $n$  = the number of sides in the polygon. Because all angles of a regular polygon are congruent, the sum of the interior angle measures is  $150n^\circ$ . By the Polygon Interior Angles Sum Theorem, the sum of the interior angle measures can also be expressed as  $180^\circ(n-2)$ .

$$150n = 180(n - 2)$$

$$150n = 180n - 360$$

$$\underline{-180n} \quad \underline{-180n}$$

$$-30n = -360$$

$$\frac{-30n}{-30} = \frac{-360}{-30}$$

$$n = 12$$

The polygon has 12 sides, so it is a regular dodecagon

## Example 3: Check

Identify the Polygon Given the Interior Angle Measure

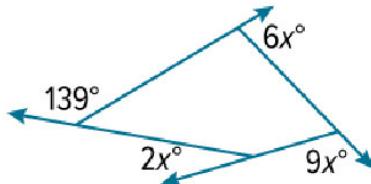
The measure of an interior angle of a regular polygon is  $120^\circ$ .

Find the number of sides in the polygon.

## Example 4

### Find Missing Values

Find the value of  $x$ .

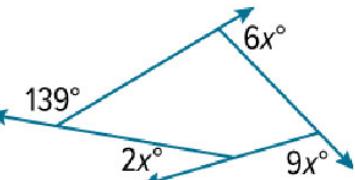


## Example 4

### Find Missing Values

Use the Polygon Exterior Angles Sum Theorem to write an equation. Then solve for  $x$ .

$$6x^\circ + 9x^\circ + 2x^\circ + 139^\circ = 360^\circ \quad \text{Write an equation.}$$
$$x = 13 \quad \text{Solve.}$$

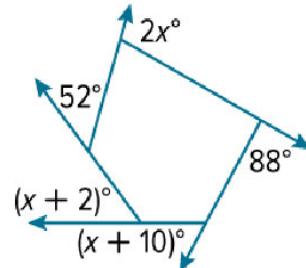


## Example 4

### Find Missing Values

#### Check

Find the value of  $x$ .



## Example 5

### Find Exterior Angle Measures of a Polygon



**Find the measure of each exterior angle of a regular dodecagon.**

## Example 5

### Find Exterior Angle Measures of a Polygon



## FIND EXTERIOR ANGLE MEASURES OF A POLYGON

A regular dodecagon has 12 congruent sides and 12 congruent interior angles. The exterior angles are also congruent, because angles supplementary to congruent angles are congruent.

Let  $n$  = the measure of each exterior angle and write and solve an equation.

$$12n = 360^\circ$$

**Polygon Exterior Angles Sum Theorem**

$$n = 30^\circ$$

**Solve.**

The measure of each exterior angle of a regular dodecagon is  $30^\circ$ .



### Example 5

Find Exterior Angle Measures of a Polygon

### Check

What is the measure of each exterior angle of a regular octagon?

