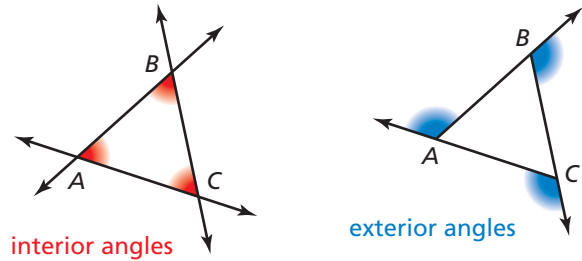


Finding Angles of Triangles

Using Interior and Exterior Angles

When the sides of a polygon are extended, other angles are formed. The original angles are the **interior angles**. The angles that form linear pairs with the interior angles are the **exterior angles**.

The theorems given below show how the angle measures of a triangle are related. You can use these theorems to find angle measures.



Triangle Sum Theorem

The sum of the measures of the interior angles of a triangle is 180° .

Exterior Angle Theorem

The measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles.

Corollary to the Triangle Sum Theorem

The acute angles of a right triangle are complementary.

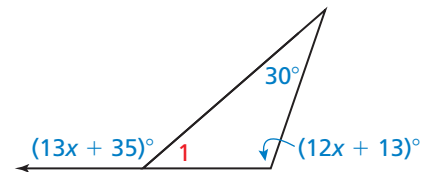
Example 1 Find $m\angle 1$.

First write and solve an equation to find the value of x .

$$(13x + 35)^\circ = 30^\circ + (12x + 13)^\circ$$

$$x = 8$$

Apply the Exterior Angle Theorem.
Solve for x .



Substitute 8 for x in $(12x + 13)^\circ$ to find the obtuse angle measure, 109° . Then write and solve an equation to find $m\angle 1$.

$$m\angle 1 + 30^\circ + 109^\circ = 180^\circ$$

$$m\angle 1 = 41^\circ$$

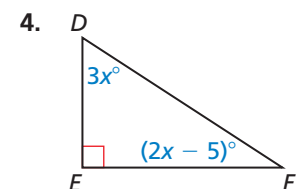
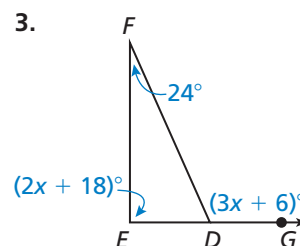
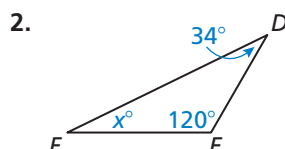
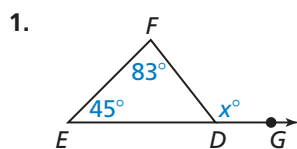
Apply the Triangle Sum Theorem.
Solve for $m\angle 1$.

► So, the measure of $\angle 1$ is 41° .

Practice

Check your answers at BigIdeasMath.com.

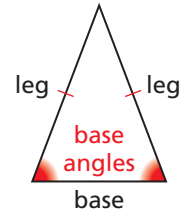
Find the value of x .



Finding Angles of Triangles

Using Isosceles and Equilateral Triangles

When an isosceles triangle has exactly two congruent sides, these two sides are the **legs**. The third side is the **base** of the isosceles triangle. The two angles adjacent to the base are called **base angles**.



You can use the theorems given below to find angle measures and side lengths.

Base Angles Theorem

If two sides of a triangle are congruent, then the angles opposite them are congruent.

Converse of the Base Angles Theorem

If two angles of a triangle are congruent, then the sides opposite them are congruent.

Corollary to the Base Angles Theorem

If a triangle is equilateral, then it is equiangular.

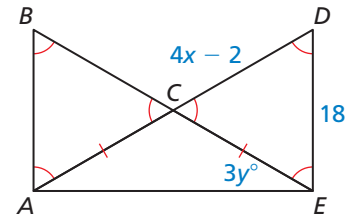
Corollary to the Converse of the Base Angles Theorem

If a triangle is equiangular, then it is equilateral.

Example 1 Find the values of x and y in the diagram.

Step 1 Find the value of x . Because $\triangle CDE$ is equiangular, it is also equilateral by the Corollary to the Converse of the Base Angles Theorem. So, $\overline{CD} \cong \overline{DE}$.

$$\begin{array}{ll}
 CD = DE & \text{Definition of congruent segments} \\
 4x - 2 = 18 & \text{Substitute.} \\
 x = 5 & \text{Solve for } x.
 \end{array}$$



Step 2 Find the value of y . By the Triangle Sum Theorem, $3(m\angle DCE) = 180^\circ$, so $m\angle DCE = 60^\circ$. Because $\angle ACE$ and $\angle DCE$ form a linear pair, they are supplementary angles and $m\angle ACE = 180^\circ - 60^\circ = 120^\circ$. The diagram shows that $\triangle ACE$ is isosceles. By the Base Angles Theorem, $\angle CAE \cong \angle CEA$. So, $m\angle CAE = m\angle CEA$.

$$\begin{array}{ll}
 120^\circ + 3y^\circ + 3y^\circ = 180^\circ & \text{Apply the Triangle Sum Theorem.} \\
 y = 10 & \text{Solve for } y.
 \end{array}$$

Practice

Check your answers at BigIdeasMath.com.

Find the value(s) of the variable(s).

