

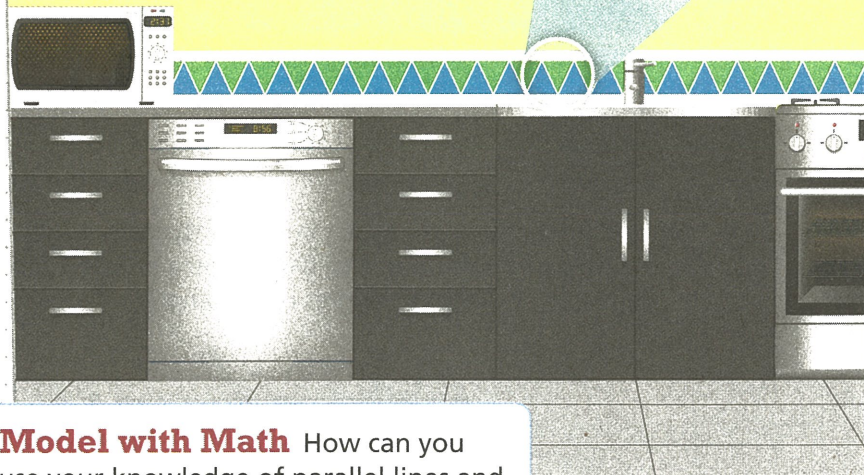
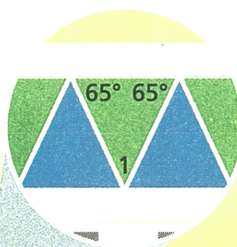


## Solve & Discuss It!



ACTIVITY

Nell cuts tile to make a decorative strip for a kitchen backsplash. She must cut the tiles precisely to be congruent triangles. She plans to place the tiles between two pieces of molding, as shown. What is  $m\angle 1$ ? Explain.



**Model with Math** How can you use your knowledge of parallel lines and transversals to solve the problem? © MP.4

## Lesson 6-9

### Interior and Exterior Angles of Triangles



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#### I can...

find the interior and exterior angle measures of a triangle.

© Common Core Content Standards  
8.G.A.5

Mathematical Practices  
MP.2, MP.4, MP.7, MP.8

## Focus on math practices

**Reasoning** What assumption(s) did you need to make to find  $m\angle 1$ ? Explain why your assumption(s) is reasonable. © MP.2



**Essential Question** How are the interior and exterior angles of a triangle related?



**EXAMPLE 1**



**Relate Interior Angle Measures in Triangles**

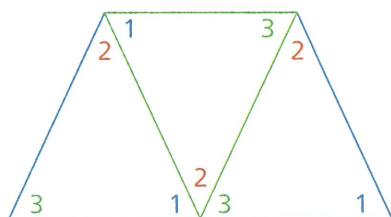
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How can you describe the relationship between the three interior angles of each triangular tile in the backplash?

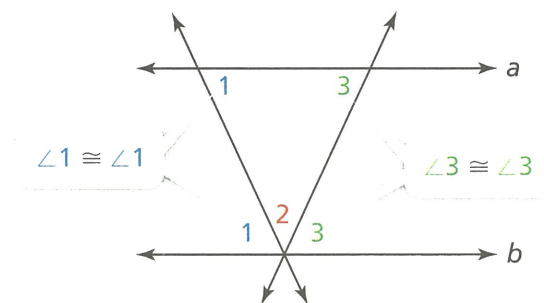


You can rotate and place the congruent tiles side-by-side to form the alternating pattern.



$\angle 1$ ,  $\angle 2$ , and  $\angle 3$  appear to fit together to form a line.

Use what you know about lines, transversals, and angle pair relationships to determine a relationship between the interior angles of a triangle.



Alternate interior angles are congruent, so  $a \parallel b$ . Since  $\angle 1$ ,  $\angle 2$ , and  $\angle 3$  form line  $b$ , a straight angle,  $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$ .

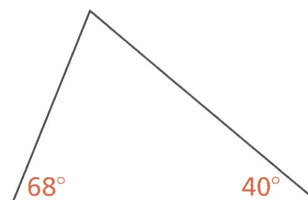
**Generalize** The sum of the measures of the interior angles of a triangle is  $180^\circ$ . © MP.8



**Try It!**

Find the unknown angle measure in the triangle at the right.

**Convince Me!** Could a triangle have interior angle measures of  $23^\circ$ ,  $71^\circ$ , and  $96^\circ$ ? Explain.



## EXAMPLE 2



### Find Exterior Angle Measures



ACTIVITY



ASSESS

In the diagram,  $m\angle 2$  is  $68^\circ$  and  $m\angle 3$  is  $42^\circ$ . What is  $m\angle 4$ ?

$\angle 1$  and  $\angle 4$  form a straight angle and are supplementary.  $\angle 1$ ,  $\angle 2$ , and  $\angle 3$  are the interior angles of a triangle.

$$m\angle 1 + m\angle 4 = 180^\circ$$

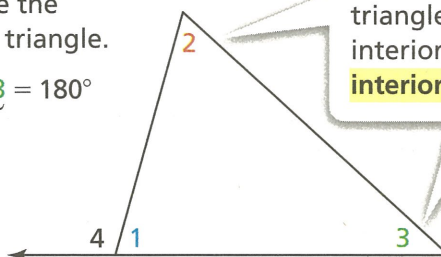
$$m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$$

$$m\angle 4 = m\angle 2 + m\angle 3$$

$$m\angle 4 = m\angle 2 + m\angle 3$$

$$= 68^\circ + 42^\circ$$

$$m\angle 4 = 110^\circ$$



For each exterior angle of a triangle, the two nonadjacent interior angles are its **remote interior angles**.

An **exterior angle of a triangle** is an angle formed by a side and an extension of an adjacent side.

**Generalize** The measure of an exterior angle of a triangle is equal to the sum of the measures of its remote interior angles. © MP.8

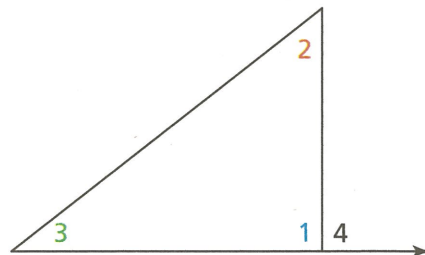
## EXAMPLE 3



### Use Algebra to Find Unknown Angle Measures

In the diagram,  $m\angle 4$  is  $(7x + 7)^\circ$ ,  $m\angle 2$  is  $(4x + 4)^\circ$ , and  $m\angle 3$  is  $(4x - 9)^\circ$ . What are  $m\angle 4$  and  $m\angle 1$ ?

**Look for Relationships** How could you write an algebraic expression to represent  $m\angle 1$ ? © MP.7



**STEP 1** Find the value of  $x$ .

$$m\angle 4 = m\angle 2 + m\angle 3$$

$$(7x + 7)^\circ = (4x + 4)^\circ + (4x - 9)^\circ$$

$$7x + 7 = 8x - 5$$

$$7x + 7 - 7x = 8x - 5 - 7x$$

$$7 = x - 5$$

$$12 = x$$

**STEP 2** Find  $m\angle 4$ .

$$m\angle 4 = (7x + 7)^\circ$$

$$= 7(12) + 7$$

$$= 84 + 7$$

$$m\angle 4 = 91^\circ$$

**STEP 3** Find  $m\angle 1$ .

$$m\angle 4 + m\angle 1 = 180^\circ$$

$$91^\circ + m\angle 1 = 180^\circ$$

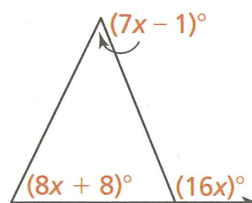
$$91^\circ + m\angle 1 - 91^\circ = 180^\circ - 91^\circ$$

$$m\angle 1 = 89^\circ$$



### Try It!

What is the measure of the exterior angle shown?



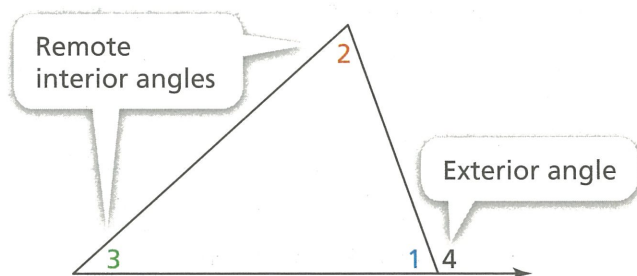


The sum of the measures of the interior angles of a triangle is  $180^\circ$ .

$$m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$$

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

$$m\angle 2 + m\angle 3 = m\angle 4$$



## Do You Understand?

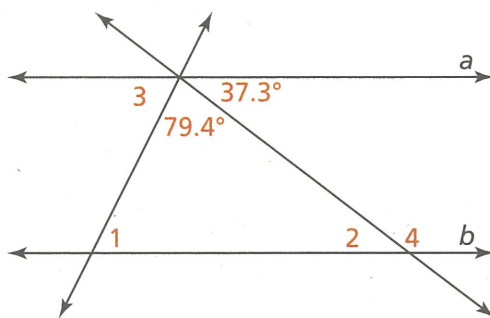
1. **Essential Question** How are the interior and exterior angles of a triangle related?

2. **Reasoning** Maggie draws a triangle with a right angle. The other two angles have equal measures. What are the possible values of the exterior angles for Maggie's triangle? Explain. © MP.2

3. Brian draws a triangle with interior angles of  $32^\circ$  and  $87^\circ$ , and one exterior angle of  $93^\circ$ . Draw the triangle. Label all of the interior angles and the exterior angle.

## Do You Know How?

Use the diagram below for 4 and 5. Assume that  $a \parallel b$ .



4. What are the measures of  $\angle 1$  and  $\angle 2$ ? Explain.

5. What are the measures of  $\angle 3$  and  $\angle 4$ ? Explain.

6. In  $\triangle ABC$ ,  $m\angle A = x^\circ$ ,  $m\angle B = (2x)^\circ$ , and  $m\angle C = (6x + 18)^\circ$ . What is the measure of each angle?





Name: \_\_\_\_\_



PRACTICE



TUTORIAL

## Practice & Problem Solving



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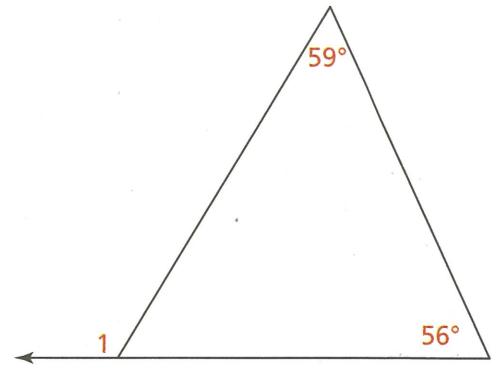
**7. Leveled Practice** For the figure shown, find  $m\angle 1$ .

Angle 1 is an  angle of the triangle.

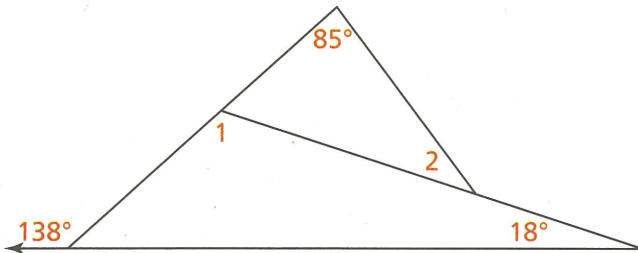
$m\angle 1$  is equal to the sum of its .

$$m\angle 1 = \boxed{\phantom{00}}^\circ + \boxed{\phantom{00}}^\circ$$

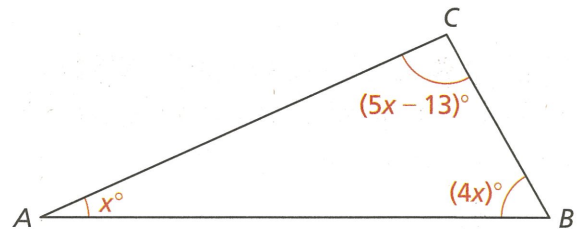
$$m\angle 1 = \boxed{\phantom{00}}^\circ$$



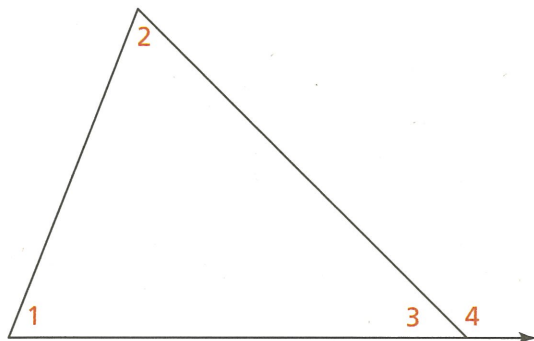
**8.** Find  $m\angle 1$  and  $m\angle 2$ .



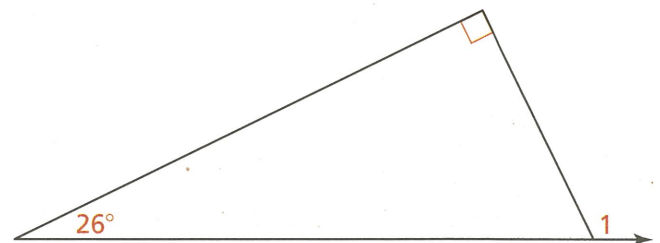
**9.** In  $\triangle ABC$ , what is  $m\angle C$ ?



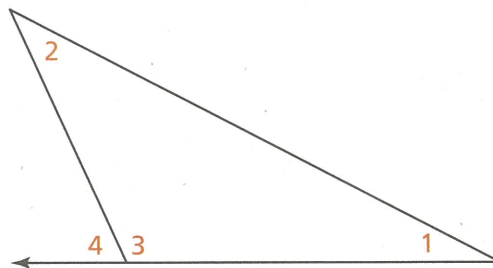
**10.** In the figure,  $m\angle 1 = (8x + 7)^\circ$ ,  $m\angle 2 = (4x + 14)^\circ$ , and  $m\angle 4 = (13x + 12)^\circ$ . Your friend incorrectly says that  $m\angle 4 = 51^\circ$ . What is  $m\angle 4$ ? What mistake might your friend have made?



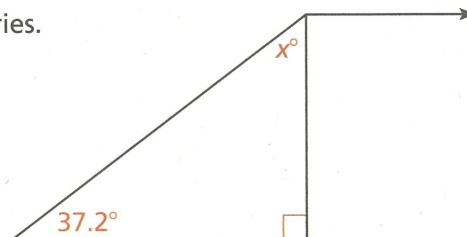
**11.** What is  $m\angle 1$ ?



- 12. Higher Order Thinking** Given that  $m\angle 1 = (16x)^\circ$ ,  $m\angle 2 = (8x + 21)^\circ$ , and  $m\angle 4 = (25x + 19)$ , what is an expression for  $m\angle 3$ ? What is  $m\angle 3$ ?



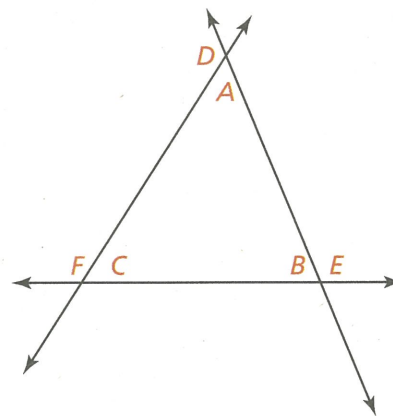
- 13.** A ramp attached to a building is being built to help with deliveries. The angle that the bottom of the ramp makes with the ground is  $37.2^\circ$ . Find the measure of the other acute angle.



## © Assessment Practice

- 14.** What are the two remote interior angles for  $\angle F$ ?

- (A)  $\angle C$  and  $\angle B$
- (B)  $\angle A$  and  $\angle B$
- (C)  $\angle A$  and  $\angle C$
- (D)  $\angle E$  and  $\angle D$



- 15.** In the figure,  $m\angle 1 = (3x + 12)^\circ$ ,  $m\angle 2 = (3x + 18)^\circ$ , and  $m\angle 3 = (7x + 10)^\circ$ . What is  $m\angle 3$ ? Explain your method.

