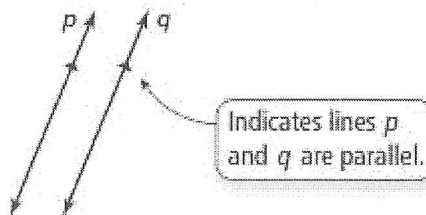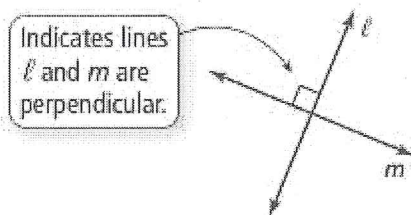# 3.1 Parallel Lines and Transversals

Standards	Learning Objectives (I can...)
8.G.5	• Identify the angles formed when parallel lines are cut by a transversal. • Find the measures of angles formed when parallel lines are cut by a transversal.

Lines in the same plane that do not _intersect_ are called _parallel_ lines.

Lines that intersect at _right angles_ are called _perpendicular_ lines.
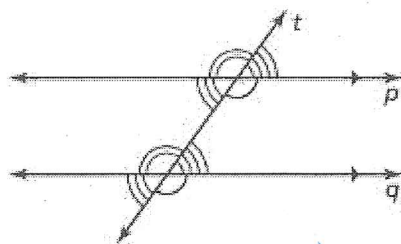

A line that intersects _two or more_ lines is called a _transversal_.

When parallel lines are cut by a transversal, several pairs of _congruent_ angles are formed.

Key Idea

Corresponding Angles

When a transversal intersects parallel lines, _corresponding_ angles are congruent.

Corresponding angles

Example 1: Finding Angle Measures

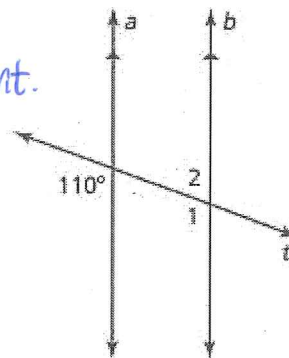**Use the figure to find the measures of (a) $\angle 1$ and (b) $\angle 2$.**

a) $\angle 1$ and the $110°$ angle are corresponding angles. They are congruent.

$$m\angle 1 = 110°$$

b) $\angle 1$ and $\angle 2$ are supplementary.

$$180° - 110° = 70°$$

$$m\angle 2 = 70°$$

On Your Own: Use the figure to find the measure of the angle. Explain your reasoning.

1. $\angle 1$

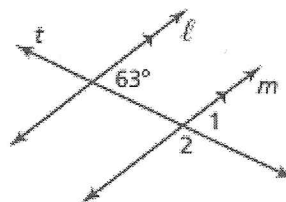$\angle 1$ and the $63°$ angle are corresponding angles. They are congruent.

$$m\angle 1 = 63°$$

2. $\angle 2$

$\angle 1$ and $\angle 2$ are supplementary.

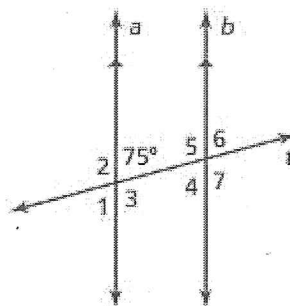$$180° - 63° = 117°$$

$$m\angle 2 = 117°$$

Example 2: Using Corresponding Angles

Use the figure to find the measures of the numbered angles.

$\angle 1$ and the $75°$ angle are vertical angles. They are congruent. $m\angle 1 = 75°$

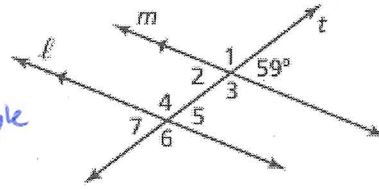$\angle 2$ and $\angle 3$ are supplementary to the $75°$ angle.

$$180° - 75° = 105°$$

$$m\angle 2 + m\angle 3 = 105°$$

~~∠1, ∠5, and ∠7 are corresponding~~

$\angle 4$ and $\angle 6$ are corresponding to the $75°$ angle

$\angle 5$ and $\angle 7$ are corresponding to the $105°$ angle.

On Your Own:

**3.** Use the figure to find the measures
of the numbered angles.

$m\angle 1 = 121°$ Supplementary to the 59° angle

$m\angle 2 = 59°$ Vertical to the 59° angle

$m\angle 3 = 121°$ Vertical to $m\angle 1$

$m\angle 4 = 121°$ Corresponding to $m\angle 1$

$m\angle 5 = 59°$ Corresponding to the 59° angle

$m\angle 6 = 121°$ Corresponding to $m\angle 3$

$m\angle 7 = 59°$ Corresponding to $m\angle 2$.

When two __parallel lines__ are cut by a transversal, __four__
interior angles are formed on the __inside__ of the parallel lines and
__4__ exterior angles are formed on the __outside__ of the parallel lines.

$\angle 3, \angle 4, \angle 5,$ and $\angle 6$
are interior angles.

$\angle 1, \angle 2, \angle 7, \angle 8$ are
exterior angles
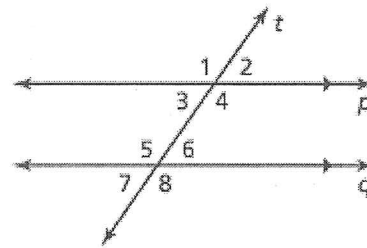
Example 3: Using Corresponding Angles

A store owner uses pieces of tape to paint a window
advertisement. The letters are slanted at an 80° angle.
What is the measure of ∠1?

   (A) 80°   (B) 100°   (C) 110°   (D) 120°

100°

Clearance

80° Sale 1

100° and angle 1 are corresponding
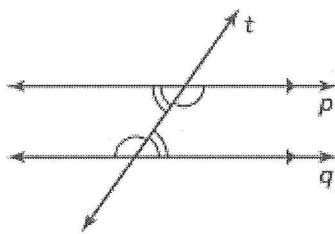angles.

So angle 1 is 100°

On Your Own:

4. **WHAT IF?** In Example 3, the letters are slanted at a 65° angle.
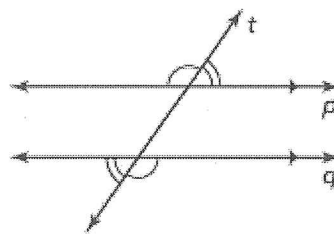   What is the measure of ∠1?

   $115°$

Key Idea

Alternate Interior Angles and Alternate Exterior Angles

When a transversal intersects parallel lines, _alternate interior angles_ are
congruent and _alternate exterior angles_ are congruent.

Alternate interior angles   **Alternate exterior angles**

Example 4: Identifying Alternate Interior and Alternate Exterior Angles

The photo shows a portion of an airport. Describe the relationship between each pair of angles.
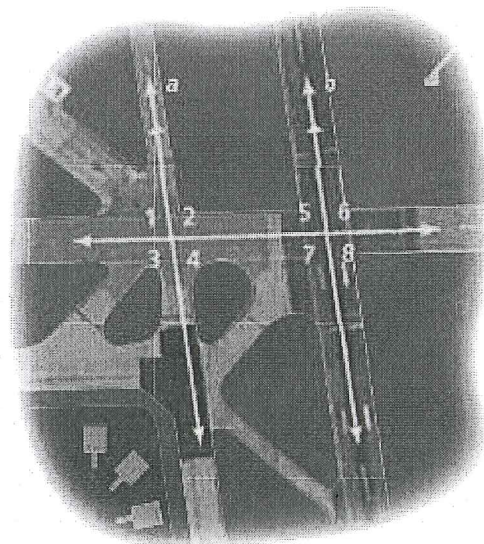
a. ∠3 and ∠6

   ∠3 and ∠6 are
   alternate exterior angles

   $∠3 ≅ ∠6$

b. ∠2 and ∠7

   ∠2 and ∠7 are

   alternate interior angles.

   $∠2 ≅ ∠7$

On Your Own:

In Example 4, the measure of ∠4 is 84°. Find the measure of
the angle. Explain your reasoning.

5. ∠3

∠3 is supplementary to 84°

m∠3 = 96°

6. ∠5

∠5 is an alternate interior
angle so it is congruent to 84°

m∠5 = 84°

7. ∠6

∠6 is an alternate exterior
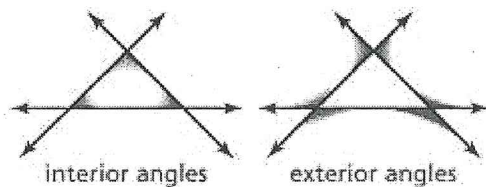angle to ∠3.

m∠6 = 96°
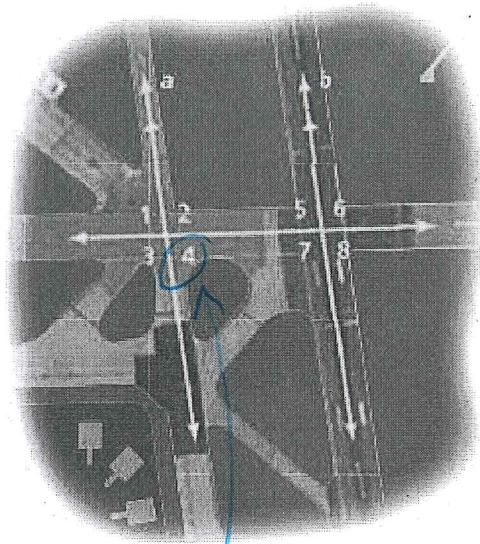
84°

3.2 Angles of Triangles

Standards	Learning Objectives (I can...)
8.G.5	• Understand that the sum of the interior angle measures of a triangle is 180 degrees. • Find the measure of the interior and exterior angles of a triangle.

The angles inside a polygon are called ___interior angles___. When the sides of a polygon are extended, other angles are formed. The angles outside the polygon that are ___adjacent___ to the interior angles are called ___exterior angles___.
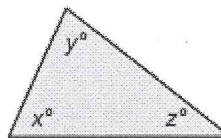
interior angles   exterior angles

Key Idea

Interior Angle Measures of a Triangle

The sum of the interior angle measures of a triangle is ___180°___.
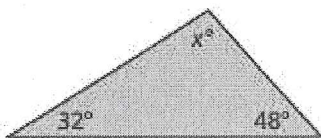
$x + y + z =$ ___180°___

Example 1: Using Interior Angle Measures

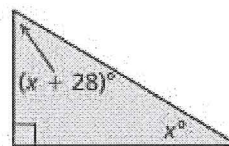**Find the value of x.**

a)

$$x + 32 + 48 = 180$$

$$x + 80 = 180$$

$$x = 100$$

b)

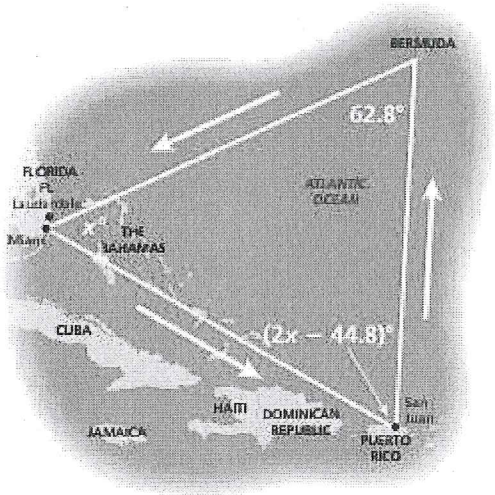$$90 + x + x + 28 = 180$$

$$2x + 118 = 180$$

$$2x = 62$$

$$x = 31$$

Example 3: Real-Life Application

An airplane leaves from Miami and travels around the Bermuda Triangle. What is the value of x?

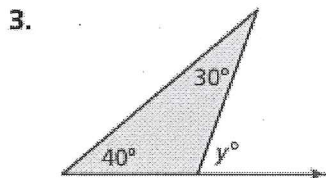(A) 26.8   (B) 27.2   (C) 54   (D) 64

$$x + 2x - 44.8 + 62.8 = 180$$
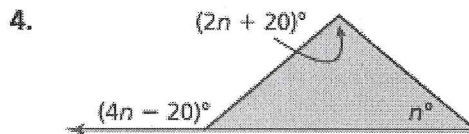
$$3x + 18 = 180$$

$$3x = 162$$

$$x = 54$$

On Your Own: Find the measure of the exterior angle.

3.

$$y = 30 + 40$$

$$y = 70$$

4.

$$4n - 20 = 2n + 20 + n$$
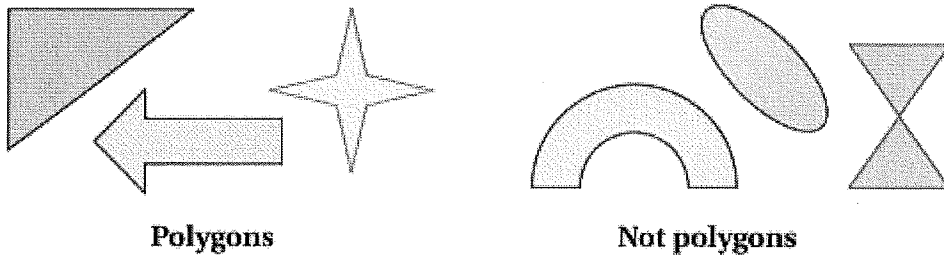
$$4n - 20 = 3n + 20$$

$$4n = 3n + 40$$

$$\underline{-3n \qquad -3n}$$

$$n = 40$$

3.3 Angles of Polygons

Standards	Learning Objectives (I can...)
8.G.5	• Find the sum of the interior angles measures of a polygon. • Understand that the sum of the exterior angle measures of a polygon is 360 degrees.

A _polygon_ is a closed plane figure made up of _three or more_ line segments that intersect only at their _endpoints_ .

Polygons   **Not polygons**

Key Idea

Interior Angle Measures of a Polygon

The sum S of the interior angle measures of a polygon with n sides is:

$$S = (n-2) \cdot 180$$

Example 1: Finding the Sum of the Interior Angle Measures

Find the sum of the interior angle measures of the school crossing sign.

The sign is in the shape of a pentagon.
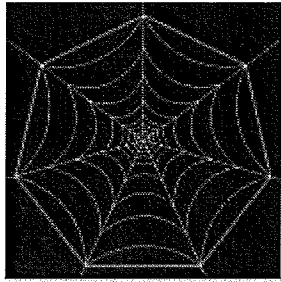It has 5 sides.

$S = (n-2) \cdot 180$

$S = (5-2) \cdot 180$

$S = 3 \cdot 180$

$S = 540°$

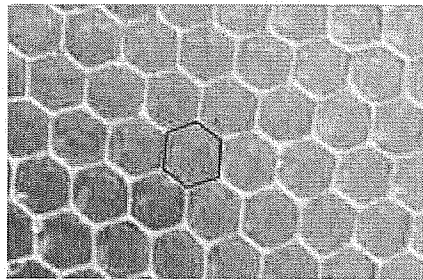**On Your Own:** Find the sum of the interior angle measures of the green polygon.

1.

$S = (7-2) \cdot 180$

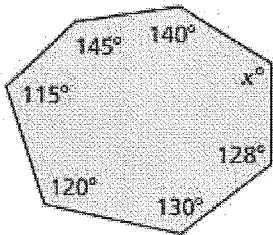$S = 5 \cdot 180$

$S = 900°$

2.

$S = (6-2) \cdot 180$

$S = 4 \cdot 180$

$S = 720°$

Example 2: Finding an Interior Measure of a Polygon

Find the value of x.

145° 140°
115°
x°
128°
120°
130°

The polygon has 7 sides.

$S = (7-2) \cdot 180$

$S = 5 \cdot 180$

$S = 900°$

$140 + 145 + 115 + 120 + 130 + 128 + X = 900°$

$778 + X = 900$

$X = 122$

On Your Own: Find the value of x.

3.

135° x°
110° 125°
125° 120°
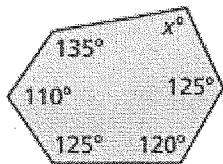
$S = (6-2) \cdot 180$

$S = 4 \cdot 180$
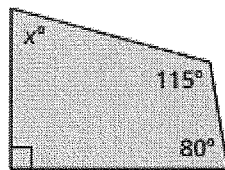
$S = 720$

$135 + 110 + 125 + 120 + 125 + x = 720$

$615 + x = 720$

$X = 105$

4.

x°
115°
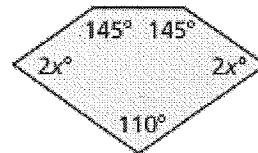80°

$S = (4-2) \cdot 180$

$S = 2 \cdot 180$

$S = 360$

$x + 115 + 80 + 90 = 360$

$x + 285 = 360$

$X = 75$

5.

145° 145°
2x° 2x°
110°

$S = (5-2) \cdot 180$

$S = 3 \cdot 180$

$S = 540$

$2x + 2x + 145 + 145 + 110 = 540$

$4x + 400 = 540$

$4x = 140$
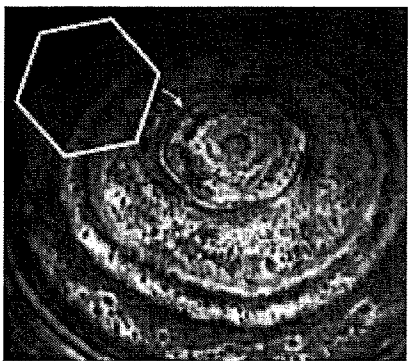
$X = 35$

Name:_____ Date:_____ Hour:_____ **Chapter 3:**

In a ___regular___ polygon, all the sides are ___congruent___, and all the
interior angles are ___Congruent___.

Example 3: Real-Life Application

A cloud system discovered on Saturn is in the approximate shape of a regular hexagon. Find the measure of each interior angle of the hexagon.

The hexagon is about 15,000 miles across. Approximately four Earths could fit inside it.

A hexagon has 6 sides. Find Sum of Interior angles.

$$S = (n-2) \cdot 180$$
$$S = (6-2) \cdot 180$$
$$S = 720$$

$$720 \div 6 = 120$$

Each measure is 120°

On Your Own: Find the measure of each interior angle of the regular polygon.

6. octagon

$$S = (8-2) \cdot 180$$
$$S = 1080$$

$$1080 \div 8 = 135$$

Each measure is 135°

7. decagon

$$S = (10-2) \cdot 180$$
$$S = 1440$$

$$1440 \div 10 = 144$$

Each measure is 144°

8. 18-gon

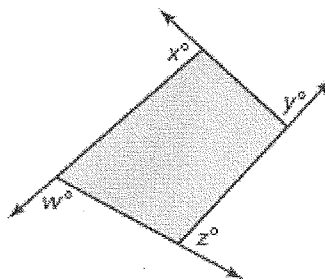$$S = (18-2) \cdot 180$$
$$S = 2880$$

$$2880 \div 18 = 160$$

Each measure is 160°

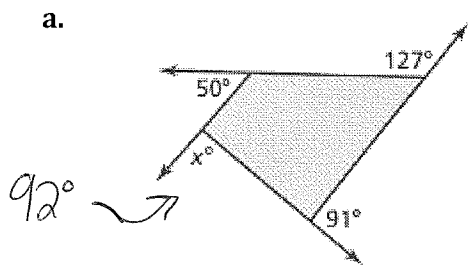# Key Idea

Exterior Angle Measures of a Polygon

The sum of the measures of the ___exterior___ angles of a convex polygon is ___360___ .

$w + x + y + z =$ ___360___

Example 4: Finding Exterior Angle Measures

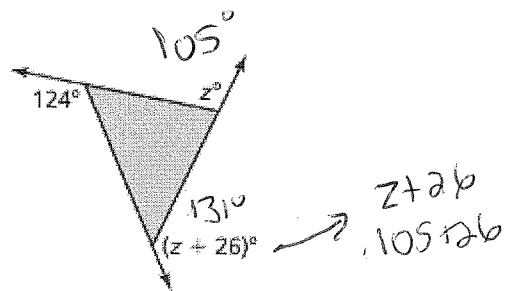**Find the measures of the exterior angles of each polygon.**

a.

127°
50°
$x°$
92°
91°

$x + 50 + 127 + 91 = 360$

$x + 268 = 360$

$x = 92$

b.

105°
124°
$z°$
131°
$(z+26)°$

$z + 26$
$105 + 26$

$124 + z + (z + 26) = 360$

$2z + 150 = 360$

$2z = 210$

$z = 105$

3.4 Using Similar Triangles

Standards	Learning Objectives (I can...)
8.G.5	• Understand the concept of similar triangles. • Identify similar triangles.

Key Idea

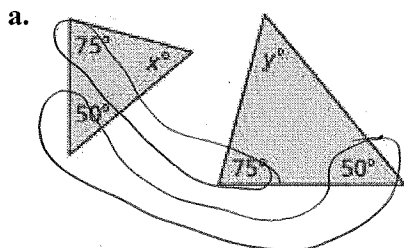**Angles of Similar Triangles**

When ___two___ angles in one triangle are ___Congruent___ to two angles in another triangle, the
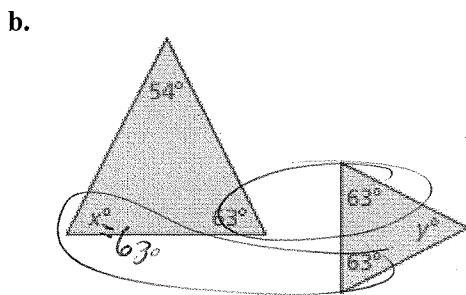___third___ angles are also congruent and the triangles are similar.
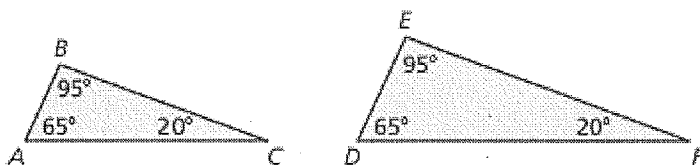
Triangle ABC is similar to Triangle DEF : ___$\triangle ABC \sim \triangle DEF$___.

Example 1: Identifying Similar Triangles

Tell whether the triangles are similar. Explain.

a.

The triangles have two pairs of
congruent angles. So, the third
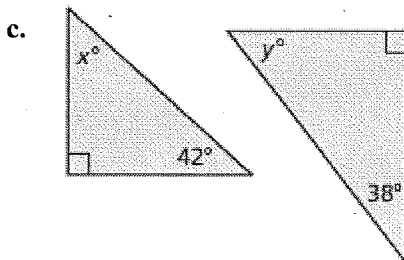angles are congruent. The triangles are
similar.

b.

$X+54+63=180$
$X+117=180$
$X=63$

The triangles have 2 pairs of congruent
angles. The third angles are congruent
and the triangles are similar.

c.

$X+90+42=180$
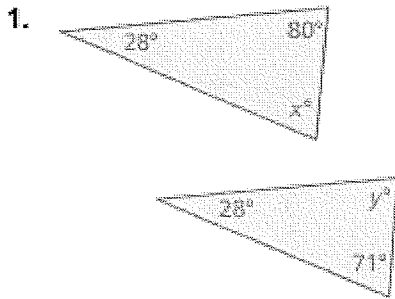$X+132=180$
$X=48$

The triangles do not have two pairs of
congruent angles. They are not similar.

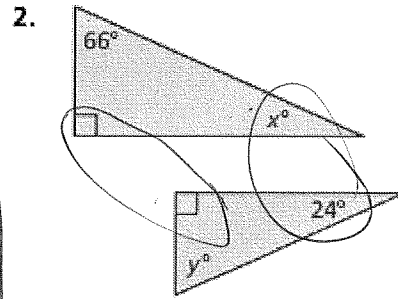**On Your Own:** Tell whether the triangles are similar. Explain.

1.

$X + 28 + 80 = 180$

$X + 108 = 180$

$x = 72$

No the triangles are not similar. Do not have 2 pairs of congruent angles.

2.

$X + 66 + 90 = 180$

$x = 24$

Yes the triangles are similar because they have two pairs of congruent angles.

Indirect ___measurement___ uses similar figures to find a ___missing___ measure when it is difficult to find directly.

Example 2: Using Indirect Measurement

You plan to cross a river and want to know how far it is to the other side. You take measurements on your side of the river and make the drawing shown. (a) Explain why △ABC and △DEC are similar. (b) What is the distance x across the river?

$\angle B$ and $\angle E$ are right angles, so they are congruent.

$\angle ACB$ and $\angle DCE$ are vertical angles, so they are congruent.

You have 2 pairs of congruent angles so the triangles are similar.
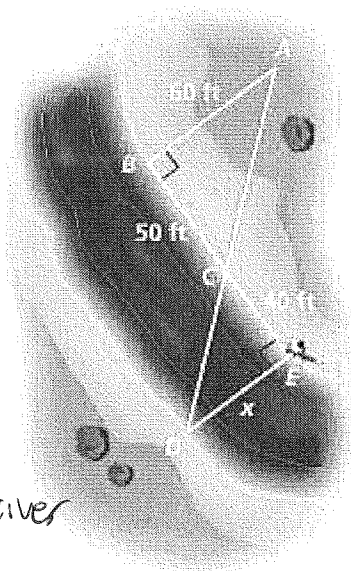
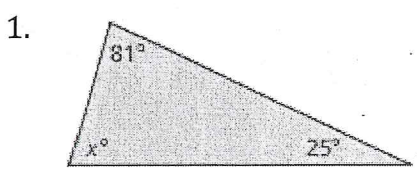$\frac{X}{60} = \frac{40}{50}$ $x = 48$

48ft across the river

On Your Own:

3. **WHAT IF?** The distance from vertex A to vertex B is 55 feet. What is the distance across the river?

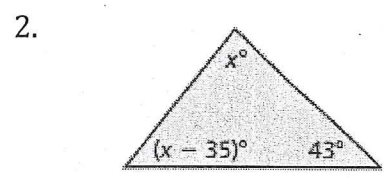$\frac{X}{55} = \frac{40}{50}$ 44 ft

On Your Own: Find the value of x.

1.

$$x + 81 + 25 = 180$$

$$x + 106 = 180$$

$$x = 74$$

2.

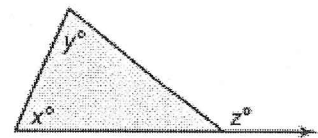

$$x - 35 + x + 43 = 180$$

$$2x + 8 = 180$$

$$2x = 172$$

$$x = 86$$
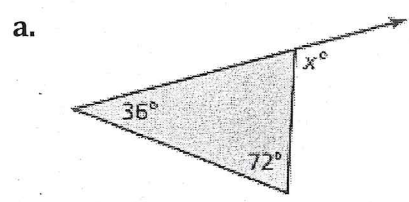
Key Idea

Exterior Angle Measures of a Triangle

The ___measure___ of an exterior angle of a triangle is equal to the ___Sum___ of the
measures of the two nonadjacent ___interior___ angles.
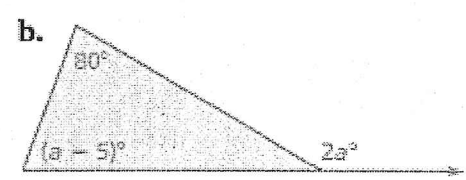

___z___ = x + y

Example 2: Finding Exterior Angle Measures

Find the measure of the exterior angle.

a.

$$x = 36 + 72$$

$$x = 108$$

b.

$$2a = 80 + a - 5$$

$$2a = 75 + a$$

$$\underline{-a \qquad -a}$$

$$a = 75$$