? ESSENTIAL QUESTION

How can you use angle relationships to solve problems?

**EXPLORE ACTIVITY** **TEKS** 7.11.C

Measuring Angles

It is useful to work with pairs of angles and to understand how pairs of angles relate to each other. **Congruent angles** are angles that have the same measure.

STEP 1 Using a ruler, draw a pair of intersecting lines. Label each angle from 1 to 4.

STEP 2 Use a protractor to help you complete the chart.

Angle	Measure of Angle
m∠1	
m∠2	
m∠3	
m∠4	
m∠1 + m∠2	
m∠2 + m∠3	
m∠3 + m∠4	
m∠4 + m∠1	
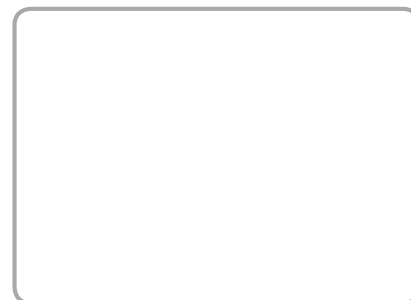
Reflect

1. **Conjecture** Share your results with other students. Make a conjecture about pairs of angles that are opposite each other.

   _____

   _____

2. **Conjecture** When two lines intersect to form two angles, what conjecture can you make about the pairs of angles that are next to each other?

   _____

   _____

Angle Pairs and One-Step Equations

Vertical angles are the opposite angles formed by two intersecting lines. Vertical angles are congruent because the angles have the same measure. **Adjacent angles** are pairs of angles that share a vertex and one side but do not overlap.
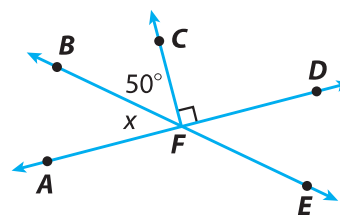
Complementary angles are two angles whose measures have a sum of 90°. **Supplementary angles** are two angles whose measures have a sum of 180°. You discovered in the Explore Activity that adjacent angles formed by two intersecting lines are supplementary.

EXAMPLE 1   TEKS 7.11.C

Use the diagram.

A **Name a pair of vertical angles.**

$\angle AFB$ and $\angle DFE$

B **Name a pair of adjacent angles.**

$\angle AFB$ and $\angle BFD$

C **Name a pair of supplementary angles.**

$\angle AFB$ and $\angle BFD$

D **Find the measure of $\angle AFB$.**

Use the fact that $\angle AFB$ and $\angle BFD$ in the diagram are supplementary angles to find m$\angle AFB$.

$$m\angle AFB + m\angle BFD = 180° \quad \text{They are supplementary angles.}$$
$$x + 140° = 180° \quad m\angle BFD = 50° + 90° = 140°$$
$$\underline{-140° \quad -140°} \quad \text{Subtract } 140° \text{ from both sides.}$$
$$x = 40°$$

The measure of $\angle AFB$ is 40°.

My Notes

Reflect

3. **Analyze Relationships** What is the relationship between $\angle AFB$ and $\angle BFC$? Explain.

_____

_____

4. **Draw Conclusions** Are $\angle AFC$ and $\angle BFC$ adjacent angles? Why or why not?
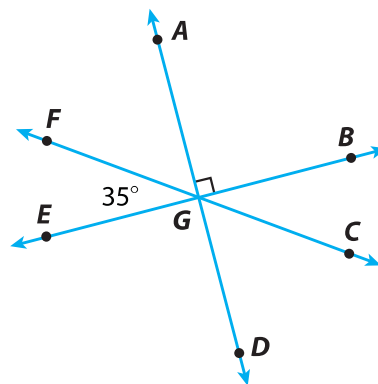
_____

_____

YOUR TURN

Use the diagram.

5. Name a pair of supplementary angles.

   _____

6. Name a pair of vertical angles.

   _____

7. Find the measure of ∠CGD. _____

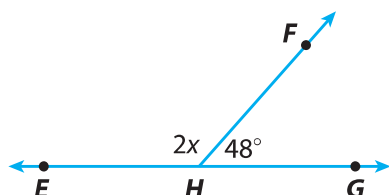# Angle Pairs and Two-Step Equations

Sometimes solving an equation is only the first step in using an angle relationship to solve a problem.

EXAMPLE 2

TEKS 7.11.C

A **Find the measure of ∠EHF.**

∠EHF and ∠FHG form a straight line.

STEP 1 Identify the relationship between ∠EHF and ∠FHG.

∠EHF and ∠FHG are supplementary angles.

Since angles ∠EHF and ∠FHG form a straight line, the sum of the measures of the angles is 180°.

STEP 2 Write and solve an equation to find x.

$$m\angle EHF + m\angle FHG = 180°$$

$$2x + 48° = 180°$$

$$\underline{ -48° \quad -48°}$$

$$2x = 132°$$

$$x = 66°$$

The sum of the measures of supplementary angles is 180°.

Subtract 48° from both sides.

Divide both sides by 2.
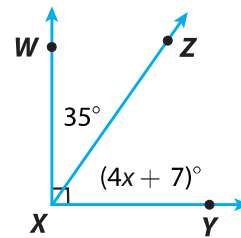
Since $m\angle EHF = 2x$, then $m\angle EHF = 132°$.

B **Find the measure of ∠ZXY.**

STEP 1 Identify the relationship between ∠WXZ and ∠ZXY.

∠WXZ and ∠ZXY are complementary angles.

STEP 2 Write and solve an equation to find x.

$$m\angle WXZ + m\angle ZXY = 90°$$ The sum of the measures of complementary angles is 90°.

$$35° + (4x + 7)° = 90°$$ Substitute the values.

$$4x + 42° = 90°$$ Combine like terms.

$$\underline{-42° \quad -42°}$$ Subtract 42 from both sides.

$$4x \qquad = 48°$$ Divide both sides by 4.

$$x = 12°$$

STEP 3 Find the measure of ∠ZXY.

$$m\angle ZXY = (4x + 7)°$$

$$= (4(12) + 7)°$$ Substitute 12 for x.

$$= 55°$$ Use the Order of Operations.

○ The measure of ∠ZXY is 55°.

YOUR TURN

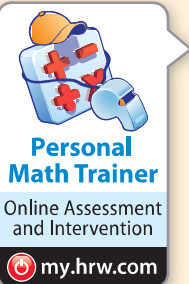8. Find the measure of ∠JML.

$$x = \boxed{}$$

$$m\angle JML = 3x$$

$$= \boxed{}$$
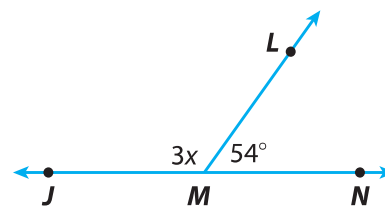
9. **Critique Reasoning** Cory says that to find m∠JML above you can stop when you get to the solution step $3x = 126°$. Explain why this works.

_____

_____

_____

Personal Math Trainer

Online Assessment and Intervention

⏻ my.hrw.com

Using Angle Measures in Triangles

You learned earlier that the sum of the measures of the angles in any triangle is 180°. You can use this property in many real-world situations.
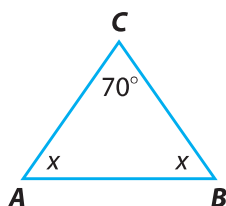
EXAMPLE 3 Real World

TEKS 7.11.C

The front of the top story of a house is shaped like an isosceles triangle. The measure of the angle at the top of the triangle is 70°. Find the measure of each of the base angles.

STEP 1   Make a sketch.

STEP 2   Write an equation.

$$m\angle A + m\angle B + m\angle C = 180°$$ The sum of the angle measures in a triangle is 180°.

$$x + x + 70° = 180°$$ Substitute values.

STEP 3   Solve the equation to find x.

$$x + x + 70° = 180°$$

$$2x + 70° = 180°$$ Combine like terms.

$$\underline{-70° \quad -70°}$$ Subtract 70° from both sides.

$$2x = 110°$$

$$\frac{2x}{2} = \frac{110°}{2}$$ Divide both sides of the equation by 2.
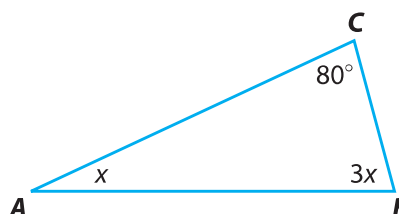
$$x = 55°$$

○   Each of the base angles measures 55°.

YOUR TURN

Use the diagram.

10. Find the value of x. _____

11. Find the measures of

∠A and ∠B. _____

Personal Math Trainer
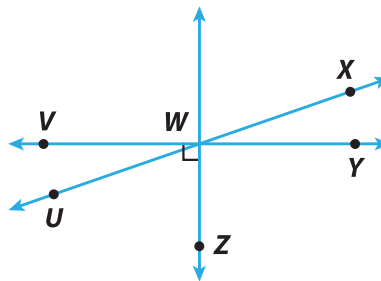Online Assessment and Intervention
my.hrw.com

For Exercises 1–2, use the figure. (Example 1)

1. **Vocabulary** The sum of the measures of $\angle UWV$ and $\angle UWZ$ is 90°, so $\angle UWV$ and $\angle UWZ$ are

   _____ angles.

2. **Vocabulary** $\angle UWV$ and $\angle VWX$ share a vertex and one side. They do not overlap, so $\angle UWV$ and $\angle VWX$ are

   _____ angles.

For Exercises 3–4, use the figure.

3. $\angle AGB$ and $\angle DGE$ are _____ angles,

   so $m\angle DGE =$ _____. (Example 1)

4. Find the measure of $\angle EGF$. (Example 2)

   $m\angle CGD + m\angle DGE + m\angle EGF = 180°$

   _____ + _____ + _____ = 180°

   _____ + 2x = 180°

   2x = _____

   $m\angle EGF = 2x =$ _____

5. Find the measures of $\angle A$ and $\angle B$. (Example 3)
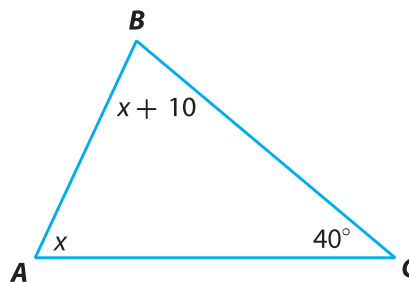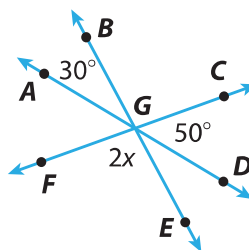
   $m\angle A + m\angle B + m\angle C = 180°$

   _____ + _____ + _____ = 180

   2x + _____ = 180

   2x = _____

   x = _____, so $m\angle A =$ _____.
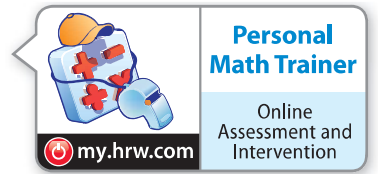
   x + 10 = _____, so $m\angle B =$ _____.

? ESSENTIAL QUESTION CHECK-IN

6. Suppose that you know that $\angle T$ and $\angle S$ are supplementary, and that $m\angle T = 3 \cdot (m\angle S)$. How can you find $m\angle T$?
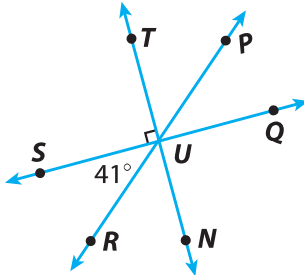
   _____

   _____

9.1 Independent Practice

TEKS 7.11.C

For Exercises 7–11, use the figure.

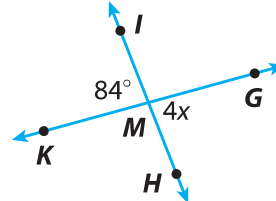**7.** Name a pair of adjacent angles. Explain why they are adjacent.

_____

_____

_____

8. Name a pair of acute vertical angles.

_____

9. Name a pair of supplementary angles.

_____

10. **Justify Reasoning** Find m∠QUR. Justify your answer.

_____

_____

_____

_____

_____

11. **Draw Conclusions** Which is greater, m∠TUR or m∠RUQ? Explain.
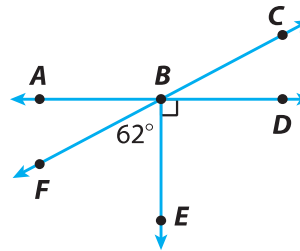
_____

_____

_____

_____

Solve for each indicated angle measure or variable in the figure.

12. x _____

13. m∠KMH _____

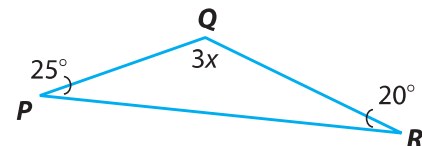**Solve for each indicated angle measure or variable in the figure.**

14. m∠CBE _____

15. m∠ABF _____

16. m∠CBA _____

Solve for each indicated angle measure or variable in the figure.

**17.** x _____

18. m∠Q _____

H.O.T. FOCUS ON HIGHER ORDER THINKING

Let △ABC be a right triangle with m∠C = 90°.

19. Critical Thinking An equilateral triangle has three congruent sides and three congruent angles. Can △ABC be an equilateral triangle? Explain your reasoning.

_____

_____

20. Counterexample An isosceles triangle has two congruent sides, and the angles opposite those sides are congruent. River says that right triangle *ABC* cannot be an isosceles triangle. Give a counterexample to show that his statement is incorrect.

_____

_____

21. Make a Conjecture In a scalene triangle, no two sides have the same length, and no two angles have the same measure. Do you think a right triangle can be a scalene triangle? Explain your reasoning.

_____

_____

_____

_____

_____

22. Represent Real-World Problems The railroad tracks meet the road as shown. The town will allow a parking lot at angle *J* if the measure of angle *J* is greater than 38°. Can a parking lot be built at angle *J*? Why or why not?

Ave.
50° J
Green   Ave.
Park

_____

_____
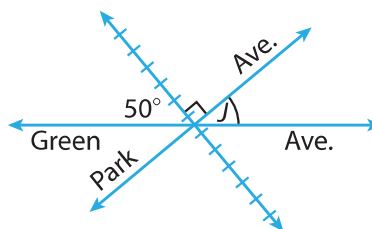
23. Analyze Relationships In triangle *XYZ*, m∠X = 30°, and all the angles have measures that are whole numbers. Angle *Y* is an obtuse angle. What is the greatest possible measure that angle *Z* can have? Explain your answer.

_____

_____

_____