



Explore It!

The intersecting skis form four angles.



ACTIVITY

Lesson 10-4

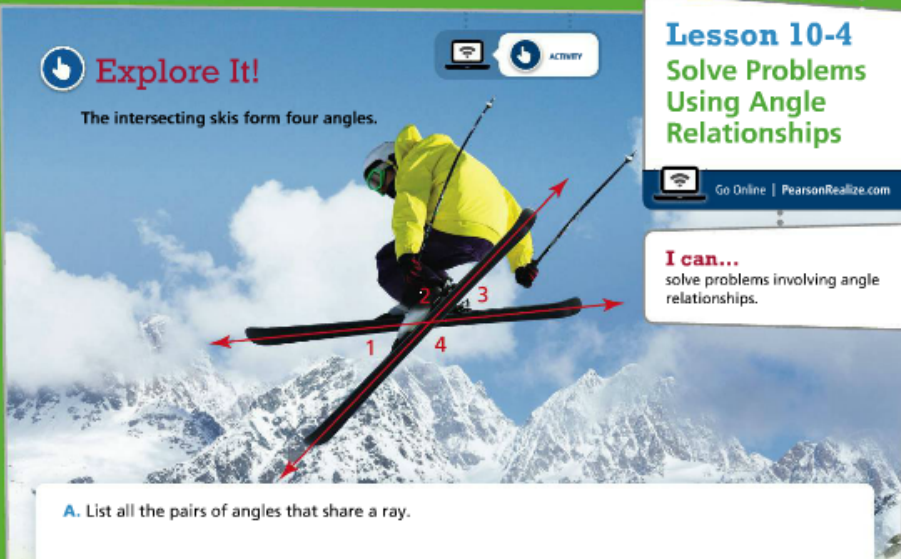
Solve Problems Using Angle Relationships



Go Online | PearsonRealize.com

I can...

solve problems involving angle relationships.



A. List all the pairs of angles that share a ray.

B. Suppose the measure of $\angle 1$ increases. What happens to the size of $\angle 2$? $\angle 3$?

C. How does the sum of the measures of $\angle 1$ and $\angle 2$ change when one ski moves? Explain.

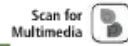
Focus on math practices

Construct Arguments Why does the sum of all four angle measures stay the same when one of the skis moves?

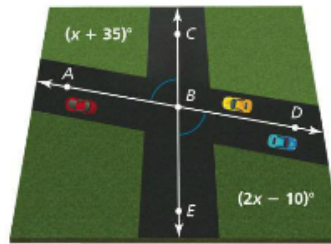
Essential Question How are angles formed by intersecting lines related?



EXAMPLE 1 Solve Problems Involving Adjacent and Vertical Angles



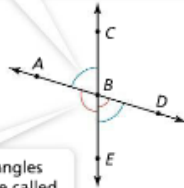
A skewed intersection has two roads that intersect at more than 20 degrees away from 90°. Determine whether the road intersection shown is skewed by finding the measures of $\angle ABC$ and $\angle DBE$.



Look for Relationships What angle measures would a skewed intersection have?

Examine how the angles are related.

Angles opposite each other are called **vertical angles**. Vertical angles have equal measures. $\angle ABC$ and $\angle DBE$ are vertical angles.



Non-overlapping angles that share a ray are called **adjacent angles**. $\angle ABE$ and $\angle EBD$ are adjacent angles, sharing ray BE .

Write and solve an equation to find the value of x .

Read "m" as "the measure of" the named angle.

$$\begin{aligned}
 m\angle ABC &= m\angle DBE \\
 x + 35 &= 2x - 10 \\
 x + 35 + 10 &= 2x - 10 + 10 \\
 x + 45 &= 2x \\
 x - x + 45 &= 2x - x \\
 45 &= x
 \end{aligned}$$

Find the measure of an angle in the intersection.

$$\begin{aligned}
 m\angle ABC &= (x + 35)^\circ \\
 &= (45 + 35)^\circ \\
 &= 80^\circ
 \end{aligned}$$

$\angle ABC$ and $\angle DBE$ both measure 80° .

Since 80° is within 20° of 90° , the road intersection is not skewed.

Try It!

$\angle MNQ$ and $\angle PNR$ are vertical angles. What is the value of x ?

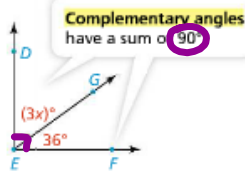
Vertical angles are , so the equation can be used to find x . The value of x is .



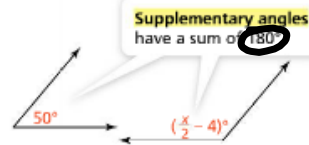
Convince Me! Why can you use an equation when solving for x in the diagram?

EXAMPLE 2 Solve Problems Involving Complementary and Supplementary Angles

- a. Ray EG splits right angle DEF into two angles, $\angle DEG$ and $\angle GEF$. Find the value of x .
 b. The two angles shown are supplementary angles. Find the value of x .



$$\begin{aligned} m\angle DEG + m\angle GEF &= 90 \\ 3x + 36 &= 90 \\ 3x + 36 - 36 &= 90 - 36 \\ 3x &= 54 \\ \frac{3x}{3} &= \frac{54}{3} \\ x &= 18 \end{aligned}$$



$$\begin{aligned} \left(\frac{x}{2} - 4\right) + 50 &= 180 \\ \frac{x}{2} + 46 &= 180 \\ \frac{x}{2} + 46 - 46 &= 180 - 46 \\ \frac{x}{2} &= 134 \\ 2 \cdot \frac{x}{2} &= 2 \cdot 134 \\ x &= 268 \end{aligned}$$

straight = 180°

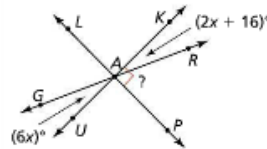
EXAMPLE 3 Find the Measure of an Unknown Angle

Find the measure of $\angle PAR$.

STEP 1 Use vertical angles to find the value of x .

$$\begin{aligned} m\angle UAG &= m\angle KAR \\ 6x &= 2x + 16 \\ 6x - 2x &= 2x - 2x + 16 \\ 4x &= 16 \\ \frac{4x}{4} &= \frac{16}{4} \\ x &= 4 \end{aligned}$$

$m\angle UAG = (6x)^\circ = (6 \cdot 4)^\circ = 24^\circ$
 So $m\angle KAR = 24^\circ$.



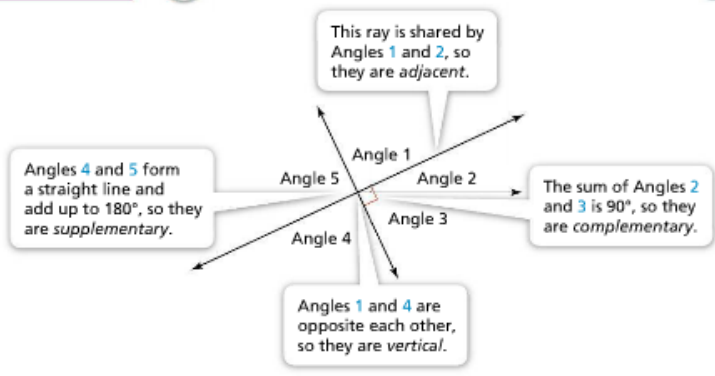
STEP 2 Use complementary angles to find the measure of $\angle PAR$.

$$\begin{aligned} m\angle KAR + m\angle PAR &= 90^\circ \\ 24^\circ + m\angle PAR &= 90^\circ \\ m\angle PAR &= 66^\circ \end{aligned}$$

Try It!

$m\angle 1$ is 4 times $m\angle 2$. $\angle 1$ and $\angle 2$ are complementary. $\angle 1$ and $\angle 3$ are vertical angles. $\angle 3$ and $\angle 4$ are supplementary. What are the measures of the four angles?

KEY CONCEPT

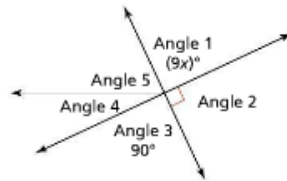


Do You Understand?

- Essential Question** How are angles formed by intersecting lines related?
- Use Structure** Can vertical angles also be adjacent angles? Explain.
- Reasoning** Do complementary and supplementary angles also have to be adjacent angles? Explain.

Do You Know How?

Use the diagram below for 4–6.



- List two pairs of adjacent angles.
- List all pairs of vertical angles.
- If $\angle 1$ and $\angle 3$ are the same measure, what is the value of x ?

Name: _____

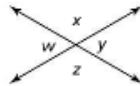


Practice & Problem Solving

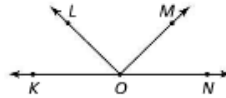


Scan for Multimedia

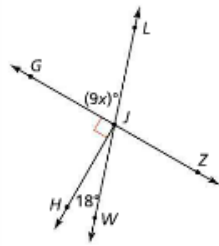
7. List each angle adjacent to $\angle w$.



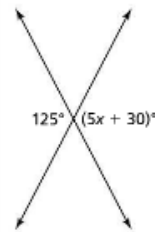
8. List two pairs of adjacent angles.



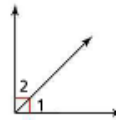
9. Find the value of x .



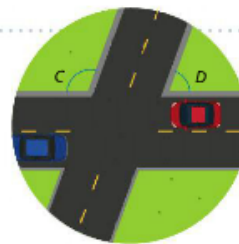
10. Find the value of x .



11. $\angle 1$ and $\angle 2$ are complementary angles. The measure of $\angle 1$ is 42° . The measure of $\angle 2$ is $(3x)^\circ$. Find the value of x .



12. Two streets form an intersection. $\angle C$ and $\angle D$ are supplementary angles. If the measure of $\angle C$ is 128° and the measure of $\angle D$ is two times the value of x , what is the value of x ?



Name: _____

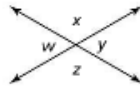


Practice & Problem Solving

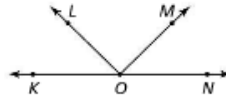


Scan for Multimedia

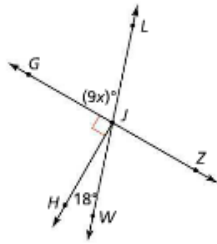
7. List each angle adjacent to $\angle w$.



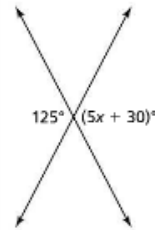
8. List two pairs of adjacent angles.



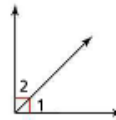
9. Find the value of x .



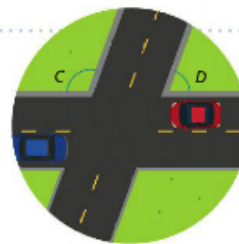
10. Find the value of x .



11. $\angle 1$ and $\angle 2$ are complementary angles. The measure of $\angle 1$ is 42° . The measure of $\angle 2$ is $(3x)^\circ$. Find the value of x .

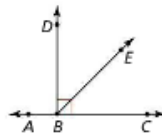


12. Two streets form an intersection. $\angle C$ and $\angle D$ are supplementary angles. If the measure of $\angle C$ is 128° and the measure of $\angle D$ is two times the value of x , what is the value of x ?



13. If $\angle A$ and $\angle B$ are supplementary angles and $\angle A$ is three times as large as $\angle B$, find the measures of $\angle A$ and $\angle B$.

14. **Higher Order Thinking** The measure of $\angle DBE$ is $(0.1x - 22)^\circ$ and the measure of $\angle CBE$ is $(0.3x - 54)^\circ$. Find the value of x .



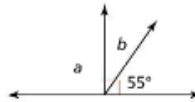
15. **Reasoning** $\angle 1$ and an angle that measures 50° are supplementary. Another angle that measures 50° and $\angle 3$ are supplementary. Show that $m\angle 1$ and $m\angle 3$ are equal.

Assessment Practice

16. Using the diagram at the right, Martin incorrectly writes $m\angle b = 125^\circ$.

PART A

Find the correct measure of $\angle b$.



PART B

What mistake did he likely make?

- Ⓐ He subtracted 55° from 90° instead of 180° .
- Ⓑ He subtracted 55° from 180° instead of 90° .
- Ⓒ He added 55° to 180° instead of 90° .
- Ⓓ He added 55° to 90° instead of 180° .

17. In the diagram at the right, $m\angle 1 = (133 - y)^\circ$, $m\angle 2 = 22^\circ$, and $m\angle 3 = (x + 48)^\circ$. Find the values of x and y .

