

# 7-1

# Pairs of Angles

## Check Skills You'll Need

1. **Vocabulary Review**  
What is the *inverse operation* of addition?

Solve each equation.

- $3a + 14 = 32$
- $6b - 4 = 26$
- $2c + 10 = 90$
- $180 = 4d + 42$

**GO for Help**  
Lesson 2-1

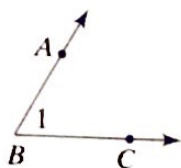
**CONTENT STANDARD**  
Essential for understanding  
8.G.5

## Vocabulary Tip

The vertex of an angle is the point of intersection of two sides of an angle or figure.

## Test Prep Tip

You can name the angle below in four ways.



$\angle 1$ ,  $\angle B$ ,  $\angle ABC$ ,  $\angle CBA$

## What You'll Learn

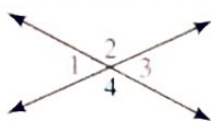
To identify types of angles and to find angle measures using the relationship between angles

**New Vocabulary** vertical angles, congruent angles, adjacent angles, supplementary, complementary, perpendicular lines

## Why Learn This?

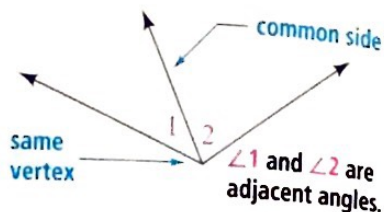
City streets cross each other in certain ways. Understanding angles can help you read and draw maps.

**Vertical angles** are formed by two intersecting lines and are opposite each other. Vertical angles are congruent. **Congruent angles** have the same measure.



$\angle 1$  and  $\angle 3$  are vertical angles;  $m\angle 1 = m\angle 3$ .  
 $\angle 2$  and  $\angle 4$  are vertical angles;  $m\angle 2 = m\angle 4$ .

**Adjacent angles** have a common vertex and a common side, but no common interior points.



## EXAMPLE

### Identifying Adjacent and Vertical Angles

- 1 **City Planning** Name a pair of adjacent angles and a pair of vertical angles in the photo at the right. Find  $m\angle JBT$ .

$\angle DBJ$  and  $\angle JBT$  are adjacent angles.

$\angle DBY$  and  $\angle JBT$  are vertical angles.

Vertical angles are congruent, so  $m\angle JBT = m\angle DBY$ . So  $m\angle JBT$  is  $80^\circ$ .

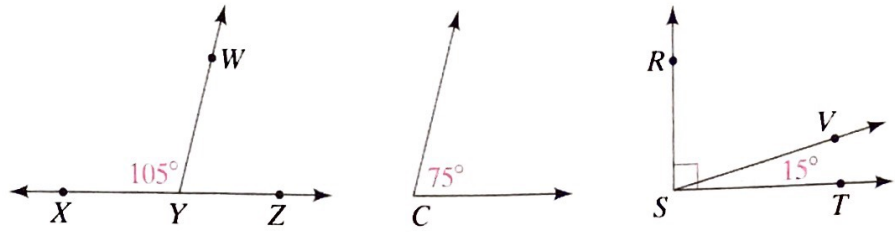
## Quick Check

1. Name another pair of vertical angles and another pair of adjacent angles in the photo.



If the sum of the measures of two angles is  $180^\circ$ , the angles are **supplementary**. If the sum of the measures of two angles is  $90^\circ$ , the angles are **complementary**.

In the diagram below,  $\angle C$  and  $\angle WYZ$  are both supplements of  $\angle XYW$ .  $\angle C$  and  $\angle VSR$  are both complements of  $\angle VST$ .



You can solve equations to find the measures of supplementary and complementary angles.

### EXAMPLE Finding Supplementary Angles

- 2 **Algebra** Suppose  $m\angle BCD = 121^\circ$ . Find the measure of its supplement.

Let  $x^\circ$  = the measure of the supplement of  $\angle BCD$ .

$$x^\circ + m\angle BCD = 180^\circ \quad \leftarrow \text{The sum of the measures of supplementary angles is } 180^\circ.$$

$$x^\circ + 121^\circ = 180^\circ \quad \leftarrow \text{Substitute } 121^\circ \text{ for } m\angle BCD.$$

$$x^\circ + 121^\circ - 121^\circ = 180^\circ - 121^\circ \quad \leftarrow \text{Subtract } 121^\circ \text{ from each side.}$$

$$x^\circ = 59^\circ \quad \leftarrow \text{Simplify.}$$

The measure of the supplement of  $\angle BCD$  is  $59^\circ$ .

### Quick Check

2. An angle has a measure of  $47^\circ$ . Find the measure of its supplement.

**Perpendicular lines** are two lines that intersect to form a right angle. Recall that a right angle has a measure of  $90^\circ$ .

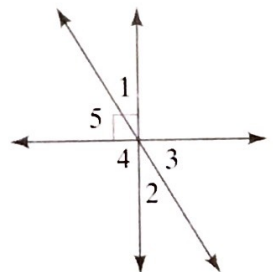
### EXAMPLE Finding Angle Measures

- 3 In the diagram at the right,  $m\angle 5 = 58^\circ$ . Find the measures of  $\angle 1$  and  $\angle 2$ .

$$m\angle 1 + 58^\circ = 90^\circ \quad \leftarrow \angle 1 \text{ and } \angle 5 \text{ are complementary.}$$

$$m\angle 1 = 32^\circ \quad \leftarrow \text{Subtract } 58^\circ \text{ from each side.}$$

Since  $\angle 1$  and  $\angle 2$  are vertical angles,  $m\angle 2 = 32^\circ$ .



### Quick Check

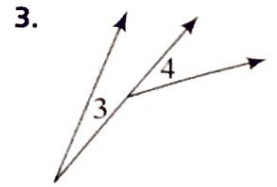
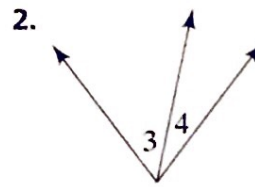
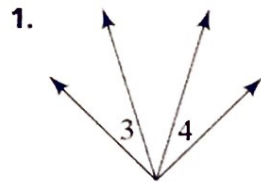
3. Find the measures of  $\angle 3$  and  $\angle 4$  in Example 3.



For: Investigating Angle Theorems Activity  
Use: Interactive Textbook, 7-1

# Check Your Understanding

**Vocabulary** Are  $\angle 3$  and  $\angle 4$  adjacent angles? Explain.



4. **Reasoning** Does every angle have a complement? Explain.

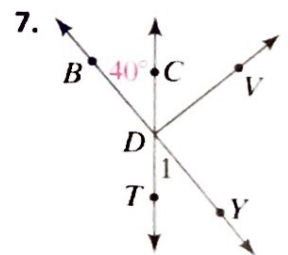
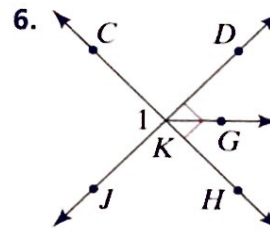
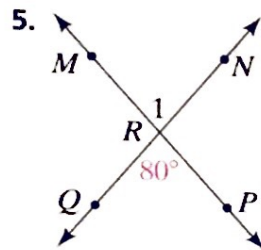
## Homework Exercises

For more exercises, see **Extra Skills and Word Problems**.

### GO for Help

| For Exercises | See Examples |
|---------------|--------------|
| 5–7           | 1            |
| 8–12          | 2            |
| 13–15         | 3            |

Name a pair of vertical angles and a pair of adjacent angles in each figure. Find  $m\angle 1$ .



Find the measure of the supplement of each angle.

8.  $14^\circ$

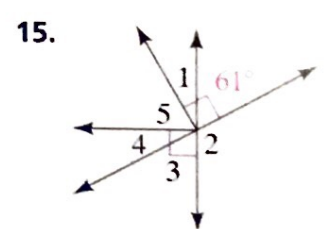
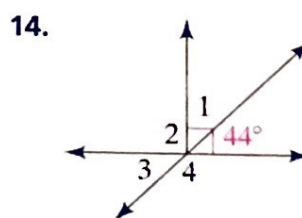
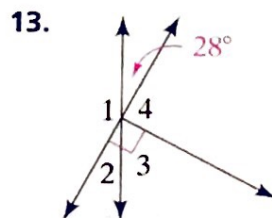
9.  $24^\circ$

10.  $145^\circ$

11.  $39^\circ$

12.  $116^\circ$

Find the measure of each numbered angle.



### GPS

16. **Guided Problem Solving** Route 43 is perpendicular to Devon Avenue. Find the measure of the acute angle formed by Route 43 and Northwest Highway.

- What kinds of angles do perpendicular lines form?
- What special pairs of angles do you see?



Find the measure of the complement and the supplement of each angle.

17.  $32^\circ$

18.  $77^\circ$

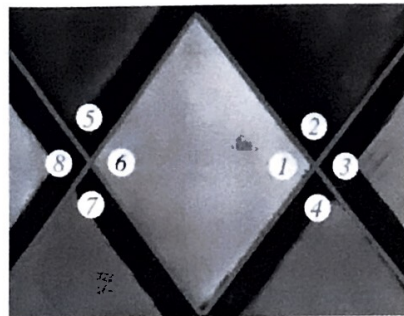
19.  $85.9^\circ$

20.  $42.3^\circ$

21.  $6.1^\circ$

**Art** Use the stained glass window below for Exercises 22–26.

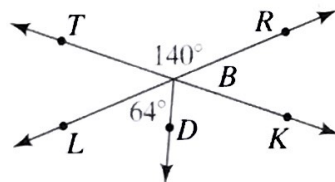
22. Are  $\angle 1$  and  $\angle 7$  adjacent? Explain.  
 23. Are  $\angle 2$  and  $\angle 3$  vertical? Explain.  
 24. Name a pair of adjacent angles.  
 25. Name a pair of vertical angles.  
 26. Suppose  $m\angle 1 = m\angle 6$ . Are  $\angle 1$  and  $\angle 5$  supplementary? Explain.



27. **Writing in Math** Can two supplementary angles have the same measure? Explain.

Use the diagram for Exercises 28–31.

28.  $\angle LBD$  and  $\angle TBL$  are ? angles.  
 29.  $\angle RBT$  and  $\angle$  ? are vertical angles.  
 30.  $m\angle KBL = \blacksquare^\circ$     31.  $m\angle DBK = \blacksquare^\circ$



32. **Challenge** Which pair of angles does NOT exist? Explain.  
 (A) adjacent supplementary    (C) complementary vertical  
 (B) vertical adjacent    (D) congruent complementary

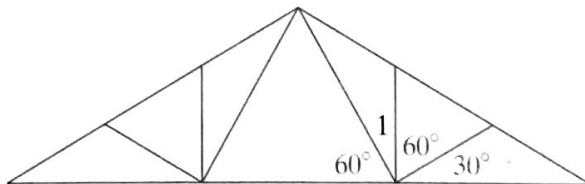


**Test Prep and Mixed Review**

**Practice**

**Multiple Choice**

33. A truss is part of the roof of a house. What is the measure of  $\angle 1$  in the “fan” truss below?



- (A)  $30^\circ$     (B)  $45^\circ$     (C)  $60^\circ$     (D)  $90^\circ$

34. A movie theater charges \$9 for an adult ticket and \$7 for a child ticket. At one showing, the theater sold 210 tickets for a total of \$1,778. Let  $x$  = the number of adult tickets sold, and let  $y$  = the number of child tickets sold. Which system of equations can be used to find the values of  $x$  and  $y$ ?

- (F)  $\begin{cases} 9x + 210y \\ 7x = 1,778y \end{cases}$     (H)  $\begin{cases} 9x + 7y = 1,778 \\ x + y = 210 \end{cases}$   
 (G)  $\begin{cases} 9x + 7y = 210 \\ x + y = 1,778 \end{cases}$     (J)  $\begin{cases} 9x + 7y = 1,778 \\ 9x + 7y = 210 \end{cases}$

**GO for Help**

| For Exercises | See Lesson |
|---------------|------------|
| 35–37         | 5-2        |

Solve each system of equations.

35.  $\begin{cases} y = 4x \\ y = x + 6 \end{cases}$     36.  $\begin{cases} y = x - 3 \\ y + 2x = 6 \end{cases}$     37.  $\begin{cases} x = 5y \\ x + y = 18 \end{cases}$