Essential Question What can you conclude about the angles formed by two intersecting lines?

Classification of Angles

| *Acute:* | *Right:* | *Obtuse:* | *Straight:* |
| Less than 90° | Equal to 90° | Greater than 90° and less than 180° | Equal to 180° |

1   ACTIVITY: Drawing Angles

Work with a partner.

a. Draw the hands of the clock to represent the given type of angle.

| Acute | Straight | Right | Obtuse |

b. What is the measure of the angle formed by the hands of the clock at the given time?

9:00   6:00   12:00

The Meaning of a Word   ● Adjacent

Geometry

In this lesson, you will
- identify adjacent and vertical angles.
- find angle measures using adjacent and vertical angles.

When two states are **adjacent**,   they are next to each other and they share a common border.
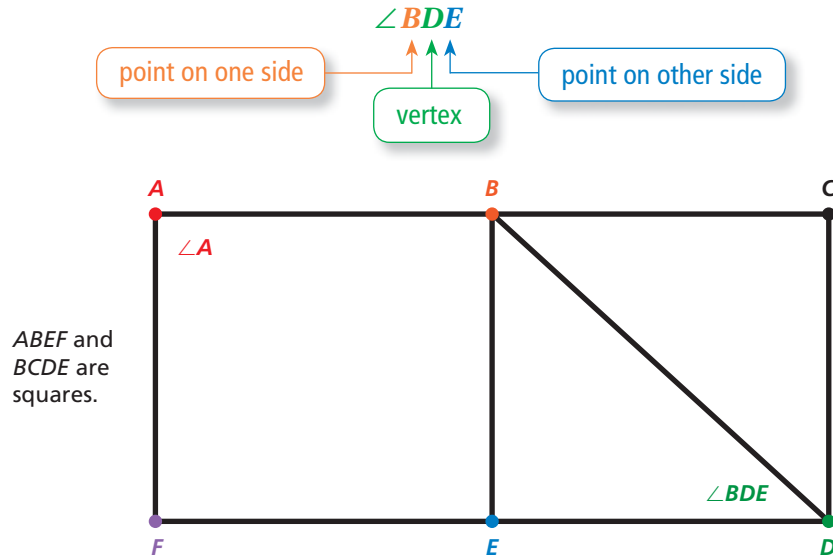
Maine

New Hampshire

Maine

New Hampshire

2 ACTIVITY: Naming Angles

Work with a partner. Some angles, such as $\angle A$, can be named by a single letter. When this does not clearly identify an angle, you should use three letters, as shown.

Math Practice

Justify Conclusions

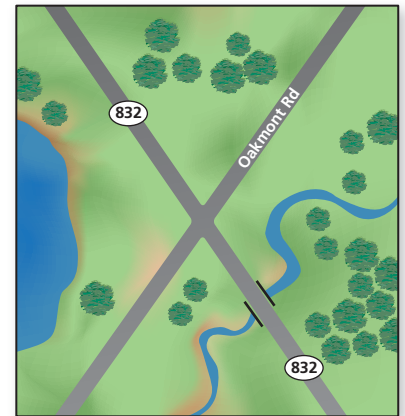When you name an angle, does the order in which you write the letters matter? Explain.

$\angle BDE$

point on one side — vertex — point on other side

ABEF and *BCDE* are squares.

$\angle A$

$\angle BDE$

a. Name all the right angles, acute angles, and obtuse angles.

b. Which pairs of angles do you think are *adjacent?* Explain.

3 ACTIVITY: Measuring Angles

Work with a partner.

a. How many angles are formed by the intersecting roads? Number the angles.

b. **CHOOSE TOOLS** Measure each angle formed by the intersecting roads. What do you notice?

What Is Your Answer?

4. **IN YOUR OWN WORDS** What can you conclude about the angles formed by two intersecting lines?

5. Draw two acute angles that are adjacent.

Practice ➡ Use what you learned about angles and intersecting lines to complete Exercises 3 and 4 on page 274.
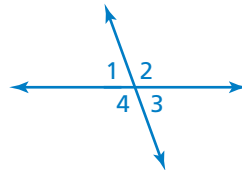
Key Vocabulary
adjacent angles, *p. 272*
vertical angles, *p. 272*
congruent angles, *p. 272*

Key Ideas

Adjacent Angles

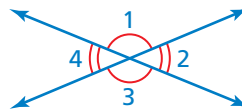**Words** Two angles are **adjacent angles** when they share a common side and have the same vertex.

Examples

∠1 and ∠2 are adjacent.
∠2 and ∠4 are not adjacent.

Vertical Angles

Words Two angles are **vertical angles** when they are opposite angles formed by the intersection of two lines. Vertical angles are **congruent angles**, meaning they have the same measure.

Examples

∠1 and ∠3 are vertical angles.
∠2 and ∠4 are vertical angles.

EXAMPLE 1 Naming Angles

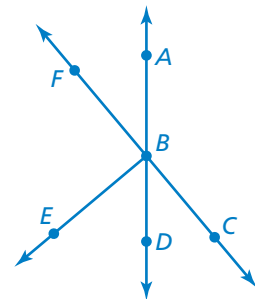Use the figure shown.

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

∠ABC and ∠ABF share a common side and have the same vertex *B*.

⋮⋮ So, ∠ABC and ∠ABF are adjacent angles.

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

∠ABF and ∠CBD are opposite angles formed by the intersection of two lines.

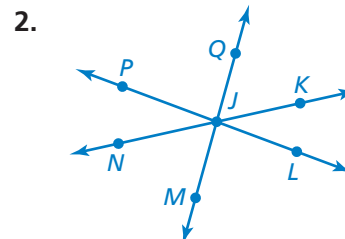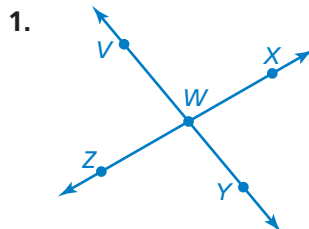⋮⋮ So, ∠ABF and ∠CBD are vertical angles.

On Your Own

Now You're Ready
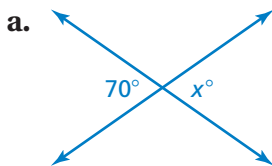Exercises 5 and 6

Name two pairs of adjacent angles and two pairs of vertical angles in the figure.
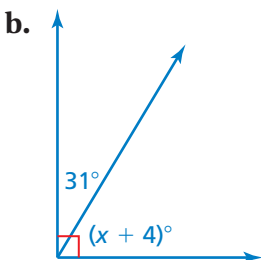
1.

2.

Multi-Language Glossary at BigIdeasMath⎷com

EXAMPLE **2** **Using Adjacent and Vertical Angles**

Tell whether the angles are *adjacent* or *vertical*. Then find the value of *x*.

a.

70°   *x*°

The angles are vertical angles. Because vertical angles are congruent, the angles have the same measure.
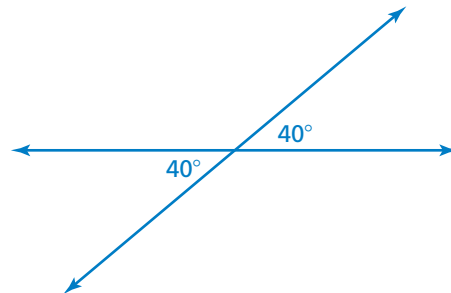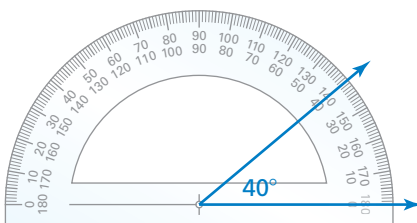
∴ So, the value of *x* is 70.

> **Remember**
>
> You can add angle measures. When two or more adjacent angles form a larger angle, the sum of the measures of the smaller angles is equal to the measure of the larger angle.

b.

31°

(*x* + 4)°

The angles are adjacent angles. Because the angles make up a right angle, the sum of their measures is 90°.

$(x + 4) + 31 = 90$	Write equation.
$x + 35 = 90$	Combine like terms.
$x = 55$	Subtract 35 from each side.

∴ So, the value of *x* is 55.

EXAMPLE **3** **Constructing Angles**
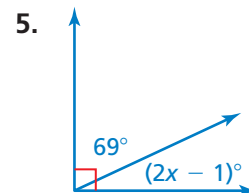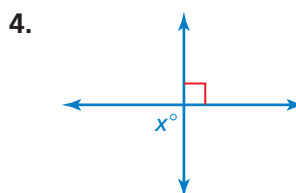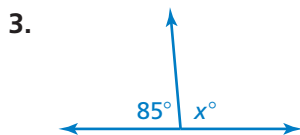
Draw a pair of vertical angles with a measure of 40°.

Step 1: Use a protractor to draw a 40° angle.

Step 2: Use a straightedge to extend the sides to form two intersecting lines.

40°

40°   40°

🔴 **On Your Own**

Now You're Ready
Exercises 8–17

Tell whether the angles are *adjacent* or *vertical*. Then find the value of *x*.

3.

85° *x*°

4.

x°

5.

69°
(2*x* − 1)°

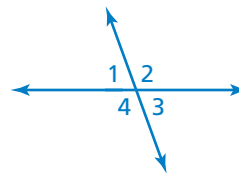**6.** Draw a pair of vertical angles with a measure of 75°.
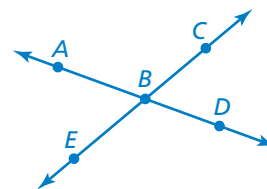
✓ Vocabulary and Concept Check

1. **VOCABULARY** When two lines intersect, how many pairs of vertical angles are formed? How many pairs of adjacent angles are formed?

2. **REASONING** Identify the congruent angles in the figure. Explain your reasoning.
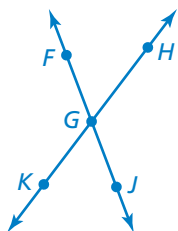

Practice and Problem Solving

Use the figure at the right.

3. Measure each angle formed by the intersecting lines.
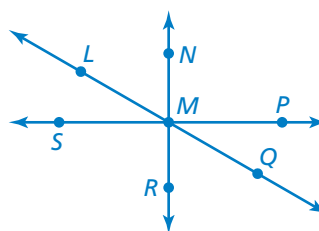
4. Name two angles that are adjacent to ∠ABC.

Name two pairs of adjacent angles and two pairs of vertical angles in the figure.

1 **5.**
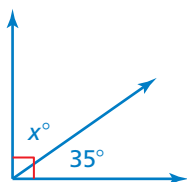

6.

7. **ERROR ANALYSIS** Describe and correct the error in naming a pair of vertical angles.
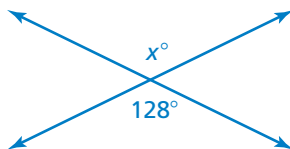

✗

∠ACB and ∠BCD
are vertical angles.

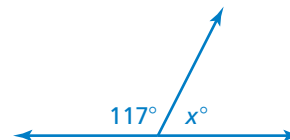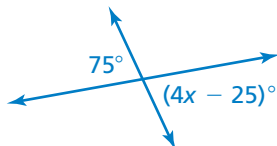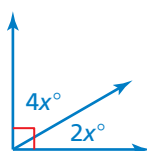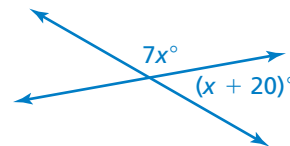**Tell whether the angles are *adjacent* or *vertical*. Then find the value of x.**

2 **8.**

$x°$
$35°$

9.

$x°$
$128°$

10.

$117°$ $x°$

11.

$75°$
$(4x − 25)°$

12.

$4x°$
$2x°$

13.

$7x°$
$(x + 20)°$

Draw a pair of vertical angles with the given measure.

③ 14. 25°   **15.** 85°   **16.** 110°   **17.** 135°

18. IRON CROSS The iron cross is a skiing trick in which the tips of the skis are crossed while the skier is airborne. Find the value of x in the iron cross shown.

127°

$(2x + 41)°$

19. OPEN-ENDED Draw a pair of adjacent angles with the given description.

    a. Both angles are acute.

    b. One angle is acute, and one is obtuse.

    c. The sum of the angle measures is 135°.

20. PRECISION Explain two procedures that you can use to draw adjacent angles with given measures.

Determine whether the statement is *always, sometimes,* or *never* true.

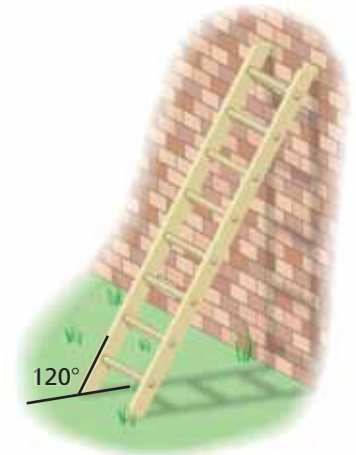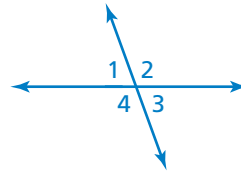**21.** When the measure of $\angle 1$ is 70°, the measure of $\angle 3$ is 110°.

22. When the measure of $\angle 4$ is 120°, the measure of $\angle 1$ is 60°.

1 2
4 3

23. $\angle 2$ and $\angle 3$ are congruent.

24. The measure of $\angle 1$ plus the measure of $\angle 2$ equals the measure of $\angle 3$ plus the measure of $\angle 4$.

25. REASONING Draw a figure in which $\angle 1$ and $\angle 2$ are acute vertical angles, $\angle 3$ is a right angle adjacent to $\angle 2$, and the sum of the measure of $\angle 1$ and the measure of $\angle 4$ is 180°.

26. Structure For safety reasons, a ladder should make a 15° angle with a wall. Is the ladder shown leaning at a safe angle? Explain.

120°

Fair Game Review *What you learned in previous grades & lessons*

Solve the inequality. Graph the solution. *(Section 4.3)*

27. $-6n > 54$ **28.** $-\frac{1}{2}x \le 17$ **29.** $-1.6 < \dfrac{m}{-2.5}$

30. MULTIPLE CHOICE What is the slope of the line that passes through the points (2, 3) and (6, 8)? *(Section 5.5)*

    Ⓐ $\dfrac{4}{5}$ **Ⓑ** $\dfrac{5}{4}$ **Ⓒ** $\dfrac{4}{3}$ **Ⓓ** $\dfrac{3}{2}$