

Classify Angles

Vocabulary Start-Up



An angle is formed by two rays that share a common endpoint. The **vertex** is the point where the two rays meet.

Complete the table by drawing the hands of a clock to represent each angle.

Type of Angle			
Right	Acute	Obtuse	Straight
exactly 90°	less than 90°	greater than 90°	exactly 180°

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

- vertex
- right angle
- acute angle
- obtuse angle
- straight angle
- vertical angles
- congruent
- adjacent angles

Math Symbols

- \angle
- \cong

Common Core State Standards

Content Standards
7.G.5

MP Mathematical Practices
1, 3, 4, 7

Real-World Link

The angle formed by a bike ramp is shown.

1. What type of angle is formed?

2. Estimate the measure of the angle.

Which **MP Mathematical Practices** did you use?
Shade the circle(s) that applies.

- | | |
|--|---|
| <input type="checkbox"/> ① Persevere with Problems | <input type="checkbox"/> ⑤ Use Math Tools |
| <input type="checkbox"/> ② Reason Abstractly | <input type="checkbox"/> ⑥ Attend to Precision |
| <input type="checkbox"/> ③ Construct an Argument | <input type="checkbox"/> ⑦ Make Use of Structure |
| <input type="checkbox"/> ④ Model with Mathematics | <input type="checkbox"/> ⑧ Use Repeated Reasoning |



Key Concept

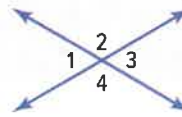
Name and Identify Angles

Work Zone

Words

Two angles are **vertical** if they are opposite angles formed by the intersection of two lines. Vertical angles are **congruent** or have the same measure.

Models



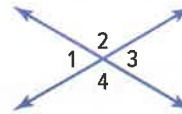
$\angle 1$ and $\angle 3$,
 $\angle 2$ and $\angle 4$

Symbols

$$\angle 1 \cong \angle 3$$

$$\angle 2 \cong \angle 4$$

Two angles are **adjacent** if they share a common vertex, a common side, and do not overlap.



Adjacent angle pairs are $\angle 1$ and $\angle 2$,
 $\angle 2$ and $\angle 3$,
 $\angle 3$ and $\angle 4$, and
 $\angle 4$ and $\angle 1$.

You can name an angle by its vertex and by its points.

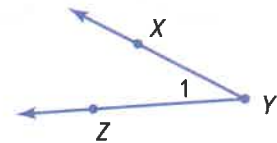
Example

Tutor

Symbols

The symbol for angle is \angle .
The symbol \cong means is congruent to.

1. Name the angle shown at the right. Then classify it as *acute*, *right*, *obtuse*, or *straight*.

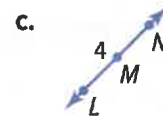
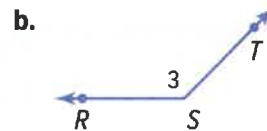
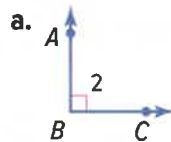


- Use the vertex as the middle letter and a point from each side, $\angle XYZ$ or $\angle ZYX$.
- Use the vertex only, $\angle Y$.
- Use a number, $\angle 1$.

Since the angle is less than 90° , it is an acute angle.

Got it? Do these problems to find out.

Name each angle in four ways. Then classify each angle as *acute*, *right*, *obtuse*, or *straight*.



a. _____

b. _____

c. _____

Show your work



Example



- 2. Identify a pair of vertical angles and adjacent angles in the diagram at the right. Justify your response.**



Since $\angle 2$ and $\angle 4$ are opposite angles formed by the intersection of two lines, they are vertical angles.

Since $\angle 1$ and $\angle 2$ share a common side and vertex, and they do not overlap, they are adjacent angles.

Got it? Do this problem to find out.

- d. Refer to the diagram in Example 2. Identify different pairs of vertical and adjacent angles. Justify your response.

Show your work.

d. _____

Find a Missing Measure

You can use what you learned about vertical and adjacent angles to find the value of a missing measure.

Example



- 3. What is the value of x in the figure?**

The angle labeled $(2x + 2)^\circ$ and the angle labeled 130° are vertical angles.

Since vertical angles are congruent, $(2x + 2)^\circ$ equals 130° .

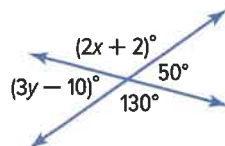
$$2x + 2 = 130 \quad \text{Write the equation.}$$

$$\underline{-2 = -2} \quad \text{Subtract 2 from each side.}$$

$$\frac{2x}{2} = \frac{128}{2} \quad \text{Divide each side by 2.}$$

$$x = 64$$

So, the value of x is 64.



Got it? Do this problem to find out.

- e. What is the value of y in the figure in Example 2?

e. _____



Example

Tutor



4. What is the value of x shown in the sidewalk?

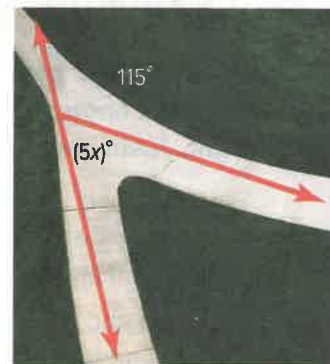
The angle labeled 115° and the angle labeled $5x$ are adjacent angles. Together they form a straight angle or 180° .

$$\begin{array}{r}
 115 + 5x = 180 \\
 -115 \quad \quad = -115 \\
 \hline
 \frac{5x}{5} = \frac{65}{5} \\
 x = 13
 \end{array}$$

Write the equation.

Subtract 115 from each side.

Divide each side by 5.



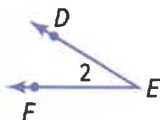
So, the value of x is 13.

Guided Practice

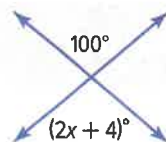
Check



1. Name the angle below in four ways. Then classify it as *acute*, *right*, *obtuse*, or *straight*. (Example 1)



2. Find the value of x in the figure. (Examples 3–4)



3. Identify a pair of vertical angles and adjacent angles on the railroad crossing sign. Justify your response. (Example 2)



Show your work.

4. **Building on the Essential Question** Describe the differences between vertical and adjacent angles.

Rate Yourself!

How confident are you about classifying angles? Check the box that applies.



For more help, go online to access a Personal Tutor.

Tutor



FOLDABLES Time to update your Foldable!

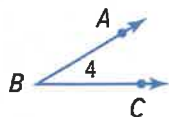
Independent Practice

Go online for Step-by-Step Solutions



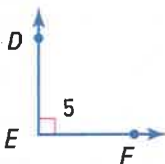
Name each angle in four ways. Then classify the angle as *acute*, *right*, *obtuse*, or *straight*. (Example 1)

1.



Show your work.

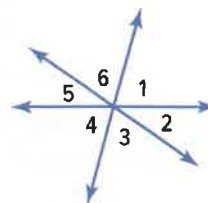
2.



3



MP Identify Structure Refer to the diagram at the right. Identify each angle pair as *adjacent*, *vertical*, or *neither*. (Example 2)



4. $\angle 2$ and $\angle 5$ _____

5 $\angle 4$ and $\angle 6$ _____

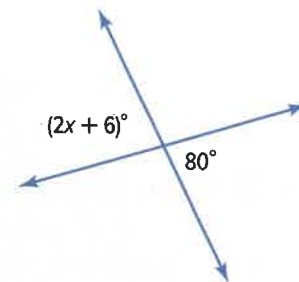
6. $\angle 3$ and $\angle 4$ _____

7. $\angle 5$ and $\angle 6$ _____

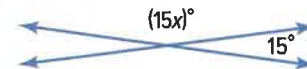
8. $\angle 1$ and $\angle 3$ _____

9. $\angle 1$ and $\angle 4$ _____

10. What is the value of x in the figure at the right? (Examples 3 and 4) _____



11. What is the value of x in the figure at the right? (Examples 3 and 4) _____



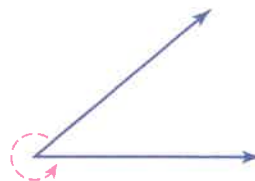
12. Angles ABC and DBE are vertical angles. If the measure of $\angle ABC$ is 40° , what is the measure of $\angle ABD$?
-



H.O.T. Problems Higher Order Thinking

13. **MP Model with Mathematics** Draw examples of angles that represent real-world objects. Be sure to include at least three of the following angles: acute, right, obtuse, straight, vertical, and adjacent. Verify by measuring the angles.
-

14. **MP Reason Inductively** Explain how you can use a protractor to measure the angle shown. Find the measure of the angle.
-



- MP Persevere with Problems** Determine whether each statement is *true* or *false*. If the statement is true, provide a diagram to support it. If the statement is false, explain why.

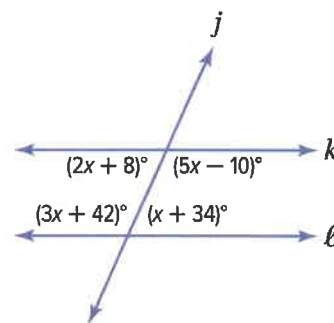
15. A pair of obtuse angles can also be vertical angles.
-

Show your work.

16. A pair of straight angles can also be adjacent angles.
-

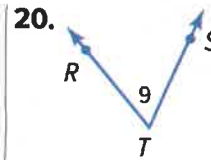
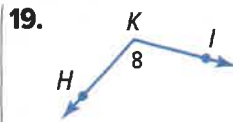
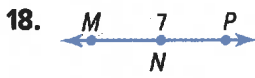
Show your work.

17. **MP Reason Inductively** Lines ℓ and k shown at the right are parallel and are intersected by line j . Explain how you can write and solve equations to find the measure of each angle. Then find the measure of each angle.
-



Extra Practice

Name each angle in four ways. Then classify the angle as *acute*, *right*, *obtuse*, or *straight*.



Homework Help

$\angle MNP, \angle PNM, \angle N, \angle 7;$
straight

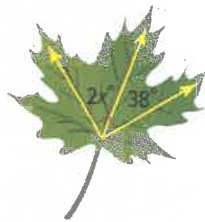
21. The corner where the states of Utah, Arizona, New Mexico, and Colorado meet is called the Four Corners.



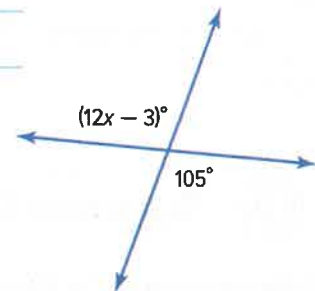
a. Identify a pair of vertical angles. Justify your response.

b. Identify a pair of adjacent angles. Justify your response.

22. What is the value of x in the figure at the right?

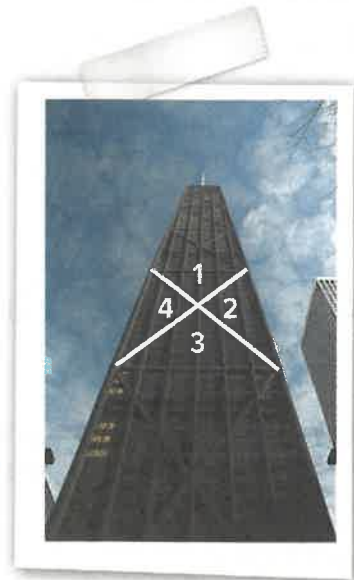


23. What is the value of x in the figure at the right?



24. **MP Identify Structure** The John Hancock Center in Chicago is shown at the right. Classify each pair of angles.

- a. $\angle 1$ and $\angle 2$ _____
- b. $\angle 2$ and $\angle 4$ _____
- c. $\angle 3$ and $\angle 4$ _____
- d. $\angle 1$ and $\angle 3$ _____
- e. If the measure of $\angle 2$ is 66° , what are the measures of the other angles? _____



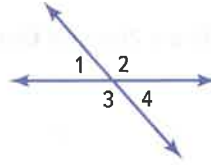


Power Up! Common Core Test Practice

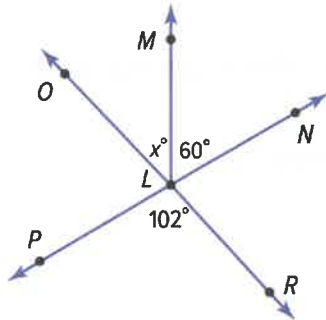
25. Refer to the figure at the right.

Fill in each box to make a true statement.

- a. $\angle 1$ and $\angle 4$ are angles.
- b. $\angle 3$ and $\angle 4$ are angles.
- c. $\angle 2$ and $\angle 4$ are angles.
- d. $\angle 2$ and $\angle 3$ are angles.



26. In the figure below, $\angle OLN$ and $\angle PLR$ are vertical angles.



Select values to complete the equation to find the measure of $\angle MLO$.

+ =

x°	30°	60°
90°	102°	180°

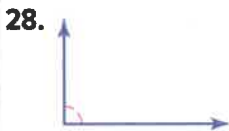
What is the measure of $\angle MLO$?

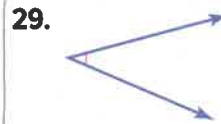


Common Core Spiral Review

Use a protractor to find the measure of each angle. 4.MD.6







30. Name the line segment at the right in two ways. 5.G.4



31. What is the name for a quadrilateral with all right angles and opposite sides that are parallel and congruent? 5.G.3
