# Section 9.R.1  **Angles and Triangles**

Go to Section 9.R.1 Learn mode in Hawkes to follow along!

## Introduction to Geometry

### Point, Line, Plane

| Undefined Term | Representation | Discussion |
|---|---|---|
| **Point** | | A point is represented by _____ |
| | | Points are labeled with _____ |
| **Line** | _____ | A line has no _____ |
| | | Lines are labeled with _____ |
| | | _____ |
| **Plane** | _____ | Flat surfaces, such as a table top or wall, represent _____ |
| | | _____ |
| | | Planes are labeled with _____ |
| | _____ | |

### Ray and Angle

| Term | Definition | Illustrations with Notation |
|---|---|---|
| **Ray** | A ray consists of _____ | |
| | _____ | |
| | _____ | _____ |
| **Angle** | An angle consists of _____ | |
| | _____ | |
| | _____ | |
| | | _____ |

## Labeling Angles

There are three common ways of labeling angles:

Using three _____          Using single                Using the single
_____              _____             _____
_____              _____             _____
                                                           _____

# Classifying Angles by Their Measures

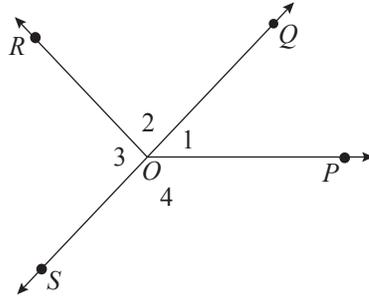The base unit when measuring angles is _____ (symbolized _____).

## Angles Classified by Measure

| Name | Measure | Illustrations with Notation |
|------|---------|------------------------------|
| **Acute** | _____ | |
| | | _____ |
| **Right** | _____ | |
| | | _____ |
| **Obtuse** | _____ | |
| | | _____ |
| **Straight** | _____ | |
| | | _____ |

▶ **Example 2    Classifying Angles by Their Measure**

Classify each angle (from Figure 3) as acute, right, obtuse, or straight.

**a.**   $\angle 1$

**b.**   $\angle 2$

**c.**   $\angle POR$

R •

Q •
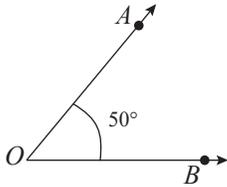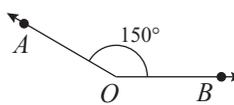
2

3    1

O

P •

4

• S

**Solution**

## Exercises

Classify each angle as acute, right, obtuse, or straight.

**1.**   A •

50°

O

B

**3.**   • A

150°

O    B •

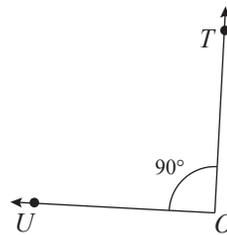**2.**   S •

180°

O

R •

**4.**   T •

90°

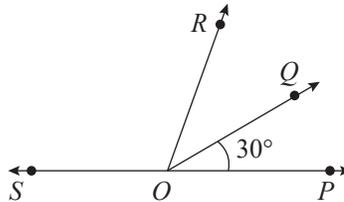U •    O
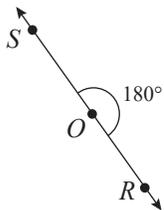
# Complementary and Supplementary Angles

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### Complementary and Supplementary Angles

1. Two angles are **complementary** if _____

2. Two angles are **supplementary** if _____

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▶ **Example 4**    **Calculating Measures of Angles**

In the figure shown, $\overleftrightarrow{PS}$ is a straight line and $m\angle QOP = 30°$.

**a.** Find the measure of $\angle QOS$.

**b.** Find the measure of $\angle SOP$.

**c.** Are any pairs of angles supplementary?



**Solution**

## Exercises

Use the definitions of complementary, supplementary, and straight angles to answer each question.

**5.** Assume that $\angle 1$ and $\angle 2$ are complementary.

    **a.** If $m\angle 1 = 15°$ what is $m\angle 2$?

    **b.** If $m\angle 1 = 3°$ what is $m\angle 2$?

    **c.** If $m\angle 1 = 45°$ what is $m\angle 2$?

    **d.** If $m\angle 1 = 75°$ what is $m\angle 2$?

**6.** Assume $\angle 3$ and $\angle 4$ are supplementary.

    **a.** If $m\angle 3 = 45°$ what is $m\angle 4$?

    **b.** If $m\angle 3 = 90°$ what is $m\angle 4$?

    **c.** If $m\angle 3 = 110°$ what is $m\angle 4$?

    **d.** If $m\angle 3 = 135°$ what is $m\angle 4$?

# Congruent, Vertical, and Adjacent Angles

If two angles have the same measure, they are said to be _____ (symbolized as ≅).

Two lines _____ if they have exactly one point in common. If two lines intersect, then two pairs

of _____ are formed. Vertical angles are _____ each other. (See Figure 5.)
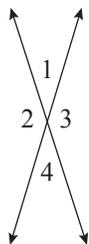


_____ are vertical angles.
_____ are vertical angles.

Figure 5

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## Vertical Angles

Vertical angles _____
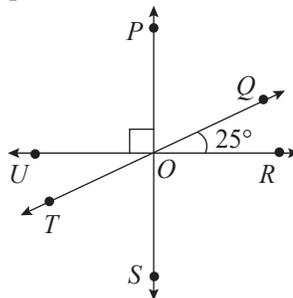
That is, vertical angles have _____

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## Adjacent Angles

Two angles are adjacent if _____

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▶ **Example 6     Calculating Measures of Angles**

In the given figure, three lines intersect at the point $O$. Find the measure of each angle.
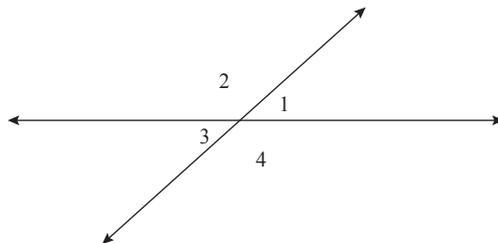
**a.**  ∠*TOU*

**b.**  ∠*ROS*

**c.**  ∠*POQ*

**d.**  ∠*SOT*



**Solution**

## Exercises

Use the definitions of adjacent and vertical angles to answer each question.



7. The figure shows two intersecting lines.

    **a.** If $m\angle 1 = 30°$ what is $m\angle 2$?

    **b.** Is $m\angle 3 = 30°$? Give a reason for your answer other than the fact that $\angle 1$ and $\angle 3$ are vertical angles.

    **c.** Name two pairs of congruent angles.

    **d.** Name four pairs of adjacent angles.

8. The figure shows two intersecting lines where $m\angle 1 = 30°$. Find the measures of the other three angles.

9. Given that $m\angle 1 = 42°$ in the figure, find the measures of the other three angles.

# Parallel and Perpendicular Lines
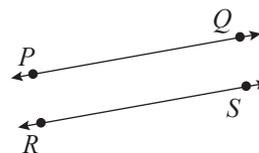
## Parallel Lines and Perpendicular Lines

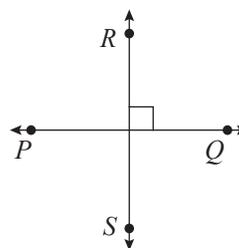| Term | Definition | Illustrations with Notation |
|---|---|---|
| **Parallel Lines** | Two lines are parallel (symbolized ∥) if _____ _____ _____ | $\overrightarrow{PQ}$ is parallel to ____ ( $\overrightarrow{PQ}$ _____ ) |
| **Perpendicular Lines** | Two lines are perpendicular (symbolized ⊥) if _____ _____ _____ | $\overrightarrow{PQ}$ is perpendicular to ____ ( $\overrightarrow{PQ}$ _____ ) |

A _____ is a line in a plane that intersects two or more lines in that plane at different points.

As shown in Figure 7, eight angles are formed when a transversal _____.
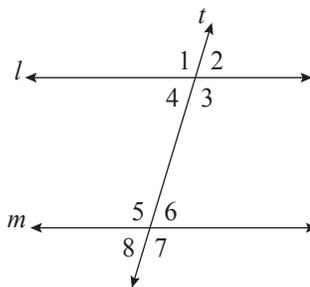
Figure 7

Some of the eight angles formed are named as follows.

- Corresponding angles: ∠1 and _____, ∠2 and _____, ∠3 and _____, ∠4 and _____
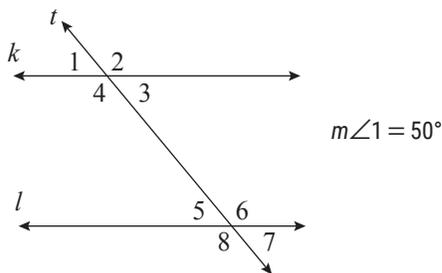- Alternate interior angles: ∠3 and _____, ∠4 and _____

## Parallel Lines and a Transversal

If two parallel lines are cut by a transversal, then the following two statements are true.

**1.** _____

**2.** _____

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▶ **Example 8** **Calculating Measures of Angles**

In the figure below, lines $k$ and $l$ are parallel, $t$ is a transversal, and $m\angle 1 = 50°$. Find the measures of the other 7 angles.
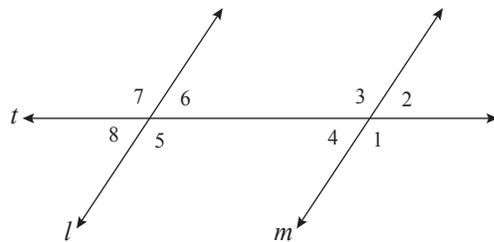
$$m\angle 1 = 50°$$

**Solution**

## Exercises

Solve.

**10.** Use the figure to answer each question. Assume $l$ and $m$ are parallel.

    **a.** If $m\angle 1 = 125°$, then $m\angle 3 =$ _____. Explain your reasoning.

    **b.** If $m\angle 8 = 55°$, then $m\angle 6 =$ _____. Explain your reasoning.

    **c.** What is $m\angle 7$? Explain your reasoning.

    **d.** Does $m\angle 2 = m\angle 6$? Explain your reasoning.

# Classifying Triangles

A **line segment** consists of _____

A **triangle** consists of _____.

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## Triangles Classified by Sides

(**Note:** In the figures, sides with equal length are indicated by the same number of tic marks.)

| Name | Property | Example |
|------|----------|---------|
| **Scalene** | _____ _____ _____ | $\Delta ABC$ is scalene since _____ <br><br> _____ |
| **Isosceles** | _____ _____ _____ | $\Delta PQR$ is isosceles since _____ |
| **Equilateral** | _____ _____ _____ | $\Delta XYZ$ is equilateral since _____ |

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## Triangles Classified by Angles

| Name | Property | Example |
|------|----------|---------|
| **Acute** | _____ _____ _____ | $\Delta ABC$ is acute since _____ |
| **Right** | _____ _____ | $\Delta PRQ$ is a right triangle since _____ |
| **Obtuse** | _____ _____ | $\Delta XYZ$ is an obtuse triangle since _____ |

## Three Properties of Triangles

In a triangle:

1.  The sum of the measures _____

2.  The sum of the lengths of _____

3.  Longer sides are _____

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▶ **Example 11   Analyzing Triangles**

In $\triangle BOR$, $m\angle B = 50°$ and $m\angle O = 70°$.

**a.**   What is $m\angle R$?

**b.**   Which side is opposite $\angle R$?

**c.**   Which sides include $\angle R$?

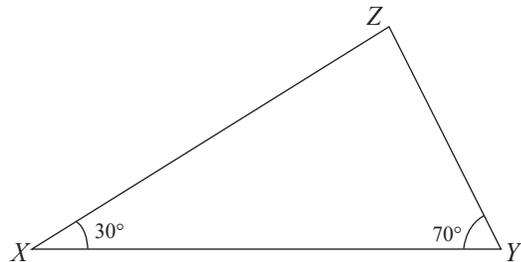**d.**   Is $\triangle BOR$ a right triangle? Why or why not?
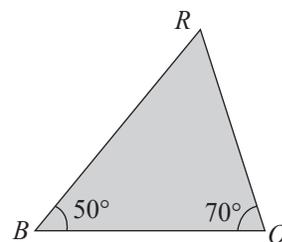
**Solution**

## Exercises

Solve.

11. In the triangle shown, $m\angle X = 30°$ and $m\angle Y = 70°$.

    a.  What is $m\angle Z$ ?

    b.  What kind of triangle is $\triangle XYZ$?

    c.  Which side is opposite $\angle X$ ?

    d.  Which sides include $\angle X$ ?

    e.  Is $\triangle XYZ$ a right triangle?



12. In the triangle shown, $m\angle T = 50°$ and $m\angle U = 40°$.

    a.  What is $m\angle S$ ?

    b.  What kind of triangle is $\triangle STU$?

    c.  Which side is opposite $\angle T$ ?

    d.  Which sides include $\angle T$ ?

    e.  Is $\triangle STU$ a right triangle?