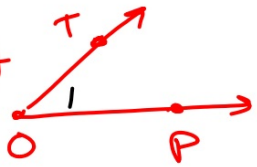
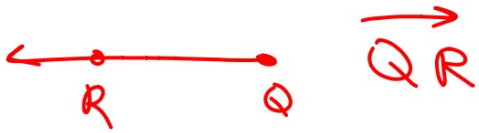
Geometry 1.4

2 rays w same endpoint




$\angle O$ $\angle POT$ $\angle TOP$ $\angle 1$

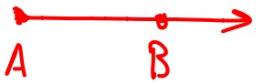
Measure and classify angles
Identify and use congruent angles
Identify and use angle bisectors




$\overrightarrow{QR}$

bisector goes through mP
divides into 2 = parts

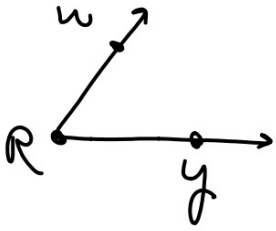
ray $\overrightarrow{AB}$ $\frac{1}{2}$ line




opposite rays


angle $\angle$ $\measuredangle$

side $\overrightarrow{CN}$ $\overrightarrow{CP}$



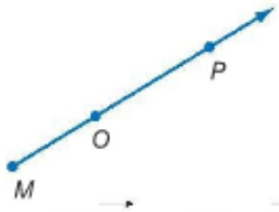

vertex

activity: plates
constructions
angle measuring

You will need a protractor and compass

## 1 Measure and Classify Angles

A **ray** is a part of a line. It has one endpoint and extends indefinitely in one direction. Rays are named by stating the endpoint first and then any other point on the ray. The ray shown cannot be named as $\overrightarrow{OM}$ because $O$ is not the endpoint of the ray.

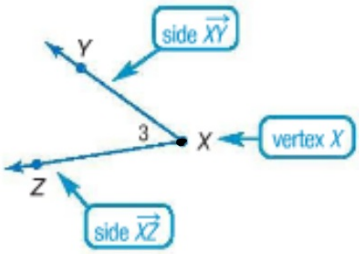


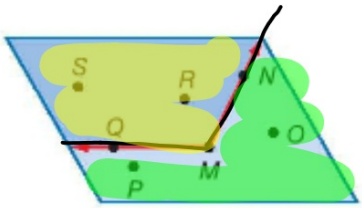

ray $MP$, $\overrightarrow{MP}$, ray $MO$, or $\overrightarrow{MO}$

If you choose a point on a line, that point determines exactly two rays called **opposite rays**. Since both rays share a common endpoint, opposite rays are collinear


$\overrightarrow{JH}$ and $\overrightarrow{JK}$ are opposite rays.

name endpoint first!


side $\overrightarrow{XY}$
Y
3
X
vertex X
Z
side $\overrightarrow{XZ}$


S
R
N
Q
O
M
P

acute
$< 90°$

obtuse
$90° - 180°$

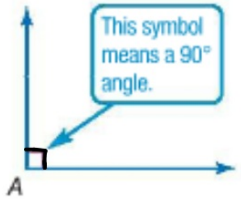
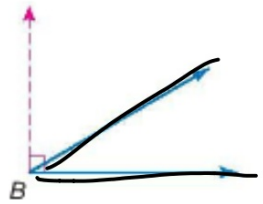
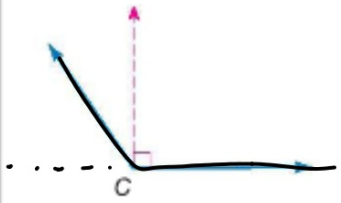
right
$= 90°$

**ReadingMath**

**Straight Angle** Opposite rays with the same vertex form a *straight angle*. Its measure is 180. Unless otherwise specified in this book, however, the term *angle* means a nonstraight angle.

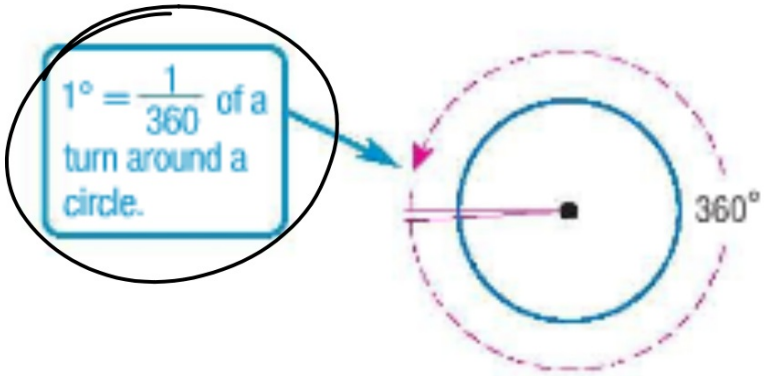
Angles can be classified by their measures as shown below.

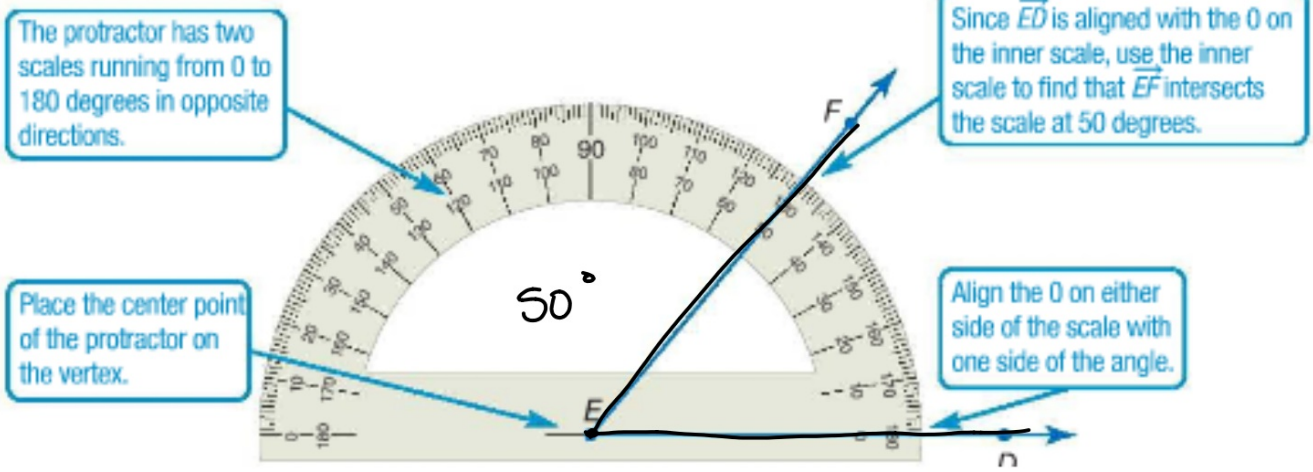
**KeyConcept Classify Angles**

| right angle | acute angle | obtuse angle |
|---|---|---|
|   |   |   |
| $m\angle A = 90$ | $m\angle B < 90$ | $180 > m\angle C > 90$ |

∠A

Plates


$1° = \frac{1}{360}$ of a turn around a circle.
360°




inner scale or outer scale?
acute or obtuse?
which side started with zero?

I asked my husband to put the casserole in the oven at 120 degrees.
It took some doing, but he finally got it.

Practice worksheet (measuring)

$m\angle A = 57°$
$m\angle B = 114°$
$m\angle DCE = 49°$
$m\angle ECF = 22°$

1. Estimate (mentally) acute or obtuse.
2. Put vertex at center marking.
3. Line up one side of angle with zero
4. The other side of the angle will determine the measure.
   (Which scale???)
5. Be as precise as you can. (±2°)

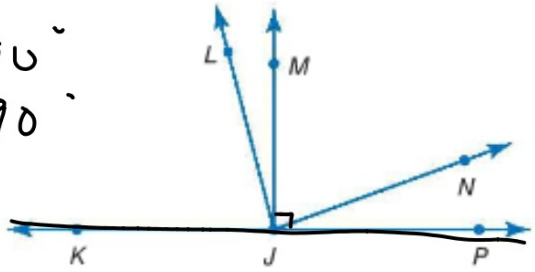
$m\angle HGJ = 88°$
$m\angle JGK = 62°$

## Example 2 Measure and Classify Angles

Copy the diagram below, and extend each ray. Classify each angle as *right*, *acute*, or *obtuse*. Then use a protractor to measure the angle to the nearest degree.

$m\angle PJM = 90^\circ$

$m\angle KJM = 90^\circ$

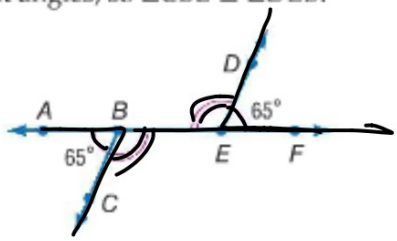


1.4 12-28 all

**2 Congruent Angles** Just as segments that have the same measure are congruent segments, angles that have the same measure are *congruent angles*.

In the figure, since $m\angle ABC = m\angle FED$, then $\angle ABC \cong \angle FED$. Matching numbers of arcs on a figure also indicate congruent angles, so $\angle CBE \cong \angle DEB$.

$m\angle ABC = m\angle DEF$

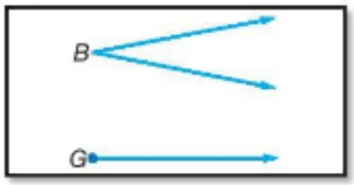



$\angle ABC \cong \angle DEF$

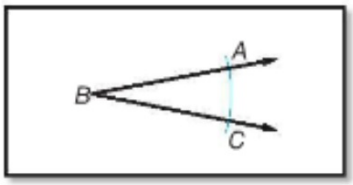
$m\angle ABC = 65°$

## Construction Copy an Angle

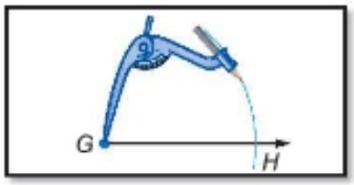
**Step 1** Draw an angle like $\angle B$ on your paper. Use a straightedge to draw a ray on your paper. Label its endpoint $G$.



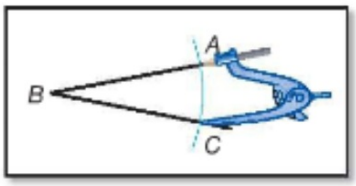

**Step 2** Place the tip of the compass at point $B$ and draw a large arc that intersects both sides of $\angle B$. Label the points of intersection $A$ and $C$.



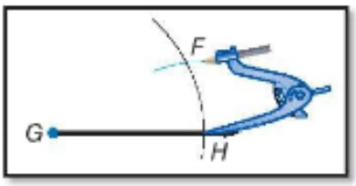

**Step 3** Using the same compass setting, put the compass at point $G$ and draw a large arc that starts above the ray and intersects the ray. Label the point of intersection $H$.



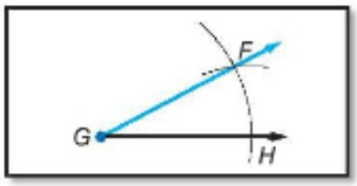

**Step 4** Place the point of your compass on $C$ and adjust so that the pencil tip is on $A$.




**Step 5** Without changing the setting, place the compass at point $H$ and draw an arc to intersect the larger arc you drew in Step 4. Label the point of intersection $F$.



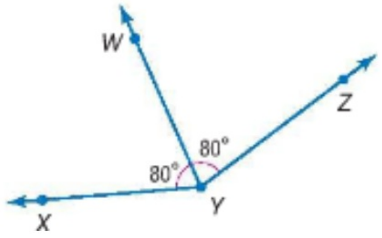

**Step 6** Use a straightedge to draw $\overrightarrow{GF}$. $\angle ABC \cong \angle FGH$



**StudyTip**

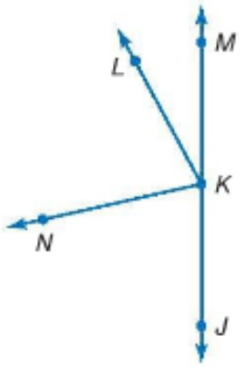
**Segments** A line segment can also bisect an angle.

A ray that divides an angle into two congruent angles is called an **angle bisector**. If $\overrightarrow{YW}$ is the angle bisector of $\angle XYZ$, then point $W$ lies in the interior of $\angle XYZ$ and $\angle XYW \cong \angle WYZ$.



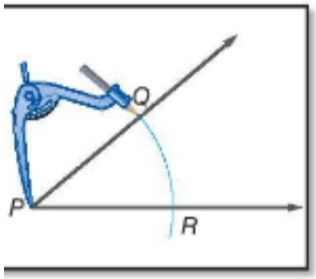
## Example 3 Measure and Classify Angles

**ALGEBRA** In the figure, $\overrightarrow{KJ}$ and $\overrightarrow{KM}$ are opposite rays, and $\overrightarrow{KN}$ bisects $\angle JKL$. If $m\angle JKN = 8x - 13$ and $m\angle NKL = 6x + 11$, find $m\angle JKN$.

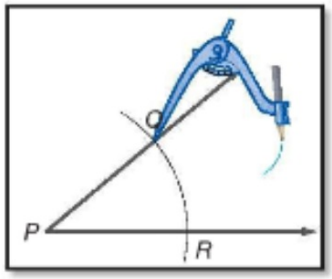


## Construction Bisect an Angle

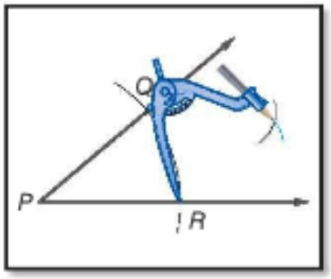
**Step 1** Draw an angle on your paper. Label the vertex as $P$. Put your compass at point $P$ and draw a large arc that intersects both sides of $\angle P$. Label the points of intersection $Q$ and $R$.




**Step 2** With the compass at point $Q$, draw an arc in the interior of the angle.




**Step 3** Keeping the same compass setting, place the compass at point $R$ and draw an arc that intersects the arc drawn in Step 2. Label the point of intersection $T$.




**Step 4** Draw $\overrightarrow{PT}$. $\overrightarrow{PT}$ is the bisector of $\angle P$.