

## Lesson 1-3

# Measuring and Constructing Angles

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## Going Deeper

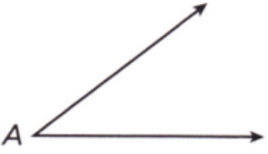
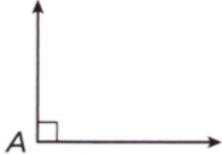
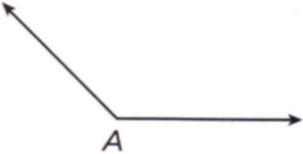

**Essential question:** *What tools and methods can you use to copy an angle and bisect an angle?*

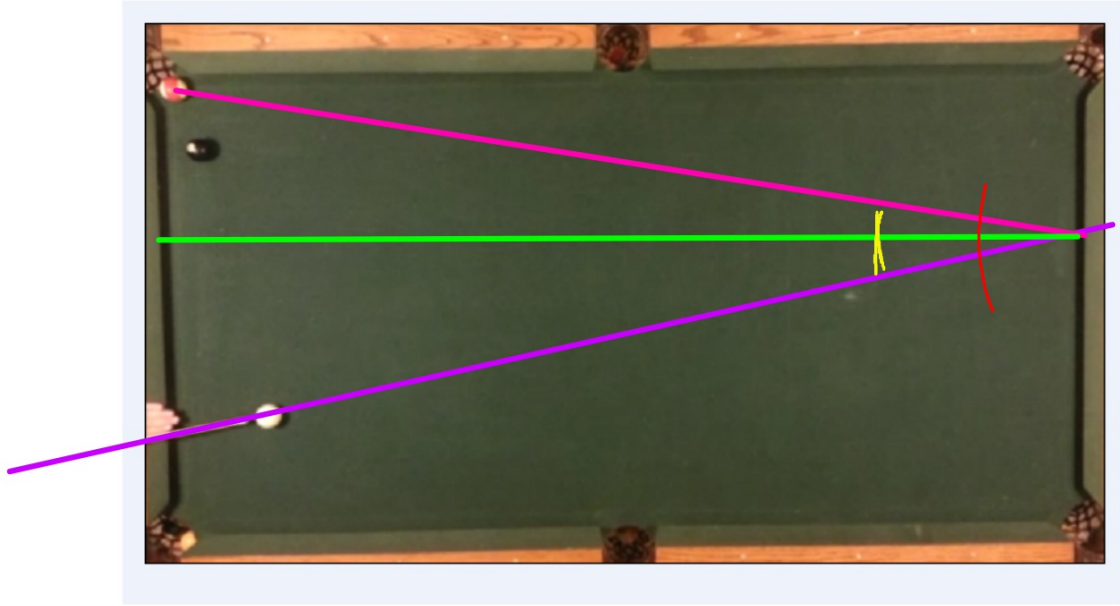
An **angle** is a figure formed by two rays with the same endpoint. The common endpoint is the **vertex** of the angle. The rays are the **sides** of the angle.

Angles may be measured in degrees ( $^{\circ}$ ). There are  $360^{\circ}$  in a circle, so an angle that measures  $1^{\circ}$  is  $\frac{1}{360}$  of a circle. You write  $m\angle A$  for the measure of  $\angle A$ .

Angles may be classified by their measures.

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Acute Angle	Right Angle	Obtuse Angle	Straight Angle
 $0^\circ < m\angle A < 90^\circ$	 $m\angle A = 90^\circ$	 $90^\circ < m\angle A < 180^\circ$	 $m\angle A = 180^\circ$



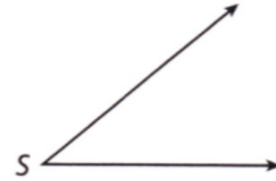
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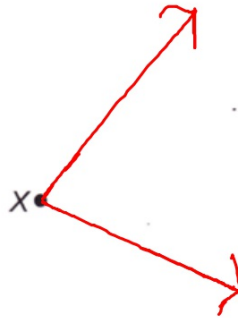
## EXAMPLE

### Copying an Angle

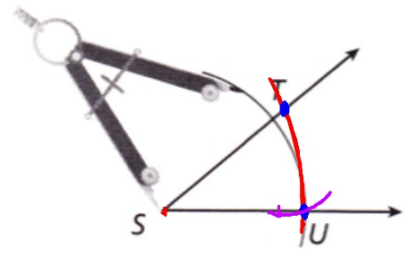
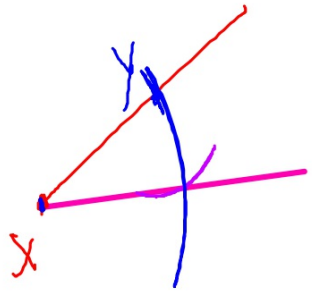
Construct an angle with the same measure as  $\angle S$ .



- A** In the space below, use a straightedge to draw a ray with endpoint X.

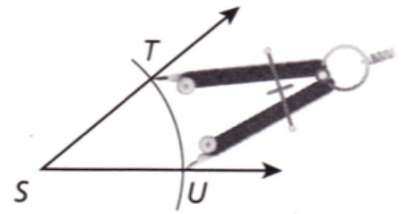


- B** Place the point of your compass on  $S$  and draw an arc that intersects both sides of the angle. Label the points of intersection  $T$  and  $U$ .



- C** Without adjusting the compass, place the point of the compass on  $X$  and draw an arc that intersects the ray. Label the intersection  $Y$ .

- D** Place the point of the compass on  $U$  and open it to the distance  $TU$ .



**E** Without adjusting the compass, place the point of the compass on  $Y$  and draw an arc. Label the intersection with the first arc  $Z$ .

**F** Use a straightedge to draw  $\overrightarrow{XZ}$ .

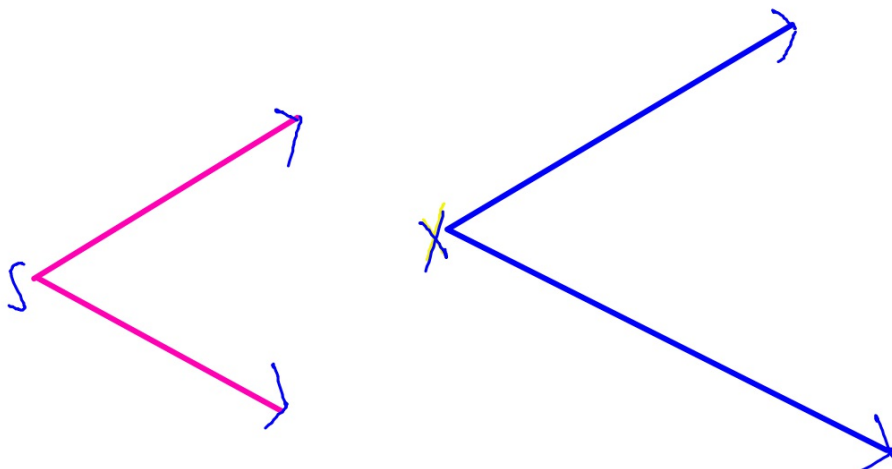
## REFLECT

1a. How can you use a protractor to check your construction?

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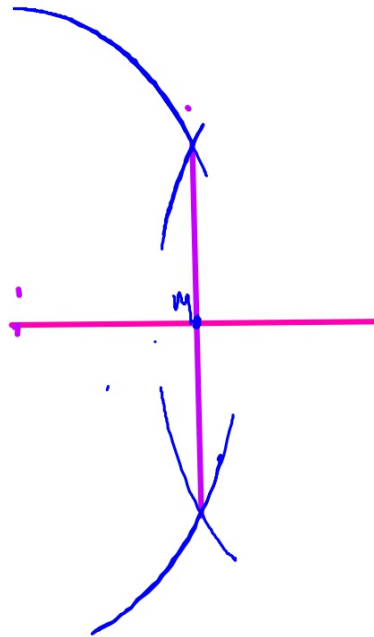
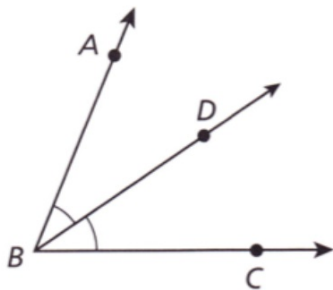
1b. If you draw  $\angle X$  so that its sides appear to be longer than the sides shown for  $\angle S$ , can the two angles have the same measure? Explain.

4.



An **angle bisector** is a ray that divides an angle into two angles that both have the same measure. In the figure,  $\overrightarrow{BD}$  bisects  $\angle ABC$ , so  $m\angle ABD = m\angle DBC$ . The arcs in the figure show equal angle measures.

The following example shows how you can use a compass and straightedge to bisect an angle.



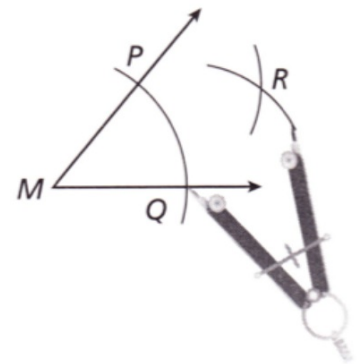
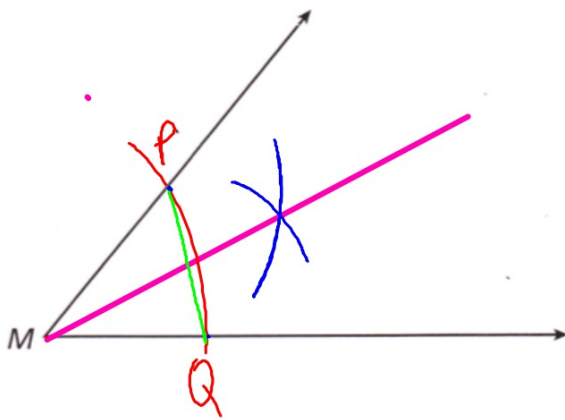
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## EXAMPLE

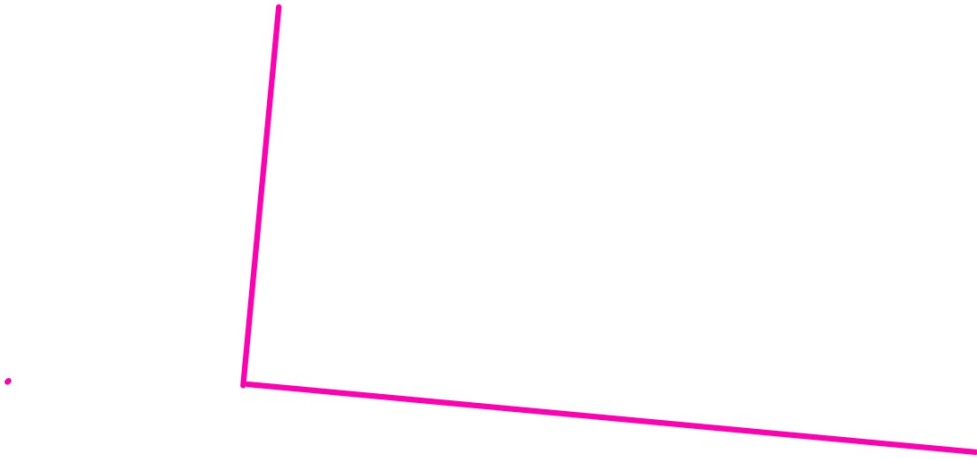
### Constructing the Bisector of an Angle

Construct the bisector of  $\angle M$ . Work directly on the angle at right.



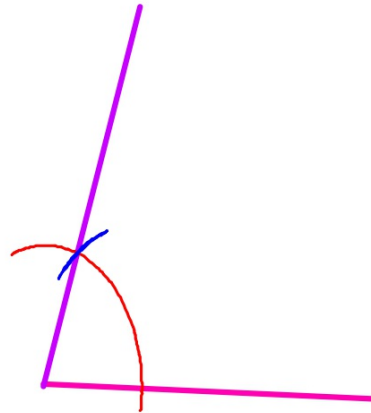
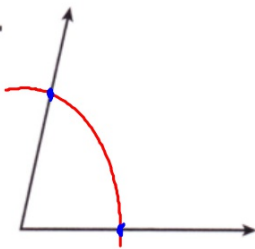
**REFLECT**

- 2a.** Explain how you could use paper folding to construct the bisector of an angle.



Construct an angle with the same measure as the given angle.

1.

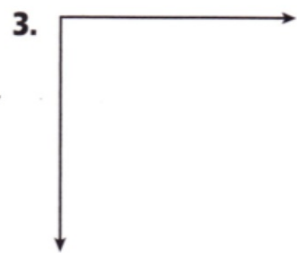


- ① make a line
- ② mark the arc (on both  $\angle$ )
- ③ measure the points on the  $\angle$  at the arc and copy
- ④ connect to make the new  $\angle$

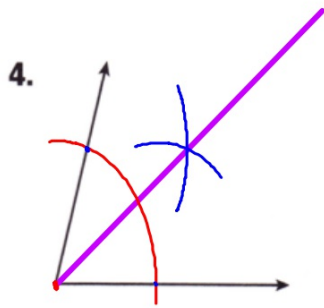
Construct an angle with the same measure as the given angle.



Construct an angle with the same measure as the given angle.



Construct the bisector of the angle.



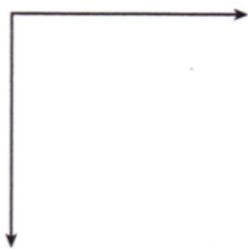
- ① mark the arc
- ② <sup>open to</sup> more than halfway, make 2 marks from the arc
- ③ connect to vertex

Construct the bisector of the angle.

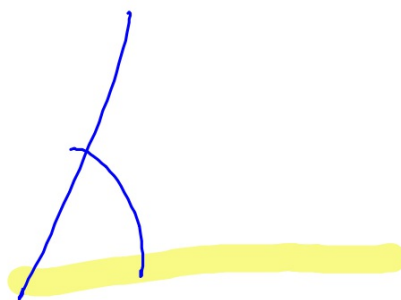
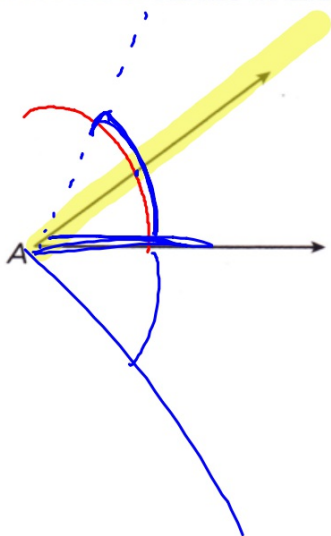


Construct the bisector of the angle.

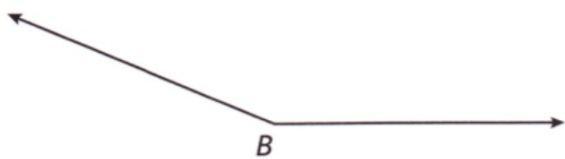
6.



7. Explain how you can use a compass and straightedge to construct an angle that has twice the measure of  $\angle A$ . Then do the construction in the space provided.



8. Explain how you can use a compass and straightedge to construct an angle that has  $\frac{1}{4}$  the measure of  $\angle B$ . Then do the construction in the space provided.



# Measuring and Copying Angles Practice

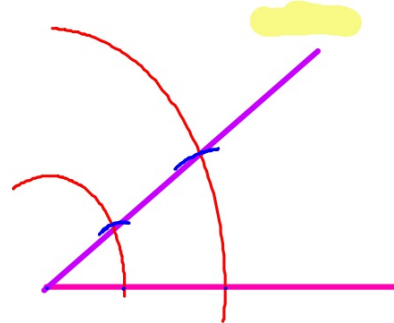
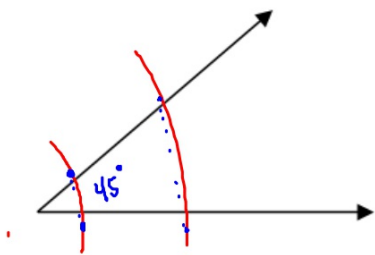
## Geometry

Name: \_\_\_\_\_

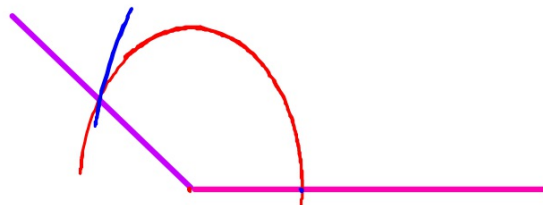
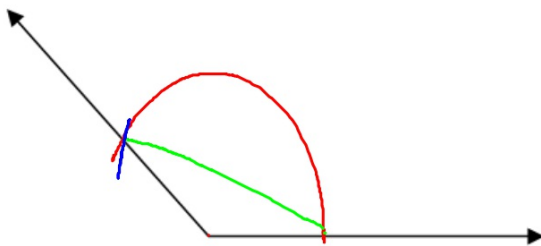
Period: \_\_\_\_\_

Measure each angle shown below with your protractor, then use your compass and straight edge to copy of the angle.

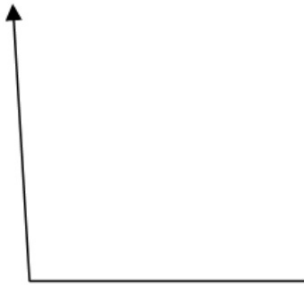
1.



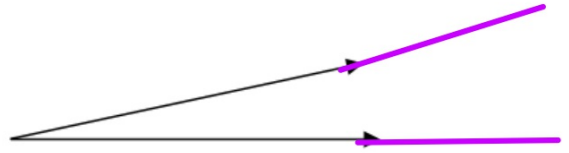
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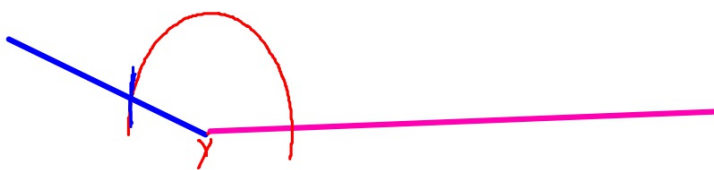
3.



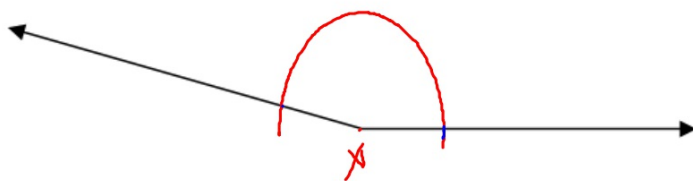
4.



5.



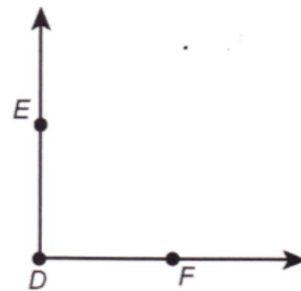
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## Additional Practice

For Exercises 1 and 2, use the figure shown.

1. Use a compass and straightedge to construct angle bisector  $\overrightarrow{DG}$ . Given that  $m\angle EDF = 90^\circ$ , find  $m\angle EDG$ .



$m\angle EDG =$  \_\_\_\_\_

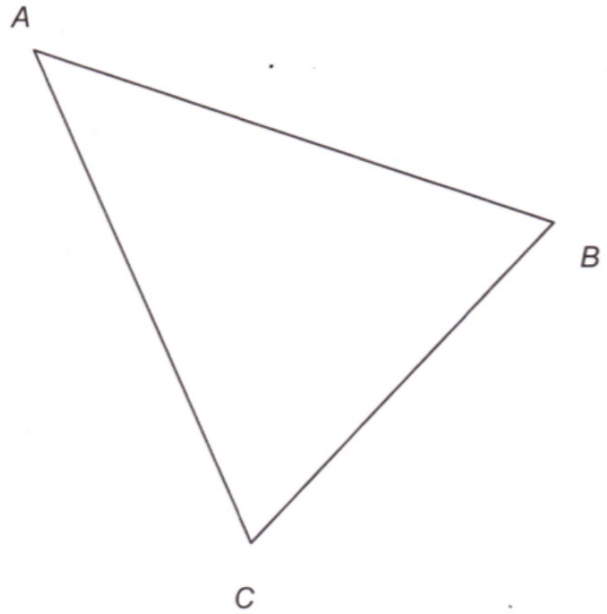
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2. Use your construction of  $\angle EDG$  from Exercise 1. Construct  $\angle XYZ$  with the same measure as  $\angle EDG$ .

3. Use a straightedge to draw an acute angle. Use a compass and straightedge to copy the angle. Then bisect the copy of the angle.

4. Use a straightedge to draw an obtuse angle. Use a compass and straightedge to copy the angle. Then bisect the copy of the angle.

**For Exercises 1–2, use the figure shown.**

1. Construct the bisector of  $\angle B$  in  $\triangle ABC$ . Construct the bisectors of  $\angle A$  and  $\angle C$ .
2. What do you notice about the bisectors?



3. Construct an angle whose measure is four times as great as  $m\angle K$ , shown below.



**Choose the best answer.**

4. Mark drew  $\angle PQR$  with measure  $168^\circ$ . He constructed the angle bisector  $\overrightarrow{QX}$ . Then he bisected  $\angle PQX$  by constructing  $\overrightarrow{PY}$ . What is  $m\angle PQY$ ?

A  $21^\circ$

B  $42^\circ$

C  $84^\circ$

D  $168^\circ$

5. Paula bisected  $\angle XYZ$ , forming angles  $\angle XYW$  and  $\angle WYZ$ . Given that  $\angle XYZ$  is an obtuse angle, which statement cannot be true?
- F  $m\angle WYZ$  is less than  $90^\circ$ .
  - G  $m\angle WYZ = m\angle XYW$
  - H  $m\angle WYZ$  is greater than  $90^\circ$ .
  - J  $m\angle XYZ = 2 \cdot m\angle XYW$