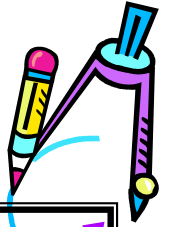# Geometry Constructions

Name:_____ Period:_____

Geometric Constructions

Construct a segment congruent to a given segment
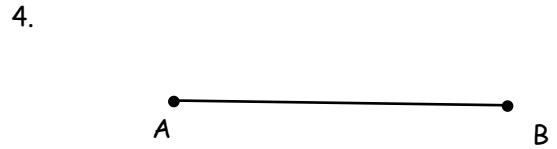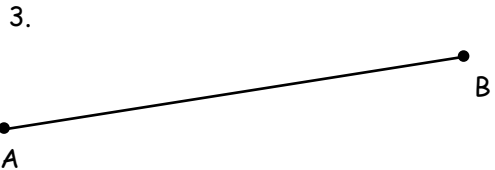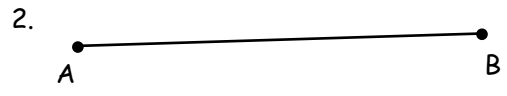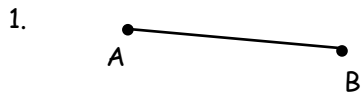
Given: $\overline{AB}$

Construct a segment congruent to $\overline{AB}$

1. Use a straightedge to draw a segment longer than the given segment. Label a point R at one endpoint of the new segment.
2. Place the compass tip at point A of the given segment. Adjust your compass width to equal the length of $\overline{AB}$.
3. Using this **same** compass setting, place the compass tip at point R and draw an arc. Label the intersection point S.
4. Erase the excess segment.
5. $\overline{AB} \cong \overline{RS}$

A ————————————— B

Construct a segment congruent to $\overline{AB}$.

1.

A ——— B

2.

A ——————————— B

3.

B

A

4.
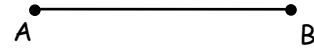
A ————————— B

Construct an angle congruent to a given angle

Given: ∠**A**

Construct an angle congruent to ∠A.

3. Draw a ray. Label the endpoint D.
4. Place the compass tip at the vertex of ∠A. Draw an arc across both sides of the given angle. Label the points of intersection with the rays B and C.
3. Using this **same** compass setting, place the compass tip at point D (the new ray) and draw a long arc across the ray. Label the intersection point E.
5. Set the compass so that it is the width of BC.
5. Using this same compass setting, place the compass tip at point E and draw an arc, intersecting the arc from step 3. Label the intersection F.
6. Draw $\overrightarrow{DF}$. ∠EDF ≅ ∠BAC

A

D
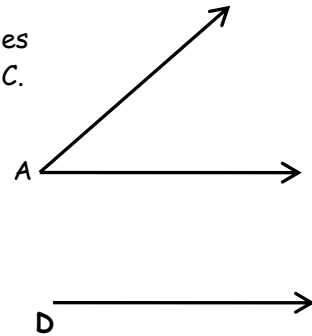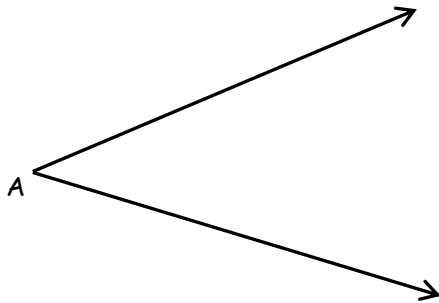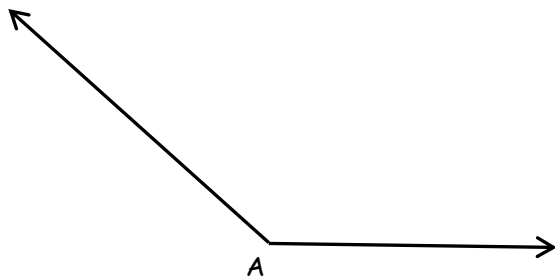
Construct an angle congruent to ∠A.   Your construction here:
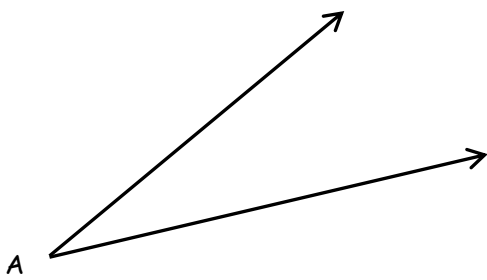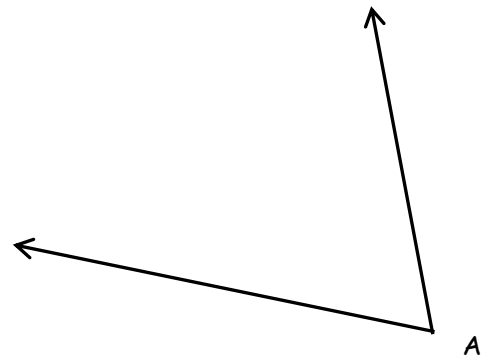
1.

A

2.

A

3.
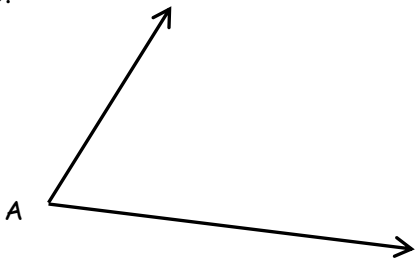
4.
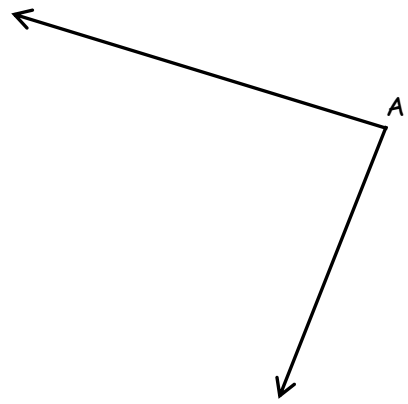
5.

6.

Perpendicular Bisector

Given: $\overline{AB}$

Construct the perpendicular bisector of $\overline{AB}$.

1. Choose a compass opening greater than 1/2 of $\overline{AB}$ and less than the length of AB. Place compass tip at A. Draw two arcs - above **and** below $\overline{AB}$.
2. Using the **same** compass opening, place compass tip at point B. Draw two arcs – above **and** below $\overline{AB}$.
3. Draw the line connecting the intersections of the two arcs. This is the perpendicular bisector of $\overline{AB}$.
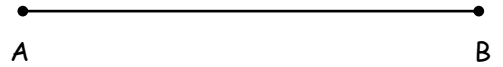
(Can also be used to find the midpoint of $\overline{AB}$.)

A ————————————————— B

Construct the perpendicular bisector of each of the following line segments.

1.

A ——————————— B

2.   C
      |
      |
      |
      D

3.

E
  \
   \
    F

4.

A ——————————— B
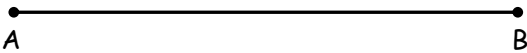
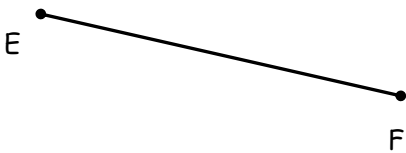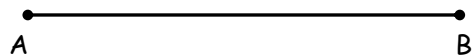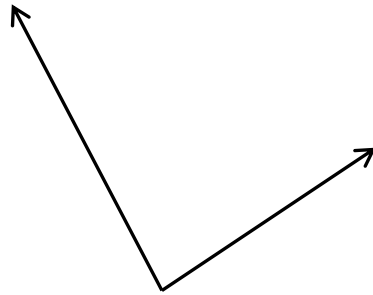## PRACTICE

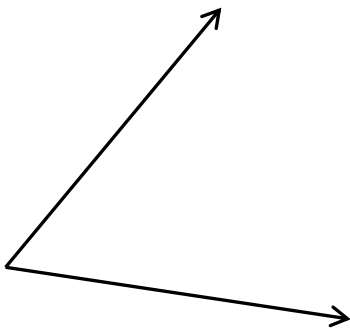Construct the segment or angle that is congruent to the given segment or angle.

1.
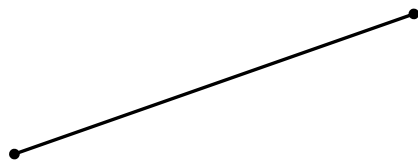
2.

3.

4.

Angle Bisector

Given: ∠A.
Construct the angle bisector of ∠A.
1. Place the compass tip at point A. Draw an arc that intersects both rays of the angle. Label the points of intersection B and C.
2. Place the compass tip at point B and draw an arc in the interior of ∠A.
3. Using this **same** compass setting, place the compass tip at point C and draw an arc that intersects the arc you drew in #2. Label the point of intersection Q.
6. Use a straightedge to draw AQ.
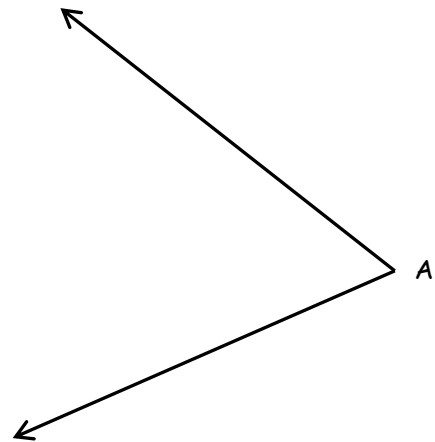   * This is the angle bisector of ∠A.
7. ∠BAQ ≅ ∠QAC
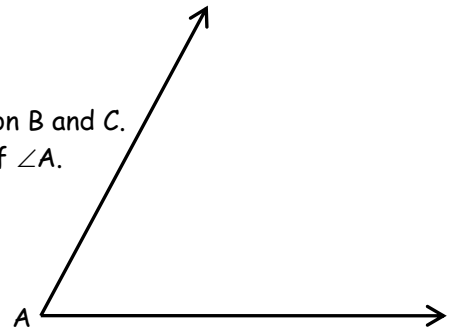
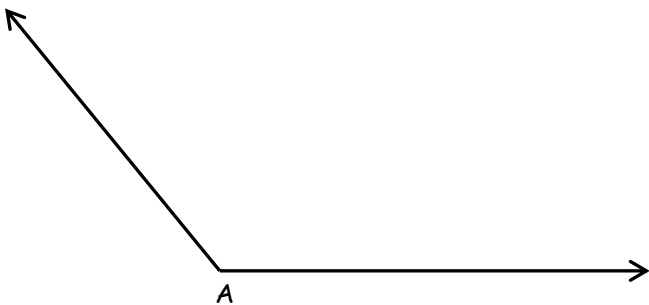Construct the angle bisectors for each of the following angles.
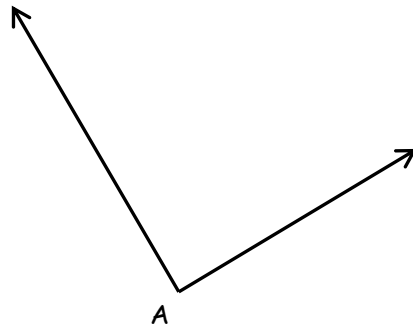
1.
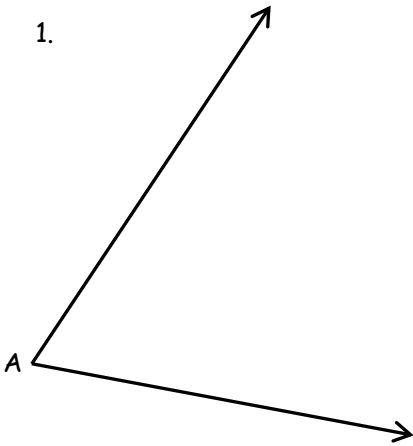
2.

3.

4.

Parallel Lines

Given: Point X and line *m*

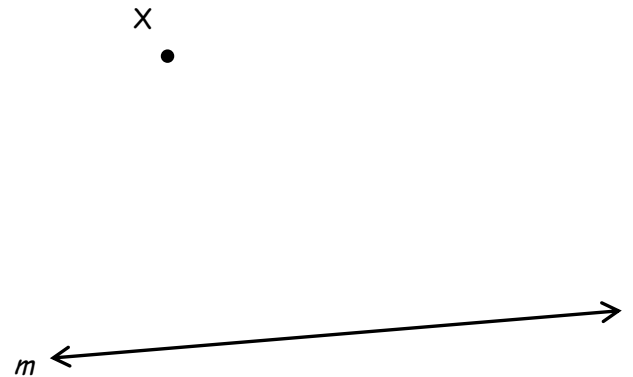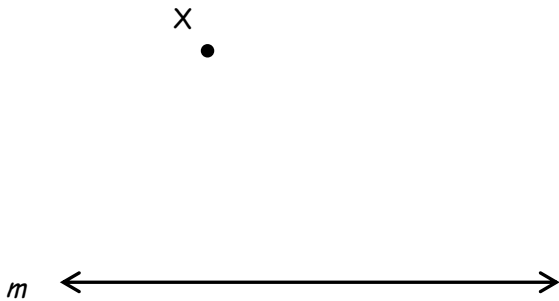Construct a line parallel to line *m* containing point X.

1. Place point A anywhere on line *m*. Draw line $\overleftrightarrow{XA}$.
2. Place compass tip at point A and draw an arc that intersects line *m* and line $\overleftrightarrow{XA}$. Label the intersection point Q with line $\overleftrightarrow{XA}$. Label the intersection point B with line *m*.
3. Using the **same** compass opening, place compass tip at point X and draw an arc of the same size. Label the intersection point T (on line $\overleftrightarrow{XA}$).
4. Place the compass tip at point B. Adjust the opening so that the pencil tip is where the arc intersects line $\overleftrightarrow{XA}$ at point Q and draw a little arc.
8. Using the **same** compass opening, place the compass tip at point T. Draw an arc from this point that intersects the arc you drew in #3. Label the point of intersection R.
9. Draw line $\overleftrightarrow{XR}$. $\overleftrightarrow{XR} \parallel m$

X •

←————————————————————————→ *m*
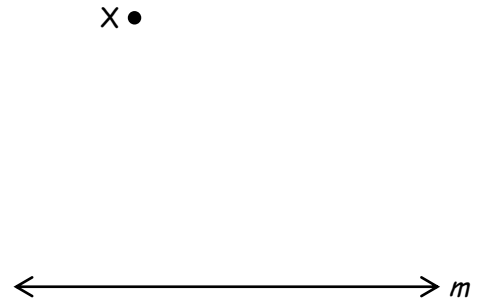
Construct a line parallel to line *m* at point X in the following problems.

1.

2.

X
•

X
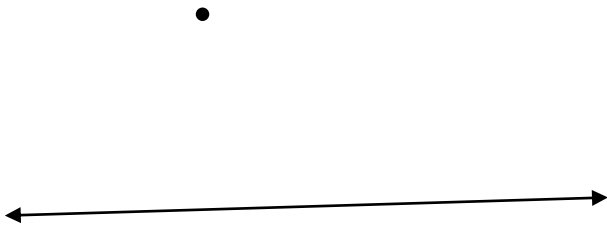•

m ←————————————————————→
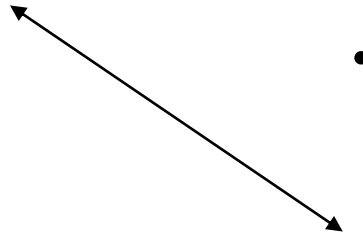
m ←————————————————————→

PRACTICE

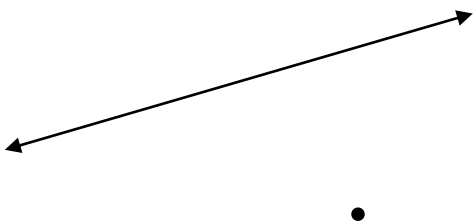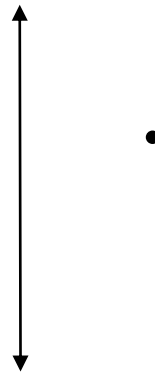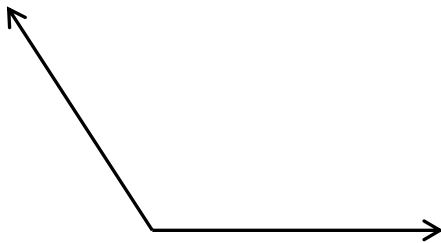Construct a line parallel to the line given through point P.

1.

2.

3.

4.

Construct the segment or angle bisector for each segment or angle.
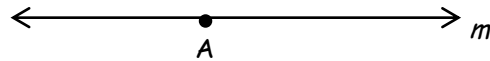
5.

6.

Perpendiculars, Given a Point ON the Line

Given: Line *m* which contains Point A

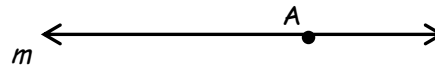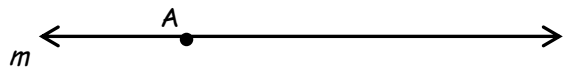Construct a perpendicular to line *m* through point A.

1. Place compass tip at point A. Using any compass opening less than the length of *m*, draw two arcs intersecting line *m* on both sides of A. Label these points C and D.
2. Place compass tip at point C. Adjust the compass so that it is greater than $\frac{1}{2}\overline{CD}$ and draw an arc above *m*.
3. Using the **same** compass opening, place compass point at point D. Draw an arc above *m* intersecting your first arc.
4. Label the intersection point X.
5. Use a straightedge to draw line $\overrightarrow{AX}$. This is perpendicular to *m* through point A.

A •

m

Construct perpendiculars to line *m* through point A.
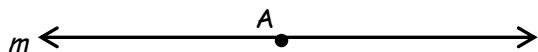
1.

A •

m

2.

A •

m

3.

A •

m

4.

A •

m

Perpendiculars, Given a Point NOT on the Line

Given: Line *m* and Point P not on the line.

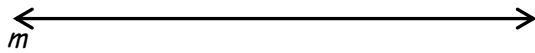Construct a perpendicular from point P to line *m*.   P •
1. Place compass tip at point P. Using an arbitrary radius, draw arcs
   Intersecting line *m* at two points. Label these points A and B.
2. Using a compass opening greater than $\frac{1}{2}\overline{AB}$, place compass
   point at point A. Draw an arc below line *m*.
3. Using the **same** compass opening, place compass tip at point B
   and draw an arc from point B below line *m,* intersecting arc from step 2.
4. Label the intersection point X.
5. Draw line $\overrightarrow{PX}$. This is perpendicular to *m* through point P.
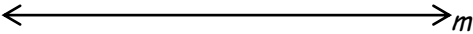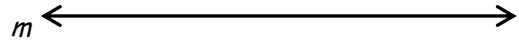
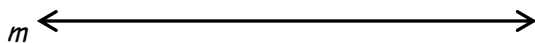Construct perpendicular lines from point P to line *m*.

1.

P •

←————————————————————→
m

2.   P •

                              m ←————————————————————→

3.

P •

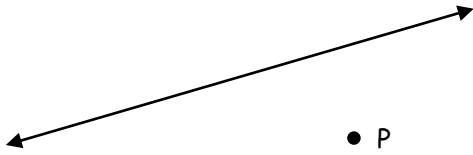*m* ←————————————————————→
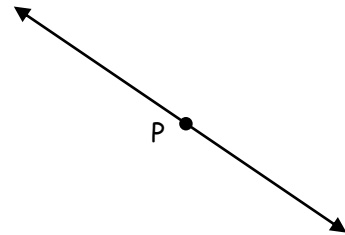
4.

←————————————————————→
m

P •
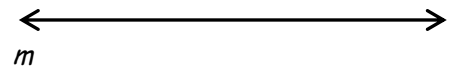
PRACTICE

Construct a line perpendicular to the line given through the point P.

1.

• P

2.

P •

3.

P •

4.

P •

5.

• P

6.

P •

Constructions Review   Date _____ Period _____
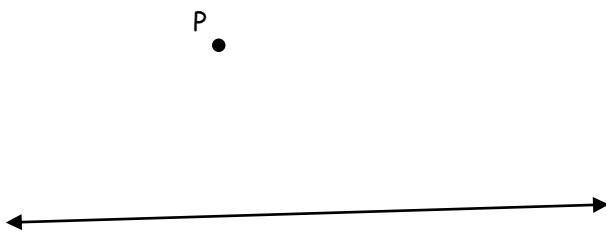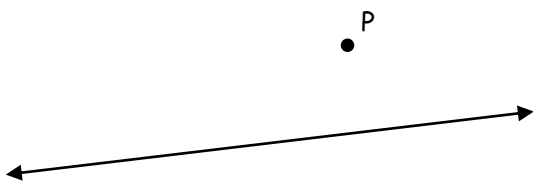
Construct the following:

1.   A line parallel to line *m* through point *X*

X •
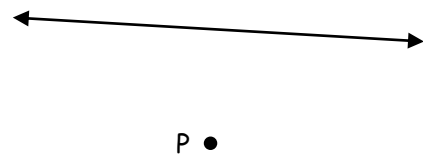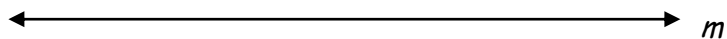

←————————————————————————→ *m*
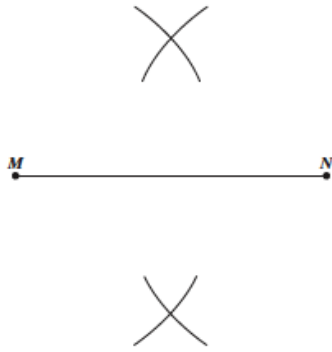

2.   The perpendicular bisector of $\overline{AB}$

•————————————————————————•
A   B
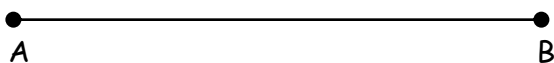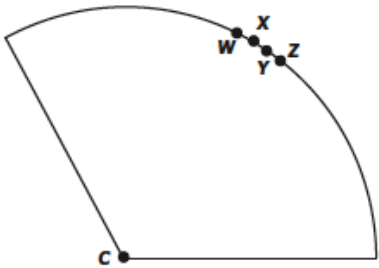

3.   The angle bisector of ∠ABC

A

B
     C
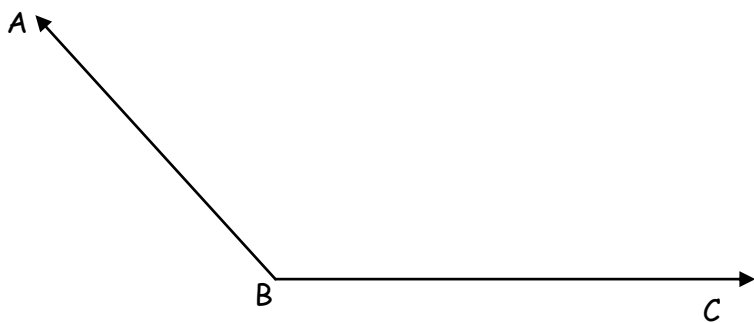
4. The arcs for a compass and straightedge construction are shown below.
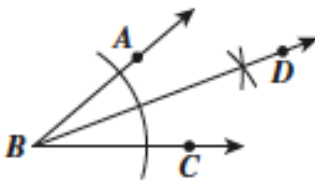
What construction is apparently being made?

A) Two lines parallel to $\overline{MN}$

B) Two congruent angles

C) A segment congruent to $\overline{MN}$

D) The perpendicular bisector of $\overline{MN}$

5. One piece of pie is left for two boys to share. Where should the pie be cut to ensure each gets an equal piece?

A) $\overline{CZ}$

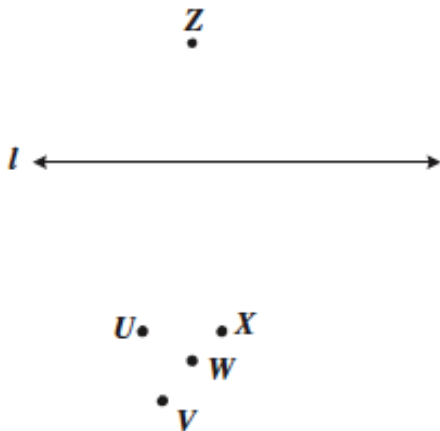B) $\overline{CY}$

C) $\overline{CX}$

D) $\overline{CW}$

6. Eric constructed BD as shown.
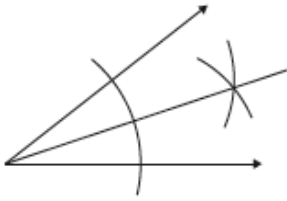
Which of the following statements *must* be true?

A) $\overline{BA} \cong \overline{BC}$

B) $\overline{BD} \cong 2\overline{BA}$

C) $m\angle ABD \cong m\angle CBD$

D) $m\angle CBD \cong 2(m\angle ABC)$

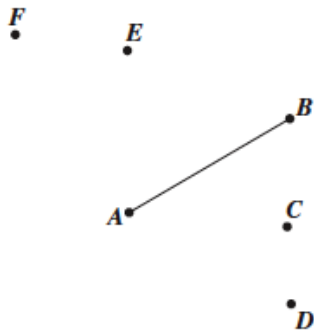7. Which point is on the line $\perp$ to l and passing through Z?

A) U

B) V

C) W

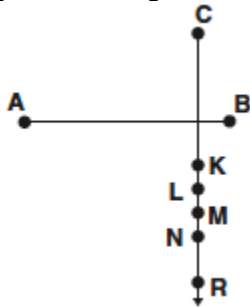D) X

8. Which of the following constructions is illustrated?

A) The angle congruent to a given angle

B) The bisector of a given angle

C) The bisector of a given segment

D) The perpendicular bisector of a given segment

9. Which line segment is apparently congruent to $\overline{AB}$?
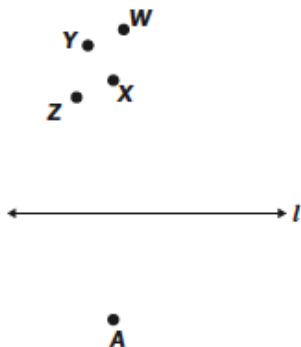
A) $\overline{AD}$

B) $\overline{AC}$

C) $\overline{AE}$

D) $\overline{AF}$

10. Which segment is congruent to $\overline{AB}$?

A) $\overline{CK}$

B) $\overline{CL}$

C) $\overline{CM}$

D) $\overline{CN}$

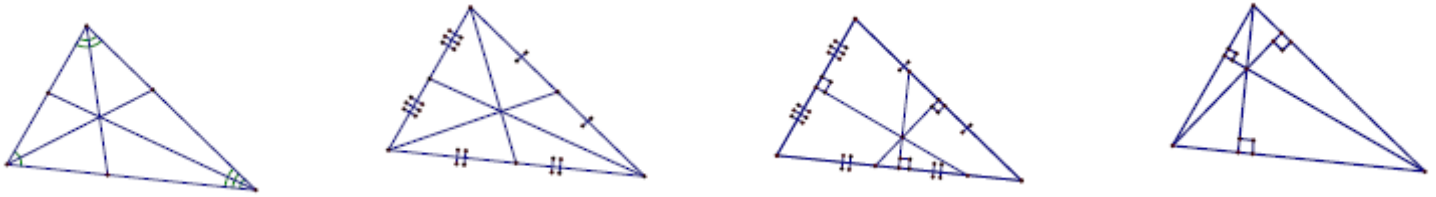11. Which point apparently lies on the perpendicular to l from A?

A) X

B) Y

C) Z

D) W

12. Fill in the blanks:

    a) The perpendicular bisectors meet at the _____.

    b) The altitudes meet at the _____.

    c) The medians meet at the _____.

    d) The angle bisectors meet at the _____.

13. In each figure below, tell what point of concurrency is illustrated and identify the construction that forms that point.

Point:_____   Point: _____   Point: _____   Point: _____

Formed by_____   Formed by_____   Formed by_____   Formed by_____

14. Given the following pictures and markings, identify if the dotted line is (a) an angle bisector, (b) a perpendicular bisector, (c) an altitude, or (d) a median. List all that apply.

a. _____
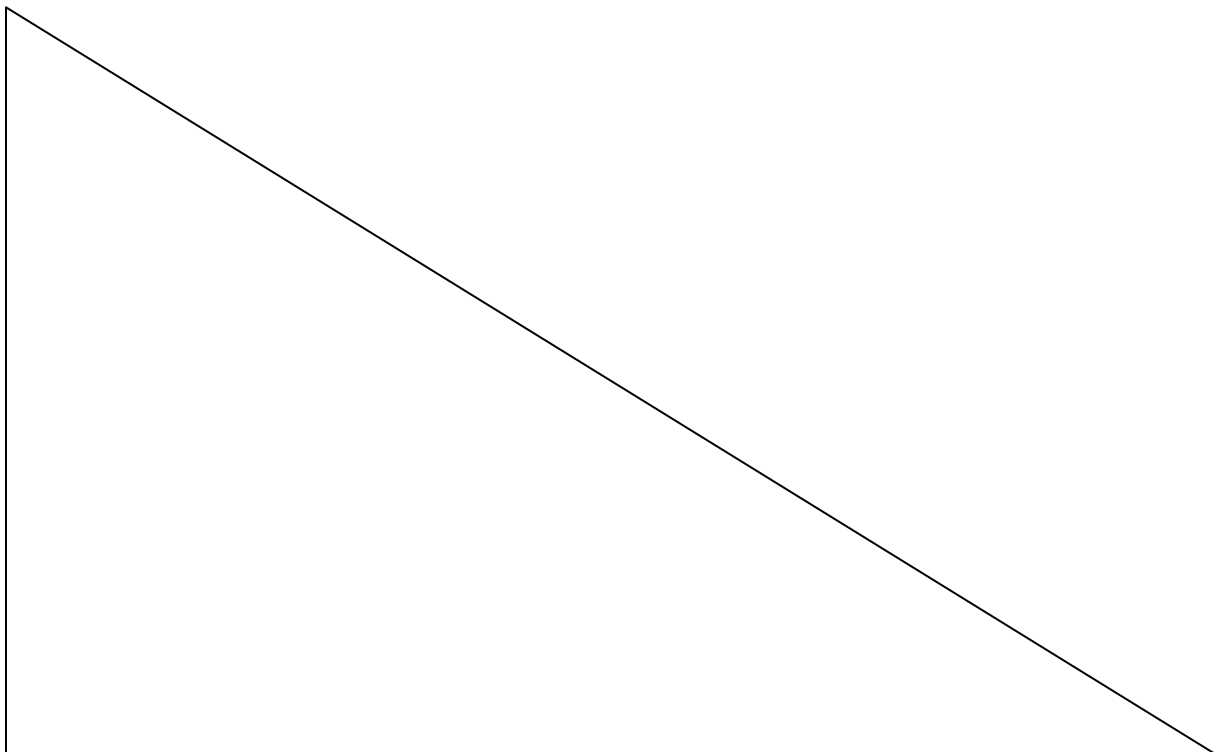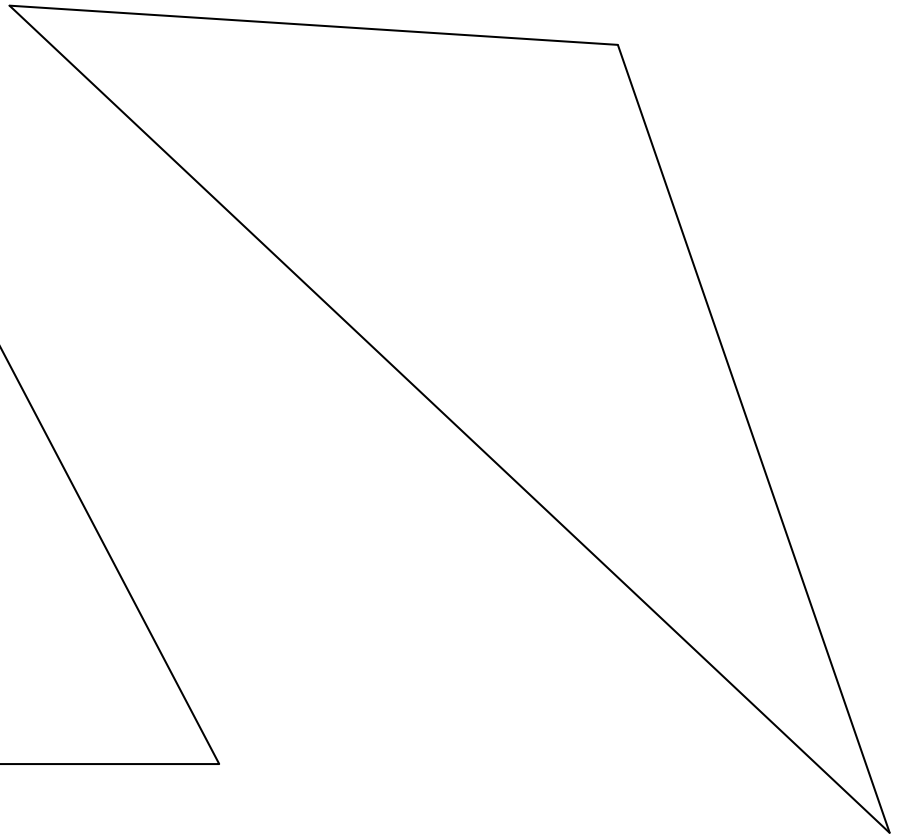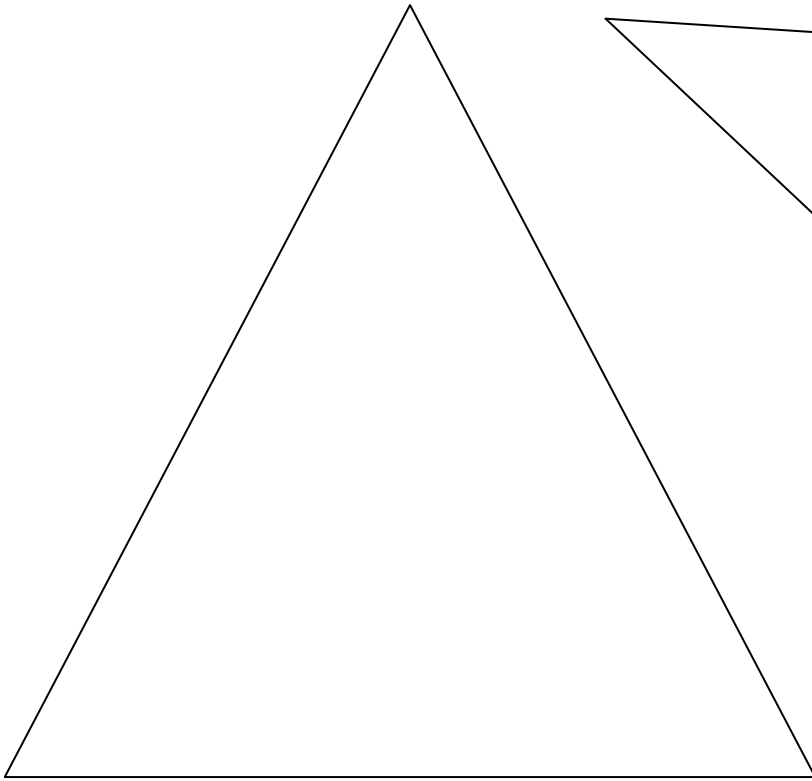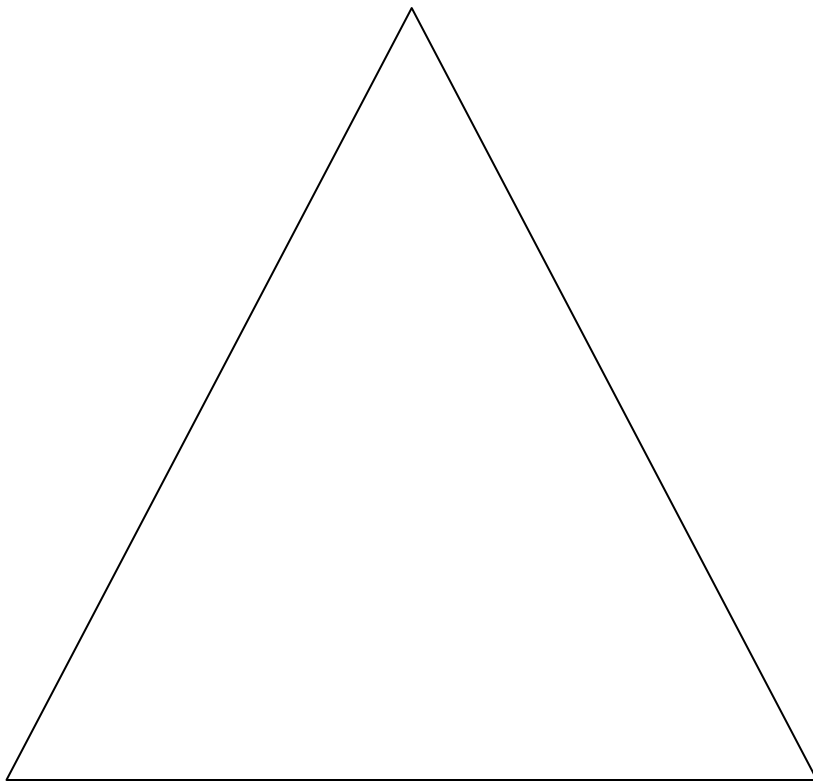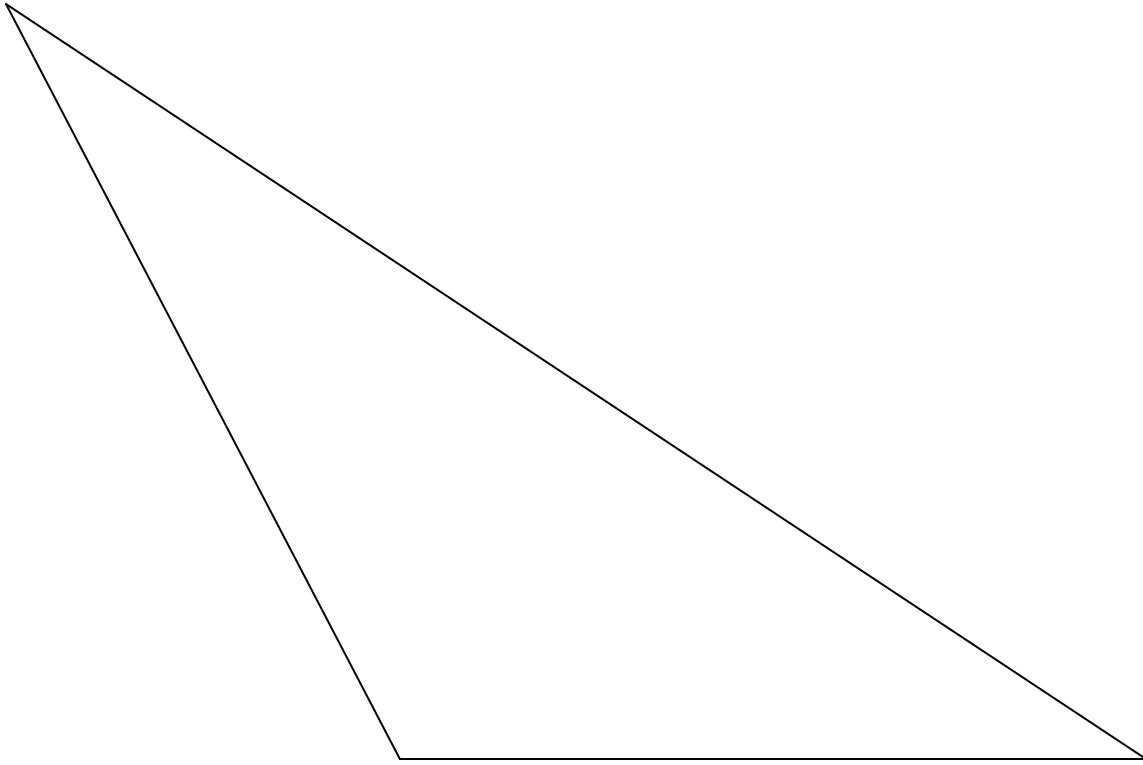b. _____
c. _____
d. _____
e. _____
f. _____
g. _____
h. _____
i. _____

Construct the incenter for each triangle.

Construct the circumcenter for each triangle.

Merry-go-round

1. The Smith Construction Company has been hired to install a new water fountain at Winstonian Park. They would like to find the best location for the fountain so that the walking distance from each of the three main pieces of playground equipment is the same. Locate the point and explain how you determined this.

Swing

See-Saw
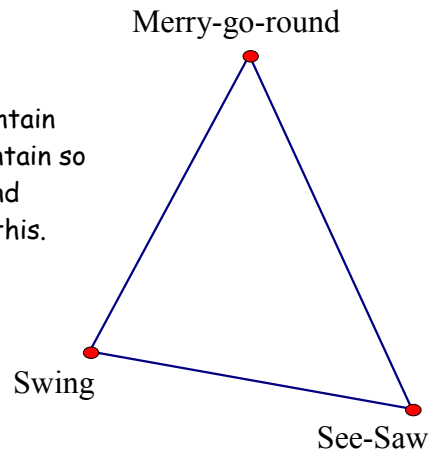
2. The first-aid center of Starved Rock needs to be at a point that is equidistant from three bike paths that intersect to form a triangle. Locate this point so that in an emergency medical personnel will be able to get any one of the paths by the shortest route possible. Which point of concurrency is it?

3. Paula Deene wishes to center a butcher-block table at a location equidistant from the refrigerator, stove, and sink. Which point of concurrency does Paula need to locate?
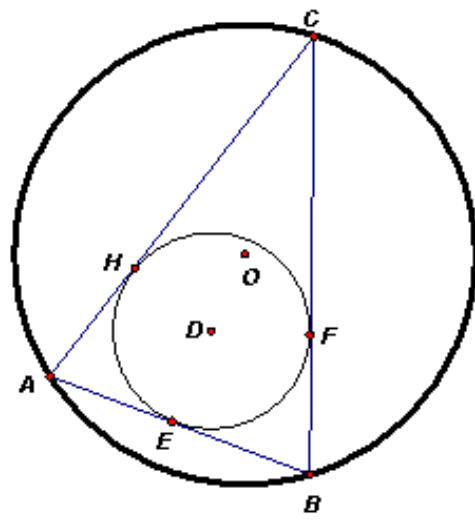
4. Which point is the circumcenter of the triangle?
   (Be sure to show all work!)

B

Point_____

Z

Y   *X*

W

C   *A*
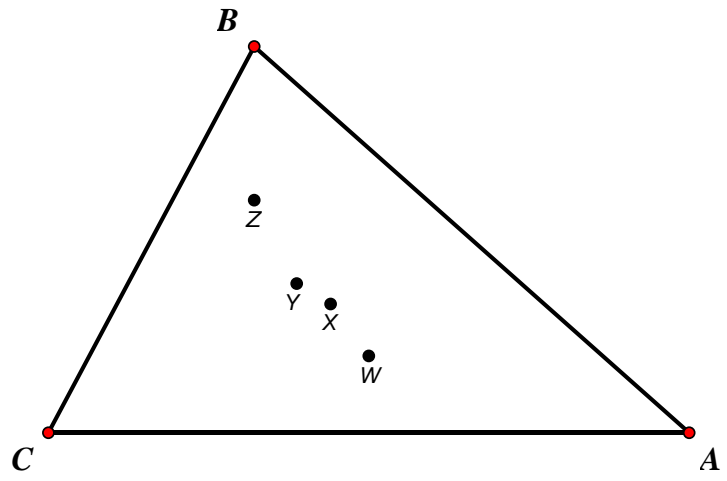
5. Identify the incenter of the triangle.

C

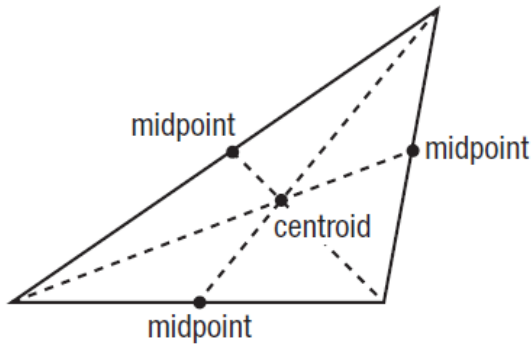Point_____

H   *O*

D   *F*

A

E

B

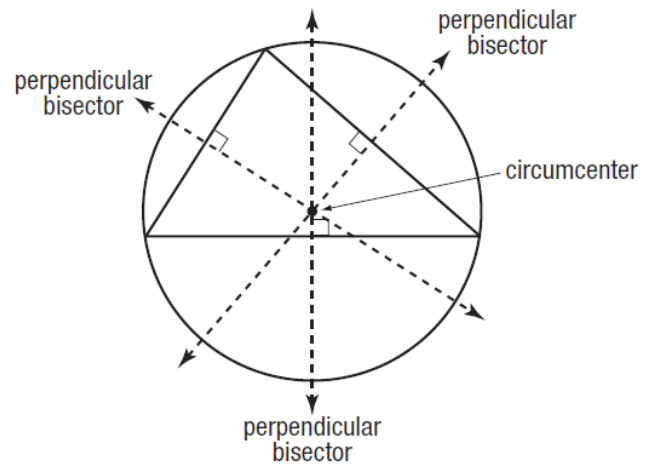# Refresher: Concurrent Lines of a Triangle

Centroid

The medians of a triangle are concurrent and intersect each other in a ratio of 2:1.
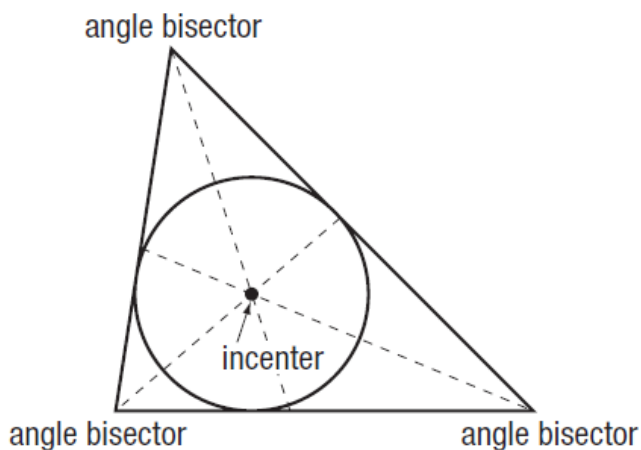

Circumcenter

Perpendicular bisectors of sides of a triangle are concurrent at a point equidistant from the vertices.

Incenter

The bisectors of the angles of a triangle meet at a point that is equally distant from the sides of the triangle.

Orthocenter   "Ortho" means "Right"

The point where the lines containing the altitudes are concurrent is called the orthocenter of a triangle.