Constructions Project Name _____

Introduction

Each construction is worth 1 point in the Test Category of the gradebook! Include all marking to receive full credit!

Total Points	**_____12**

The study of Geometry was born in Ancient Greece, where mathematics was thought to be embedded in everything from music to art to the governing of the universe. Plato, an ancient philosopher and teacher, had the statement, "Let no man ignorant of geometry enter here," placed at the entrance of his school. This illustrates the importance of the study of shapes and logic during that era. Everyone who learned geometry was challenged to construct geometric objects using two simple tools, known as Euclidean tools:

- A straight edge without any markings (you may use a ruler, just be sure NOT to use the numbers on the ruler)
- A compass

The straight edge could be used to construct lines, the compass to construct circles. As geometry grew in popularity, math students and mathematicians would challenge each other to create constructions using only these two tools. Some constructions were fairly easy (Can you construct a square?), some more challenging, (Can you construct a regular pentagon?), and some impossible even for the greatest geometers (Can you trisect an angle? In other words, can you divide an angle into three equal angles?). Archimedes (287-212 B.C.E.) came close to solving the trisection problem, but his solution used a marked straight edge. Let's see what constructions can you create.

****Note: Be sure to ALWAYS label the center of the circle, when drawing a circle!!**

1. Your First Challenge: Let's construct a line segment.

Step 1	Construct a circle with a compass on a sheet of paper.
Step 2	Mark the center of the circle and label it point A.
Step 3	Mark a point on the circle and label it point B.
Step 4	Draw $\overline{AB}$.

You Try!

Constructions Project Name _____

2. Your Second Challenge: Let's copy a line segment.

https://www.youtube.com/watch?v=s282TNIHGCo

Below is a line segment $\overline{AB}$. Using only an unmarked straight edge and compass, can you construct another line segment the same length beginning at point C?

Steps:

- Draw a Ray away from segment AB from point C.
- Place one end of your compass on top of point A.
- Open the compass so the other end is on top of point B.
- DON'T move your compass opening and place your compass on point C. use the pencil to create an arc away from point C and on the ray drawn earlier.
- Label a point on the arc, and call it point D.
- Label the new segment CD.

You Try! Copy the line segment

3. Your Third Challenge: Let's copy an angle.

https://www.youtube.com/watch?v=9j1Q2GWRRnw

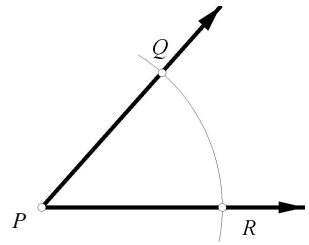
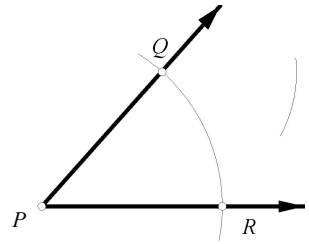
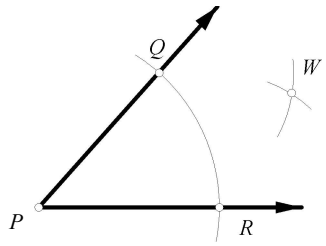
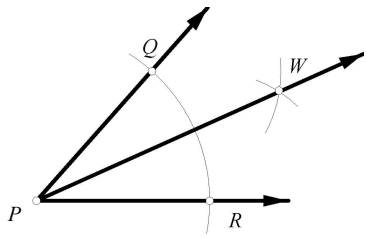
Now that you know how to copy a segment, copying an angle is easy.

- Construct a ray from point **D** of any length. This will be one side of the constructed angle.
- Place the sharp point of the compass in point **A** and make an arc to cross both sides of the angle. Label where the arc intersects the angle as points **B** and **C**.
- Without changing the compass setting, put the sharp point of the compass in point **D**. Make an arc similar to the arc made in the previous step and label the point of intersection as **E**.
- Put the sharp point of the compass in point **B** and open the compass so it touches point **C**.
- Without changing the compass setting, put the sharp point of the compass in point **E** and make an arc to cross the existing arc. Label this point of intersection as point **F.**
- Using your straightedge, construct a ray from point **D** through point **F**.

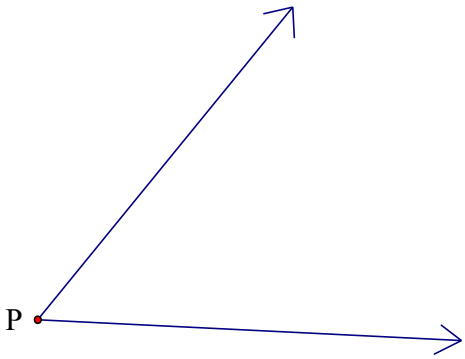
Constructions Project Name _____

4. Your Challenge: Let's bisect an angle.

https://www.youtube.com/watch?v=nysMOfPsAfI

1. Let point *P* be the vertex of the angle. Place the compass on point *P* and draw an arc across both sides of the angle. Label the intersection points *Q* and *R*.	
2. Place the compass on point *Q* and draw an arc across the interior of the angle.	
3. Without changing the radius of the compass, place it on point *R* and draw an arc intersecting the one drawn in the previous step. Label the intersection point *W*.	
4. Using the straightedge, draw ray *PW*. This is the bisector of $\angle QPR$.	

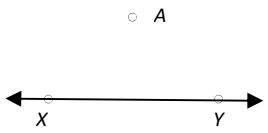
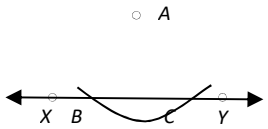
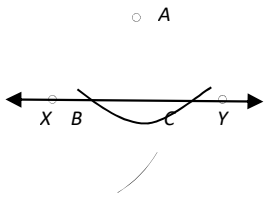
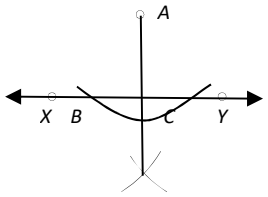
You try:



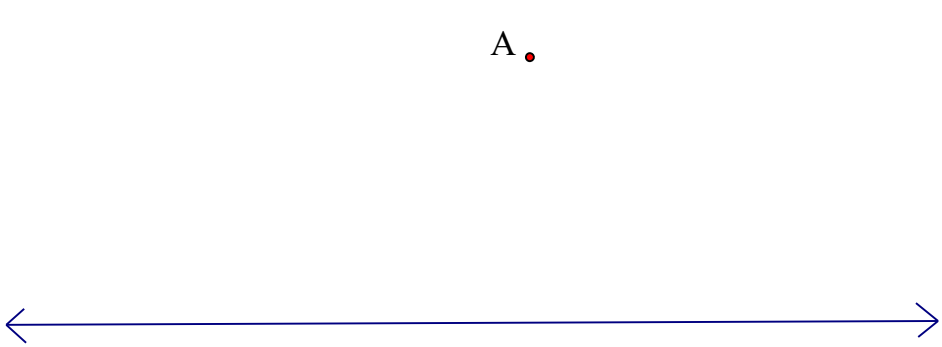
Constructions Project Name _____

5. Construct a line perpendicular to a given line through a point not on the line.

http://mathopenref.com/constperpextpoint.html

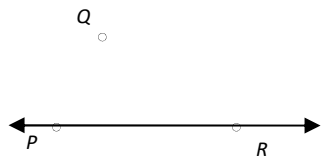
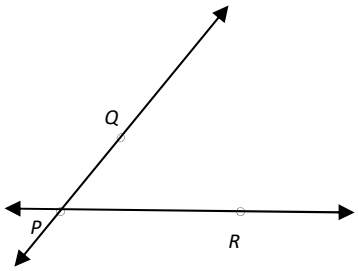
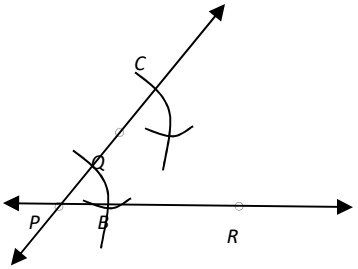
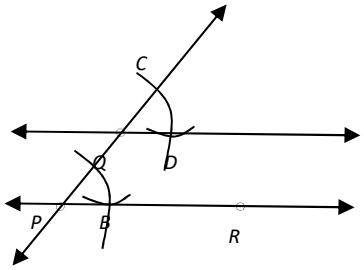
1. Begin with $\overleftrightarrow{XY}$ and point *A*.	
2. Place the compass at point *A*. Adjust the compass radius so that an arc will cross $\overleftrightarrow{XY}$ twice as shown here. Label the intersection points *B* and *C*.	
3. Draw an arc with the center of the compass at point *B* as shown here.	
4. Without changing the compass radius, place the compass on point C. Draw another arc intersecting the previously drawn arc. Label the intersection point D. $\overleftrightarrow{XY} \perp \overline{AD}$.	

You try:



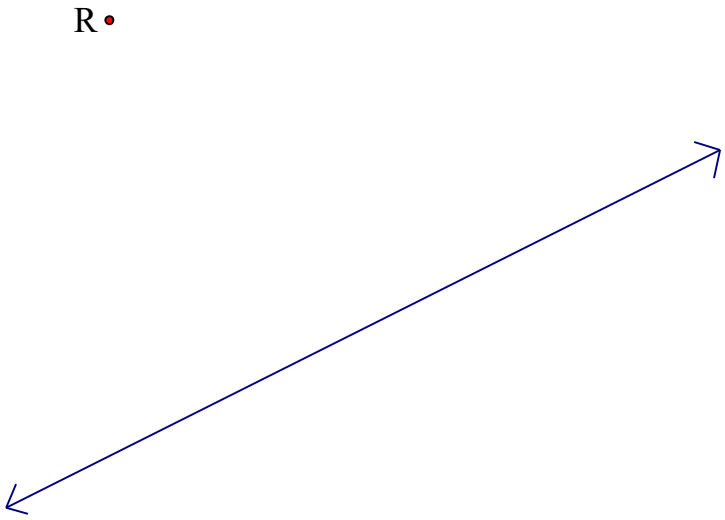
6. Construct a line parallel to a given line through a point not on the line.

http://mathopenref.com/constparallel.html

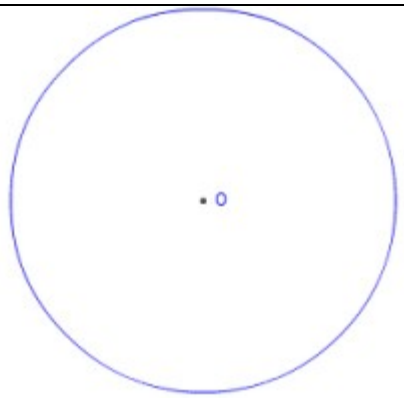
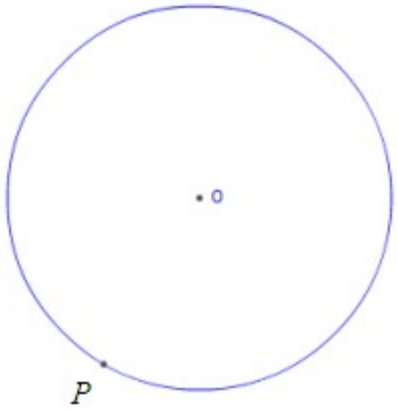
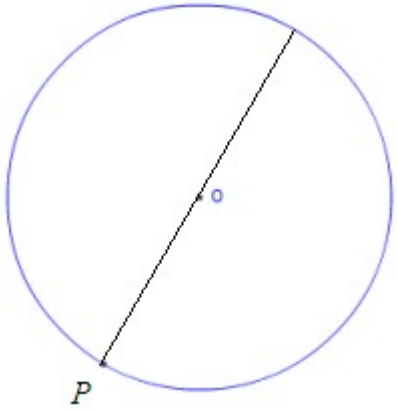
1. Draw $\overleftrightarrow{PR}$ as the given line and point *Q* not on $\overleftrightarrow{PR}$.	
2. Draw $\overleftrightarrow{PQ}$ which will be the transversal.	
3. Place the compass on point *P* and draw an arc across both sides of the angle intersecting at points *A* and *B*. Using the same radius, draw another arc at point *Q*. Place the center of the compass at point *A* and mark where point *B* intersects line $\overleftrightarrow{PR}$. Repeat this at point *C.* Be sure the two corresponding angles are congruent.	
4. Draw $\overleftrightarrow{QD} \parallel \overleftrightarrow{PR}$.	

Constructions Project Name _____

You try! Construct a line parallel to a given line through a point not on the line. Label your construction and write a statement relating the two lines.



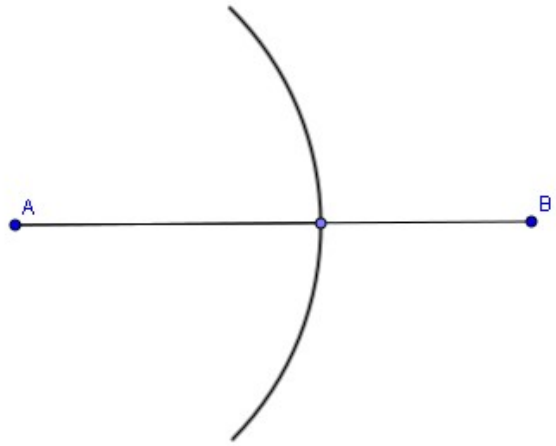
7. Constructing the Diameter of a Circle

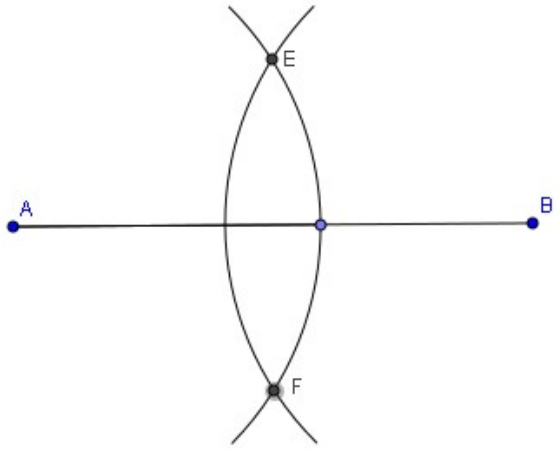
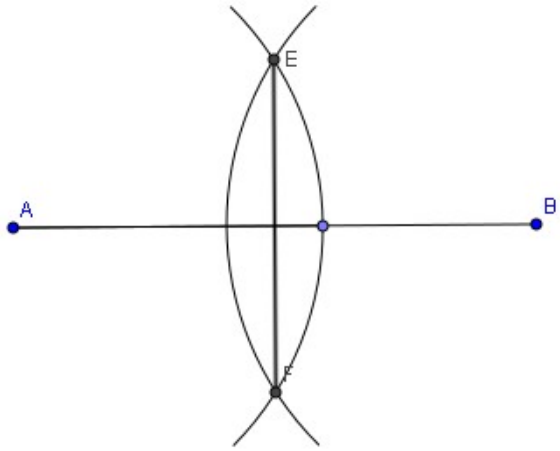
1. Start by constructing a circle with the compass. The circle can have any length radius. Label the center of the circle as point O.	
2. Mark a point anywhere on the circle. Label this point P.	
3. Using the straight-edge, construct a line segment from point P, through point O, and extending to the other side of the circle. This line segment is the **diameter** of the circle.	

You try!

8. Constructing the Perpendicular Bisector of a Line Segment

https://www.youtube.com/watch?v=QAMOFWrKEUA

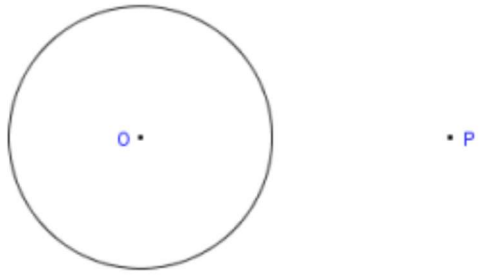
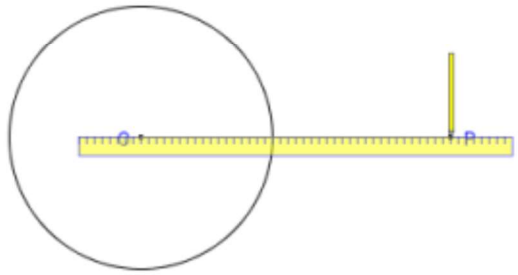
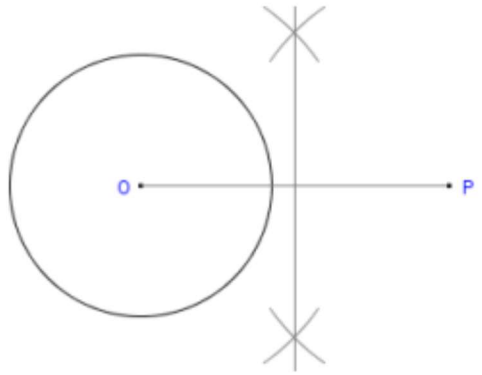
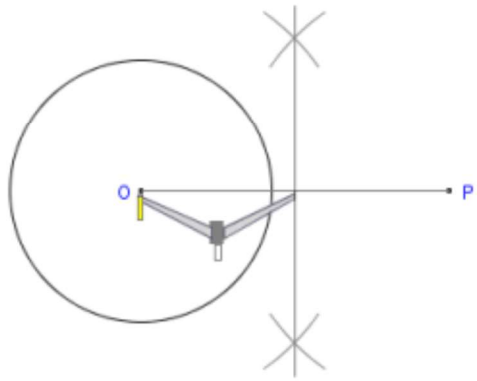
1. Construct a line segment (of any length) using the straight-edge. Label the two endpoints of the line segment A and B.	
2. Using the compass, measure off a length that is more than half of the distance from A to B.	
3. Position the point of the compass at point A, and draw an arc extending through line segment $\overline{AB}$.	

4. Move the compass point to point B, keeping it open to the same length measure. Draw an arc extending through line segment $\overline{AB}$. The arcs constructed in steps 3 and 4 should intersect at two points. Label these intersection points E and F.	
5. Using the straight-edge, construct a line segment $\overline{EF}$. This line segment is the perpendicular line segment of line segment $\overline{AB}$.	

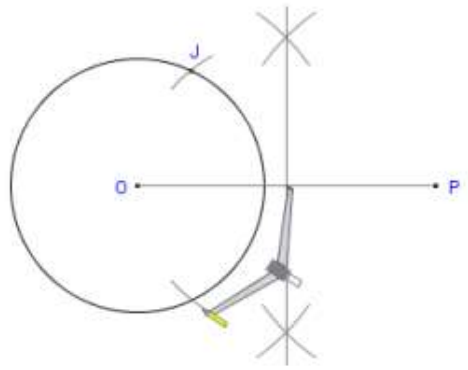
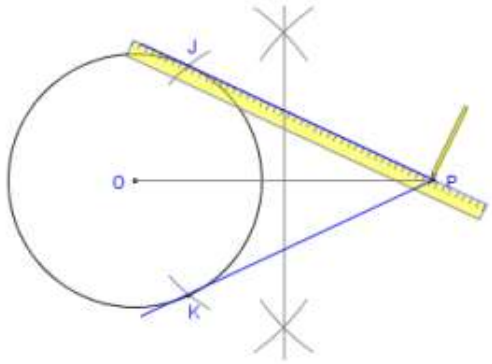
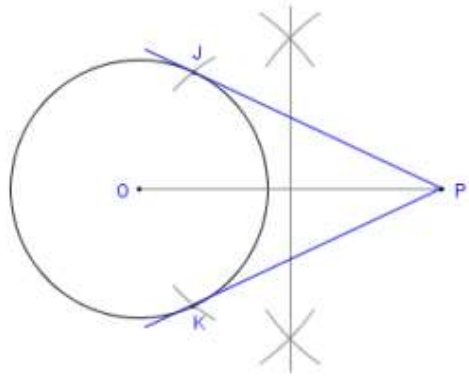
You try!

Constructions Project Name _____

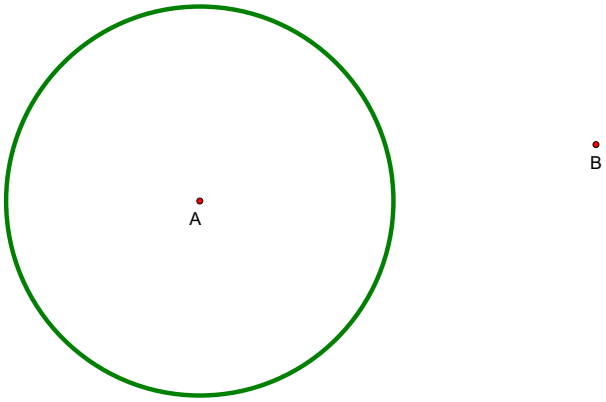
9. Constructing a Tangent from a Point Outside the Circle

After doing this	Your work should look like this
We start with a given circle with center O, and a point P outside the circle.	
1. Draw a straight line between the center O of the given circle and the given point P.	
2. Find the midpoint of this line by constructing the line's perpendicular bisector. (See Constructing the Perpendicular Bisector of a Line Segment.	
3. Place the compass on the midpoint just constructed, and set it's width to the center O of the circle.	

Constructions Project Name _____

4. Without changing the width, draw an arc across the circle in the two possible places. These are the contact points J, K for the tangents.	
5. Draw the two tangent lines from P through J and K.	
6. Done. The two lines just drawn are tangential to the given circle and pass through P.	

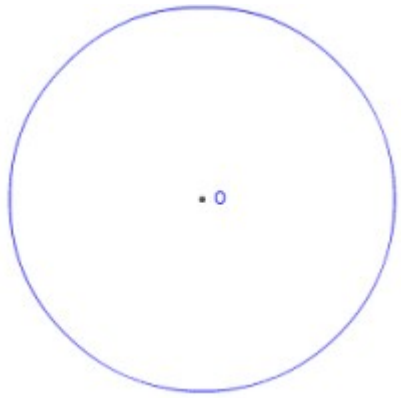
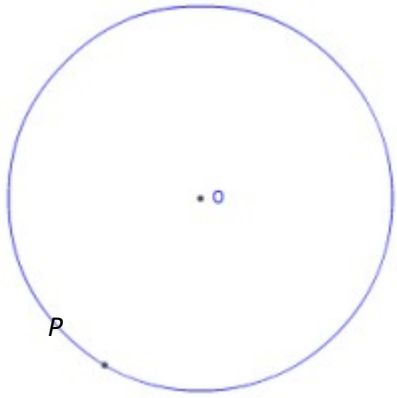
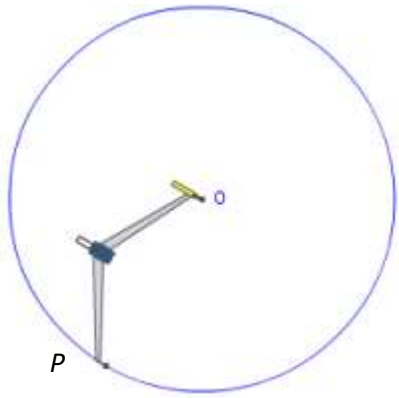
You Try: Construct a tangent from point B.

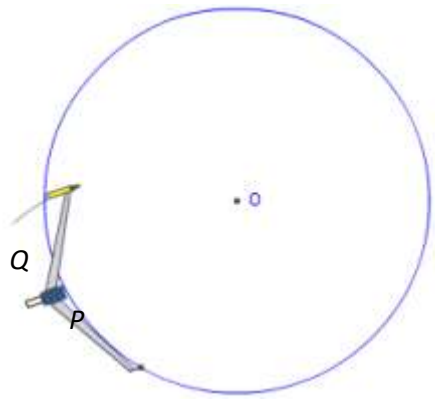
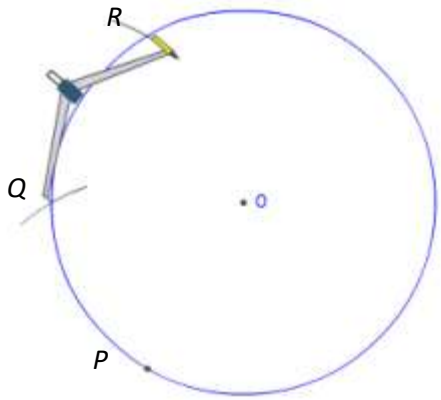
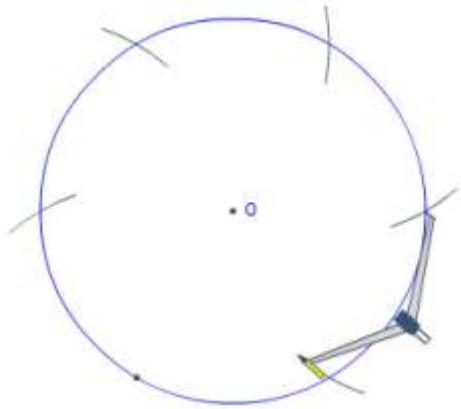


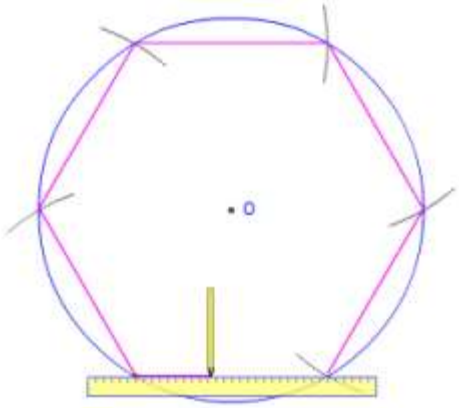
Constructions Project Name _____

10. Construction of an Inscribed Hexagon

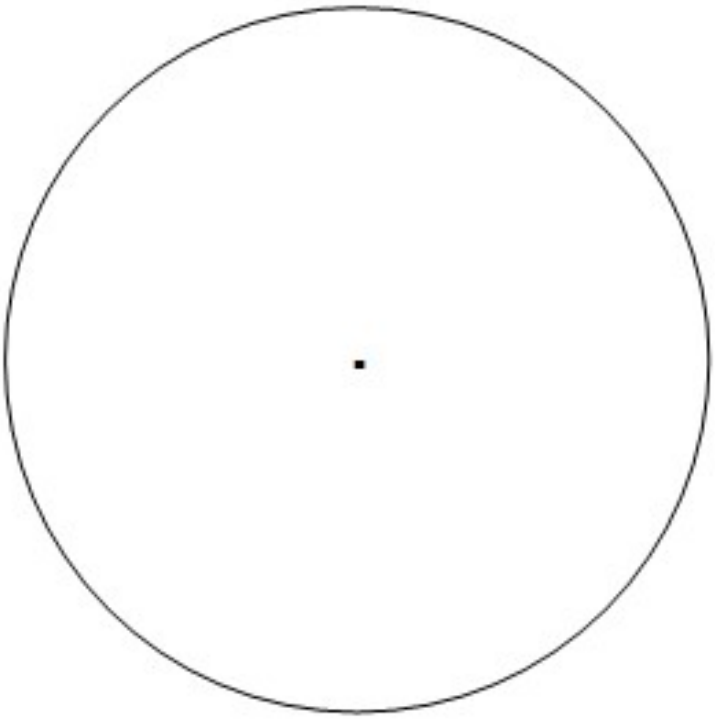
1. Constructing a ***hexagon*** inscribed in a circle. http://mathopenref.com/constinhexagon.html

We start with the given circle, center O.	
1. Mark a point anywhere on the circle. Label this point P. This will be the first vertex of the hexagon.	
2. Set the compass on point P and set the width of the compass to the center of the circle O. The compass is now set to the radius of the circle $\overline{OP}$.	

3. Make an arc across the circle. This will be the next vertex of the hexagon. Call this point Q. (It turns out that the side length of a hexagon is equal to its circumradius - the distance from the center to a vertex).	
4. Move the compass on to the next vertex Q and draw another arc. This is the third vertex of the hexagon. Call this point R.	
5. Continue in this way until you have all six vertices. PQRSTU	

6. Draw a line between each successive pairs of vertices, for a total of six lines.	
7. Done. These lines form a regular hexagon inscribed in the given circle. Hexagon PQRSTU	

You Try! Construct the largest ***regular hexagon*** that will fit in the circle below.



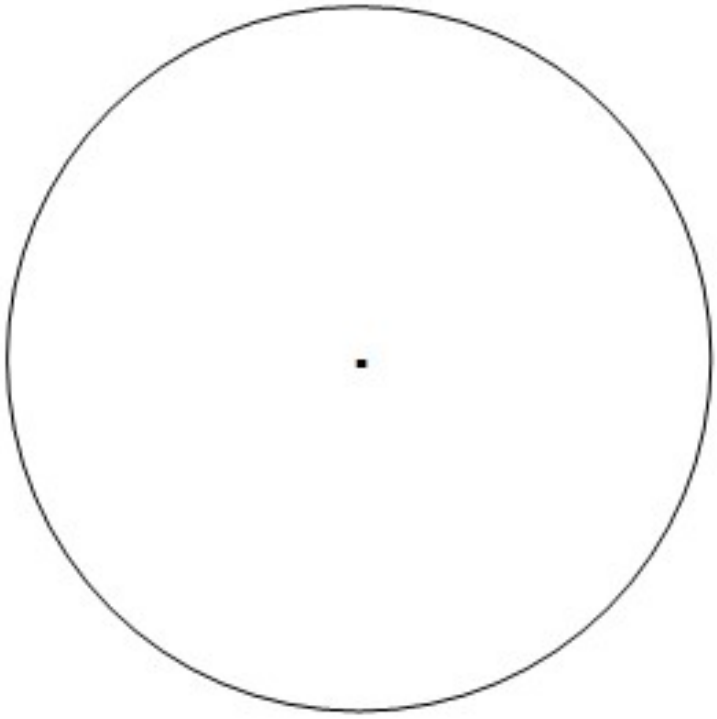
Constructions Project Name _____

11. Insribed Equilateral Trianlge

To construct an ***equilateral triangle*** inscribed in a circle. Repeat steps #1-5 above for the inscribed hexagon, then the last step would be to use your straight edge to connect every other arc with each other. This will create 3 lines total; therefore, creating an equilateral triangle inscribed in a circle.
Online resources:

https://www.youtube.com/watch?v=MYaQWHGRAcY

You Try! Construct the largest ***equilateral triangle*** that will fit in the circle below.



12. Constructing an Inscribed Square

Construct a ***square*** inscribed in a circle.

Steps:

1. Draw the diameter of the circle below. Label the endpoints *A* and *B*.
2. Construct the perpendicular bisector of segment *AB*. Label the endpoints *C* and *D*. (Refer to *constructions above.)*
3. Connect points *A, B, C,* and *D* to form a square.

Online resources:

http://www.mathopenref.com/constinsquare.html

You try! Construct an inscribed square.