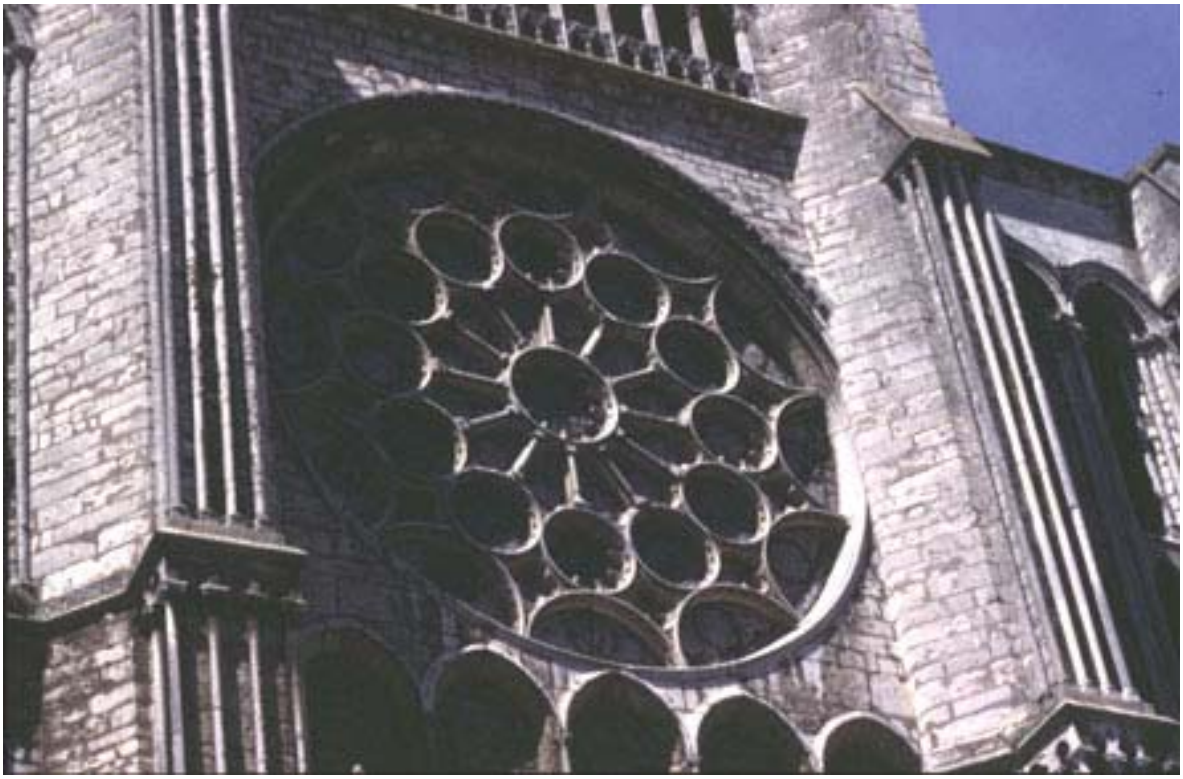
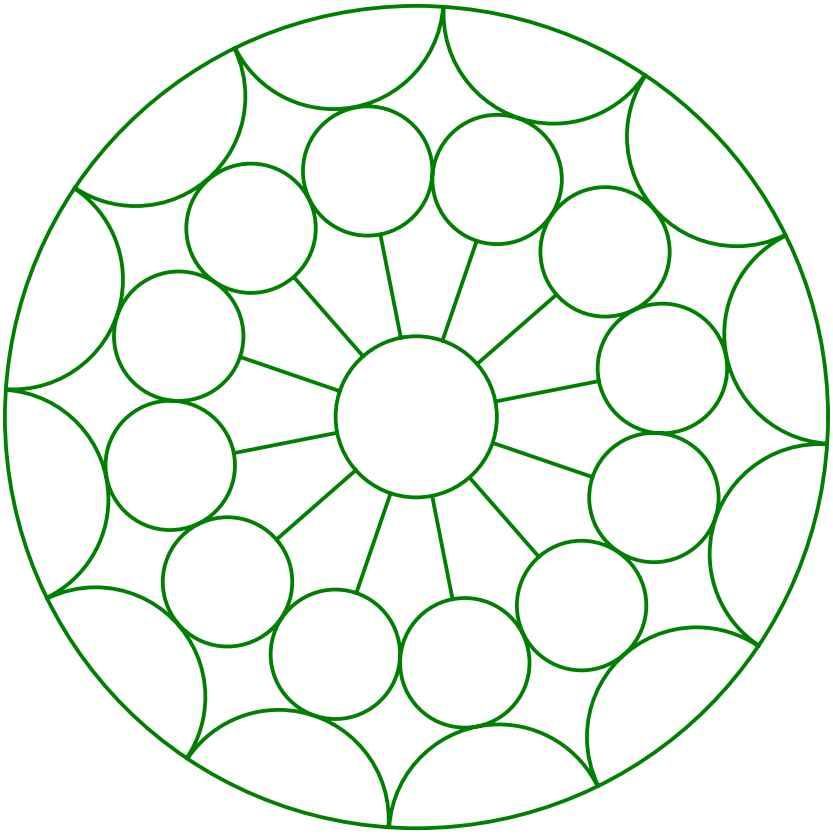
Geometer's Sketchpad—Rose Construction



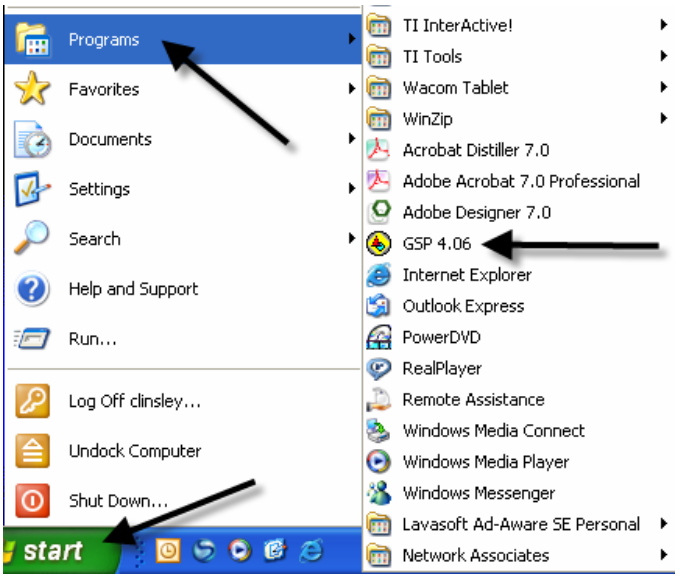


Opening a New Sketch

To **open** the Geometer's Sketchpad, click on the icon on your desktop

GSP 4.06.lnk

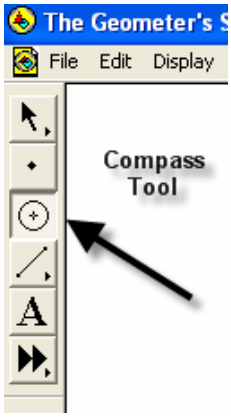
or click on **Start**, **Programs** and find the GSP icon. A new blank sketch will open up.

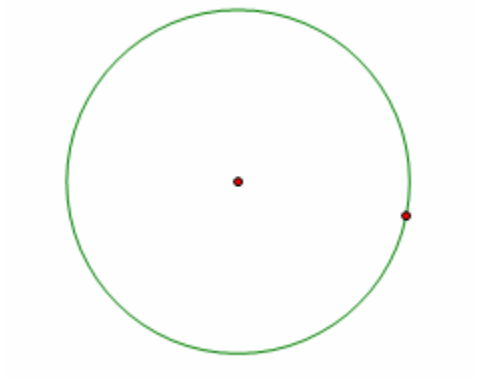


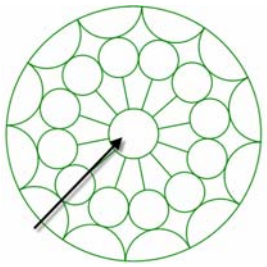
To open a **new sketch** in Geometer's Sketchpad, click on **File**, **New Sketch**.

Circle Construction

Construct a circle with the **Compass Tool**.







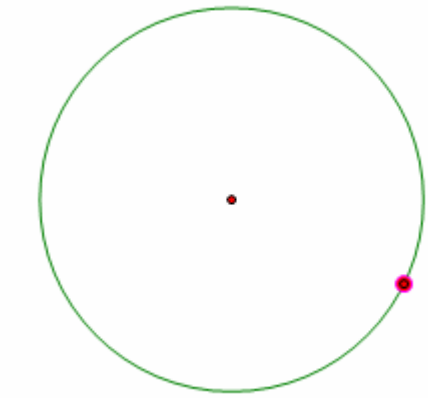
Construct the inner circle.

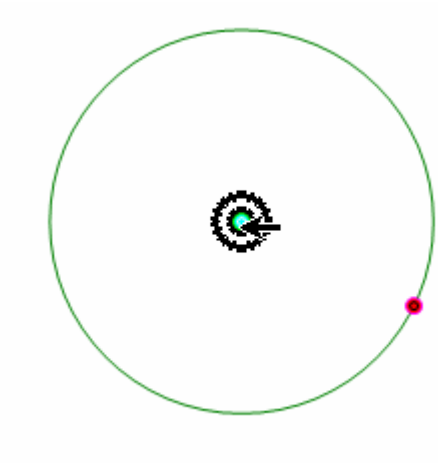
Since there are 12 congruent spokes in the rose, we can use 30 degree rotations in our construction.

Angle Construction

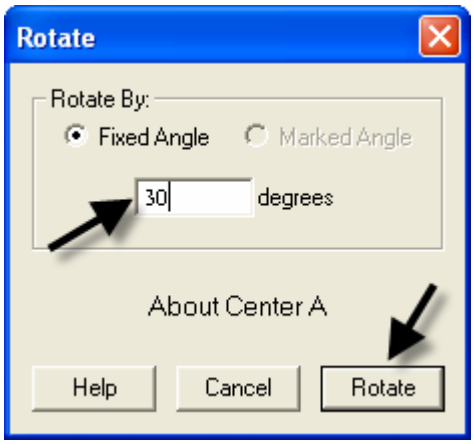
Construct a 30^{o} angle by rotating a point on the circle.

Highlight the point on the circle, then double click the center of the circle to mark the angle of rotation. You will see concentric circles radiating from the center as it is marked.

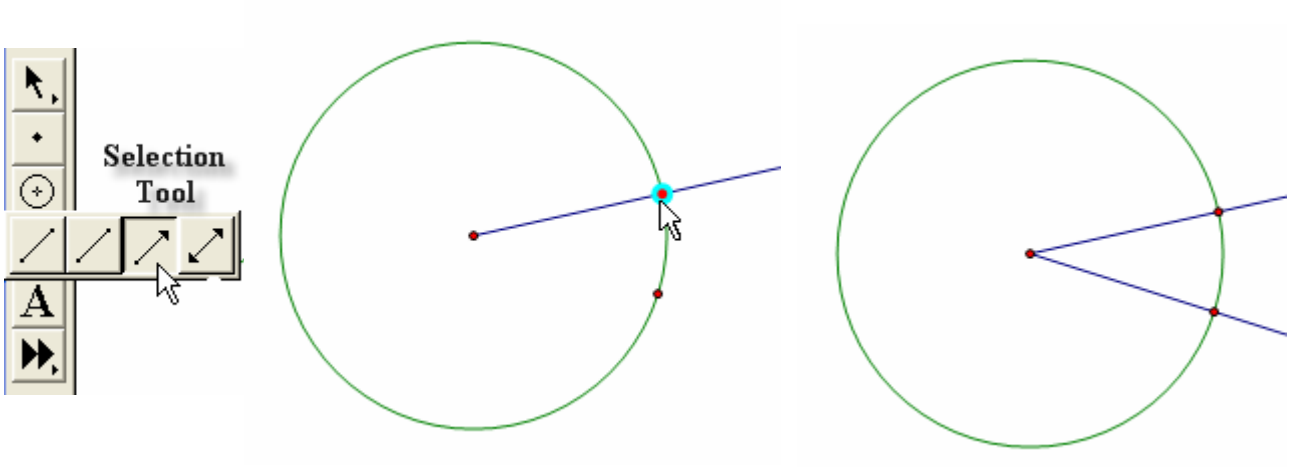




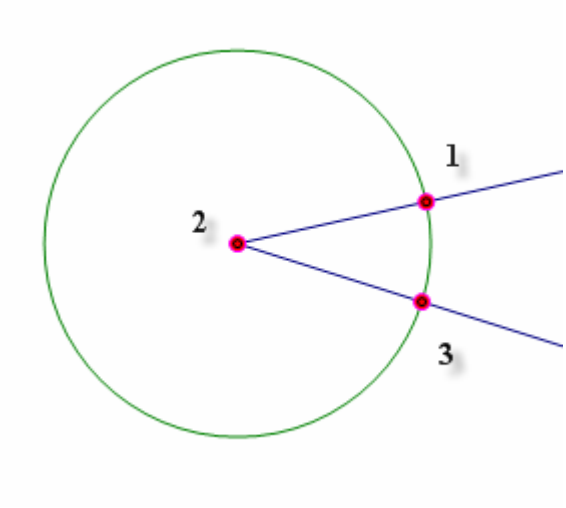
Use **Transform** from the menu bar with the **Rotate** option to rotate. Enter 30^{o} in the window when the box pops up and click on **Rotate**.

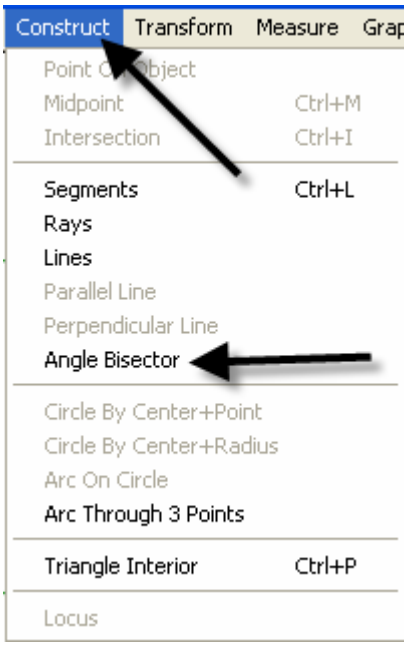


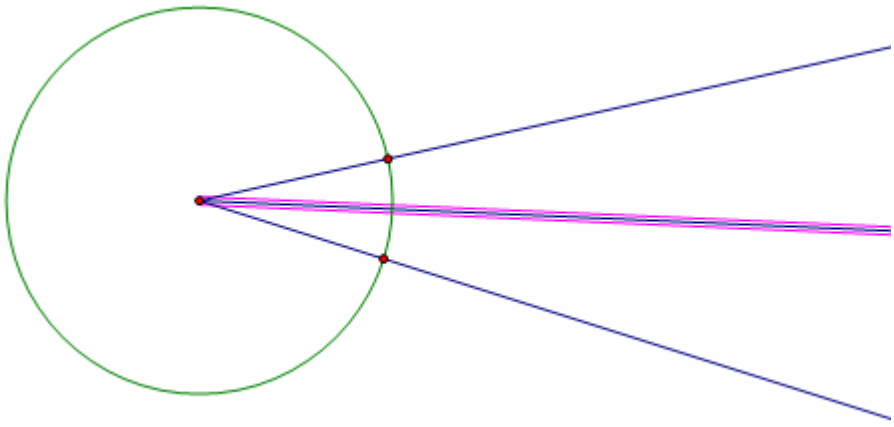
Construct an angle from the center of the circle through each point on the circle. Using the **Straightedge** tool, select the **Ray** option. Click on the center of the circle to attach the endpoint, and then line up the point of the ray on top of the point on the circle. Repeat for the second ray.

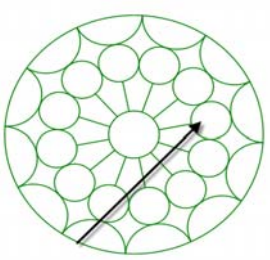


Construct the angle bisector by first selecting the three points of the angle, then using **Construct** from the menu bar with the **Angle Bisector** option.



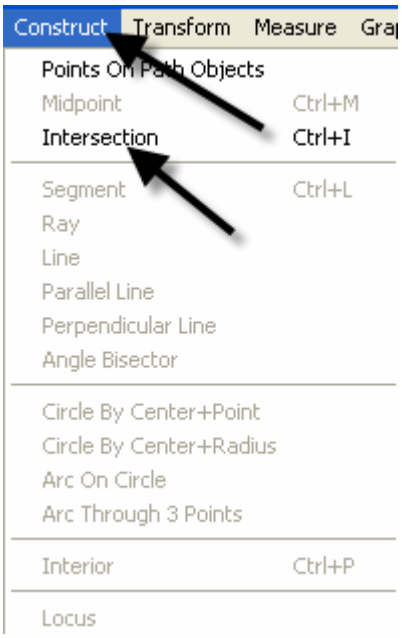


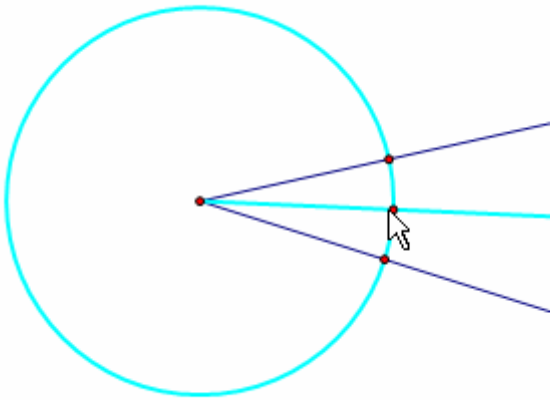




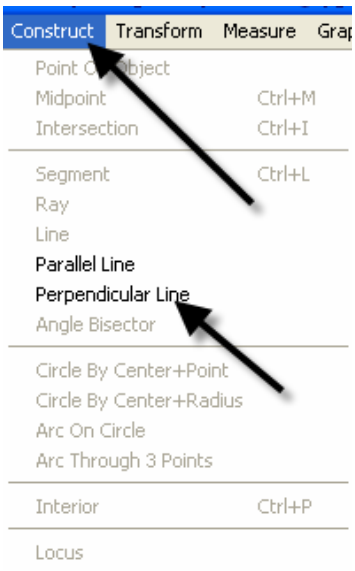
We can find the center of the small circle by reflecting the original circle over a line perpendicular to the angle bisector.

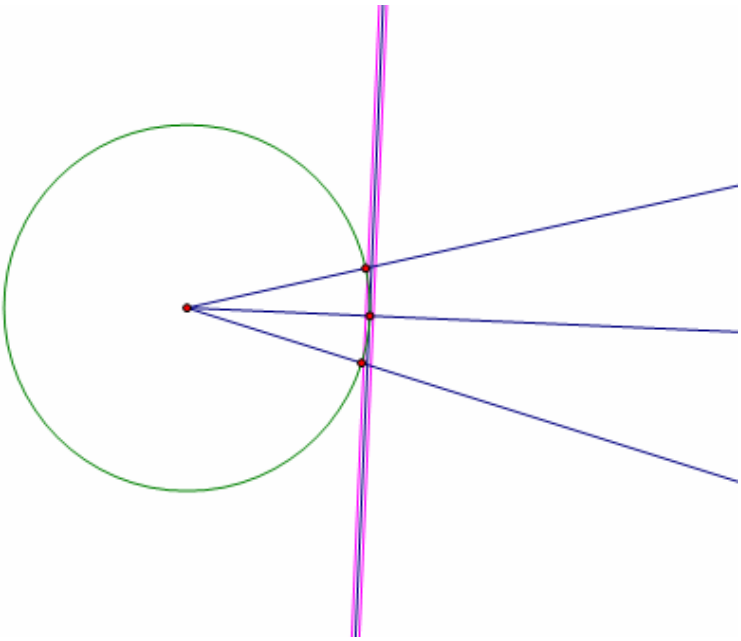
Construct a point where the angle bisector intersects the circle, either by selecting the angle bisector and the circle, then using **Construct** from the menu bar with **Intersection** option or by using the **Point** tool and placing the point on the intersection (You will know you are on the intersection when both the circle and the angle bisector change color.)



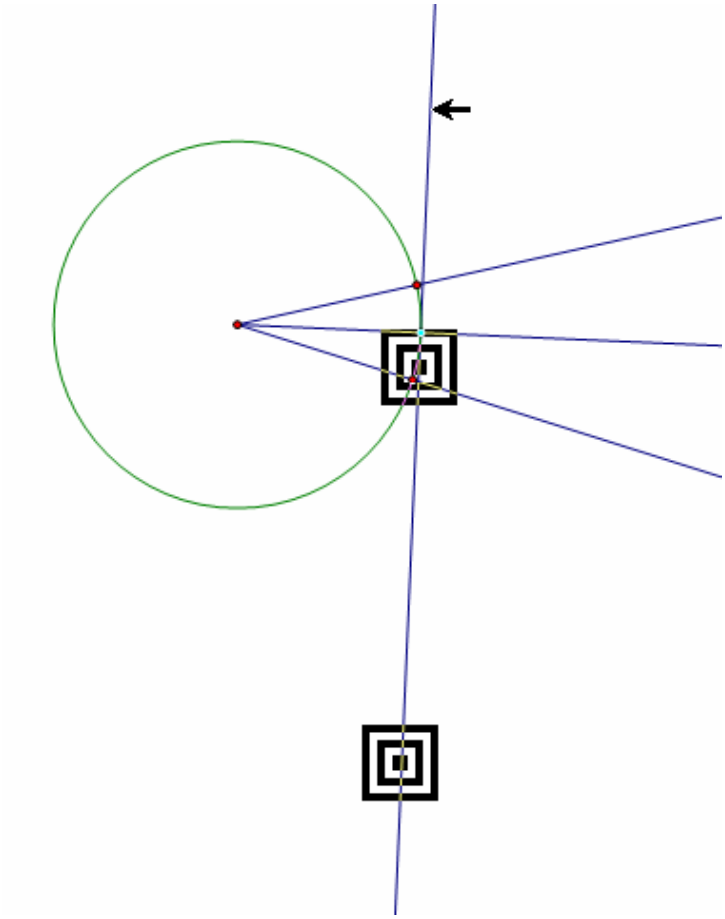


Construct a tangent to the circle through the point of intersection of the circle and the angle bisector by first selecting the point of intersection and the angle bisector, then using **Construct** from the menu bar with the **Perpendicular Line** option.

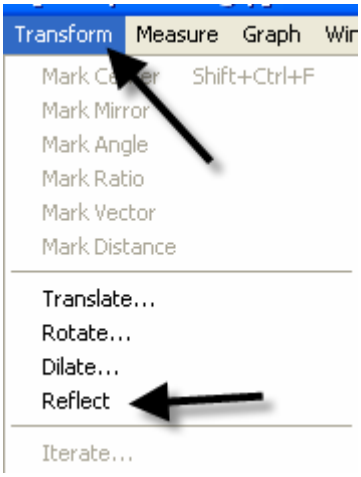


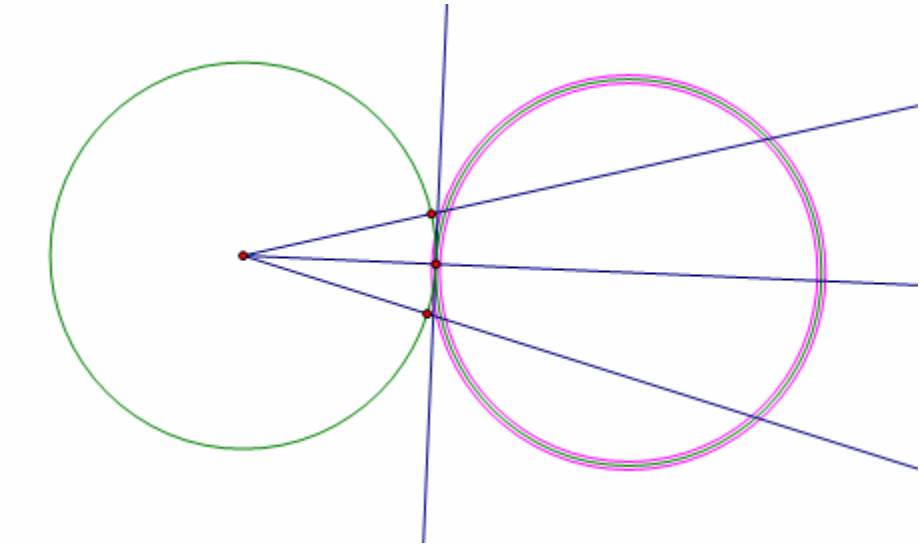


Mark the tangent line as a line of reflection by double clicking on the line. You will see a double set of concentric boxes flash as the line is being marked.

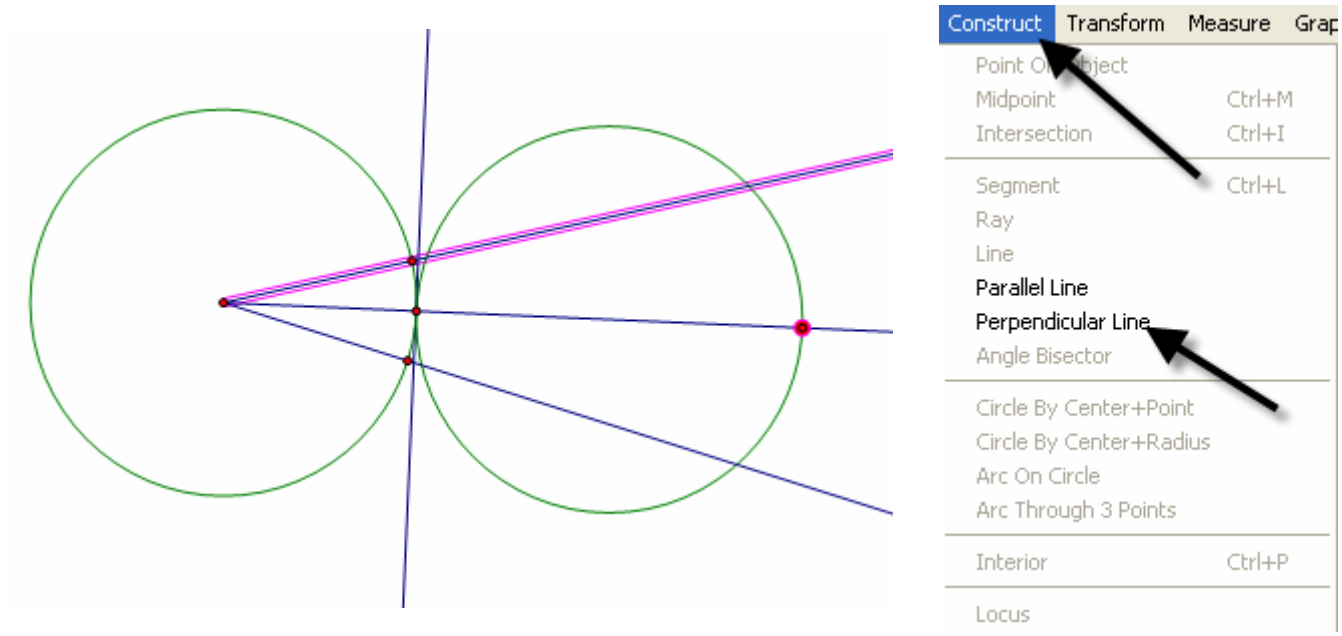


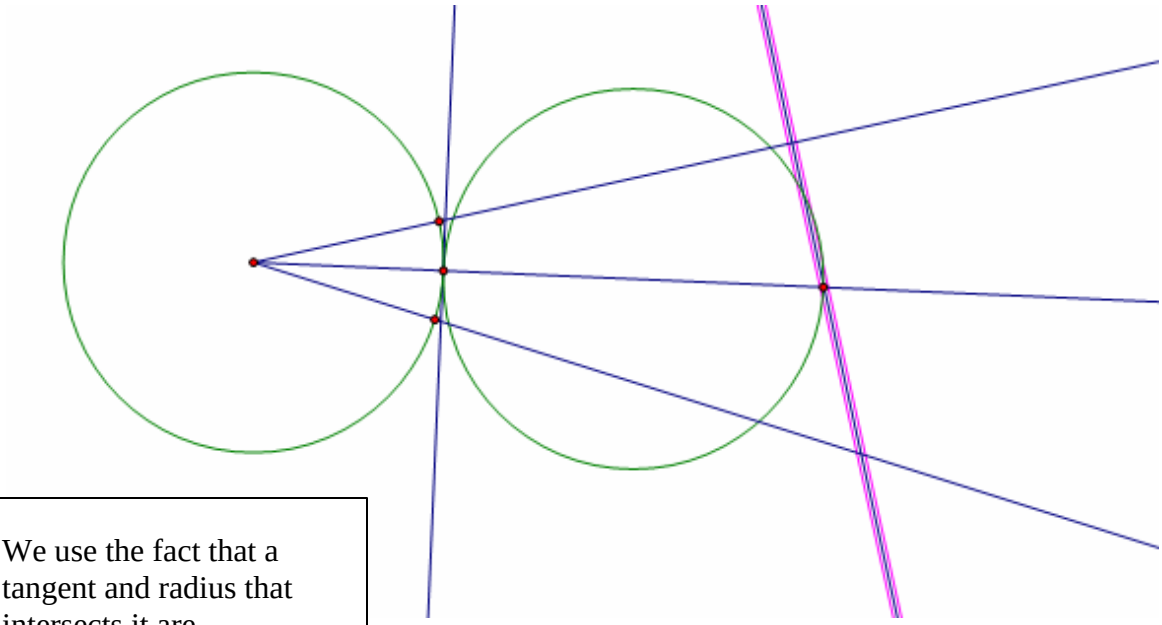
Reflect the circle across the line of reflection by selecting the circle and using **Transform** from the menu bar with the **Reflect** option.





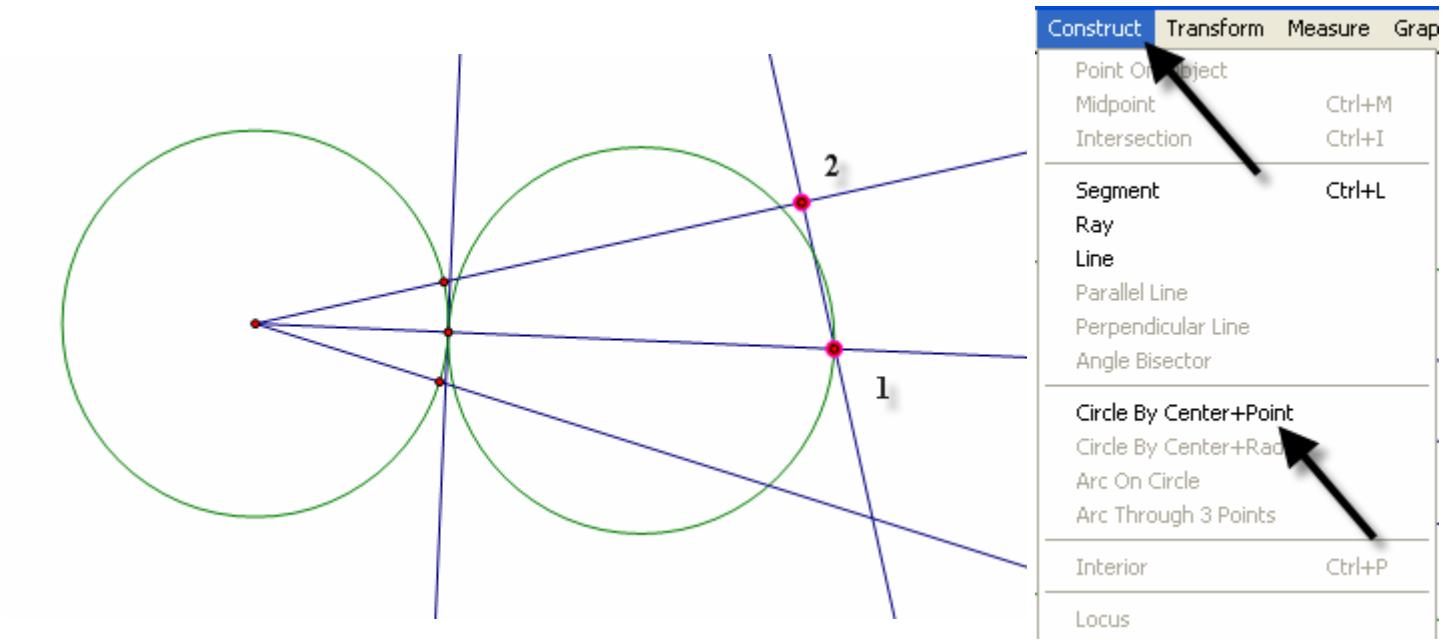
Construct the intersection of the angle bisector and the circle, then construct a line through it and perpendicular to one side of the angle. Select the point of intersection and the ray that forms one side of the angle, then use **Construct** from the menu bar with the **Perpendicular Line** option.

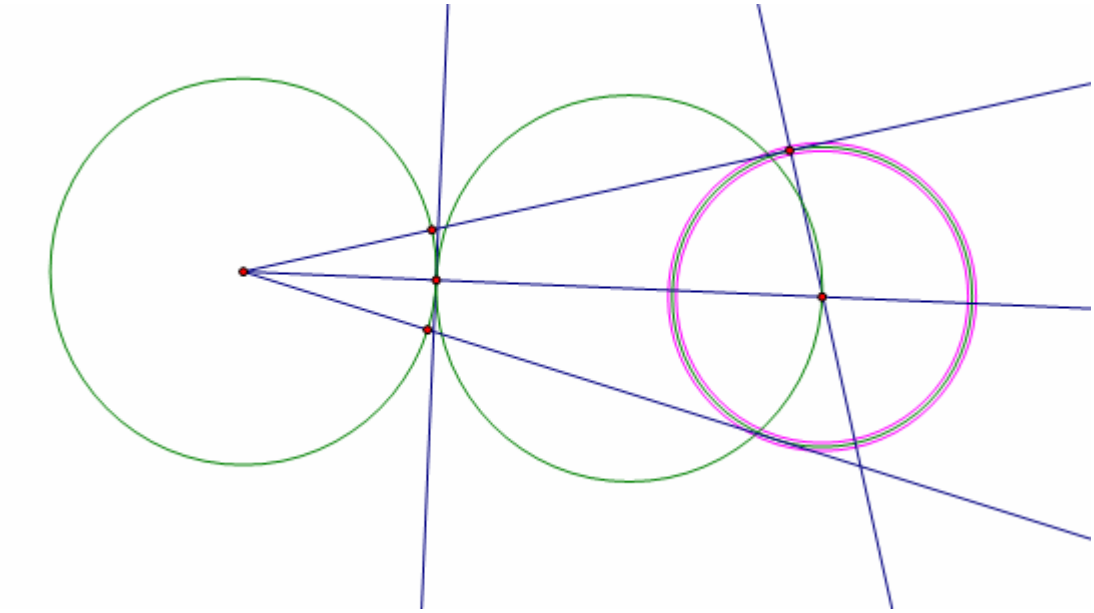




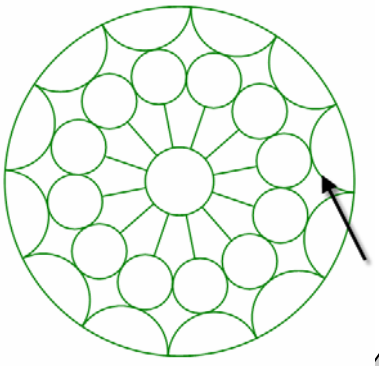
We use the fact that a tangent and radius that intersects it are perpendicular to construct a circle tangent to the rays.

Construct the point of intersection with the new perpendicular line and the side of the angle. Select the points in the order shown below. Use **Construct** from the menu bar with the **Circle By Center+Point**.

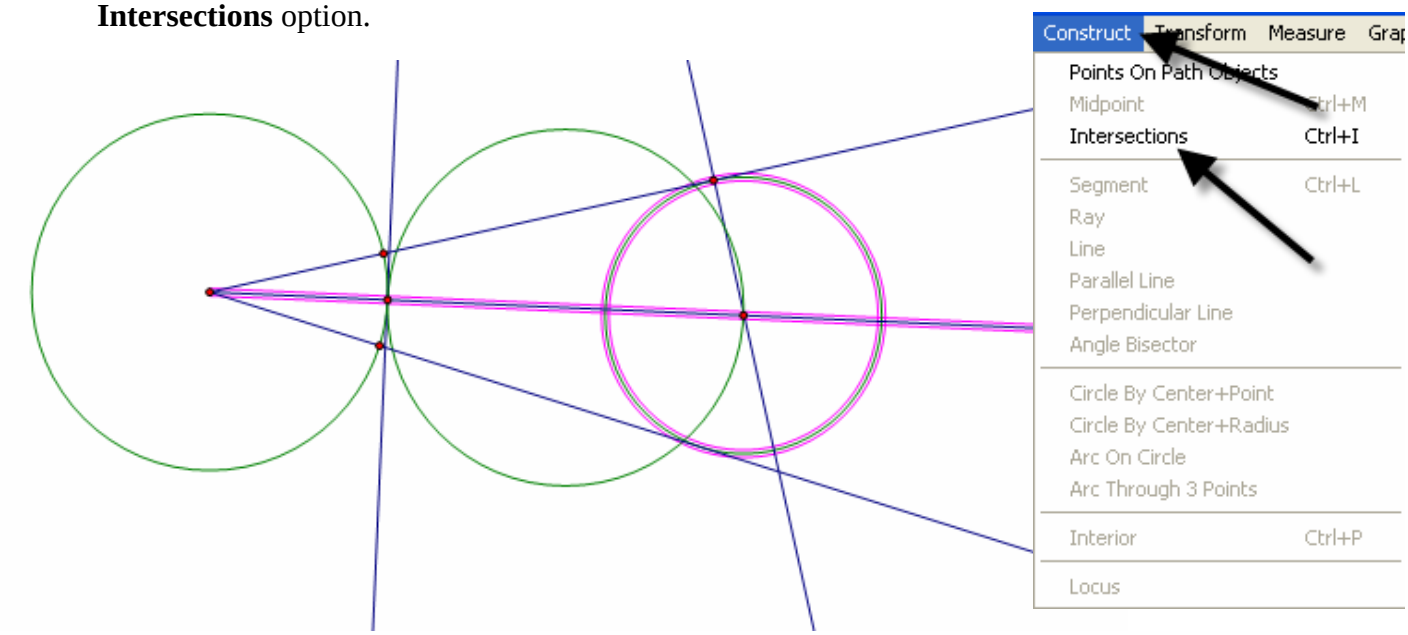


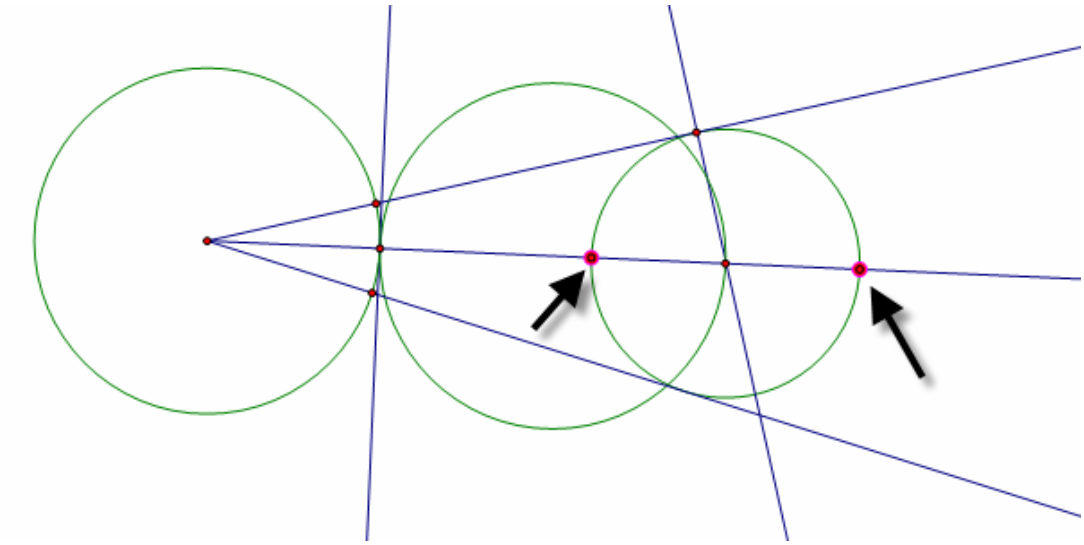


We need to construct an arc that is tangent to the rays that form the angle as well as tangent to the small circle. We will use proportional reasoning to determine the center of the circle the arc lies on.

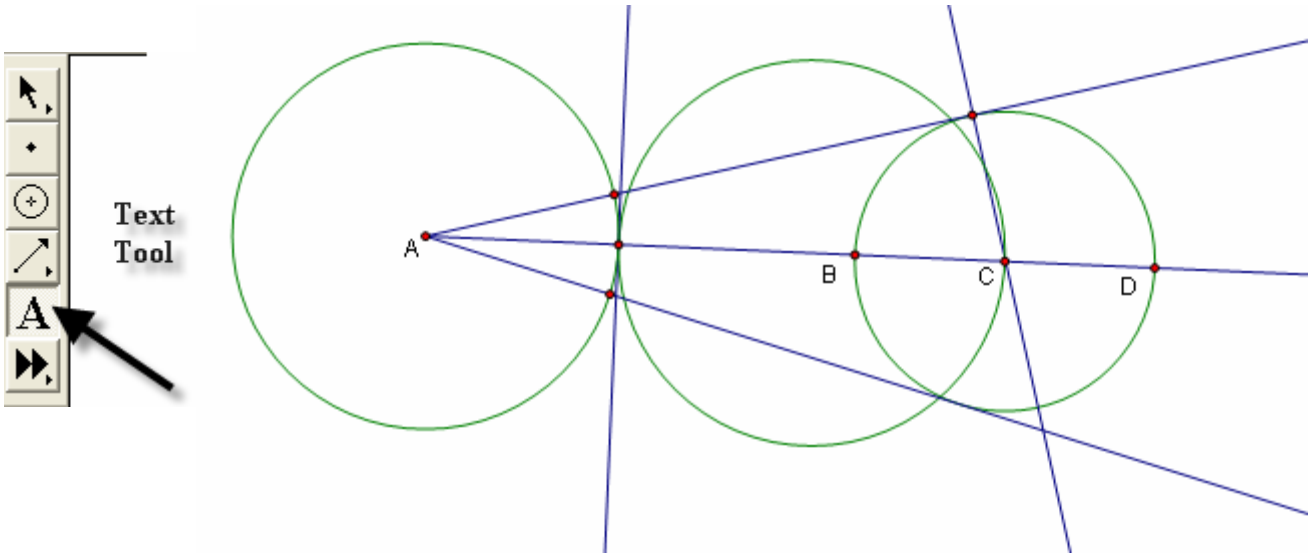


Construct the intersection of the small circle with the angle bisector by first selecting the circle and the angle bisector, then using **Construct** from the menu bar with the **Intersections** option.

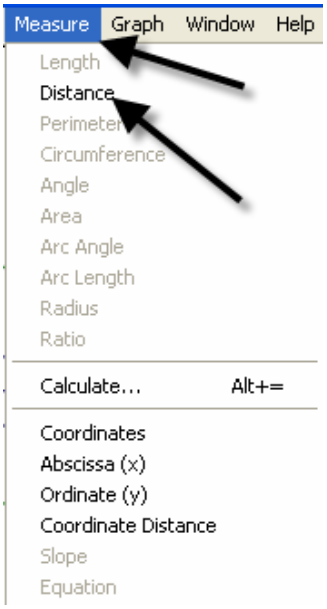


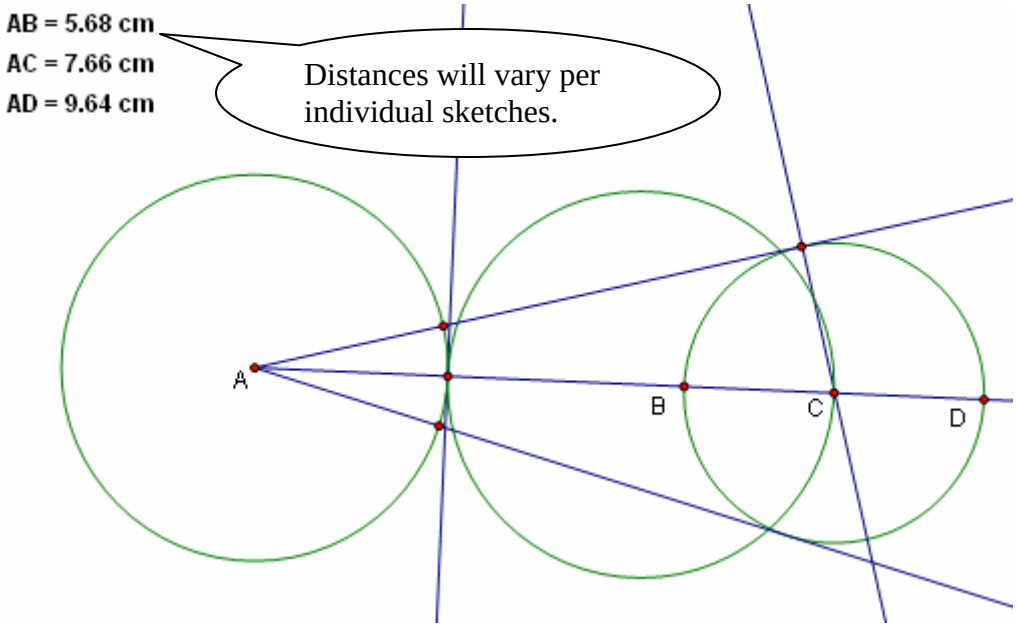


To use points to set up measures to use in the proportion, label points with the **Text** tool according to the sketch below.

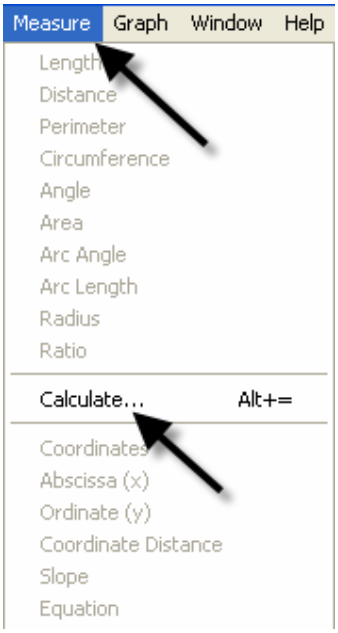


To set up the proportion, measure the following distances AB, AC and AD by selecting the endpoints of the segments and using **Measure** from the menu bar with the **Distance** option. The center of circle that will be tangent to the sides of the angle and tangent to the small circle at point D will have a proportional distance from A based on the following proportion: $\frac{AB}{AD} = \frac{AC}{Ax}$ which can be rewritten as $Ax = \frac{AC \cdot AD}{AB}$.

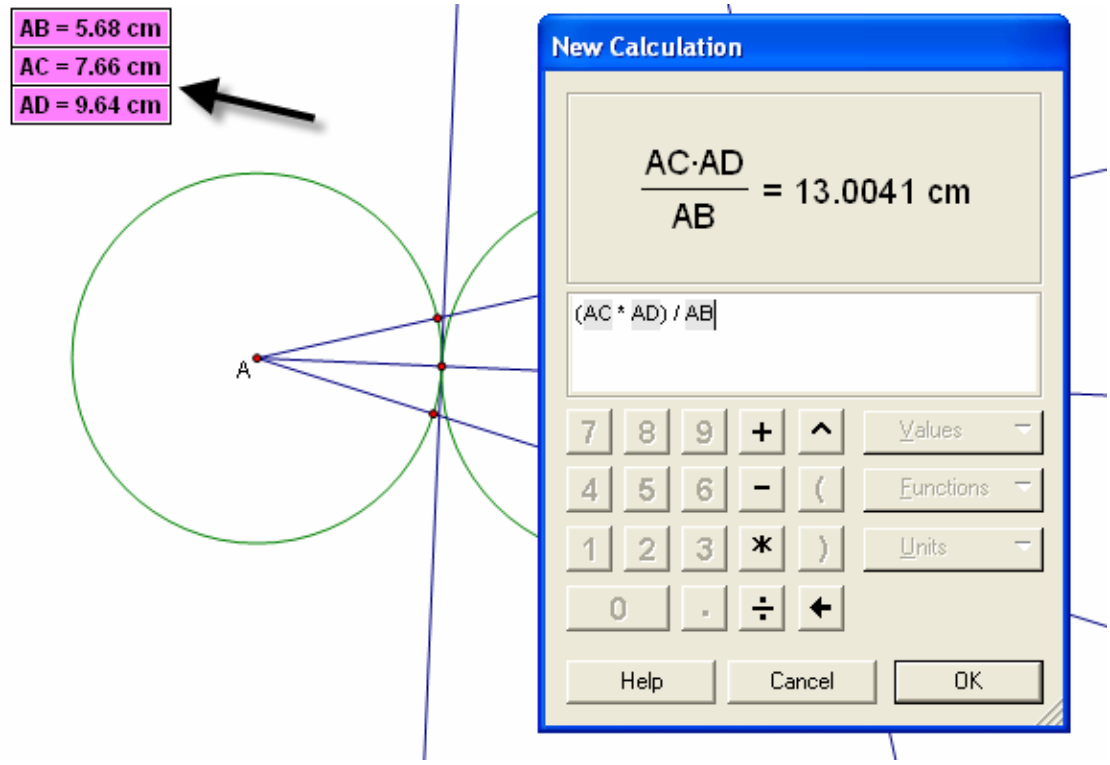




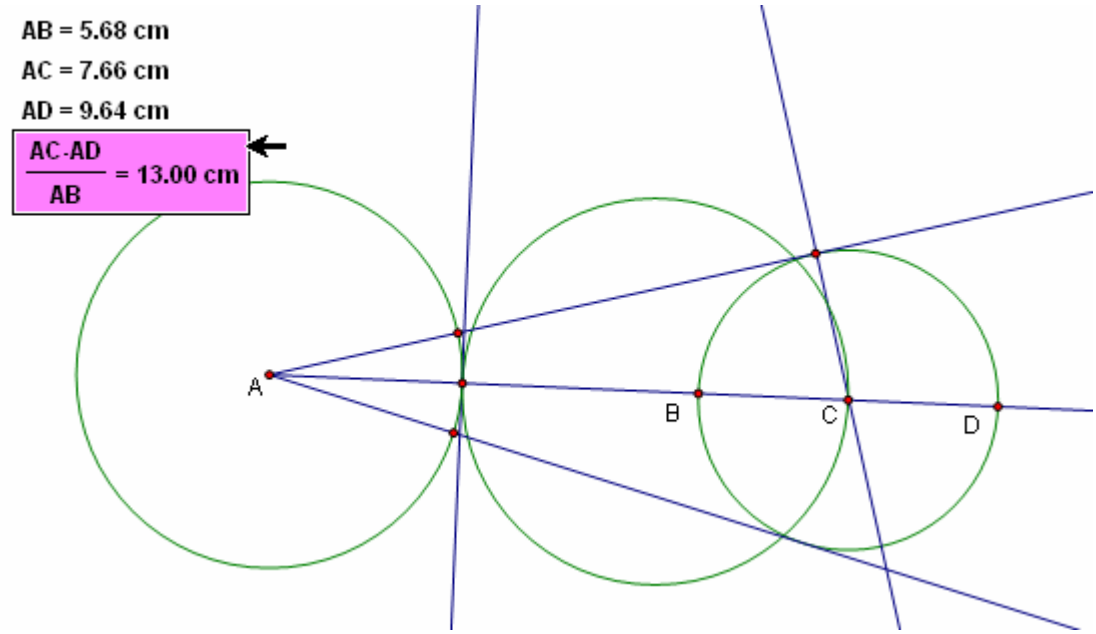
Use **Measure** from the menu bar with the **Calculate** option to compute the distance from A to the center of the new circle, $Ax = \frac{AC \cdot AD}{AB}$.



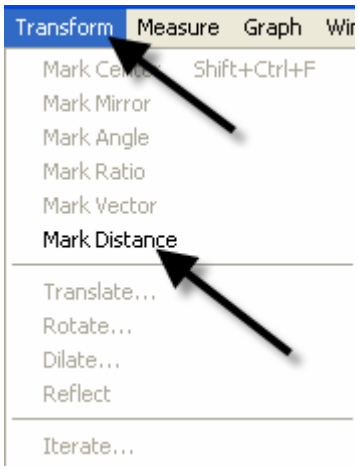
Click on the desired measure to enter the values in the calculator, then click **OK**.



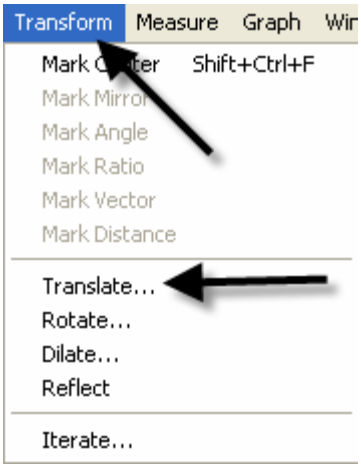
Select the solution for the distance of the new center from ***A***.

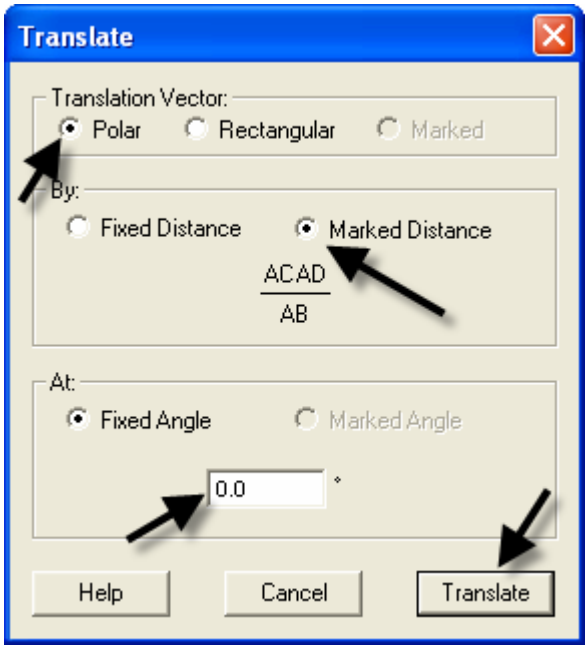


Use **Transform** from the menu bar with the **Mark Distance** option. The highlighted box with the solution in it will flash as it marked.

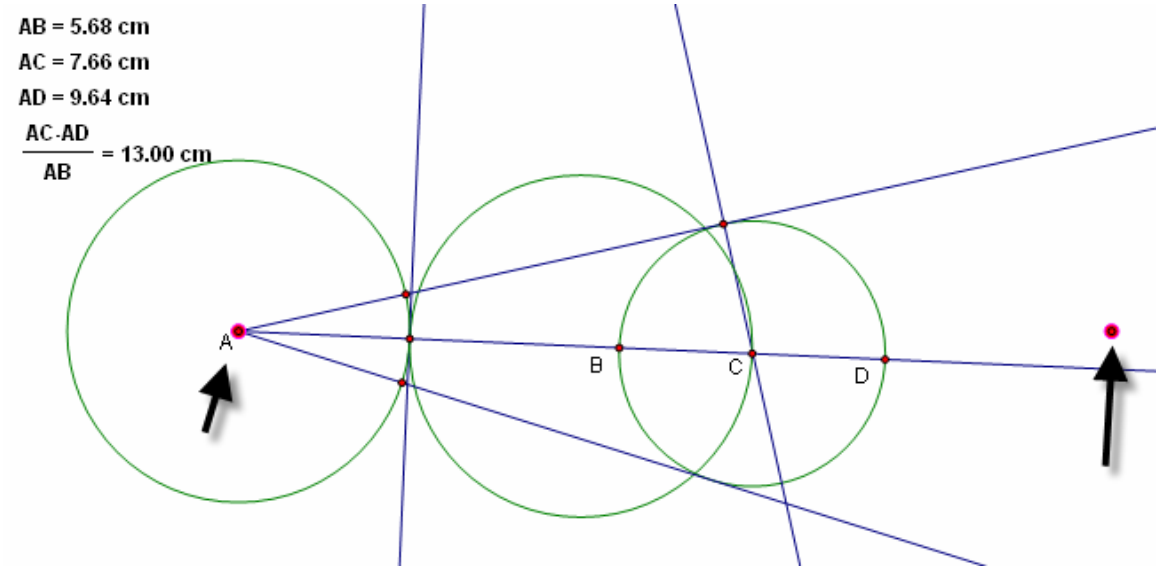


Select point ***A*** and use **Transform** from the menu bar with the **Translate** option. A pop-up box will appear that will allow you to select the following options.

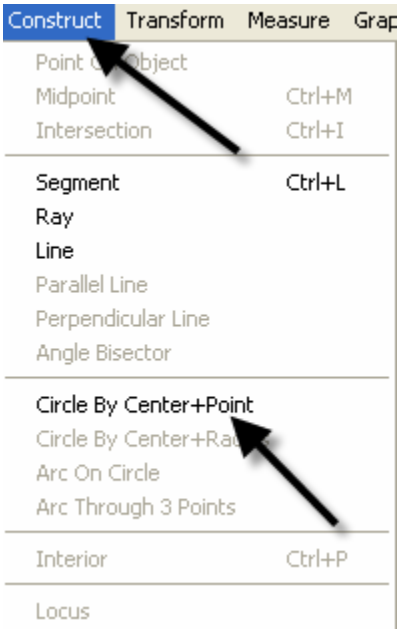




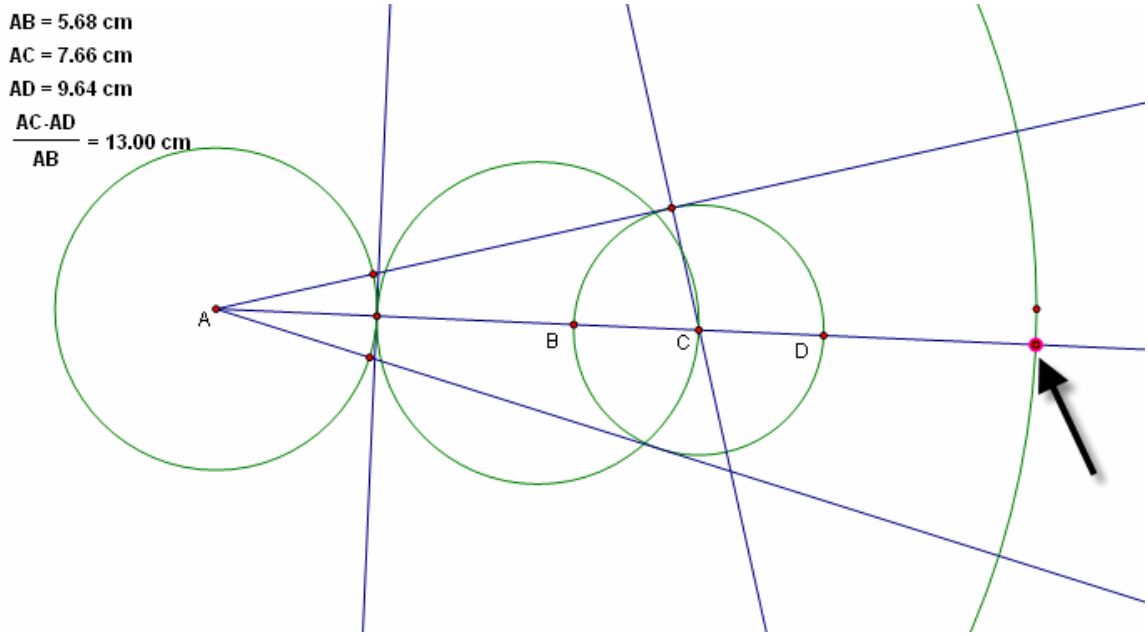
A new point will appear in the blank space of the sketch. In order, select point A followed by the newly translated point.



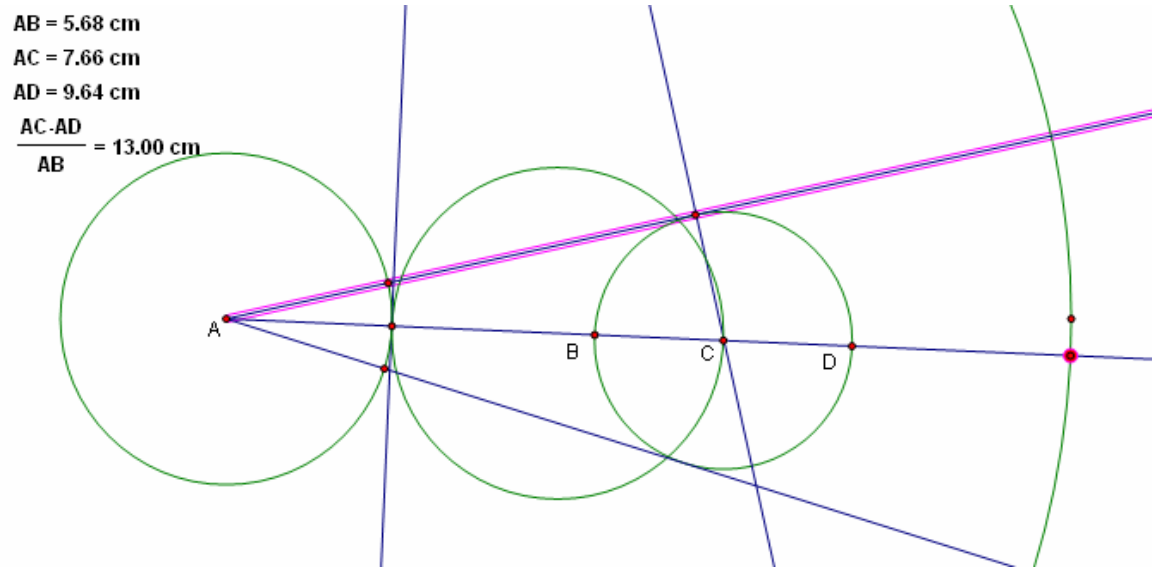
Use **Construct** from the menu bar with **Circle By Center+Point**.

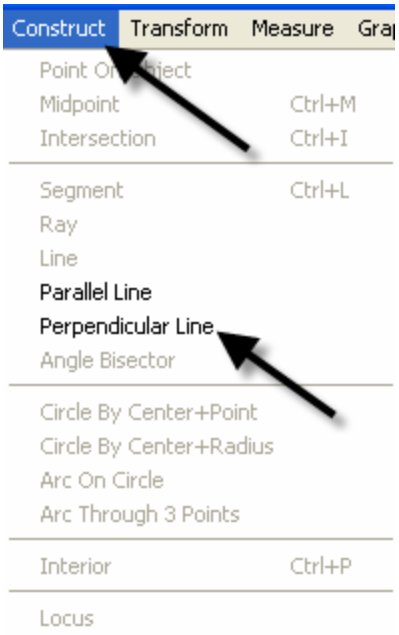


This will create a large circle whose point of intersection with the angle bisector will be the center of the new circle. Construct the intersection.

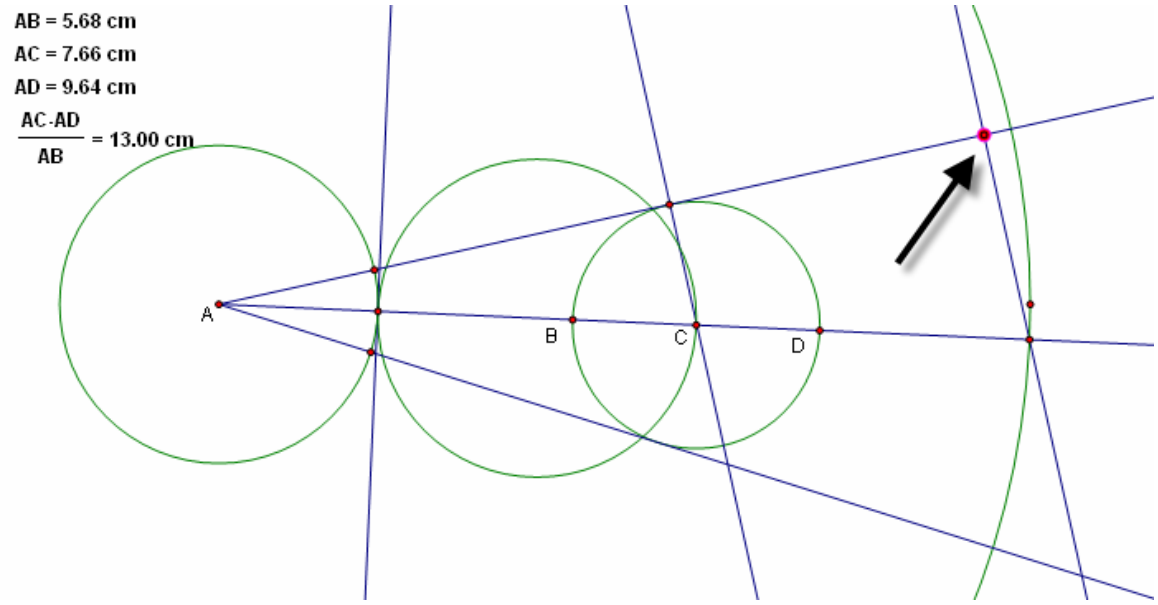


To find the radius of the circle, highlight the new point and the ray that makes the side of the angle. Then use **Construct** from the menu bar with the **Perpendicular Line** option.

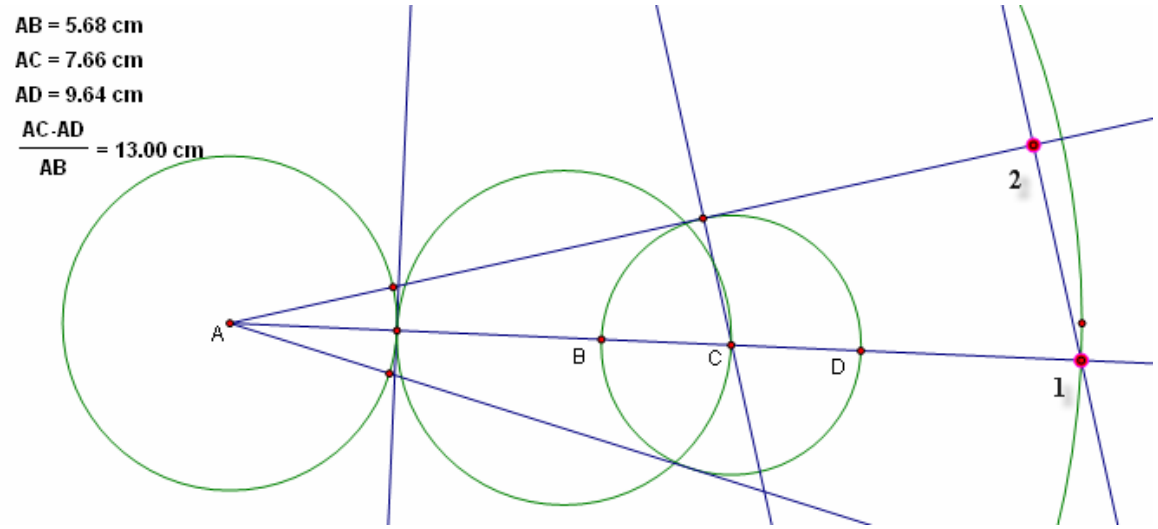


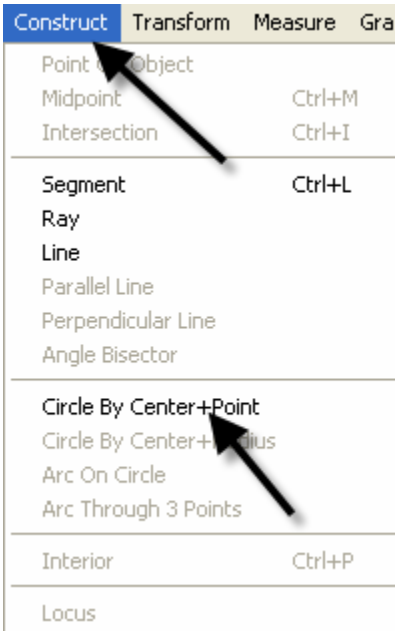


Construct a point of intersection where the new perpendicular line intersects with the side of the angle, then deselect it.

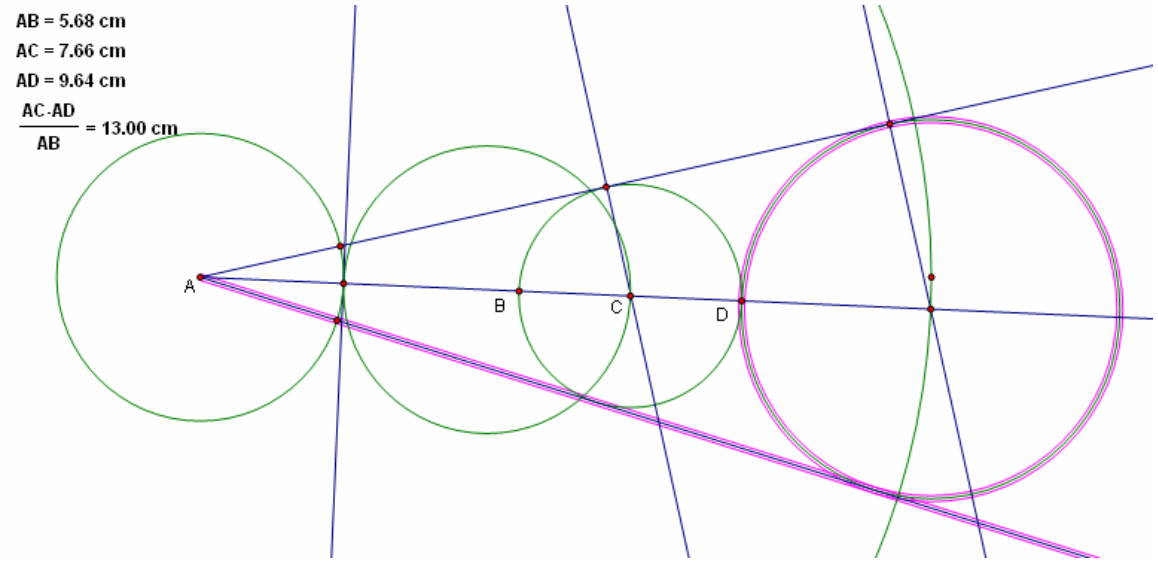


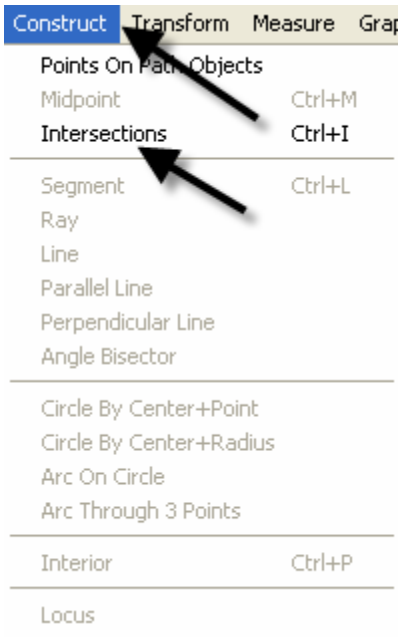
In order, select the new center point and the new point of intersection (see picture) and use **Construct** from the menu bar with the **Circle By Center+Point** option.



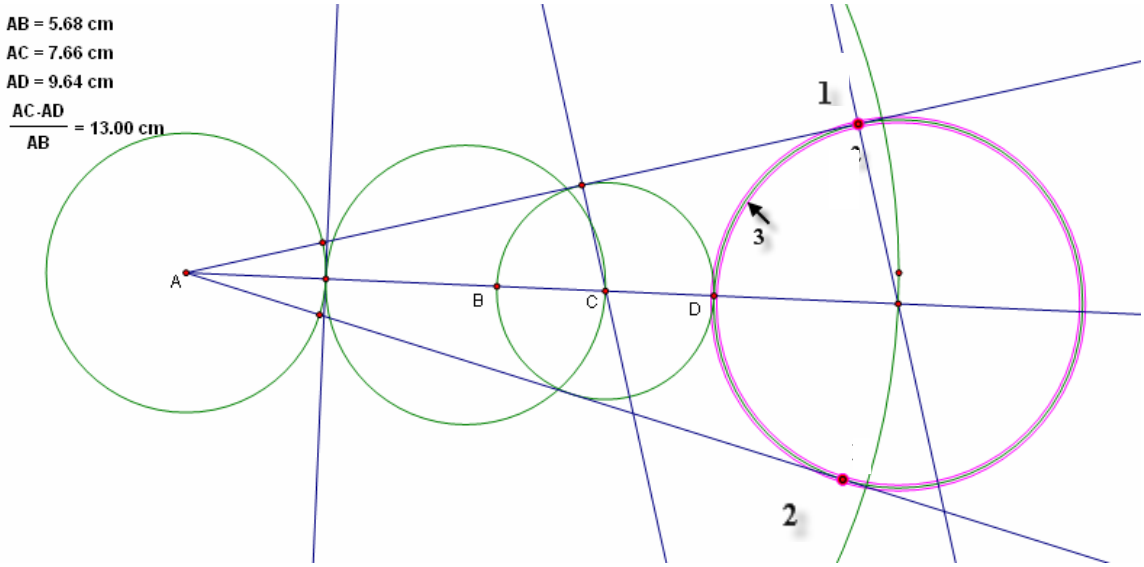


Select the new circle and the other ray that forms the angle. Use **Construct** from the menu bar with the **Intersection** option to create a point of tangency.

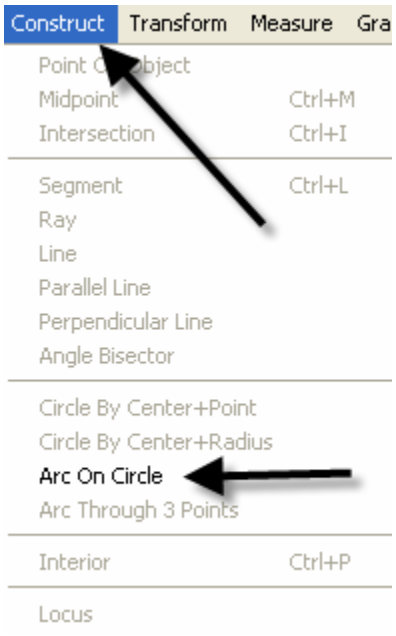


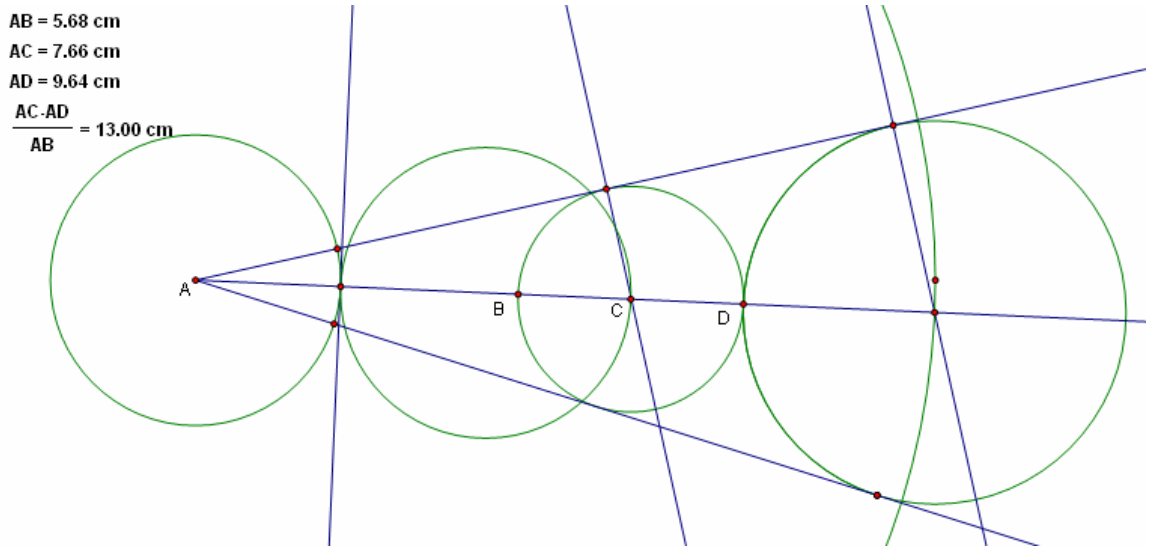


Construct the arc by selecting the points in a counter clockwise order, then selecting the circle.

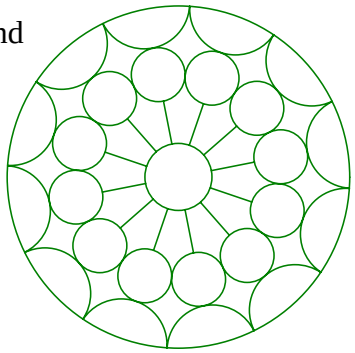


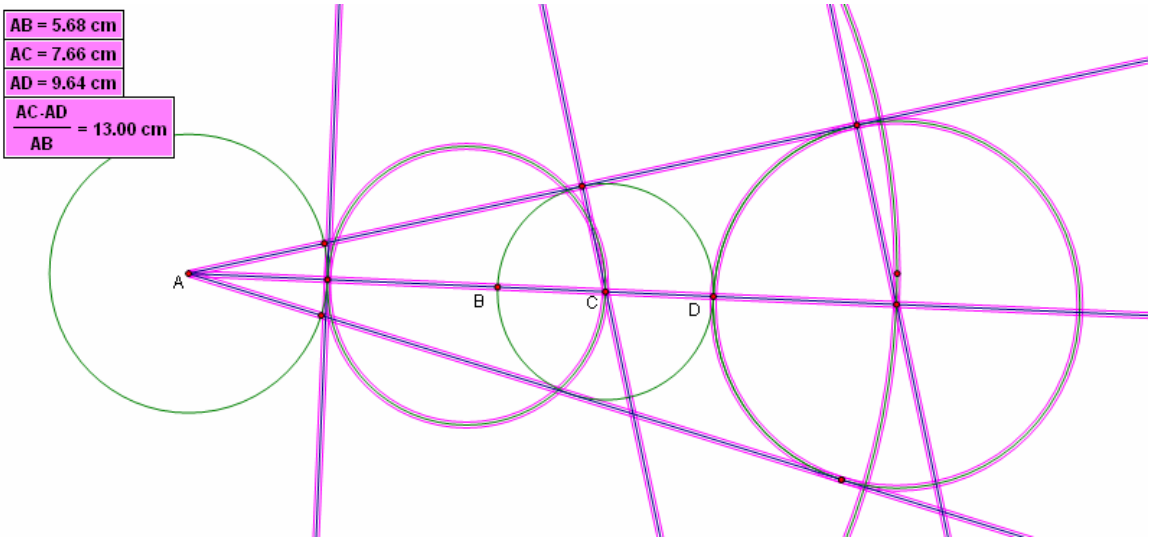
Next use **Construct** from the menu bar with the **Arc on a Circle** option.

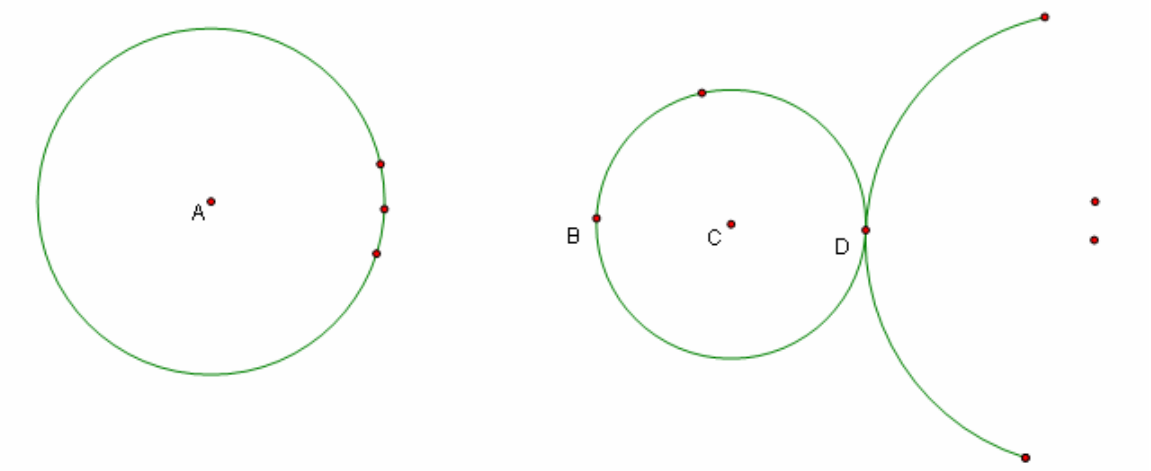




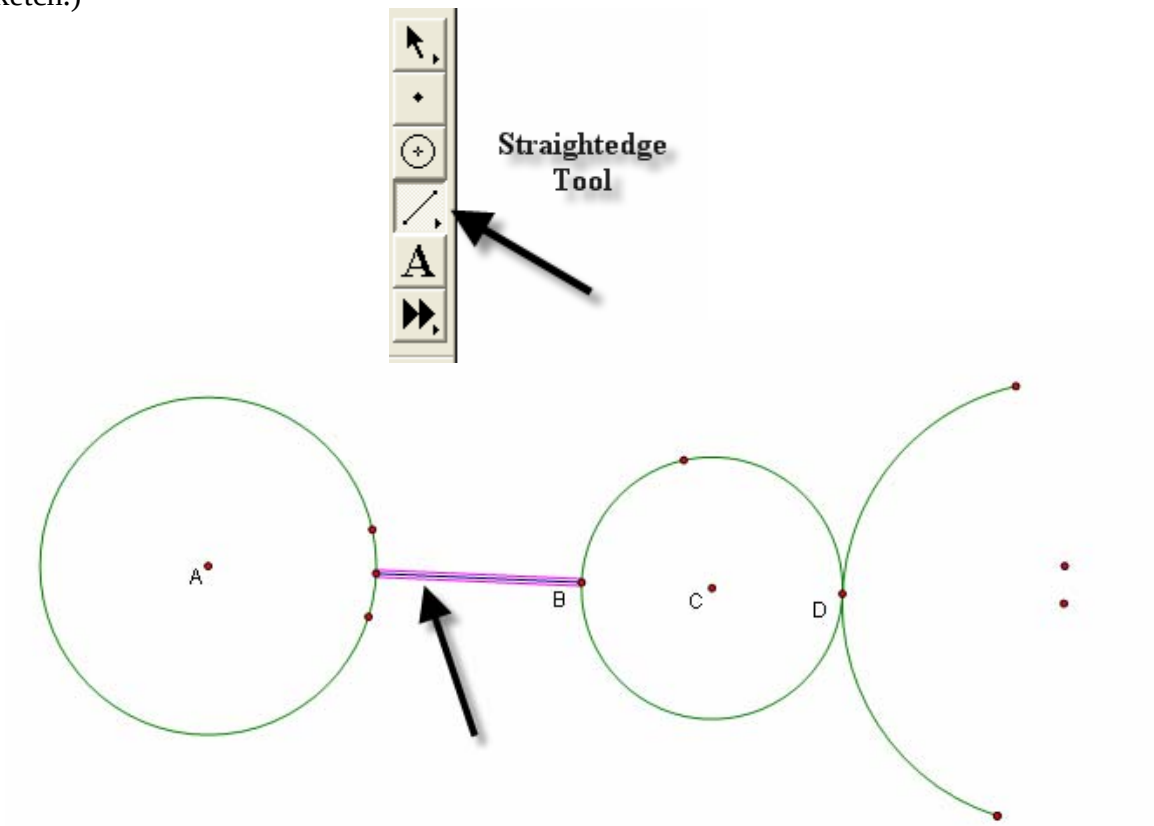
Hide all undesired parts of the construction by selecting them and using **Display** from the menu bar with the **Hide Path Objects** option.



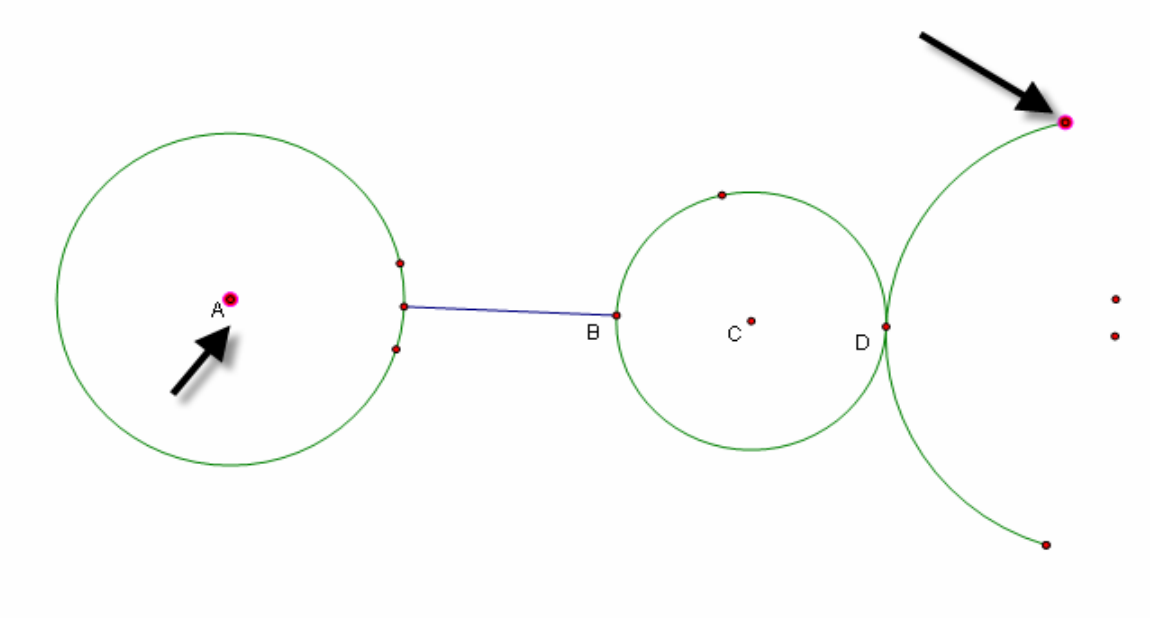


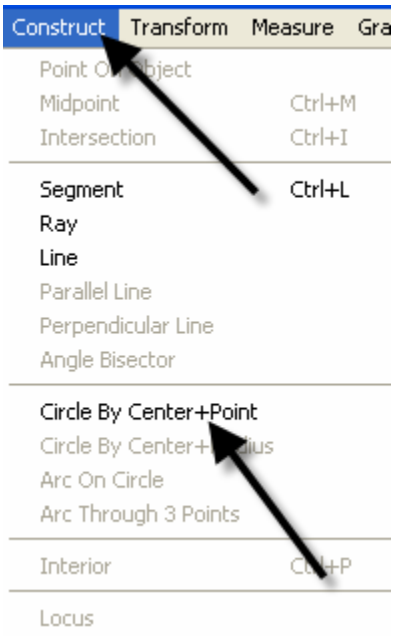


With the Straightedge Tool, construct a segment from the original circle to point ***B*** (See sketch.)

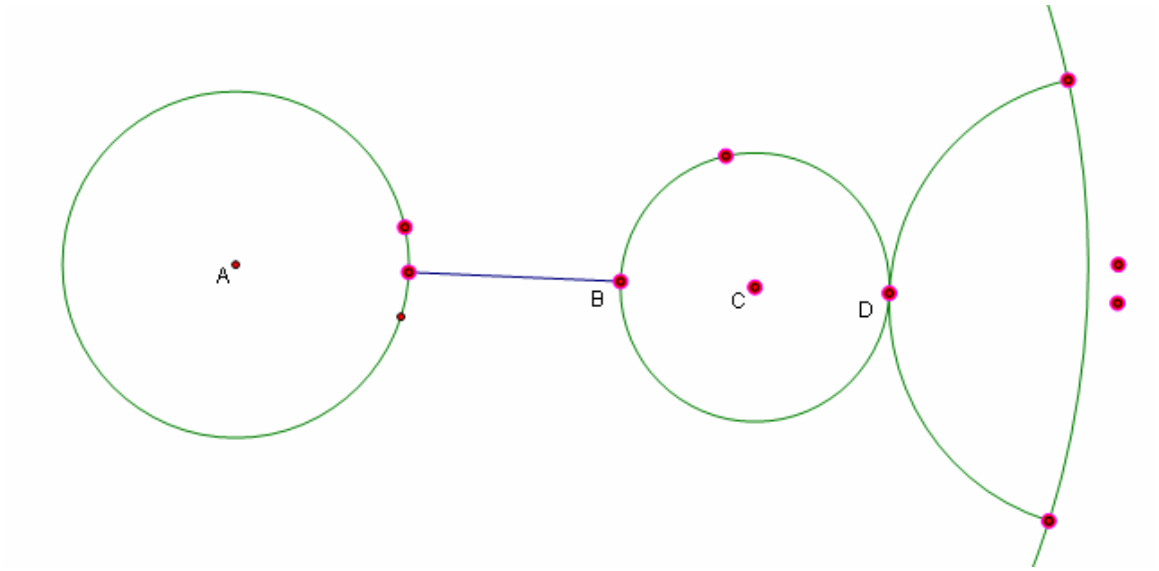


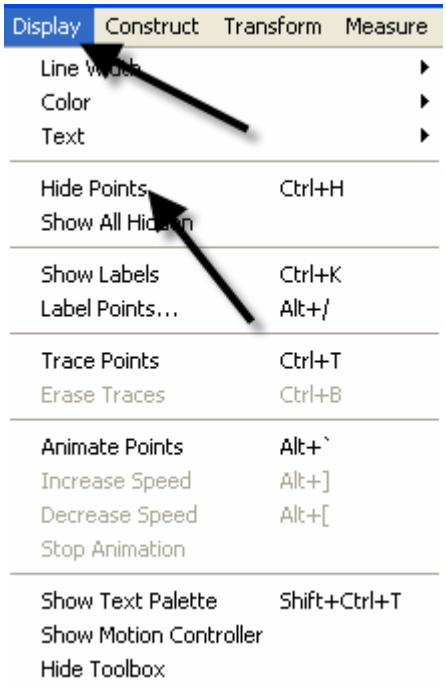
Select point ***A*** and one of the endpoints of the arc and use **Construct** from the menu bar with **Circle By Center+Point**.



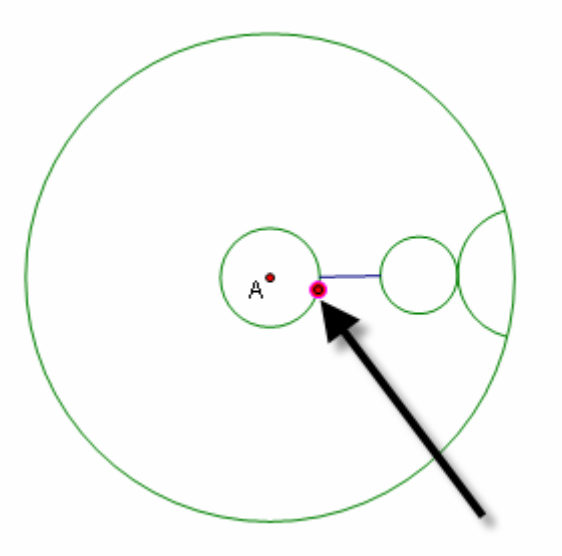


Hide the unnecessary points by first selecting them, then use Display from the menu bar with the **Hide Points** option.

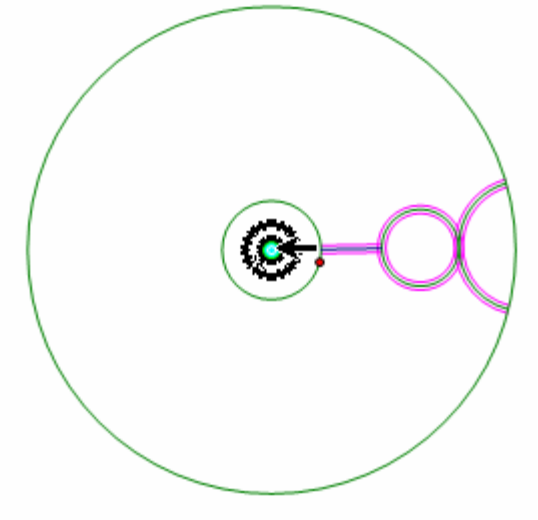




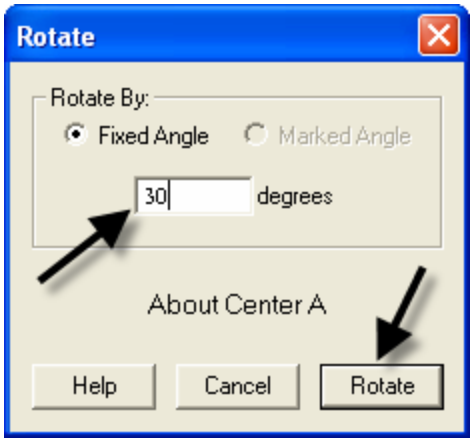
Shrink the construction by selecting the control point on circle ***A*** and moving it toward the center.

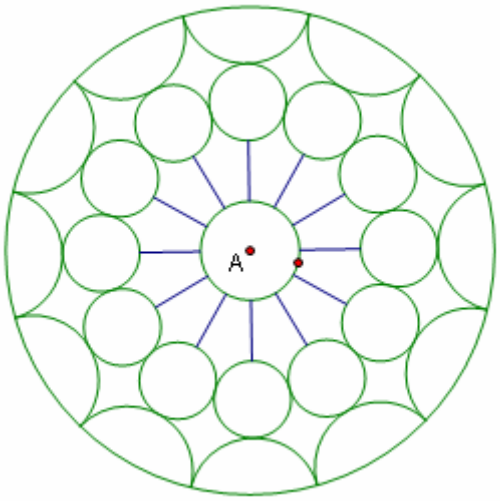


To rotate the construction around the circle, select the arc, small circle and segment. Double click on point ***A*** to mark the center of rotation. There will be concentric circles radiating out from point ***A*** as it is marked. Use **Transform** from the menu bar with the **Rotate** option.



A pop-up window will appear that will allow 30^{o} to be entered in the window. Then select Rotate. Repeat the rotation until the construction is complete.





Hide point A if desired, but leave the control point for adjusting the size of the construction. If you want, you can select the entire construction and adjust the line thickness and color using **Display** from the menu bar with **Line Width/Thick** option, then **Display** with the **Color** option.