

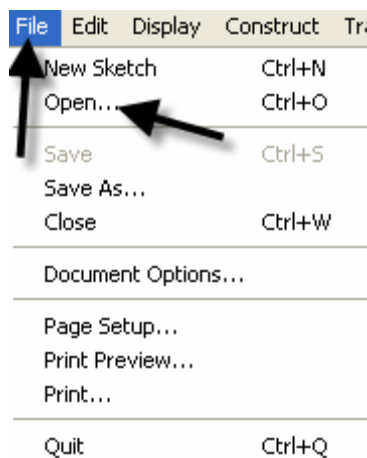
Geometer's Sketchpad—Techno Polly

Opening an Existing Sketch

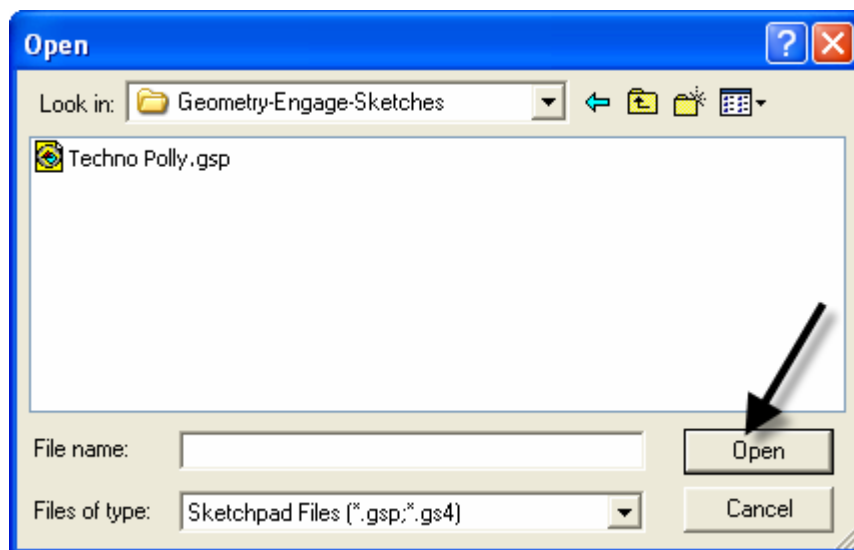
1. To open an **existing sketch** in Geometer's Sketchpad, first click on the icon on your desktop then when the program opens click on **File, Open**.



GSP 4.06.lnk

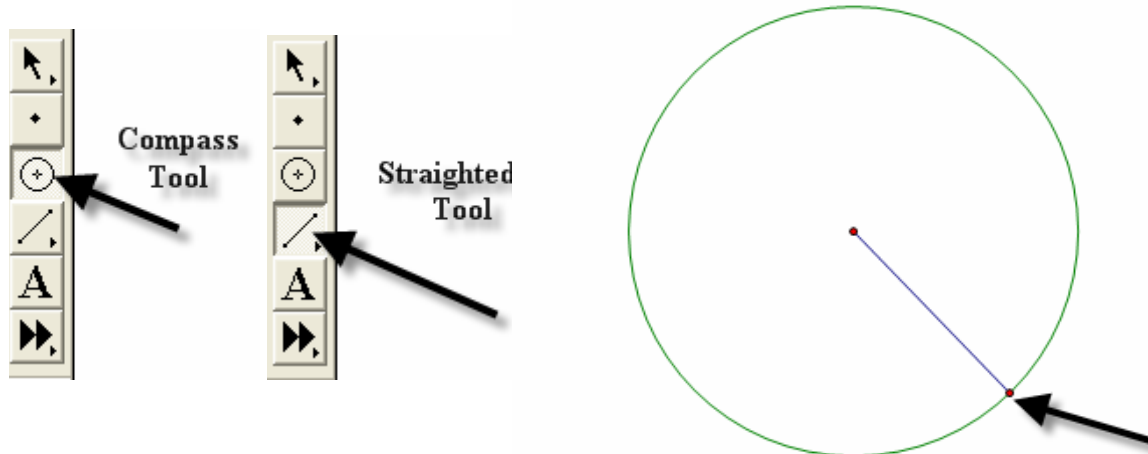


2. A pop-up window will appear. Follow the directions for your particular computer system to get to the file where the existing sketches are stored. Select the desired file by clicking on it, then click the **Open** button.

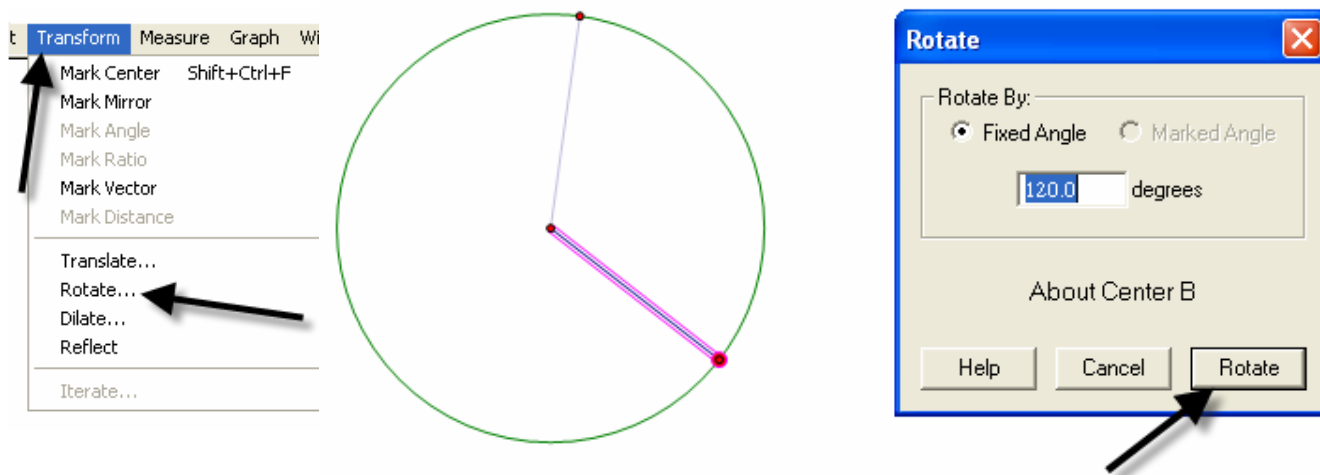


Polygarden Landscaping Company Equilateral Triangle with Graph

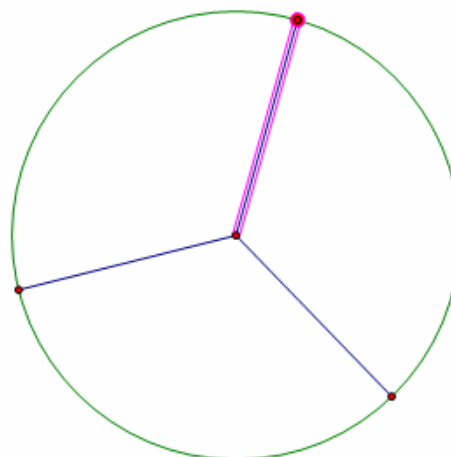
Using the **Compass tool** and the **Straightedge tool**, construct a circle and its radius. Be sure the radius is attached to the point that is constructed on the side of the circle—this will later allow all vertices of the triangle to act as control points to adjust the size of triangle.



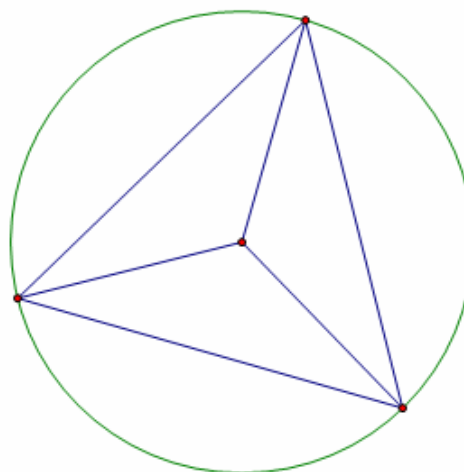
With the selection tool, highlight the radius and the point of intersection on the circle. Double click on the center point of the circle to mark it as a point of rotation. There will be a flash of concentric circles around the point as it is marked. From the Menu Bar use the **Transform** option and choose **Rotate**. A window will pop up with a box to enter the number of degrees of rotation desired. In this case enter 120 degrees, the number of degrees of the central angle of an equilateral triangle inscribed in a circle. Click the **Rotate** button to complete the rotation.



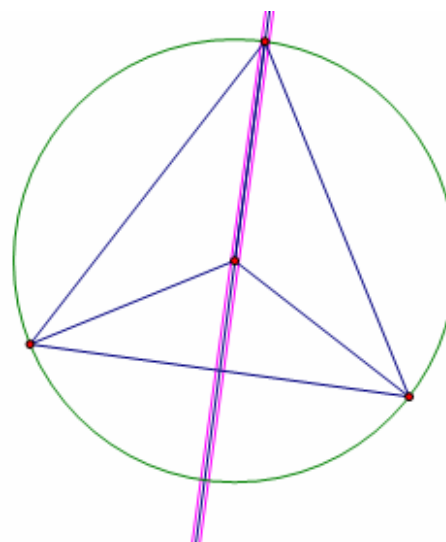
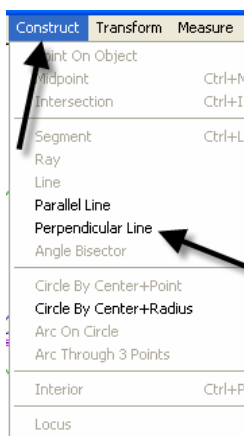
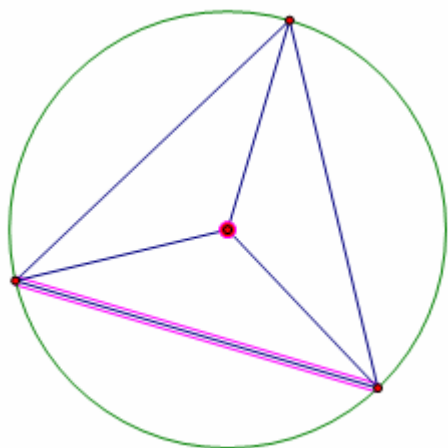
After the rotation, the new radius and its point of intersection are highlighted. The center point is still “marked” as the point of rotation. To rotate the radius, simply use the **Transform** and **Rotate** options again. The 120 degrees should still in the pop-up window; so to complete the rotation, click on the **Rotate** button.



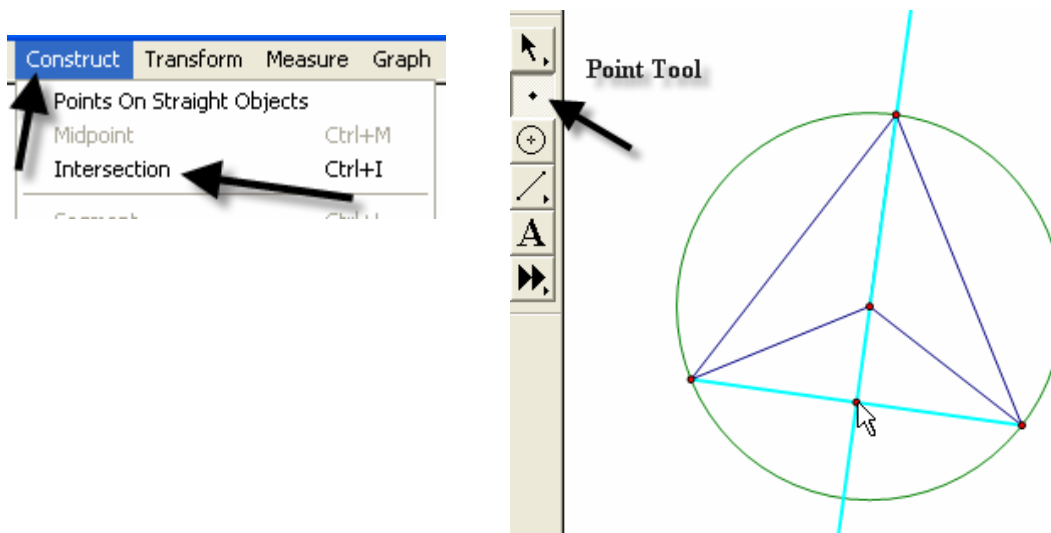
Use the **Segment** tool to connect the points on the circle forming the equilateral triangle.



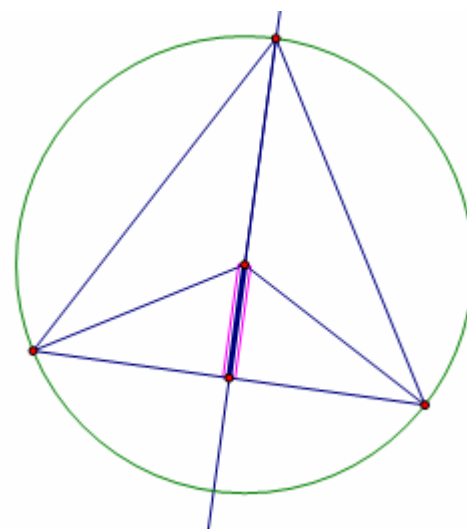
Construct a line perpendicular to one side of the triangle through the center by first highlighting the side and the center, then using the Construct and Perpendicular options from the Menu Bar.



Construct the point of intersection between the side of the triangle and its perpendicular either by using the **Point** tool and clicking at the intersection when both lines turn blue OR by highlighting the side and the perpendicular and using the **Construct** and **Intersection** options from the Menu Bar.



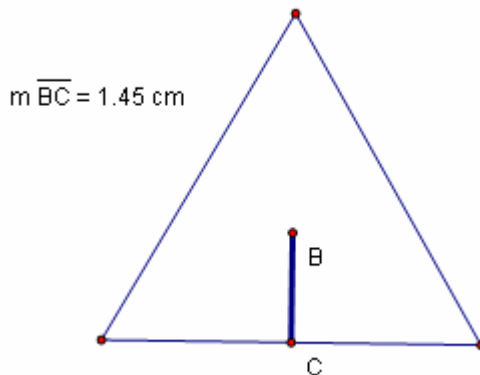
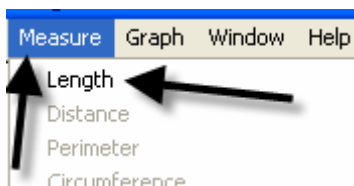
To construct the apothem, the only part of the perpendicular needed is the segment connecting the center to the side. Use the **Straightedge** tool to construct a segment (on top of the perpendicular line) that joins the two points.



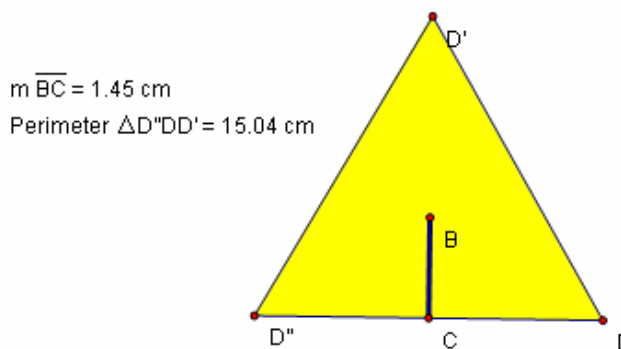
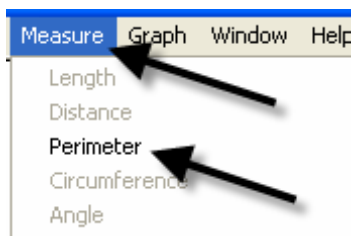
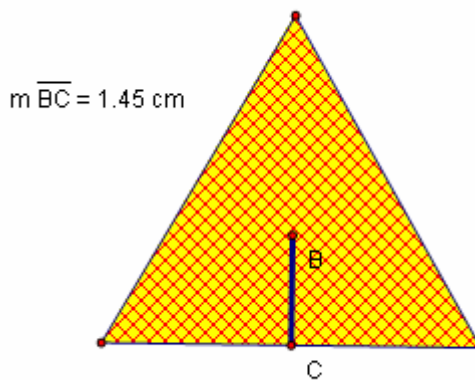
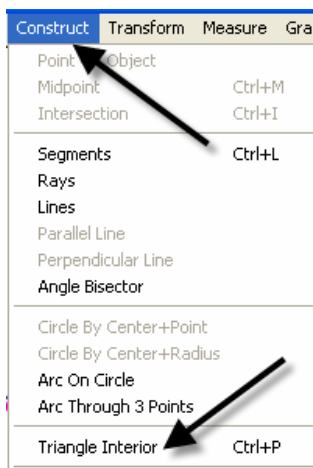
To hide the circle and the unnecessary lines, simply highlight them and use the **Display** and **Hide Path Objects** from the Menu Bar.



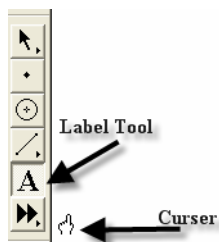
To measure the length of the apothem, highlight it and use the **Measure** and **Length** options from the Menu Bar. The points will automatically be labeled, and the measurement will appear. This measurement will be highlighted, and a click in the blank white area of the screen will deselected it.



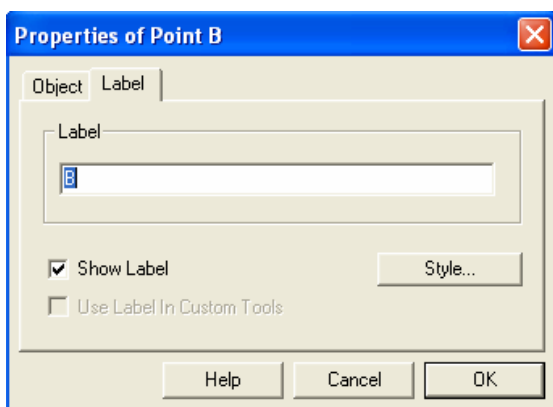
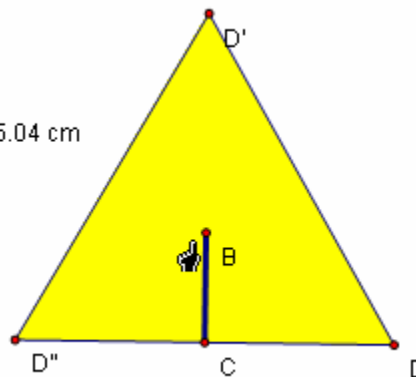
To use the **Measure** and **Perimeter** options from the menu bar, the *interior* of the triangle must first be constructed. Highlight the vertices. Use the **Construct** and **Triangle Interior** options from the Menu Bar. Once constructed, the interior is automatically selected (This is shown by cross hatching.) allowing the **Measure** and **Perimeter** options to become available. Click on them to measure.



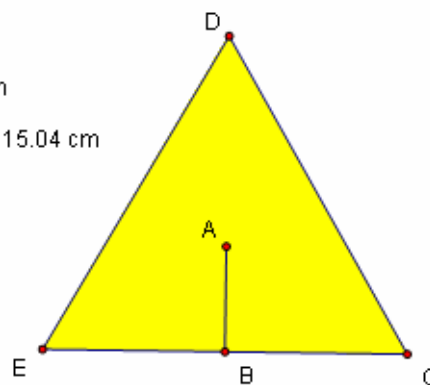
Geometer's Sketchpad labels automatically. In this particular case it used point D as the original point on the circle and D' and D'' as the rotated points. If desired, rename the points by selecting the Text tool. A little outline of a hand will appear as the cursor. As the cursor becomes lined up with a label, it will change. Double click on a point and a window will pop up with a box allowing for the new name to be entered. As points are changed, the label with their respective measurements will also change.



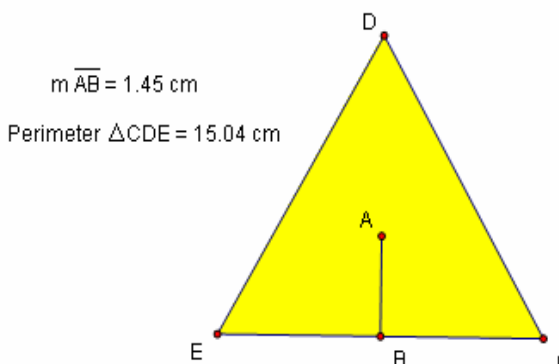
$m \overline{BC} = 1.45 \text{ cm}$
Perimeter $\triangle D''DD' = 15.04 \text{ cm}$



$m \overline{AB} = 1.45 \text{ cm}$
Perimeter $\triangle CDE = 15.04 \text{ cm}$

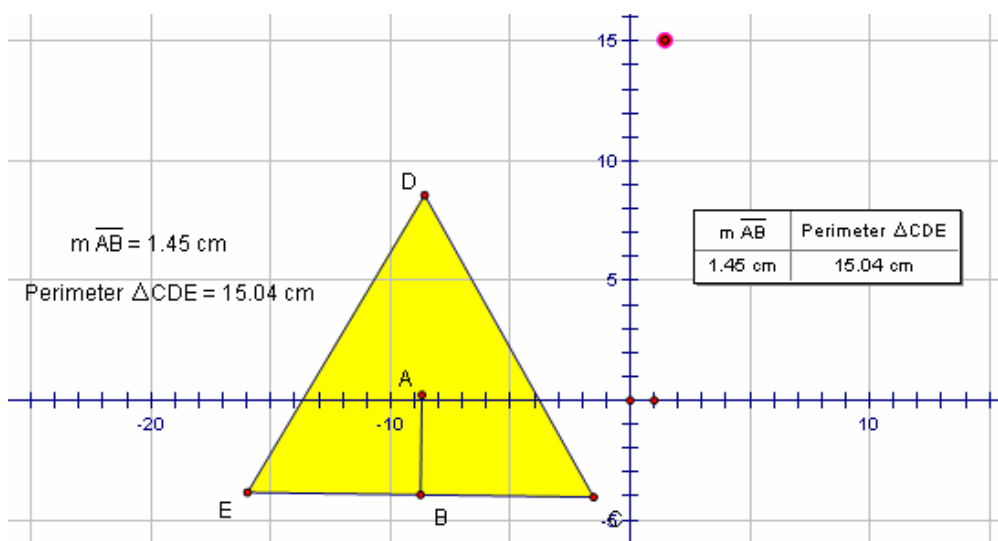


To build a table to explore the relationship between the length of the apothem and the perimeter, highlight in order first the independent variable followed by the dependent variable. In this case, the *measurement* of the apothem is the independent variable and the *perimeter* the dependent variable. Once highlighted, use the **Graph** and **Tabulate** options from the **Menu Bar**. A table with each value will appear. This table can be moved anywhere on the screen that is convenient.



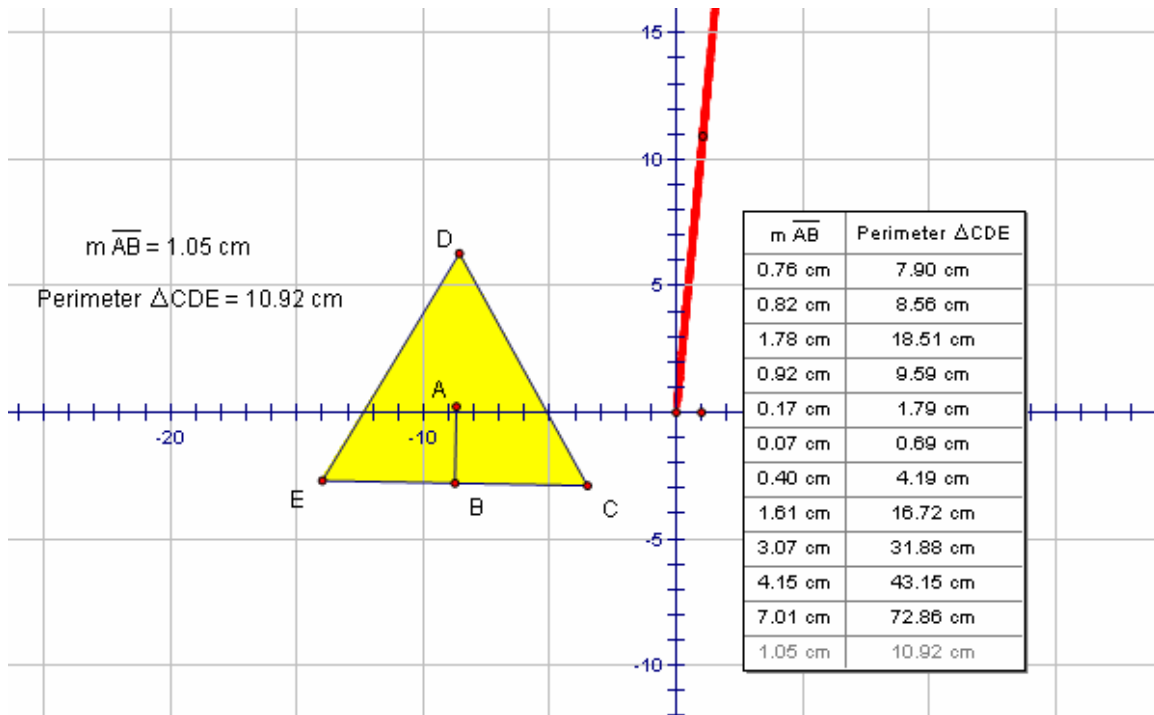
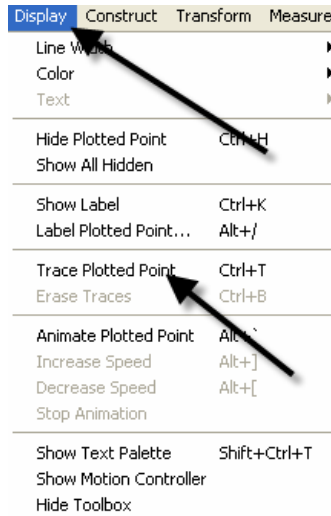
$m \overline{AB}$	Perimeter $\triangle CDE$
1.45 cm	15.04 cm

To plot the points, again highlight the independent then the dependent variable. In this case the length of the apothem then the perimeter. Once highlighted use the **Graph** and **Plot as (x, y)** option from the **Menu Bar**. A coordinate grid appears behind the triangle with the point highlighted.



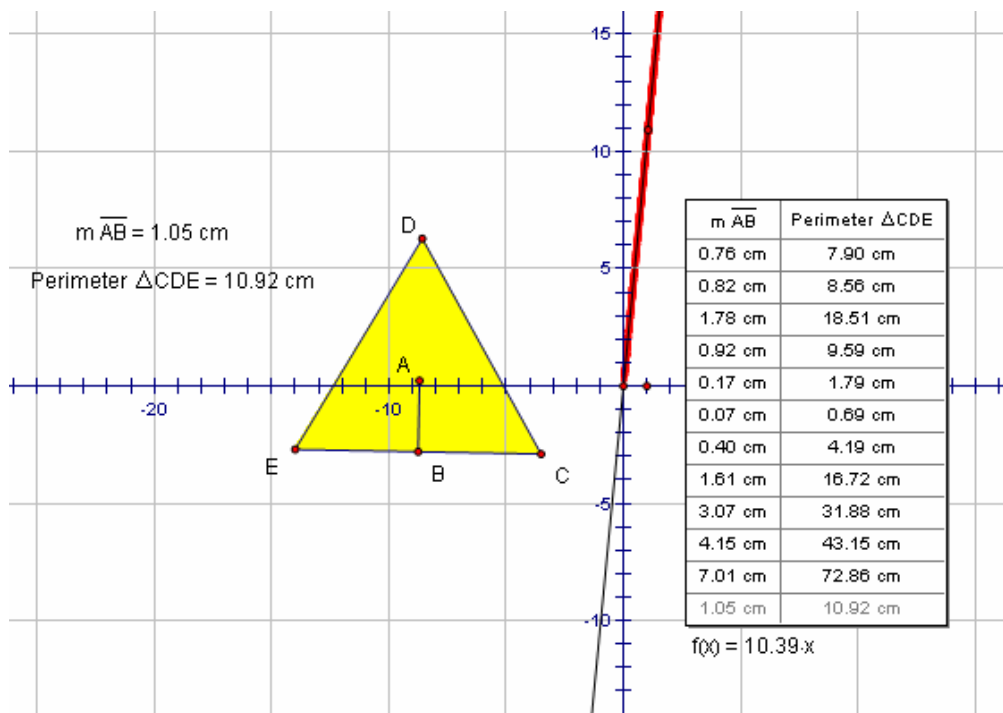
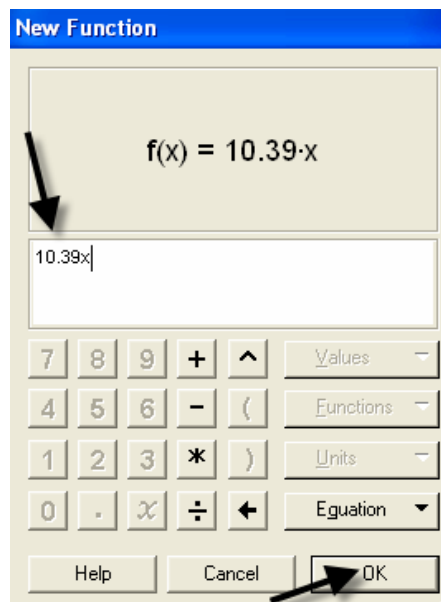
$m \overline{AB}$	Perimeter $\triangle CDE$
1.45 cm	15.04 cm

To trace the point, highlight it and use the Display and Trace Plotted Point options from the Menu Bar. The point will trace on the coordinate grid as the triangle is manipulated from any one of its vertices. To add data to the table, double click in the table, adjust the size of the triangle and repeat until the number of data points desired are accumulated.

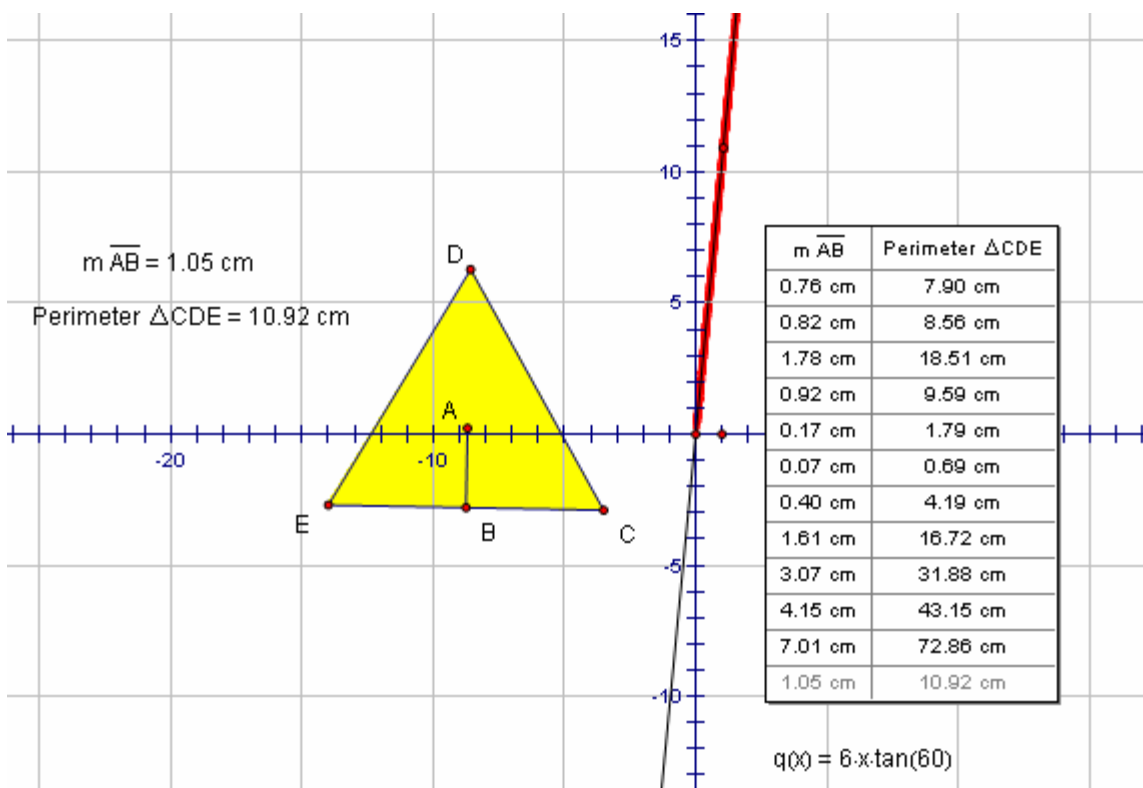
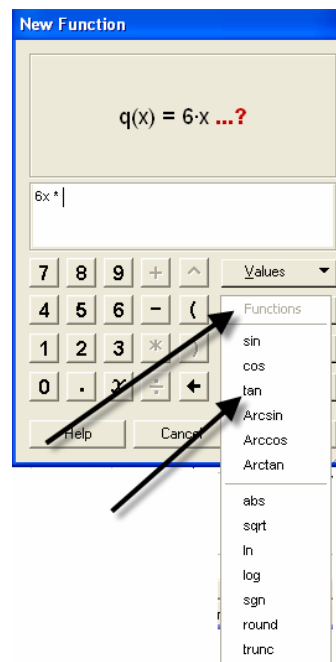


Verify a Function Rule

To use Geometer's Sketchpad to verify a function rule, in this case $y = 10.39x$, use the **Graph** and **Plot New Function** options from the Menu Bar. A calculator window will pop up allowing the equation to be entered. After entering the function, click the **OK** button. The function will graph, hopefully over the existing data, thus verifying the function rule.



To verify using a trigonometric function, follow the same procedure, but use the calculator to enter the specific trigonometric function desired. For instance, $y = 6x \tan(60^\circ)$. The function will then graph verifying the plotted data.



Sketchpad Skills Investigation

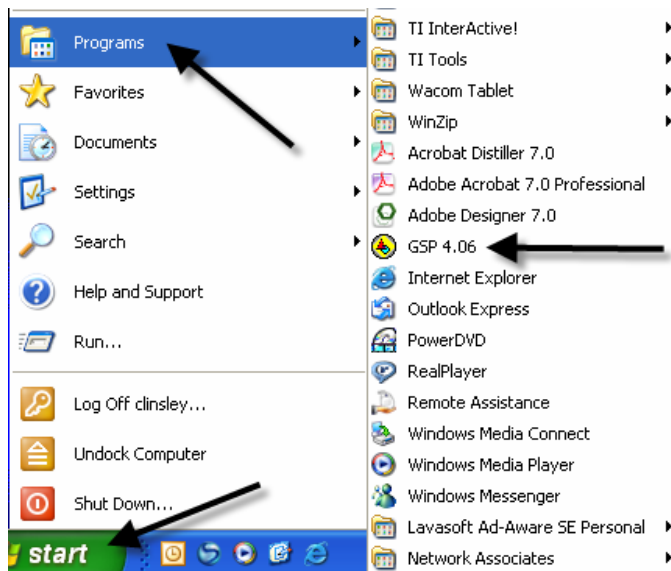
Opening a New Sketch

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

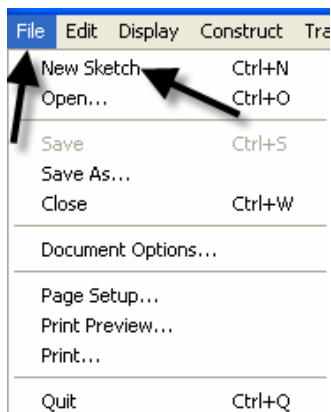


GSP 4.06.lnk

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**.



Creating Points

Select the **Point Tool** and click in the white blank space.



Notice that the last item created stays highlighted. To deselect the last item, use the **Selection Tool** to click anywhere in the blank white space.

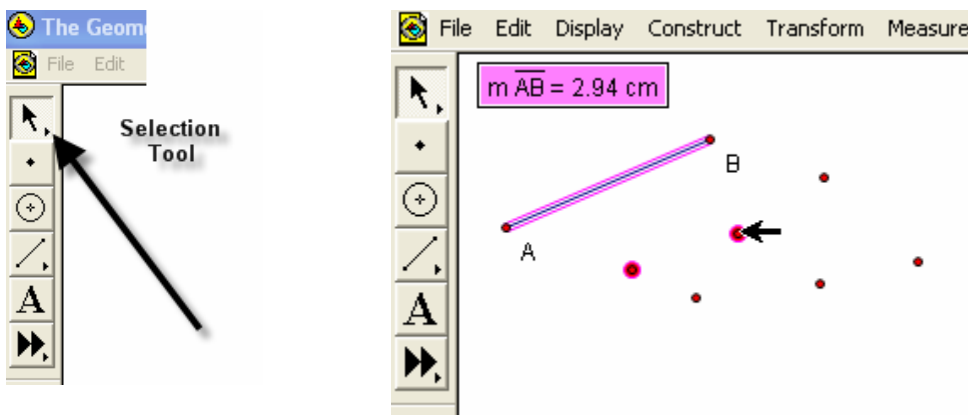


To label points, use the **Text Tool**. Notice that the curser turns into an outline of a hand. As you line up on a point, the hand fills in. Click the mouse to label the point.

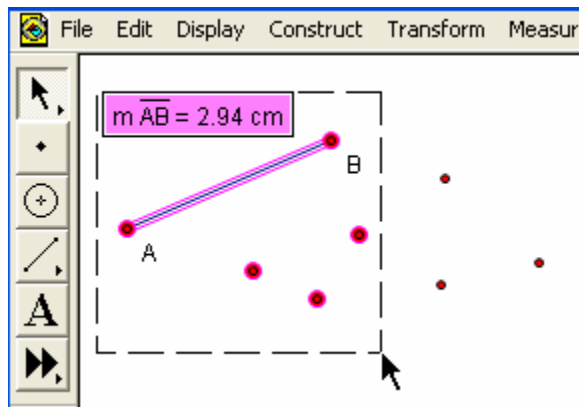


Selection Tool

The selection tool allows for selection/deselection of items in two different ways. First, simply click on the item to be selected/deselected. An item that is highlighted is pink.



The second way is to click and drag. An outline box will appear that will select/deselect everything it touches.



Deleting

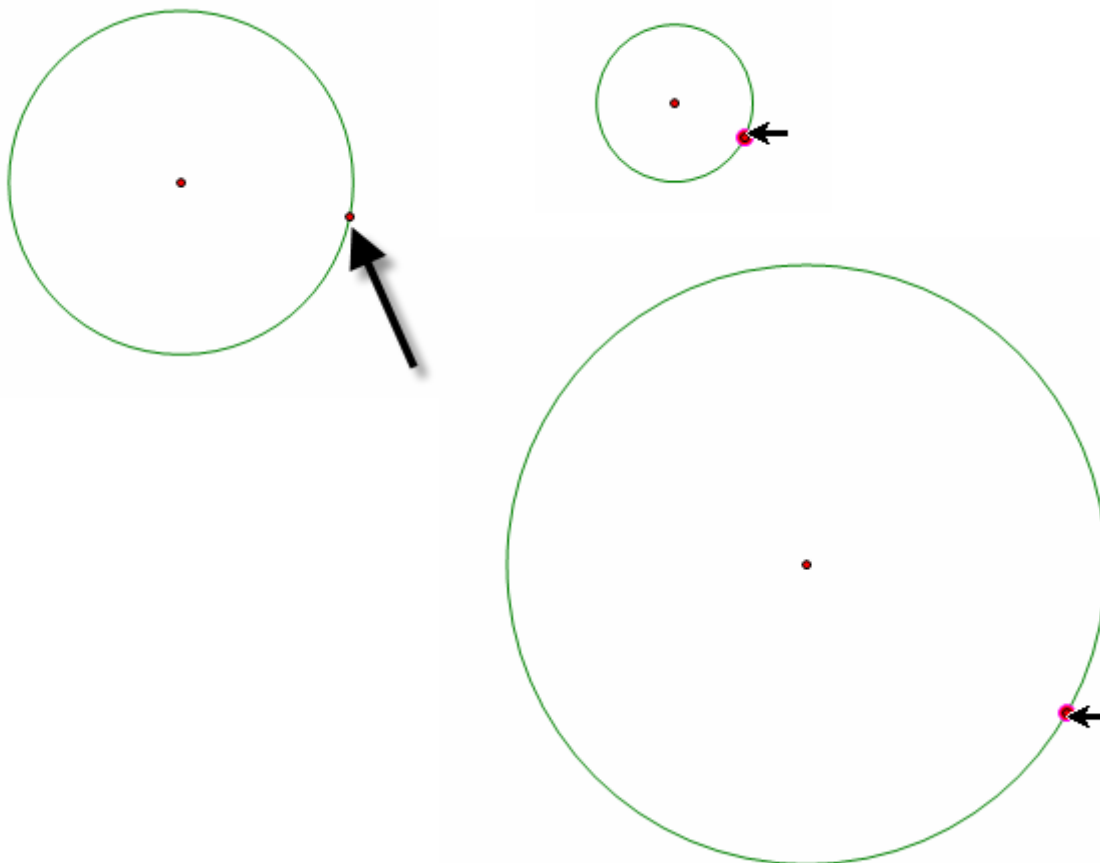
To delete items, simply select them, so they are highlighted, and then hit the **Delete** key on the keyboard.

Circles

To construct a circle use the **Compass Tool**. Notice that the circle forms from the inside out.

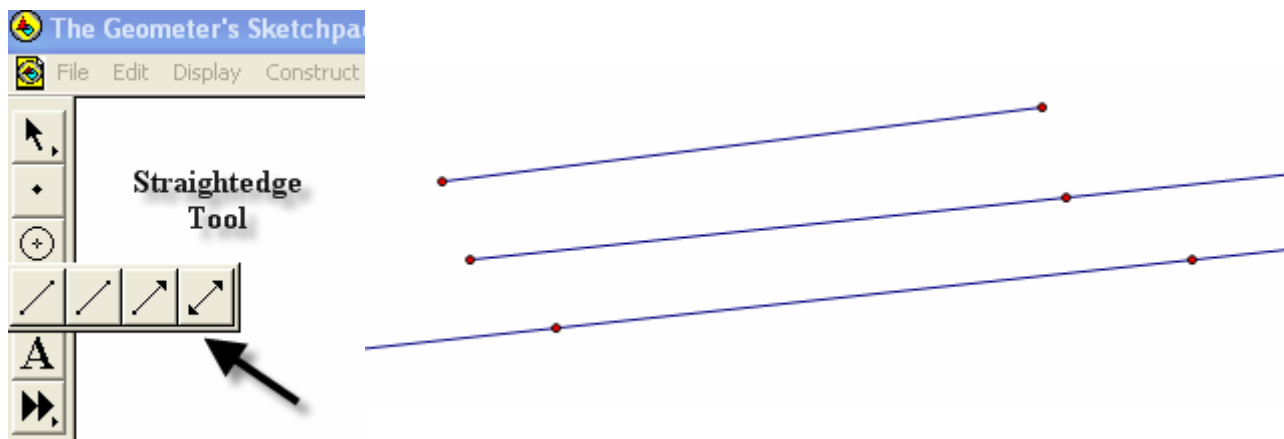


The point on the side of the circle is a control point that will allow the size of the circle to get larger and smaller by clicking and dragging.

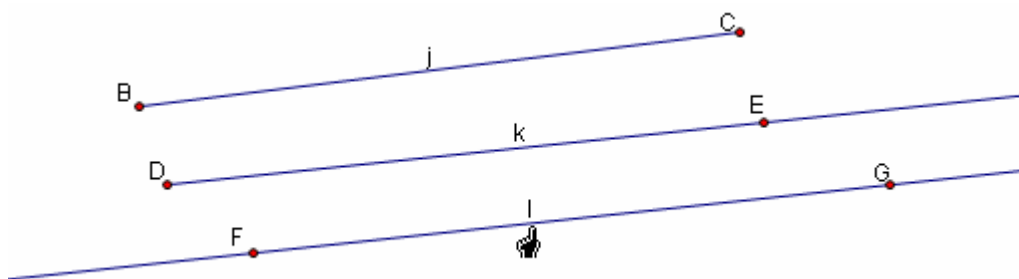


Lines, Rays and Segments

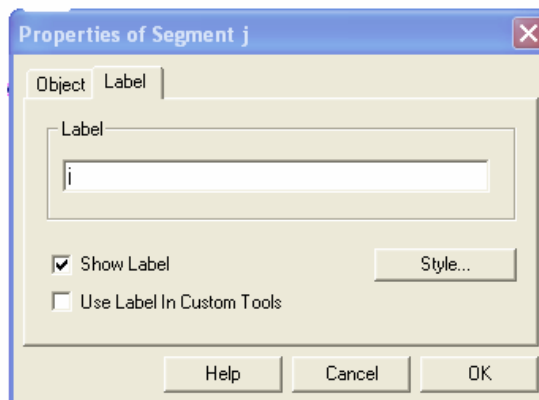
To create lines, rays or segments, click on the **Straightedge** tool, then slide the cursor to the right to choose the desired tool. Each figure is formed from two points. The segment has two distinct endpoints; the ray has one endpoint and then travels off the screen, and the line has both ends traveling off the screen.



Label the figures by first selecting the **Text** tool and either clicking on two points on the figure or by clicking on the figure between two points.

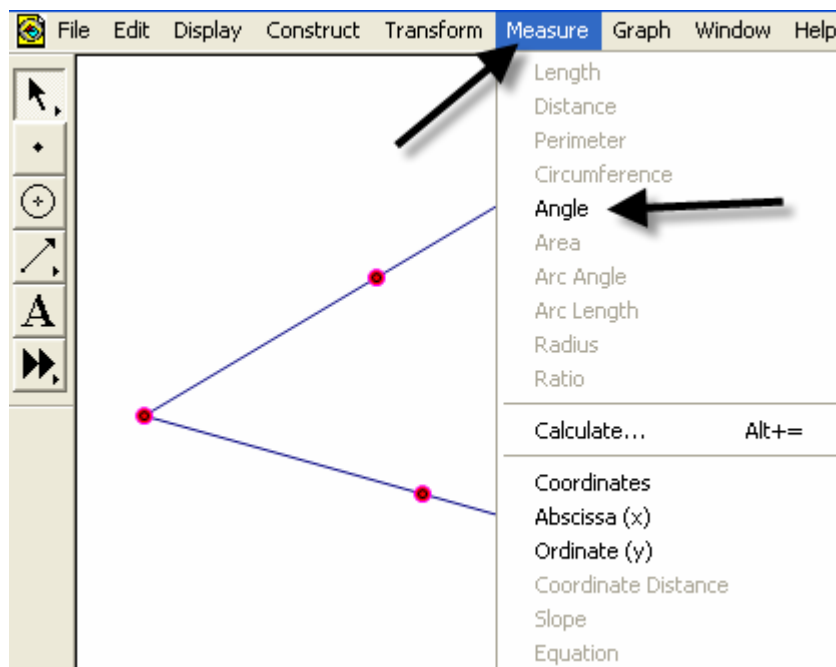


Labels can be changed by double clicking on the label. A box will pop up that provides a place to edit or delete a label.

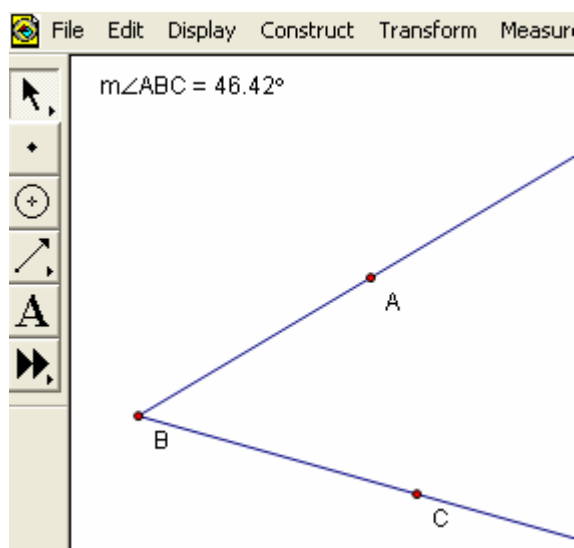


Measuring an Angle

To measure an angle, first highlight it by clicking on three points that could be used to name it, one on a side, then the vertex, and then one on the other side. Use the **Measure** option on the menu bar and select **Angle**.

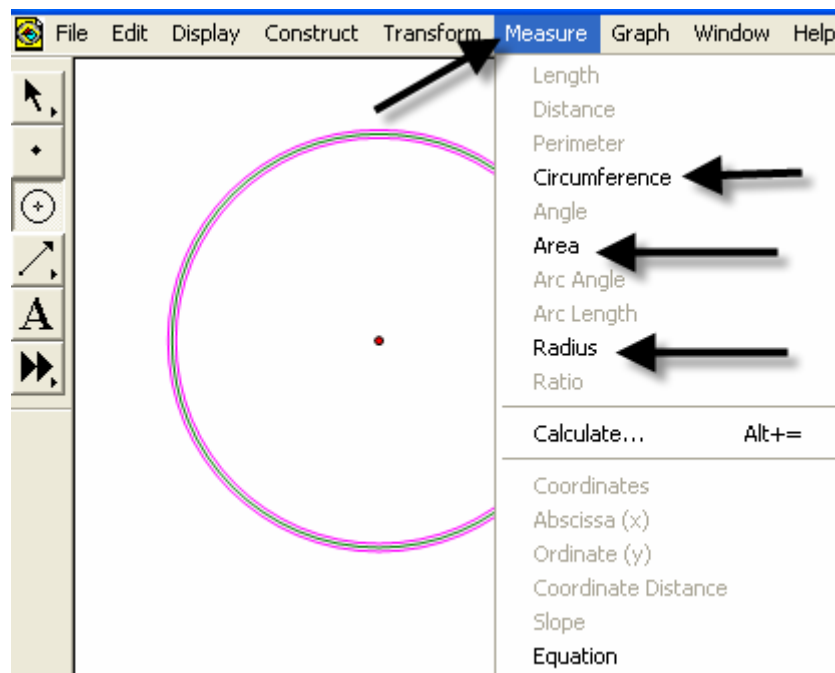


The measurement will appear and the program will automatically label points if they weren't labeled prior to measurement.



Measuring a Circle

To measure a circle, first highlight it by clicking on it. Use the **Measure** option on the menu bar and select the measurement desired.

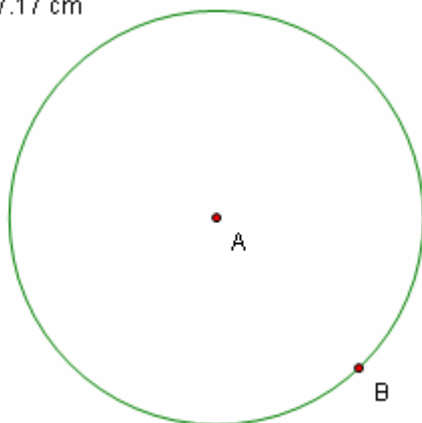


The measurement will appear, and the program will automatically label points if they weren't labeled prior to measurement.

Circumference $\odot AB = 17.17$ cm

Area $\odot AB = 23.46$ cm²

Radius $\odot AB = 2.73$ cm

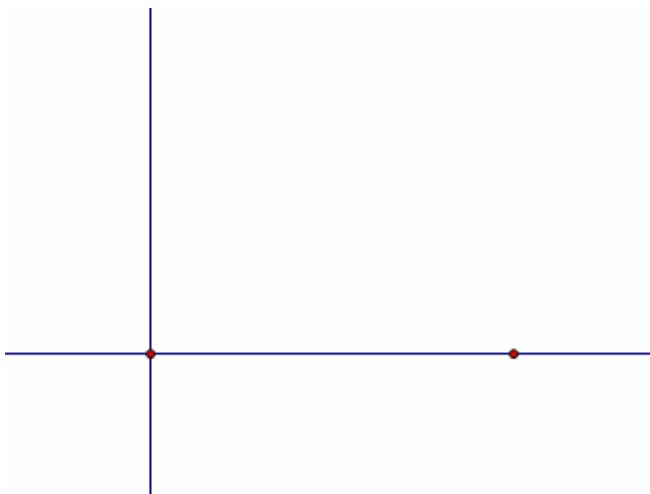
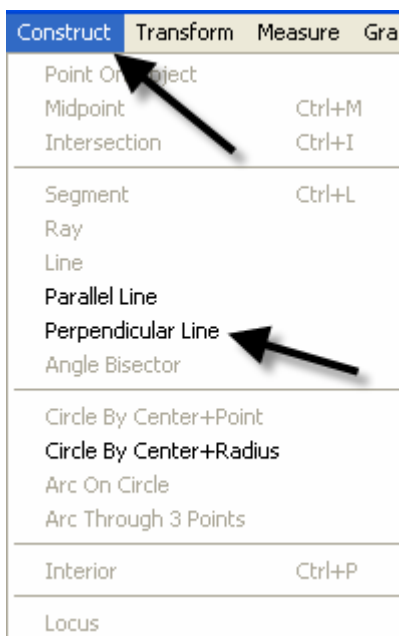


30-60-90 Triangle

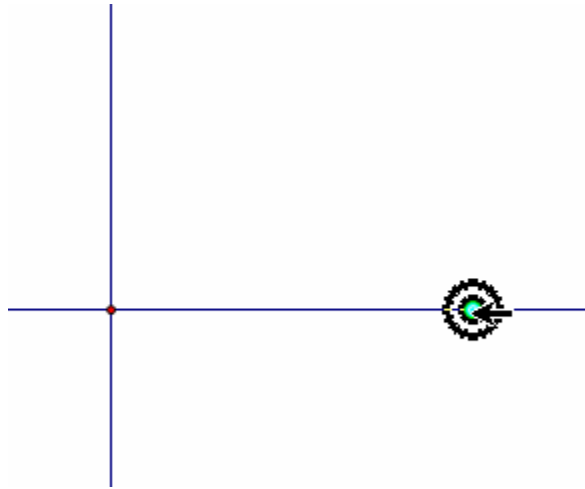
1. Draw a horizontal line. If you hold the shift key before letting of the line, it will make it horizontal for you.



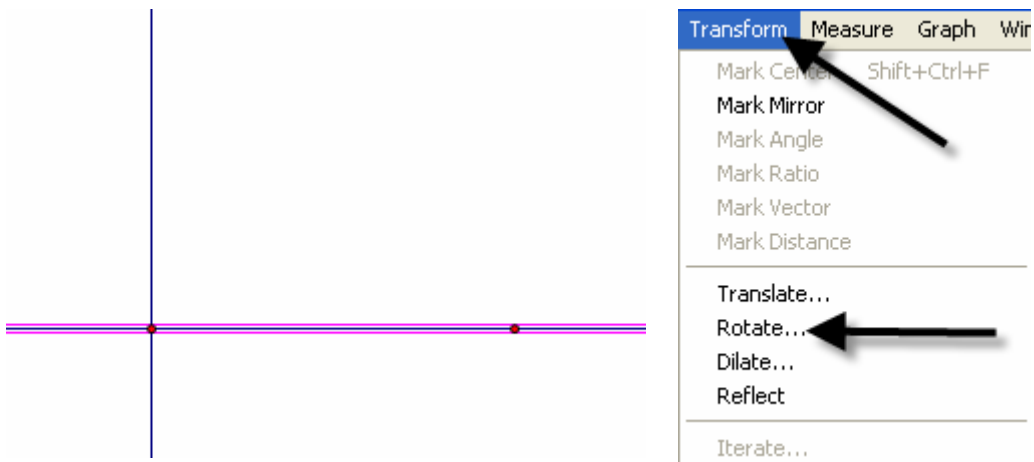
2. Construct a perpendicular line by first highlighting the line and one of the points, then clicking on the Construct menu.



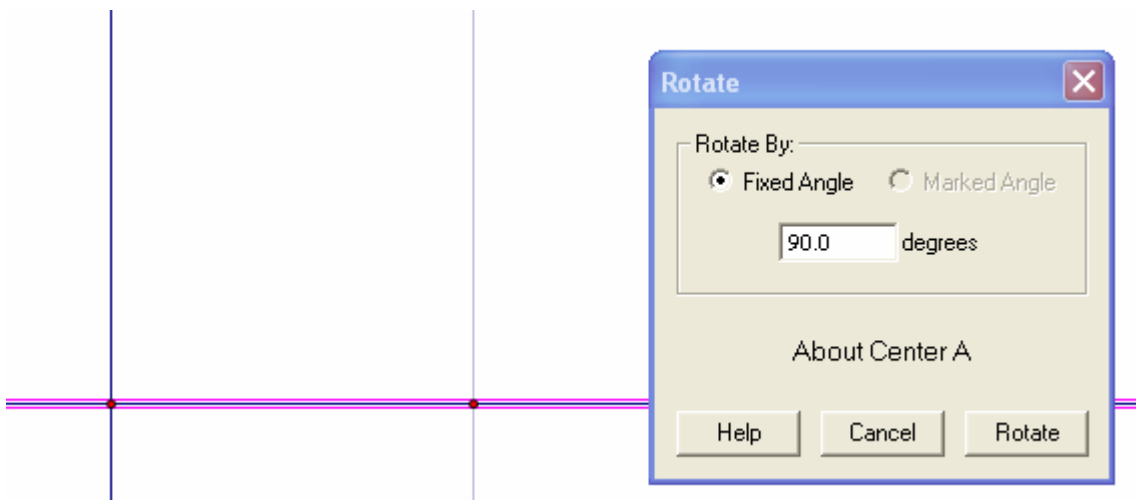
3. Create the third side by rotating the original line to form either a 30 or 60 degree angle.
- a) Mark the point of rotation by double clicking on it. There will be a quick flash of concentric circles around the point as it is marked.



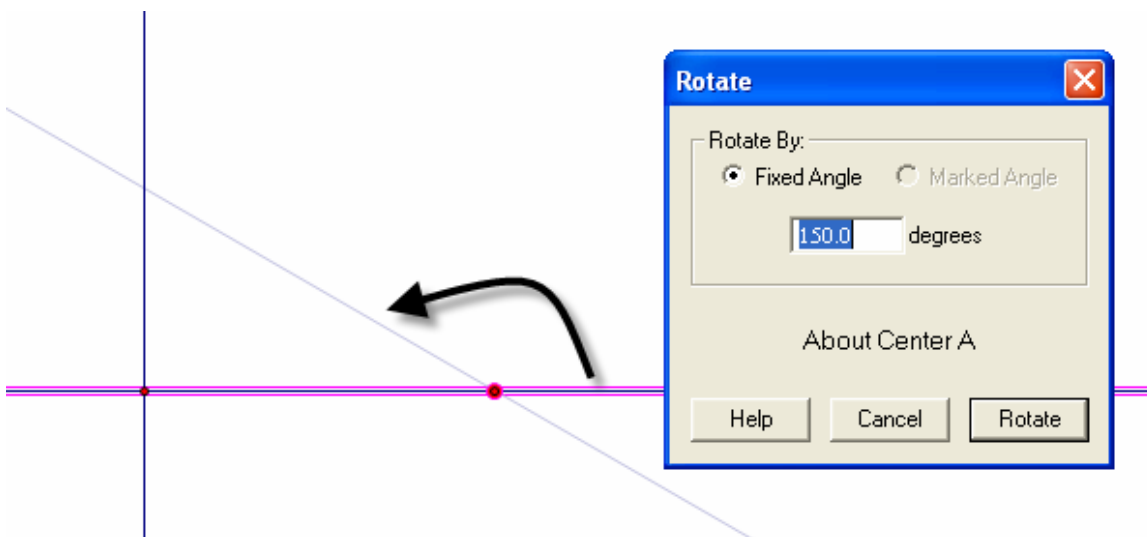
- b) Highlight the original line and use the **Transform** menu with the **Rotate** option.



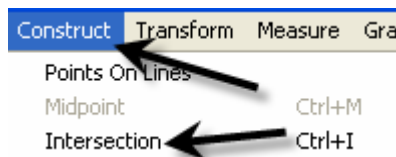
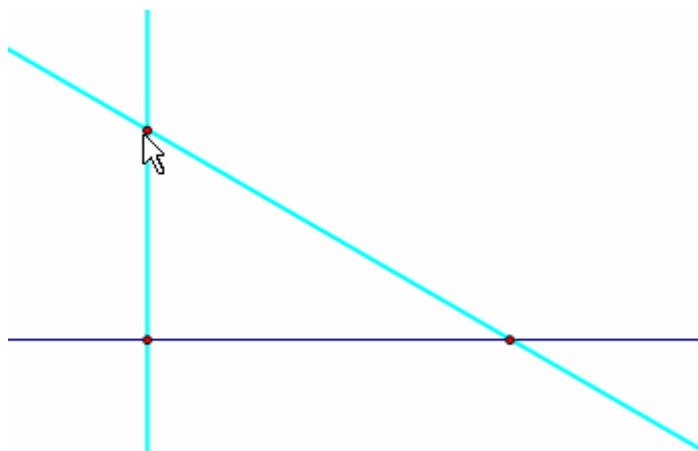
A box will pop up that allows the number of degrees of rotation to be entered. Notice that a shadow of the rotated line appears. This shadow line is a preview of where the rotated line will go. Geometer's Sketchpad has a default of 90 degrees.



Change the number to a multiple of 30 to get the desired effect. Geometer's Sketchpad treats the point of rotation as the origin and rotates from the side of standard position.



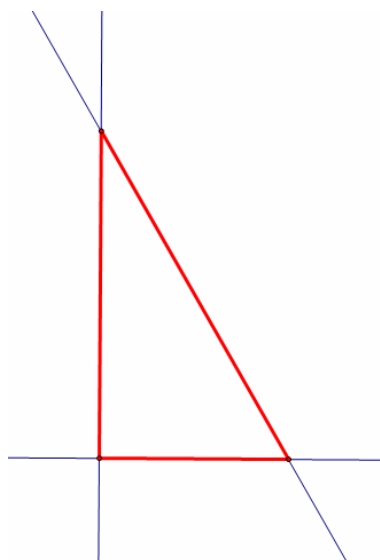
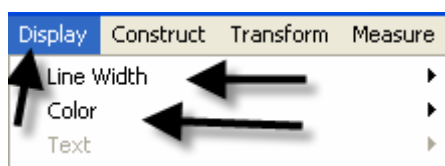
- Construct a point of intersection where the perpendicular line meets the rotated line either by using the **Point** tool and placing a point or by highlighting both lines and using the **Construct** menu with the **Intersection** option.



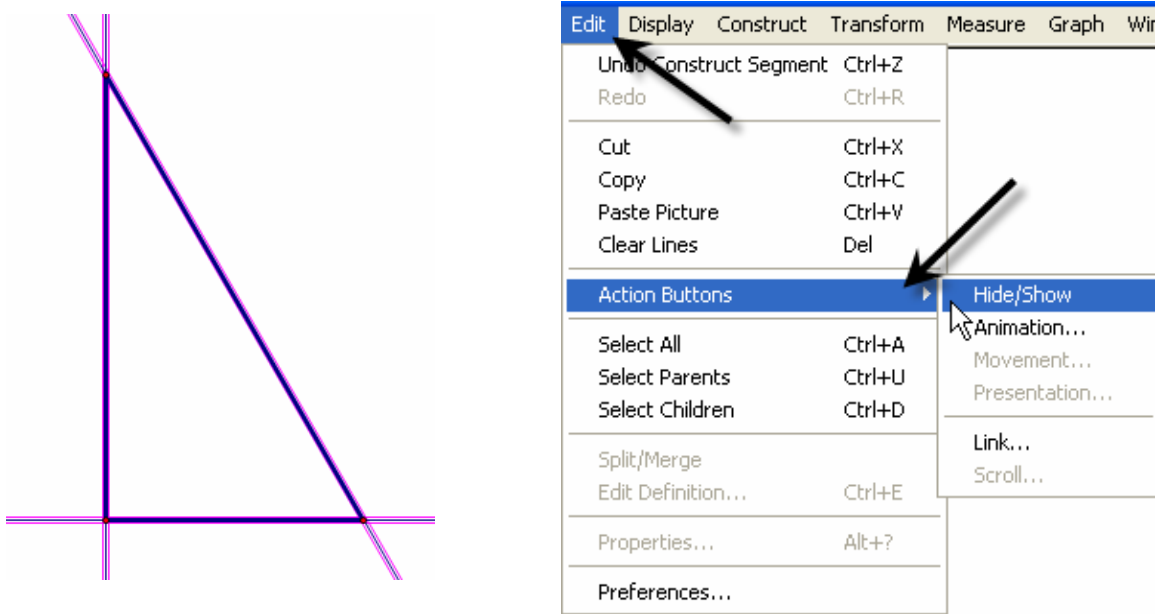
Construction Clean Up

1. To “clean up” a construction, it is often necessary to construct segments, arcs, etc. over the parts of the final product. Follows is an example of a 30-60-90 triangle.

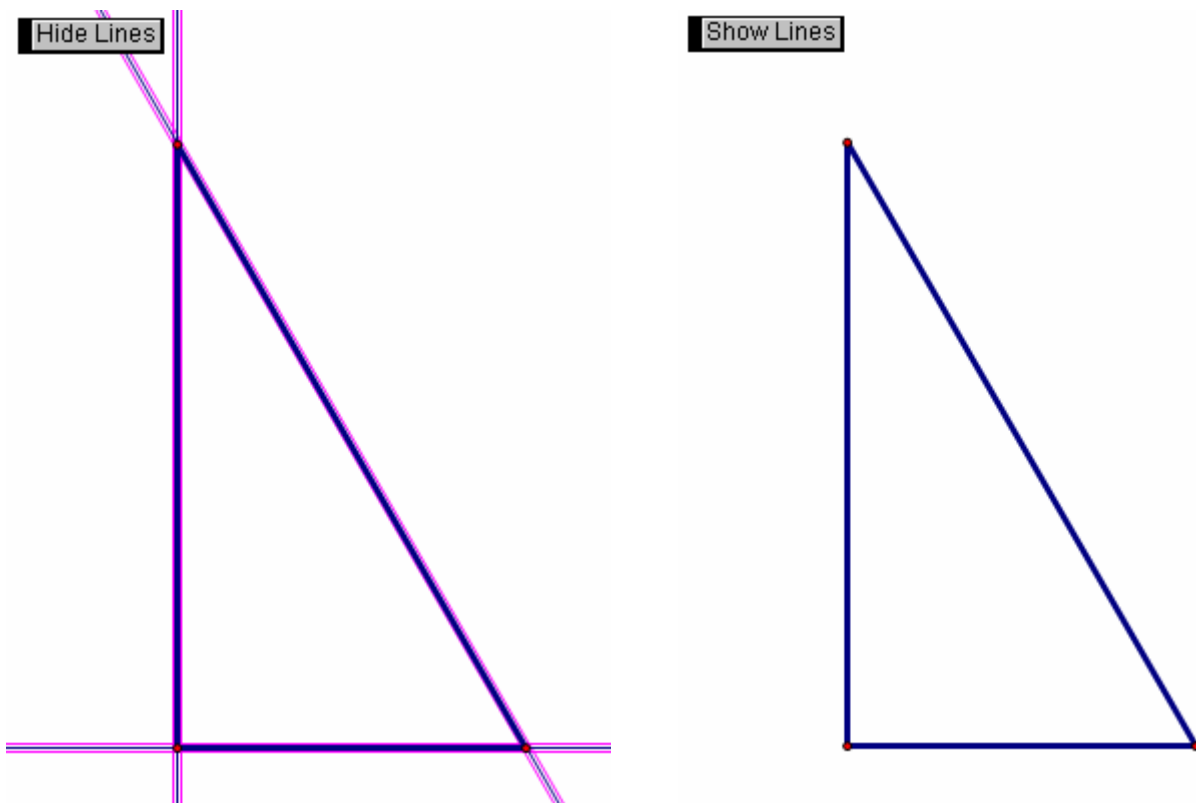
- Use the **Straightedge tool** to draw segments on top of the sides of the triangle. After drawing the first one, use the **Display** menu to change the **Line Width** and **Color** of the segment. Subsequent segments will then be drawn with this color and thickness.



- To hide construction lines ,create a **Hide/Show** button by highlighting the lines then using the **Edit** menu and the **Action Buttons** → **Hide/Show** option.

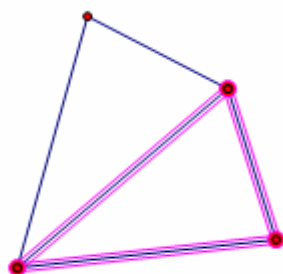
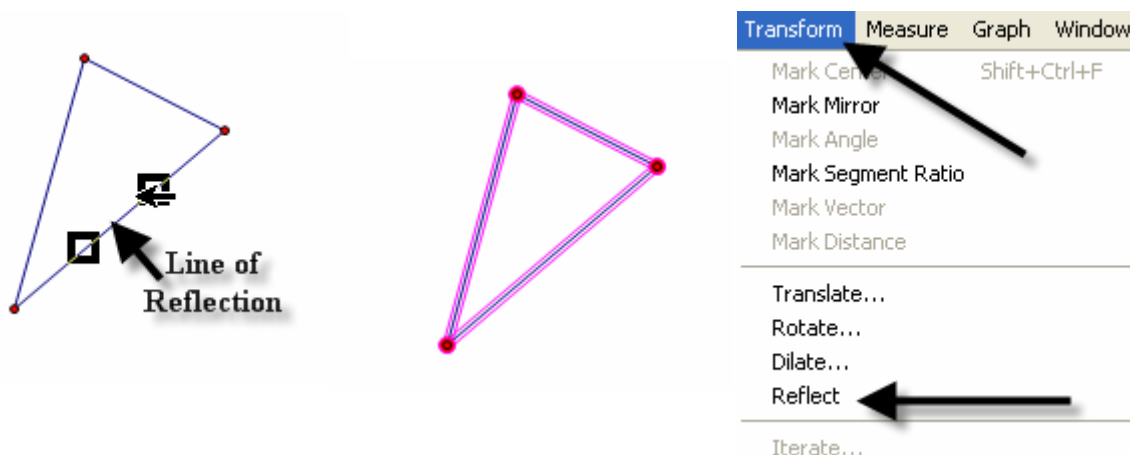


The **Hide Lines** button appears which works as a toggle switch between **Hide** and **Show** when clicked on.

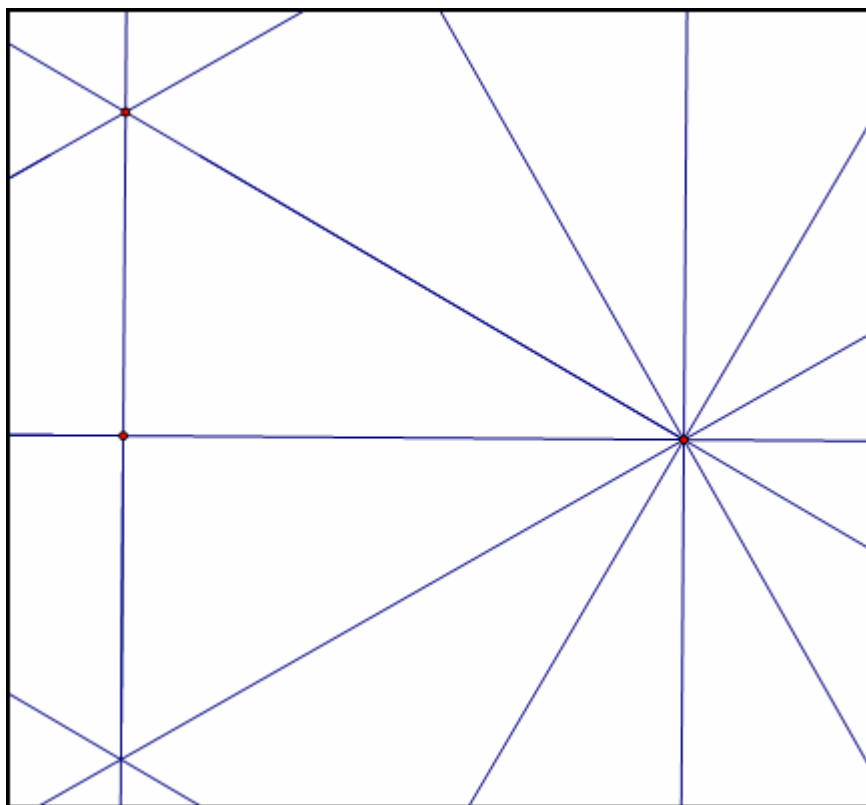


Reflecting

To transform a figure by reflecting, first mark the line of reflection by double clicking on it. A quick flash of two sets of concentric squares will appear on the line as the marking process is taking place. Next, use the Selection tool to highlight the figure to be reflected. Use the Transform menu and the Reflect option to complete the reflection.



30-60-90 triangle tessellation by reflection



Explore Geometric Properties in the World

Importing Pictures from the Internet

1. Position the cursor on the picture.



2. RIGHT click on your mouse and select COPY.

Open Link
Open Link in New Window
Save Target As...
Print Target

Show Picture
Save Picture As...
E-mail Picture...
Print Picture...
Go to My Pictures
Set as Background
Set as Desktop Item...

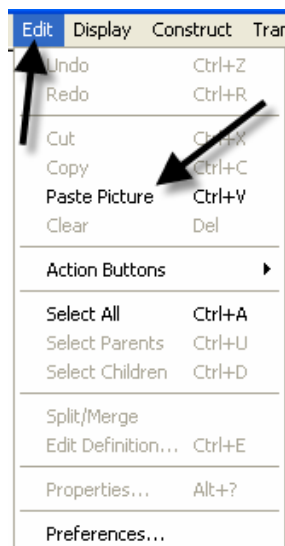
Cut
Copy
Copy Shortcut
Paste

Add to Favorites...

Convert to Adobe PDF
Convert to existing PDF

Properties

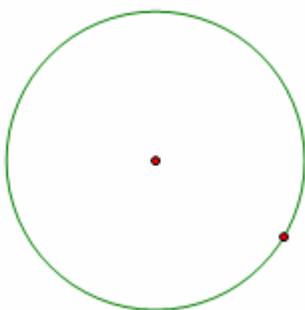
3. Return to your sketch in Geometer's Sketchpad. Use the **Edit** and **Paste Picture** options from the **Menu** bar.



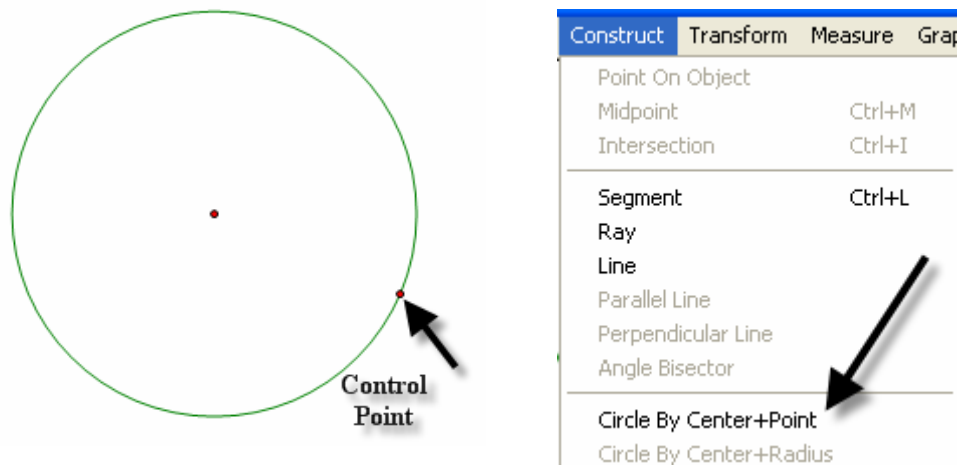
Dome Floor Dilemma

Sector Construction

1. Circle Construction
 - a) Use the **Compass** tool to construct a circle.

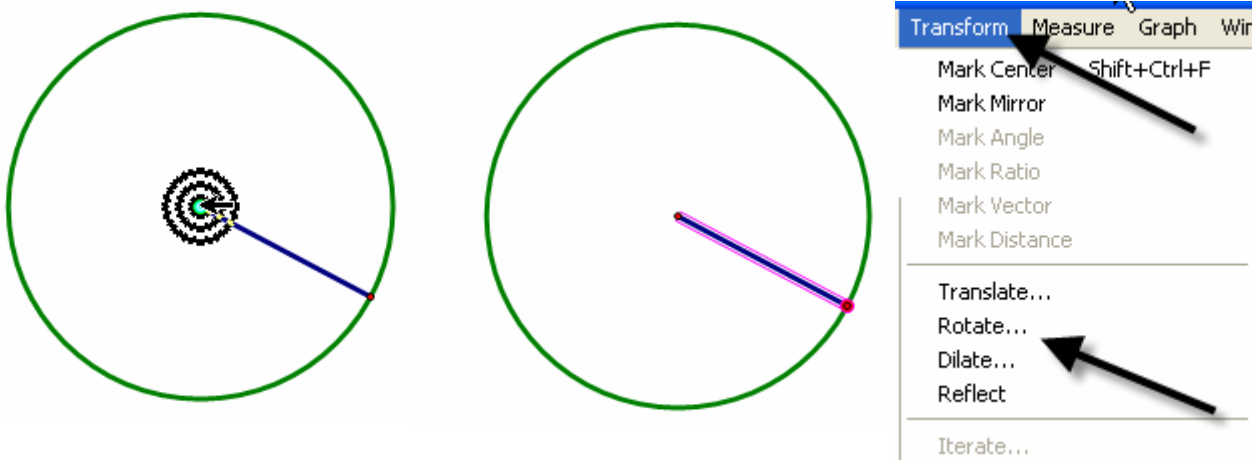


- b) Use the **Segment** tool or the **Construct** menu to construct a radius of the circle. Connect the radius from the center to the “control” point on the circle. To use the **Construct** menu, first select the center and the point on the circle, then use **Construct** with the **Circle By Center+Point** option.

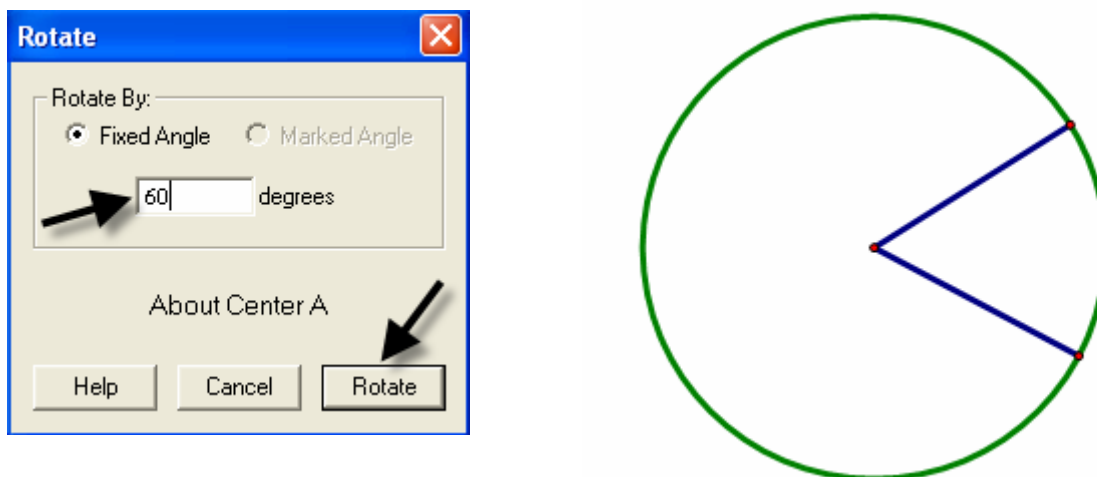


2. Rotate Radius

- a) To rotate the radius and its endpoint that lies on the circle, first mark the point of rotation by double clicking on the center of the circle. You will see a quick flash of concentric circles as the “marking” takes place, then highlight the radius and the endpoint that lies on the circle. Use the **Transform** menu and choose the **Rotation** option.

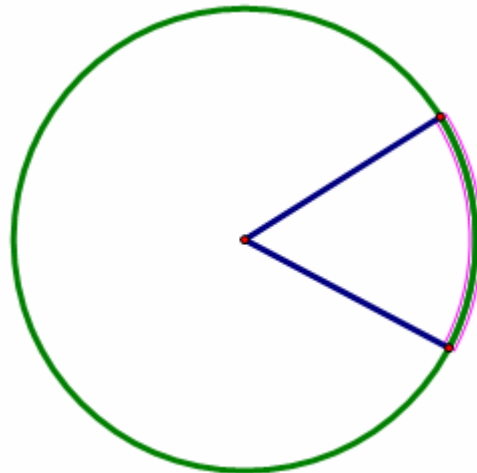
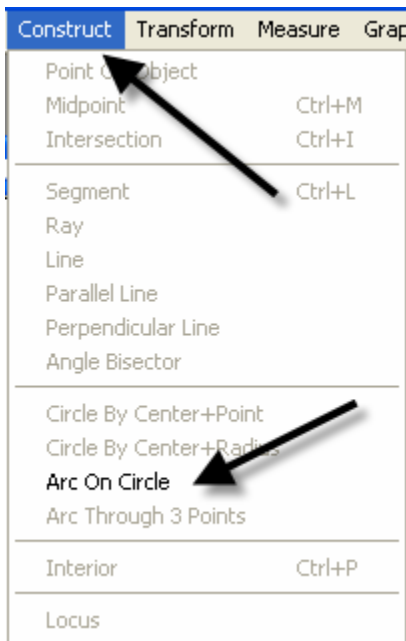
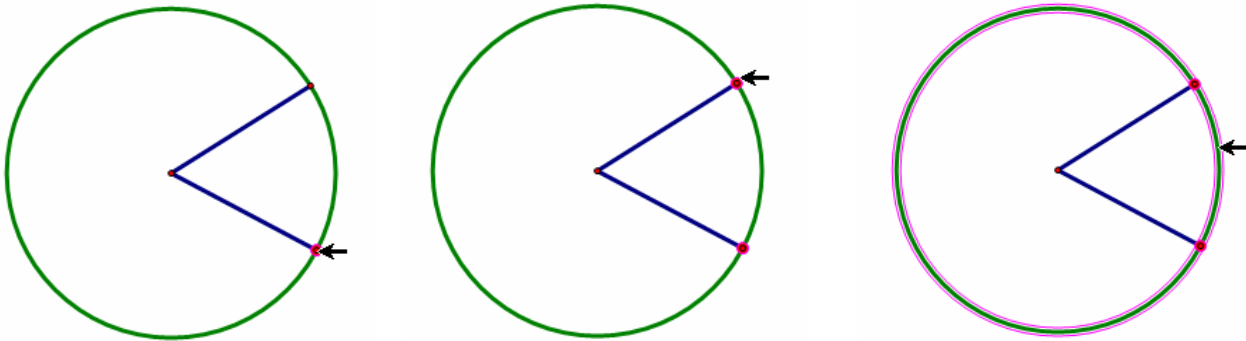


- b) A box will pop up that allows the desired degrees of rotation to be entered. For this construction, enter 60°, then click on **Rotate**.



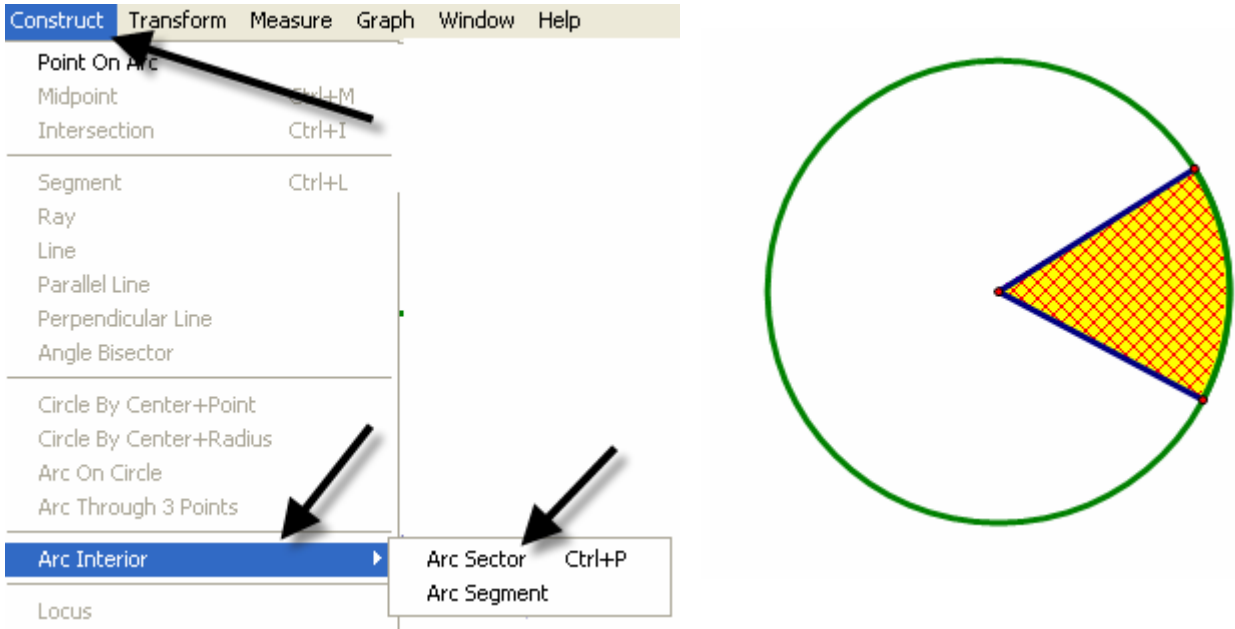
3. Construct Intercepted Arc

To construct the intercepted arc of the sector, select the endpoints of the radii in a counter clockwise direction. Then select the circle and use the **Construct** menu to construct **Arc on Circle**.



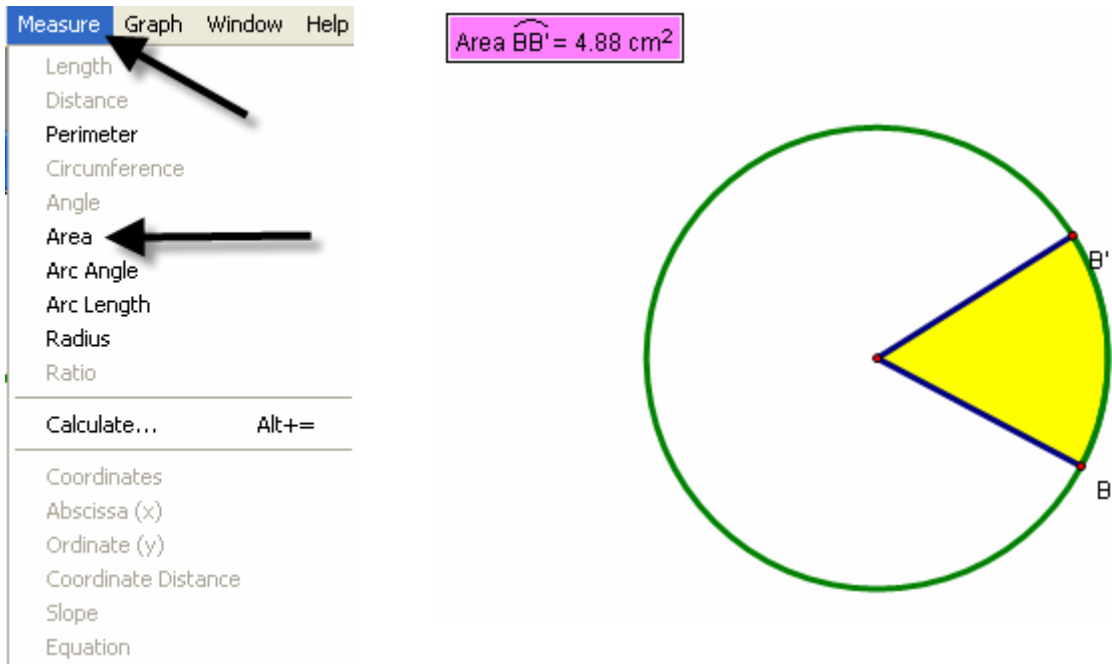
4. Construct Arc Sector

While the newly constructed arc is still highlighted, create the arc sector interior by using the **Construct** menu with the options, **Arc Interior** then **Arc Sector**.

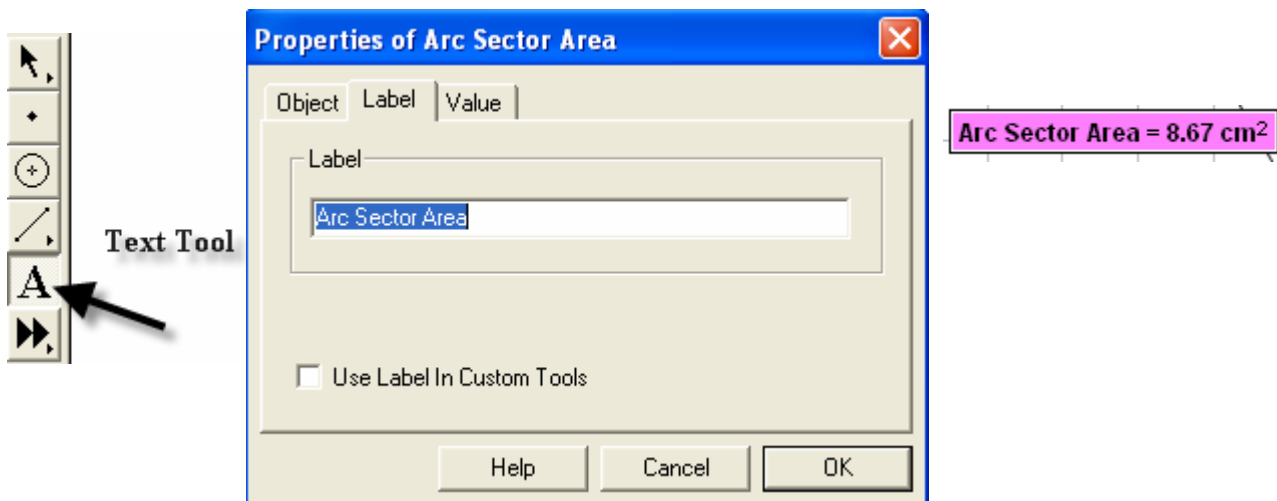


5. Measure Area and Length

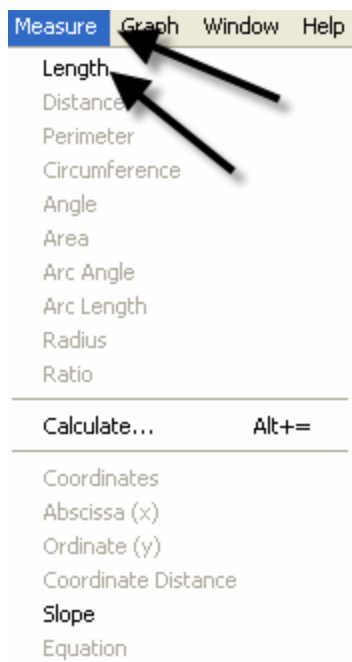
a) To measure the area of the sector, highlight the sector by clicking in it, then use **Measure** from the menu bar with the **Area** option. A highlighted labeled box will appear. Be sure to un-highlight the box by clicking in any white space on the sketch.



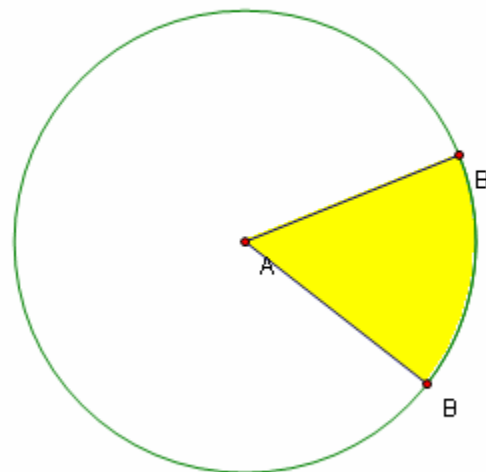
- b) Change the label of the Area to read **Arc Sector Area** by first selecting the Text tool, then double clicking on the Area label and typing in the new label in the pop-up window.



- c) To measure the length of the radius, first highlight any radii, then use the Measure menu with the Length option. Again a labeled highlighted box will appear.

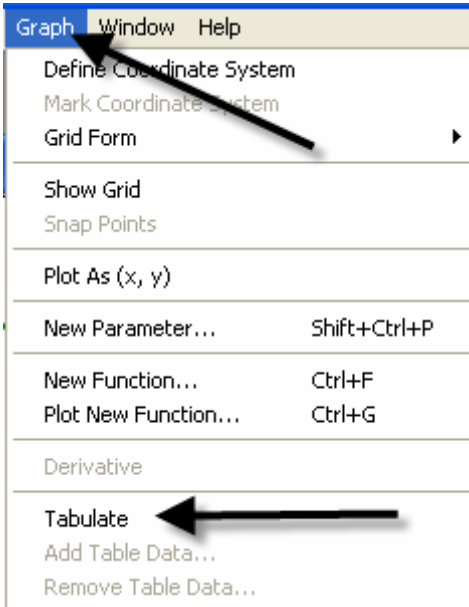


Arc Sector Area = 4.88 cm²
m \overline{AB} = 3.05 cm



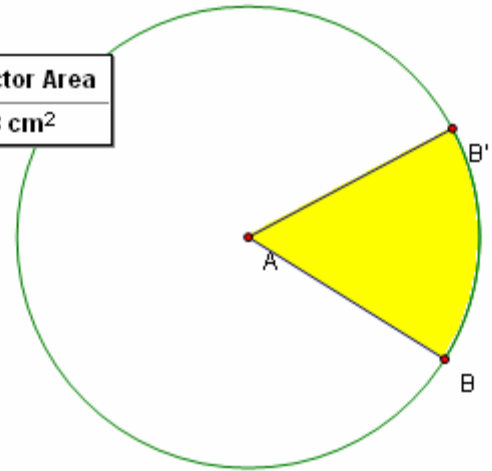
6. Create a Table

To create a table to explore the relationship between the length of the radius and the area of the sector, highlight their measures respectively. Then use **Graph** from the menu bar with the **Tabulate** option. A labeled highlighted table will pop up on the sketch.



Arc Sector Area = 4.88 cm²
 $m \overline{AB} = 3.05 \text{ cm}$

$m \overline{AB}$	Arc Sector Area
3.05 cm	4.88 cm ²



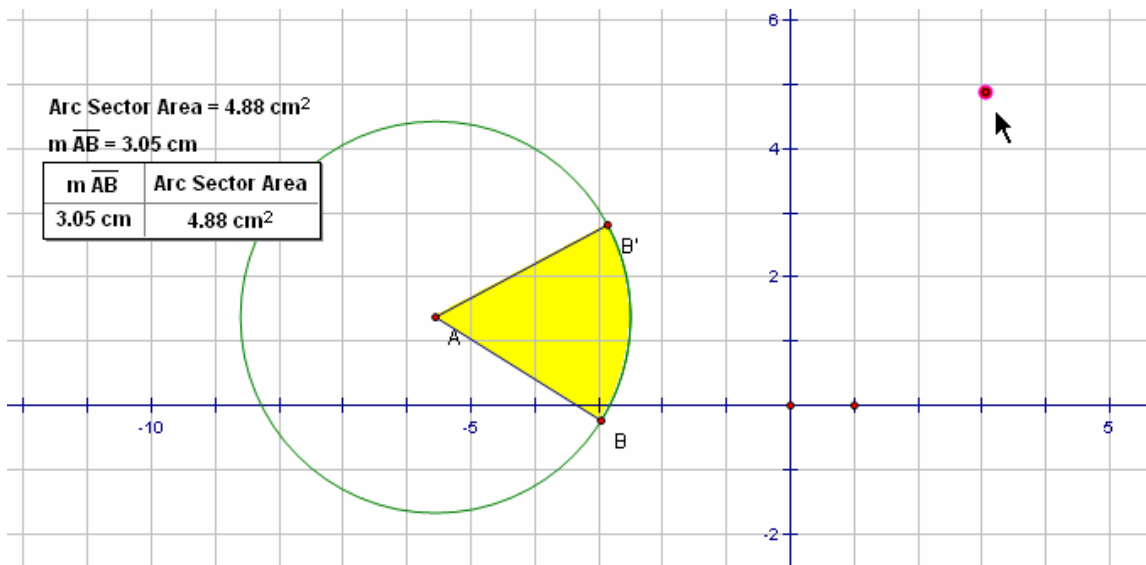
7. Plot Point

- a) To plot the point represented in the table, again highlight the measure values in the respective order: length of radius then area of sector. Use **Graph** from the menu bar with the **Plot as (x,y)** option.

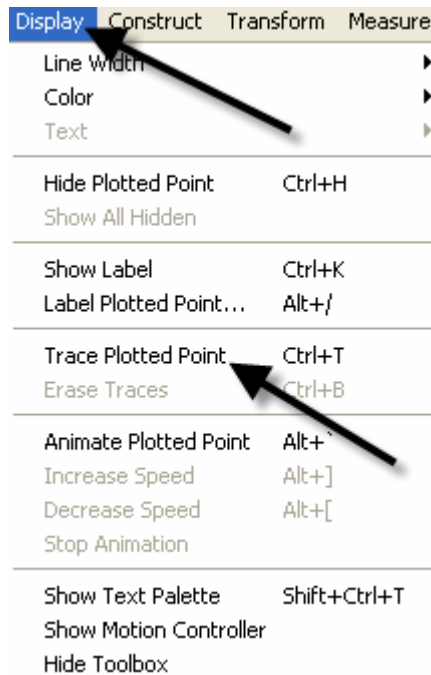
Arc Sector Area = 4.88 cm²
 $m \overline{AB} = 3.05$ cm



- b) The coordinate grid appears with the highlighted point on the grid.



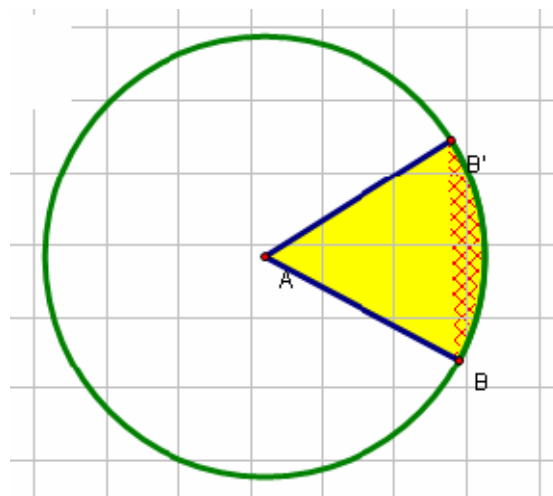
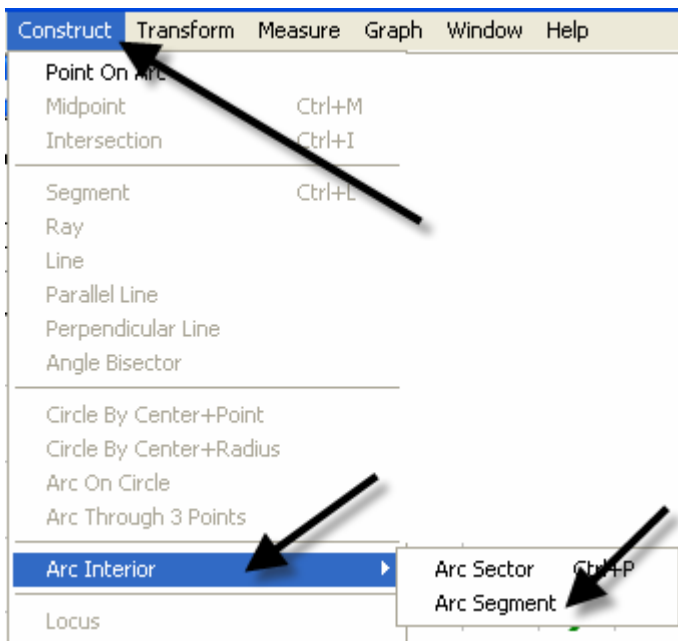
- c) To turn on the trace option, highlight the plotted point and use **Display** from the menu bar with the **Trace Plotted Point** option. This will allow any new points added to the table to be plotted automatically.



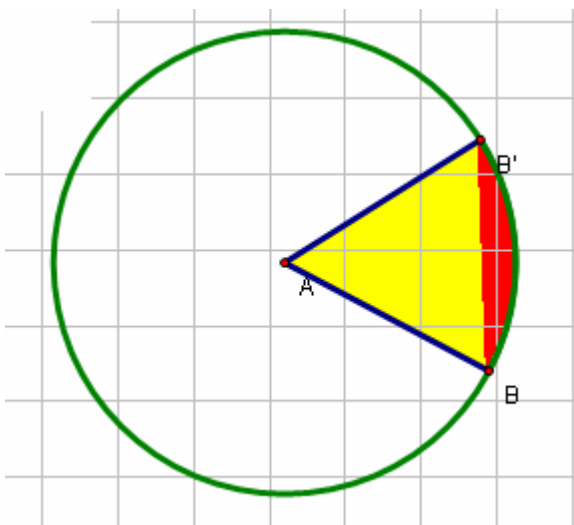
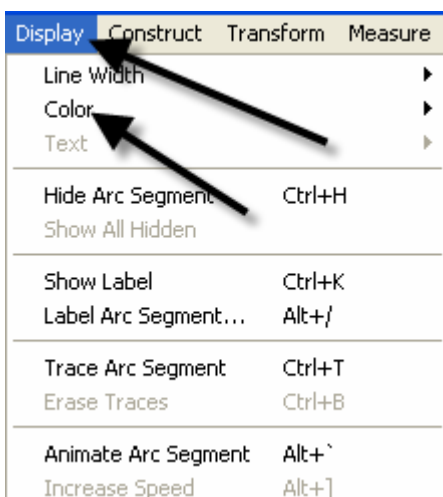
The Arc Segment Construction

1. Construct Arc Segment

To construct the arc segment, first select the arc by double clicking on the arc. Then use **Construct** from the menu bar with the **Arc Interior**, then **Arc Segment** options.

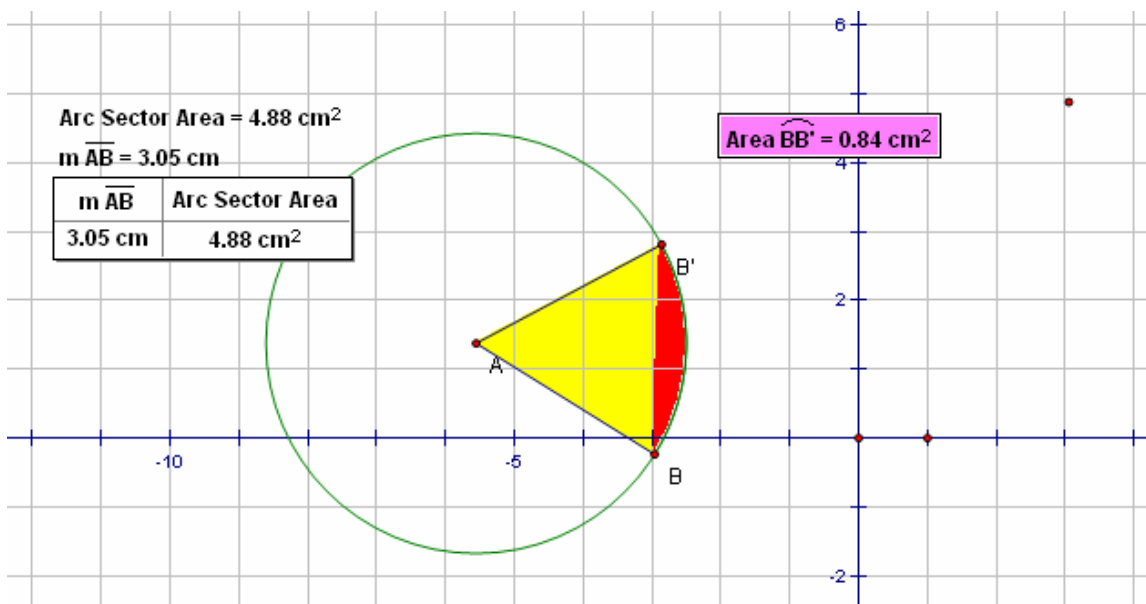
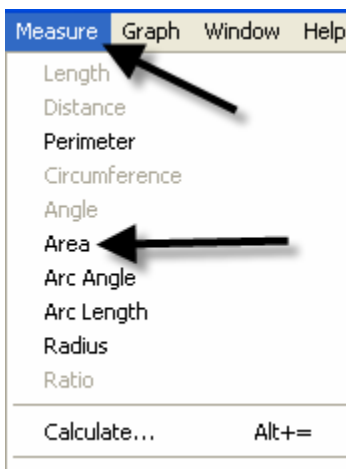


2. Change the color of the segment by using Display with the Color option.

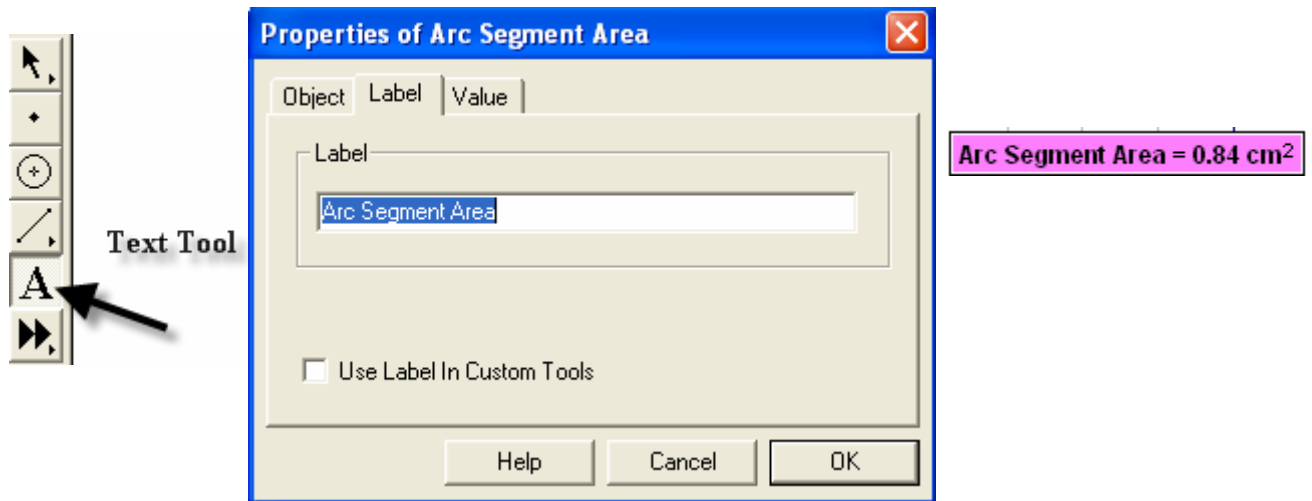


3. Measure Arc Segment Area

a) To measure the area of the arc segment, highlight it by clicking in the interior of the arc sector, then use **Measure** from the menu bar with the **Area** option. With the measurement still highlighted, you may move it to a new location on the sketch for easier viewing. Remember to click in any blank space to deselect the measurement.

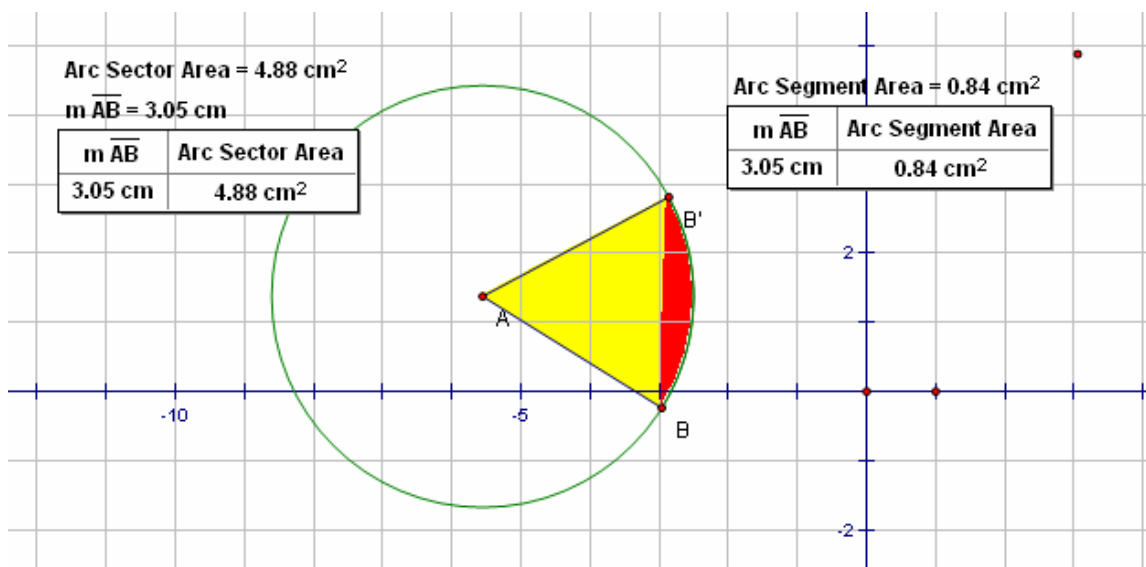
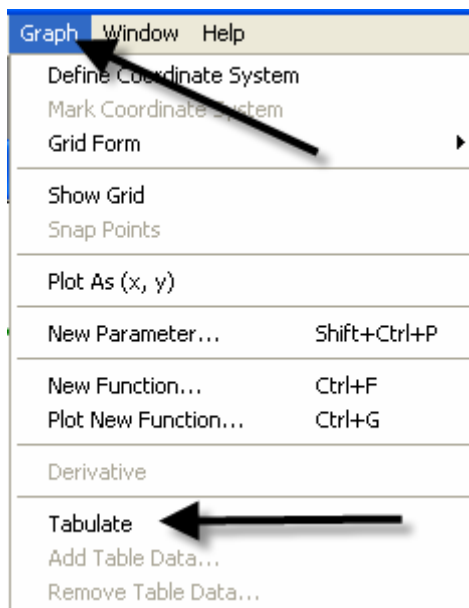


- b) Change the label of the Area to read **Arc Segment Area** by first selecting the Text tool, then double clicking on the Area label and typing in the new label in the pop-up window.



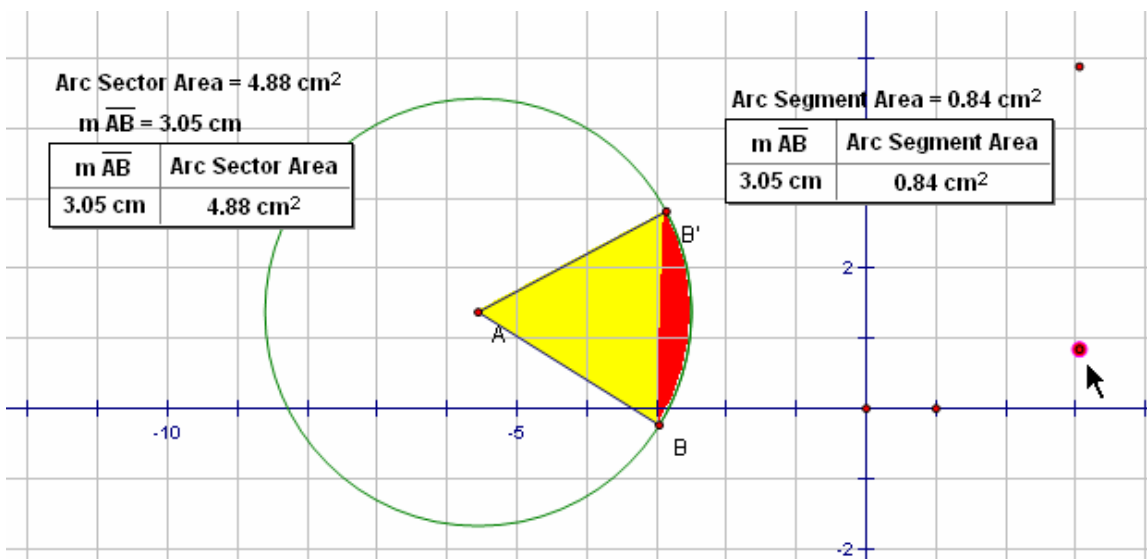
4. Create Table

To create a table to explore the relationship between the length of the radius and the arc segment area, highlight their measures respectively. Then use Graph from the menu bar with the Tabulate option. A labeled highlighted table will pop up on the sketch.

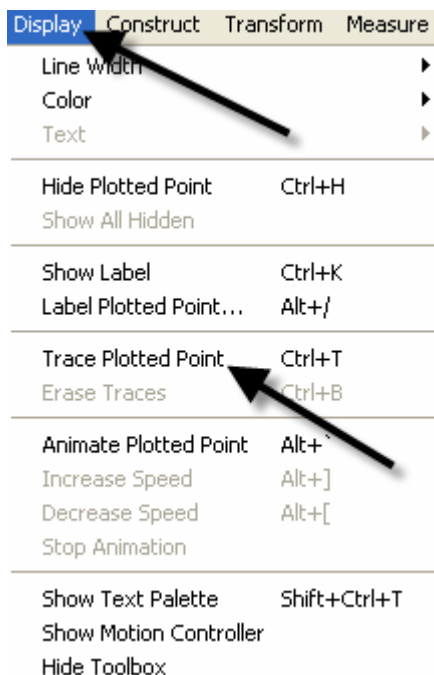


5. Plot and Trace Point

- a) To plot the point represented in the table, highlight the measure values in the respective order: length of radius, then area of the arc segment. Use **Graph** from the menu bar with the **Plot as (x, y)** option.



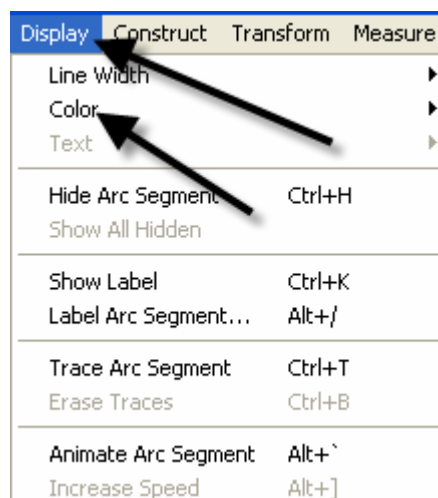
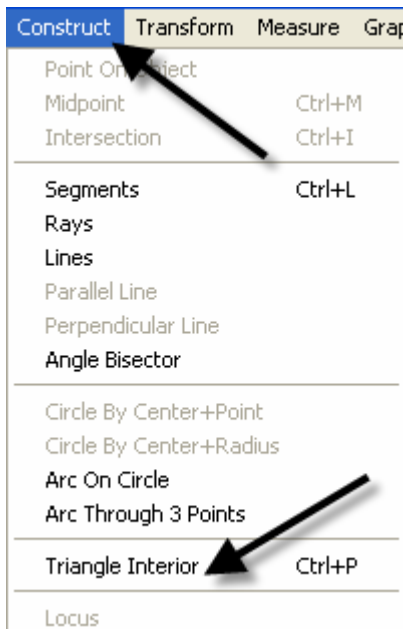
- b) To turn on the trace option, highlight the plotted point and use Display from the menu bar with the Trace Plotted Point option. This will allow any new points added to the table to be plotted automatically.



The Triangle Construction

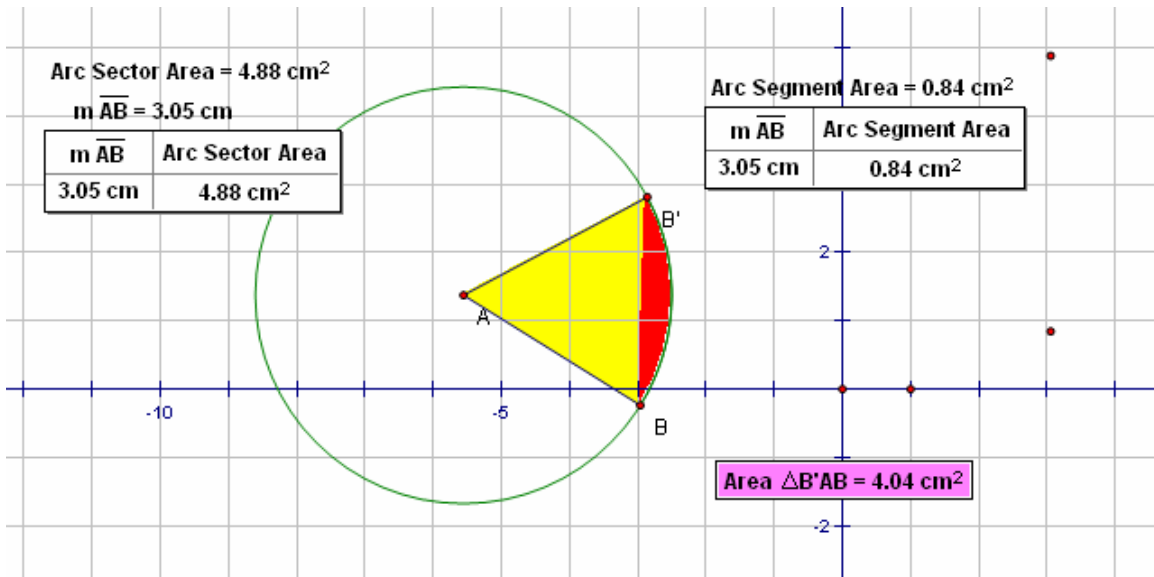
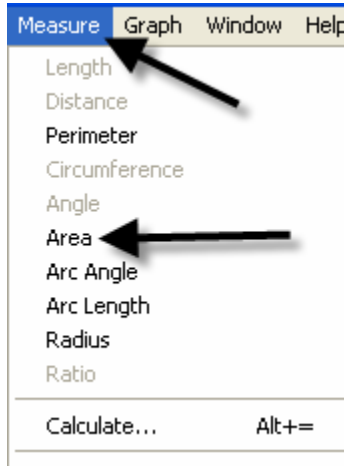
1. Construct Triangle Interior

To construct the triangle interior, first select the vertices of the triangle, then use **Construct** from the menu bar with the **Construct Triangle Interior** option. The color will change to the last color selected, so use **Display** from the menu bar with the **Color** option to make the triangle a different color than the arc segment.



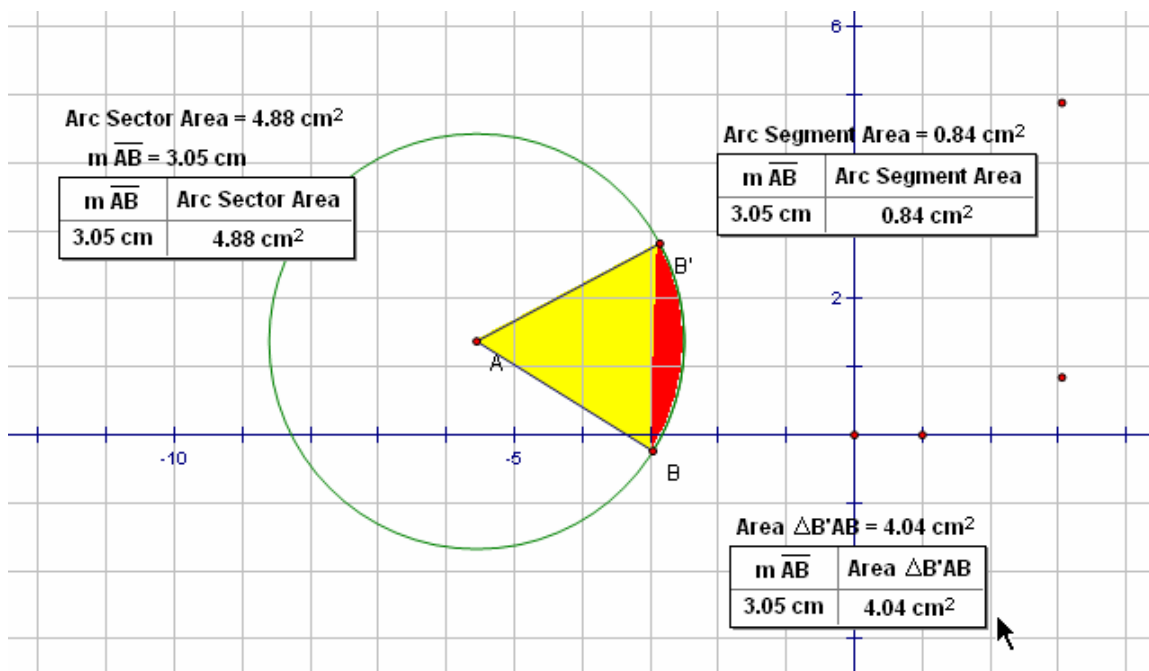
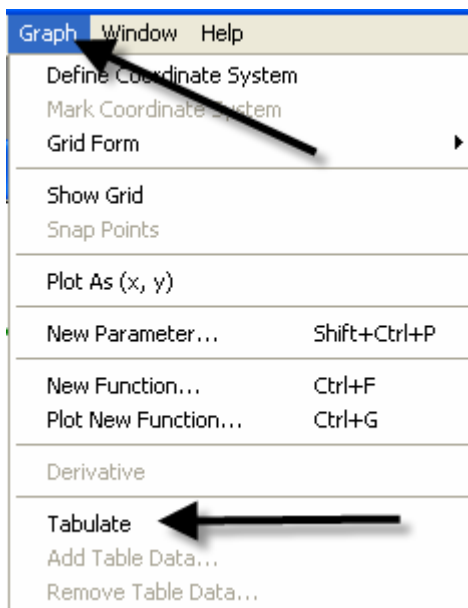
2. Measure Triangle Area

To measure the area of the triangle, click the triangle interior (may require double clicking to keep from selecting the entire sector) and use **Measure** from the menu bar with the **Area** option. With the measurement still highlighted, you may move it to a new location for easier viewing.



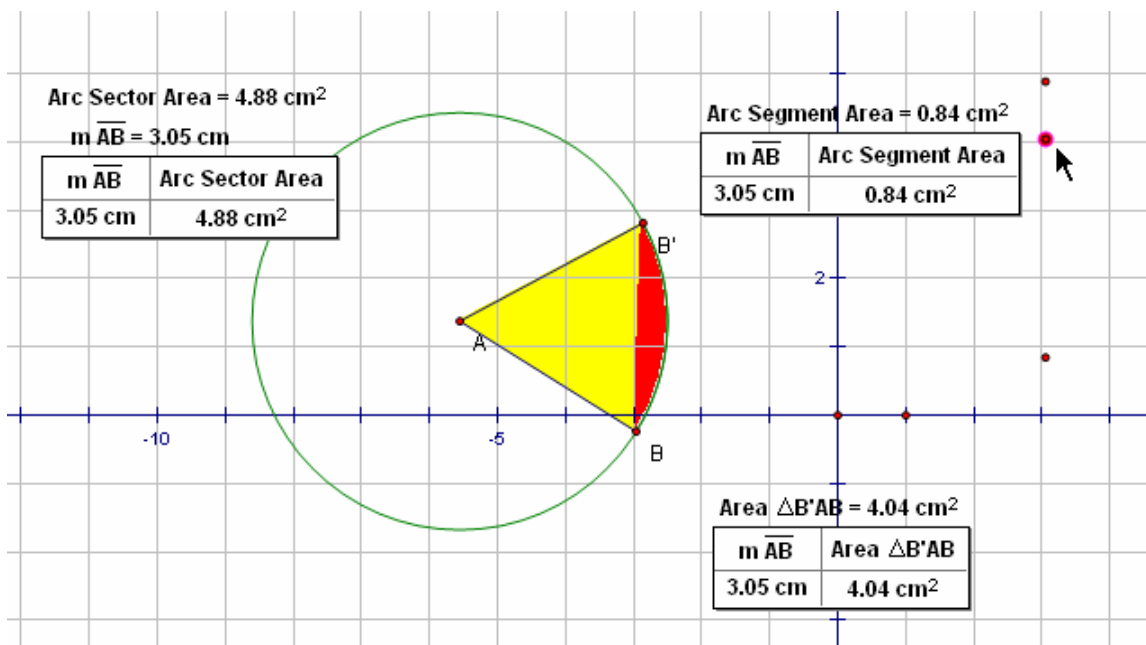
3. Create Table

To create the table to explore the relationship between the length of the radius and the area of the triangle, highlight both measures respectfully. Use **Graph** from the menu bar with the **Tabulate** option.

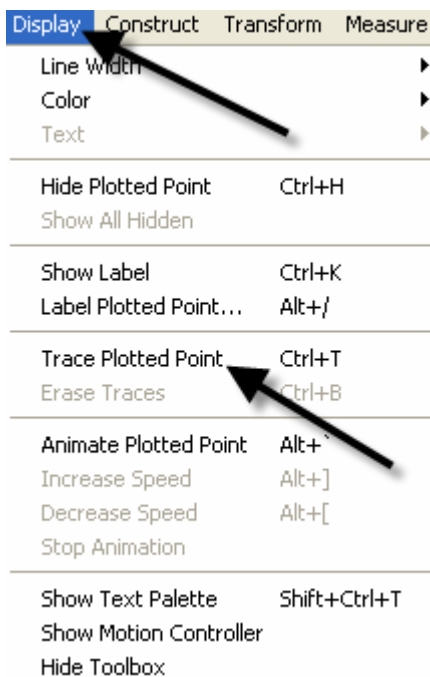


4. Plot and Trace Point

- a) To plot the point in the table, highlight the measures again: length of the radius and area of the triangle. Use **Graph** from the menu bar with the **Plot as (x, y)** option.



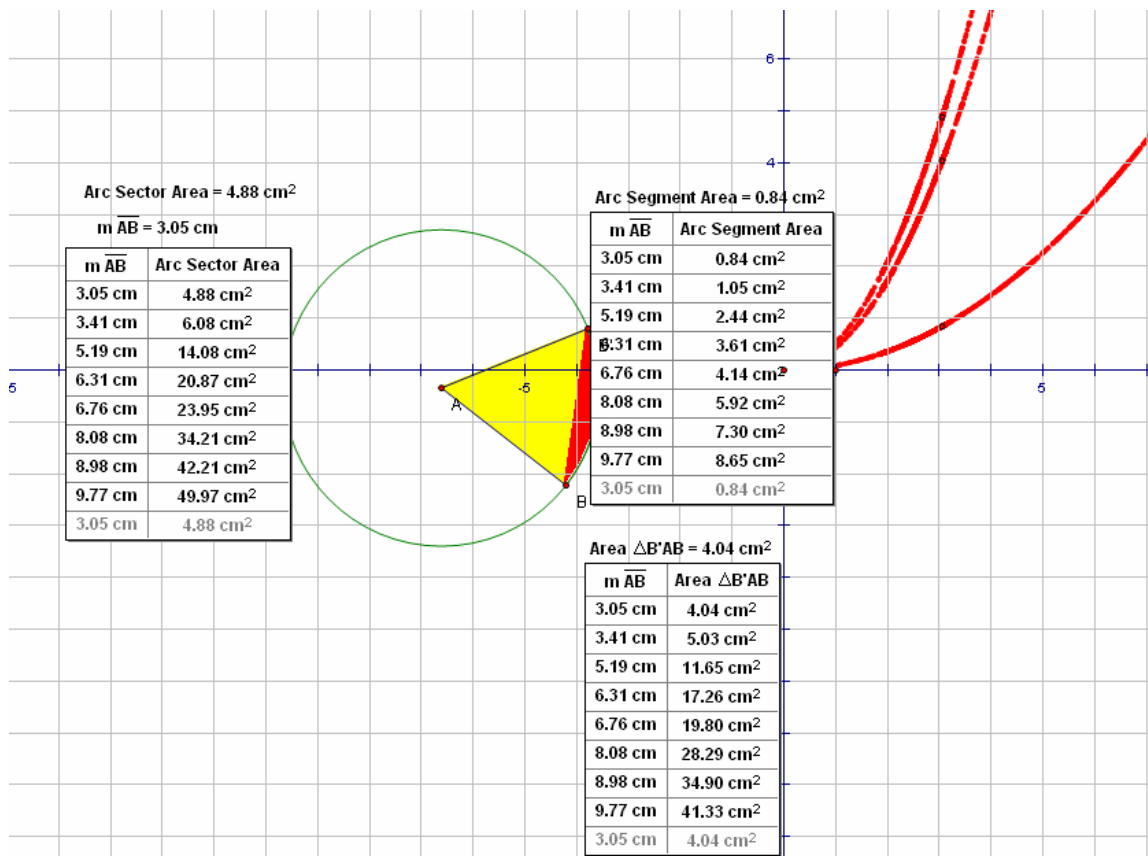
- b) To trace the plotted point, highlight the plotted point and use **Display** from the menu bar with the **Trace Plotted Point** option. This will allow any new points added to the table to be plotted automatically.



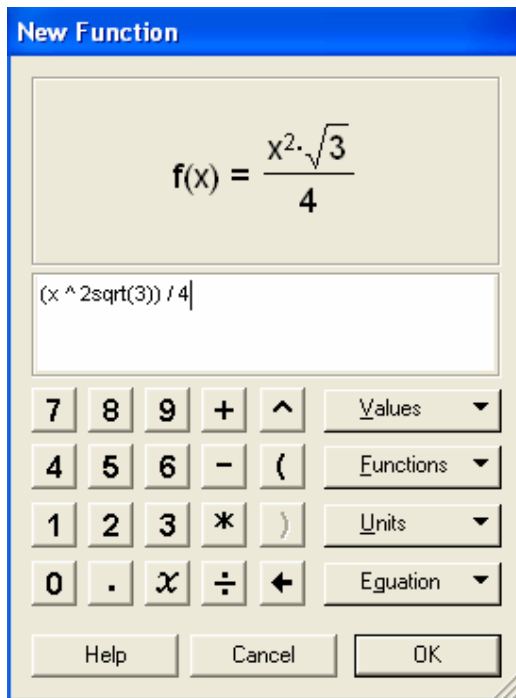
Dome Floor Dilemma—Function Rule Verification

Function Rule Verification—Geometer’s Sketchpad.

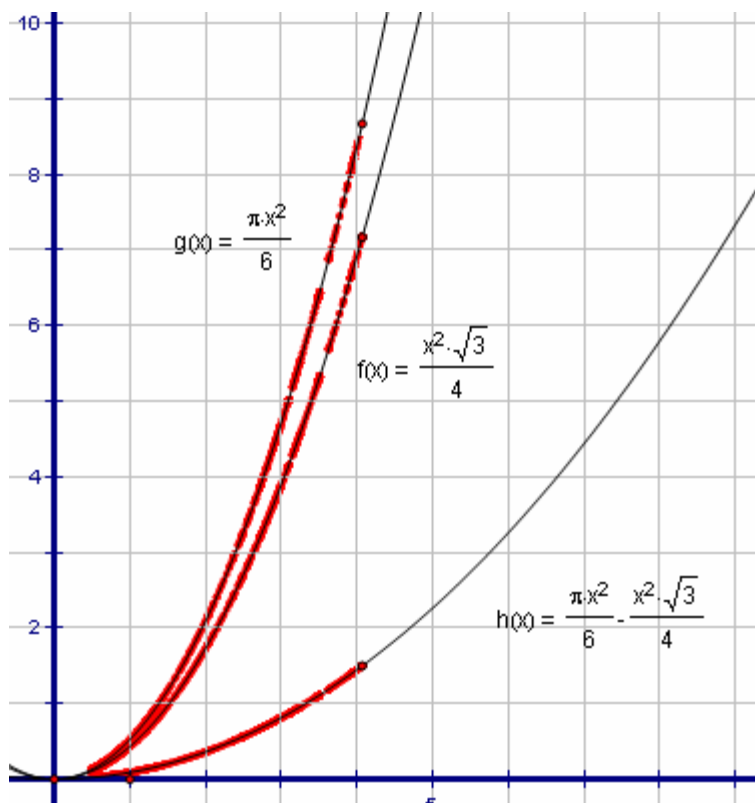
- Using the existing sketch from the Dome Floor Dilemma Exploration, use **Graph** with the **Plot New Function** option.



A **New Function** box will pop up, allowing the function rule to be entered. Then click on the **OK** button.



The function will then graph on the coordinate grid. If it is right, it will graph directly on top of its corresponding points, thus verifying the rule. Repeat this process for all function rules.

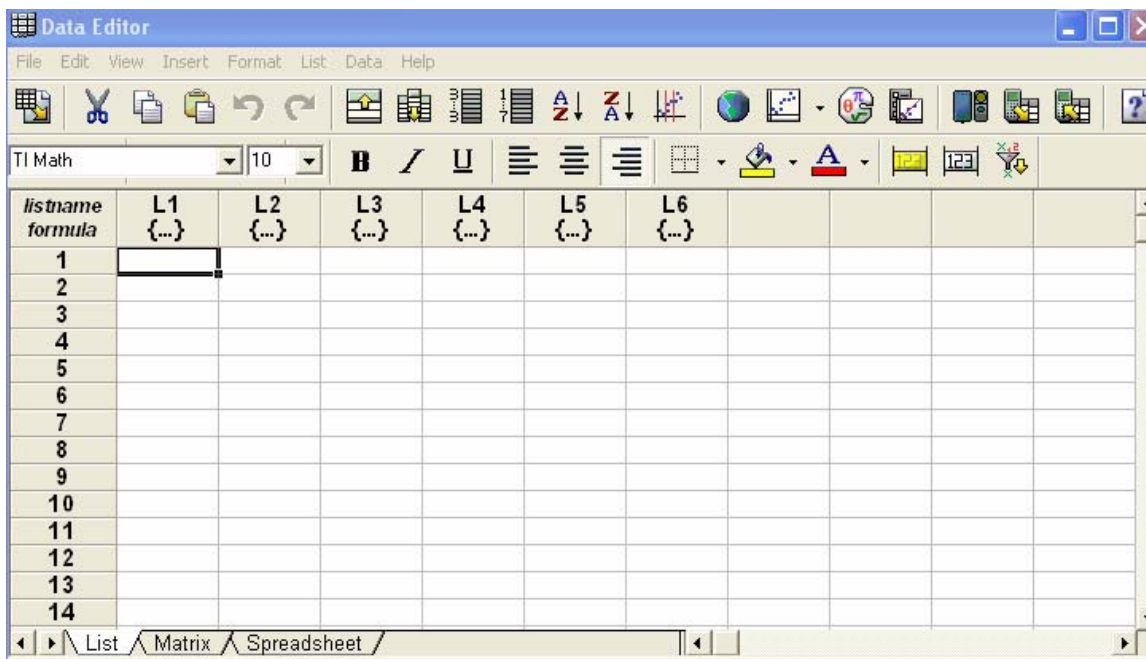
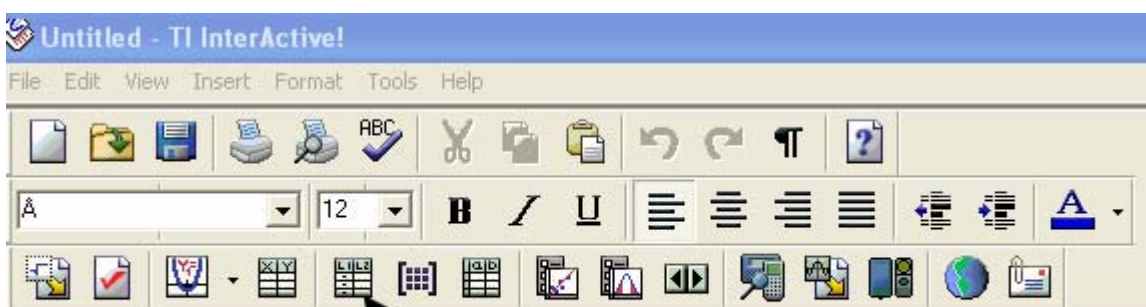


Function Rule Verification—TI-Interactive.

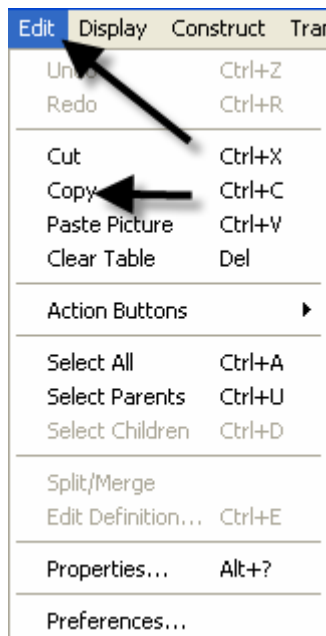
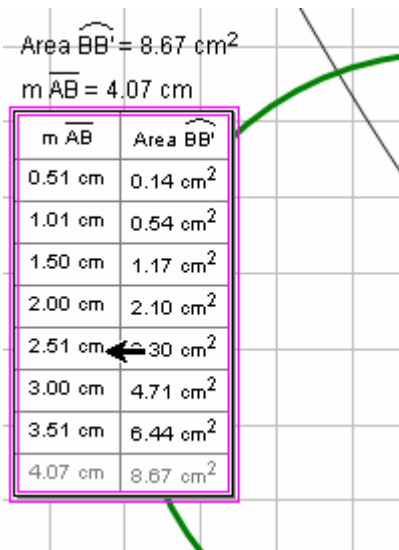
1. With your sketch in Geometer's Sketchpad still open, open TI-Interactive by pressing on the TI-Interactive icon.



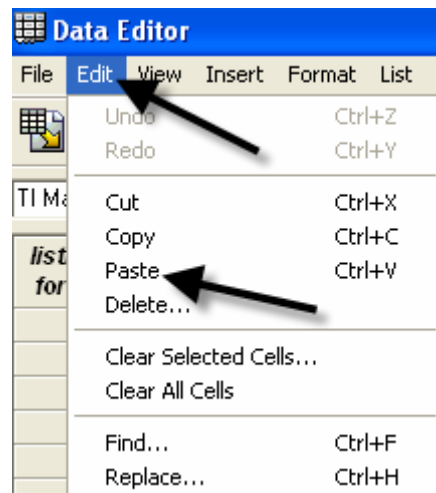
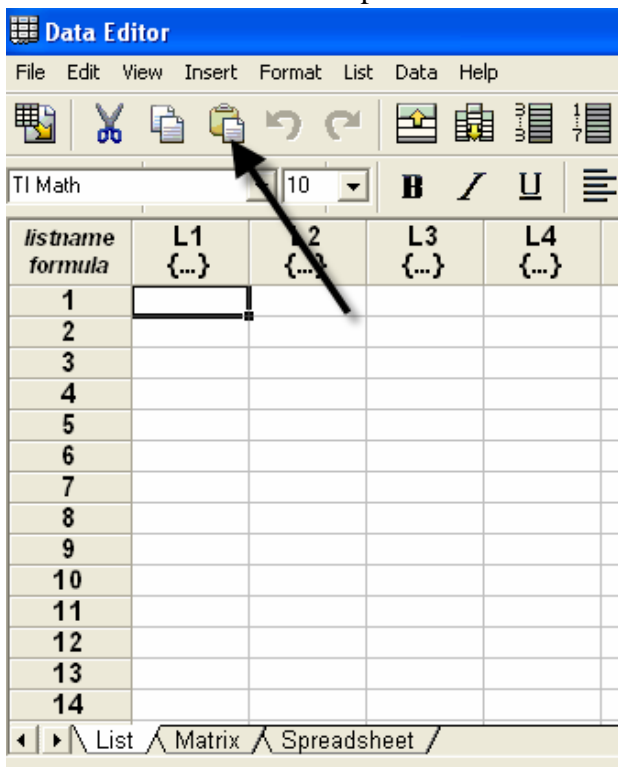
2. Click on the **List Icon** to get the **Data Editor** screen.



3. Select one of the tables from your sketch in **Geometer's Sketchpad** by clicking on it. Use **Edit** from the menu bar with the **Copy** option.



4. Return to the **Data Editor** and click on the **Paste** icon or use **Edit** from the menu bar with the **Paste** option.



- Notice that the table headings also transfer. Delete the non-numerical data; and if you like, enter the point of origin in its place.

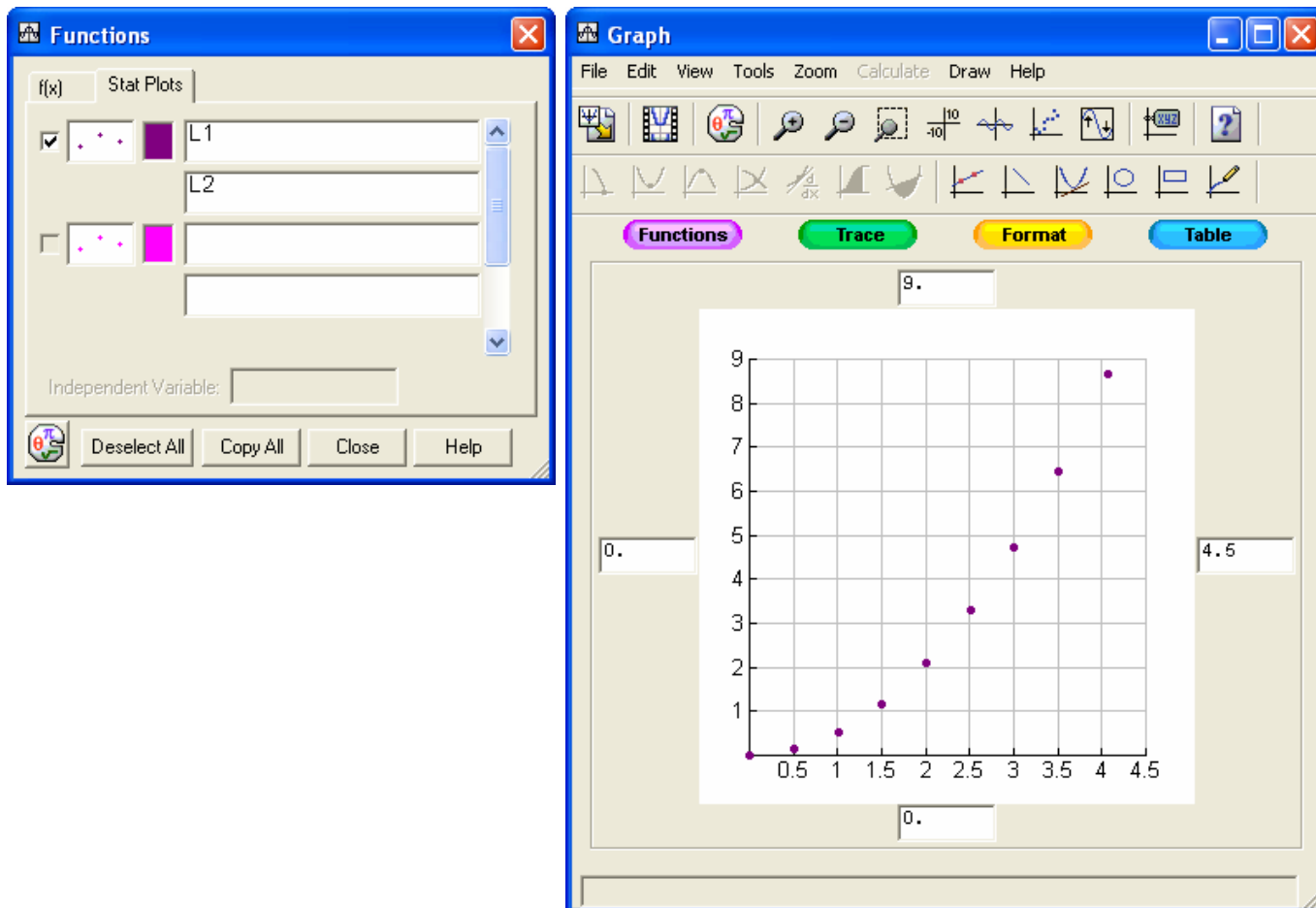
listname	L1	L2	L3
formula	{...}	{...}	{...}
1	m*ab+area*bb		
2	0.51	0.14	
3	1.01	0.54	
4	1.5	1.17	
5	2	2.1	
6	2.51	3.3	
7	3	4.71	
8	3.51	6.44	
9	4.07	8.67	
10			
11			
12			

listname	L1	L2	L3
formula	{...}	{...}	{...}
1	0	0	
2	0.51	0.14	
3	1.01	0.54	
4	1.5	1.17	
5	2	2.1	
6	2.51	3.3	
7	3	4.71	
8	3.51	6.44	
9	4.07	8.67	
10			
11			
12			

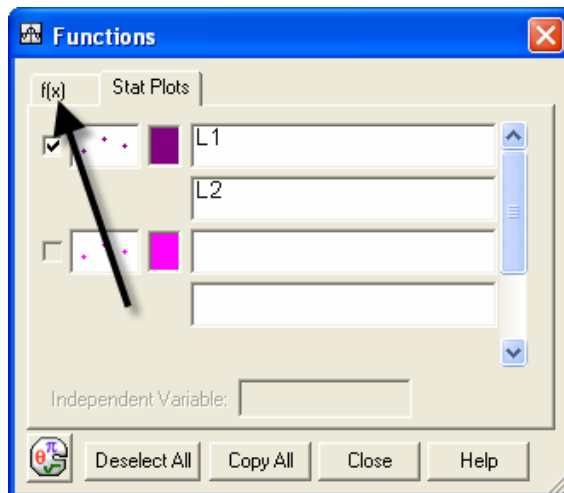
- Highlight the data you want to graph and click the **Scatter Plot** icon.


listname	L1	L2	L3	L4	L5	L6
formula	{...}	{...}	{...}	{...}	{...}	{...}
1	0	0				
2	0.51	0.14				
3	1.01	0.54				
4	1.5	1.17				
5	2	2.1				
6	2.51	3.3				
7	3	4.71				
8	3.51	6.44				
9	4.07	8.67				
10						
11						
12						

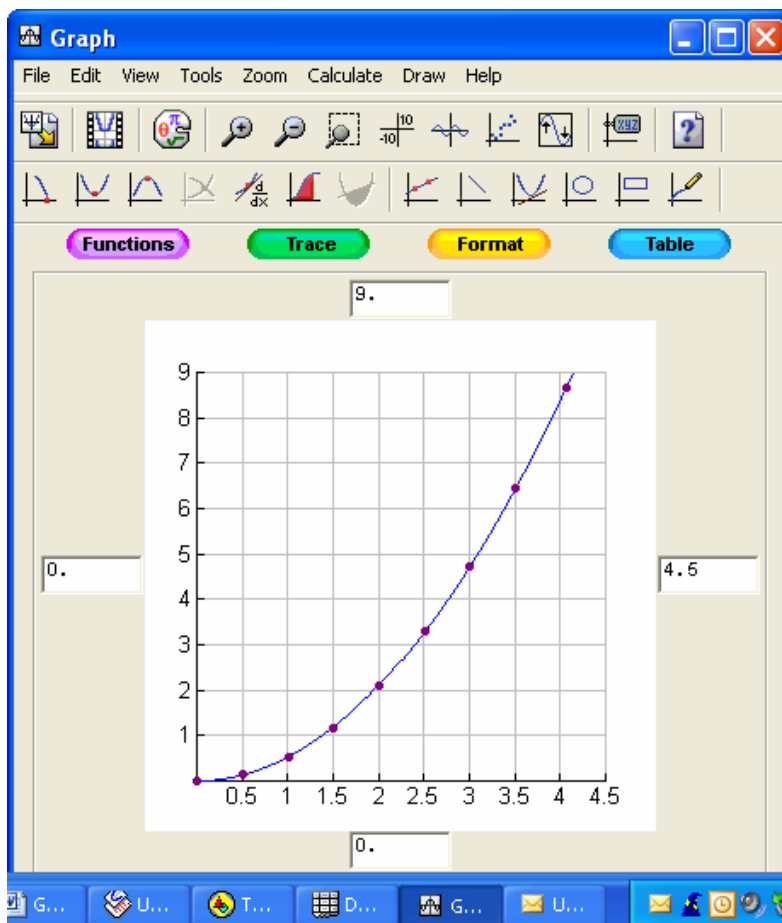
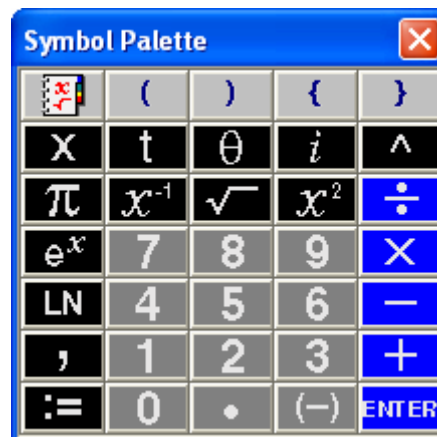
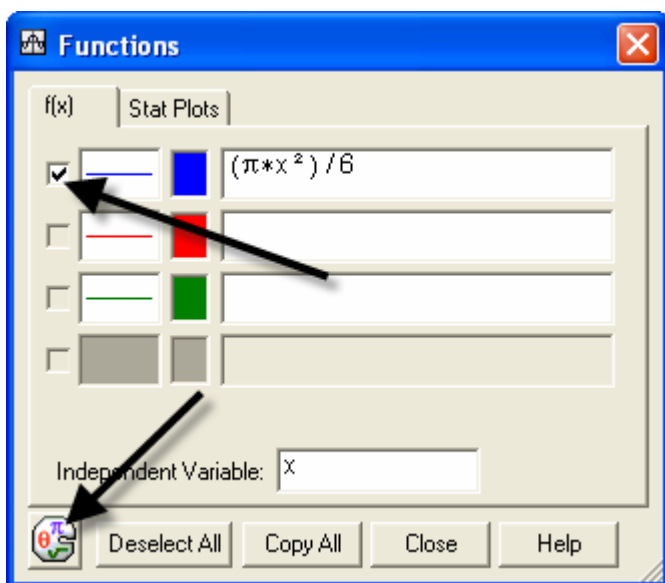
The **Functions** window and the **Graph** window will pop up with **L1** and **L2** listed in the **Stat Plots** windows and the points plotted on the **Graph**.



7. To enter the function for verification, click on the **f(x)** tab.

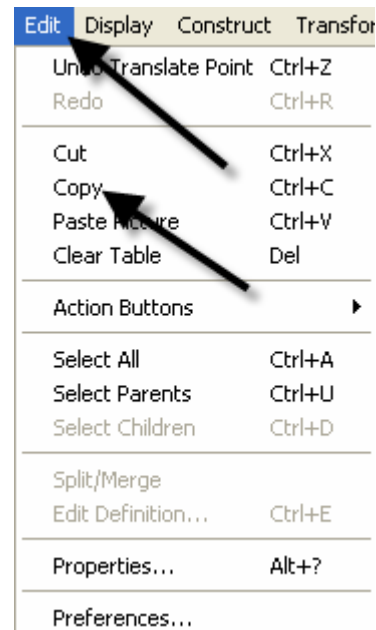


- To enter the function, press the Symbol Pallet icon . This lets the Symbol Palette pop up. Enter the function and check the box to graph the function.

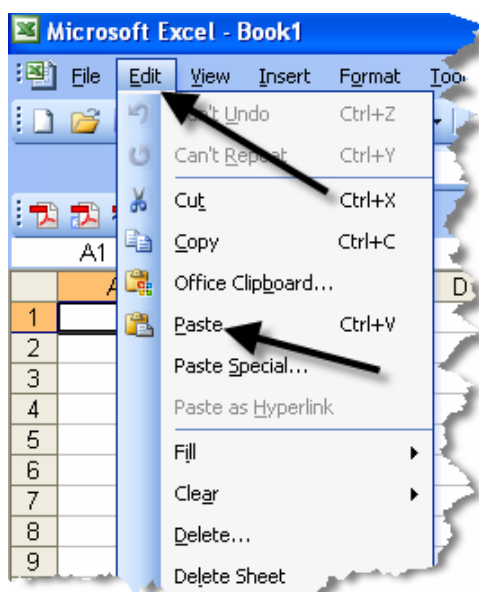


Function Rule Verification—Spreadsheet

- Copy the table from **Geometer's Sketchpad** by first selecting it, then use **Edit** from the menu bar with the **Copy** option.



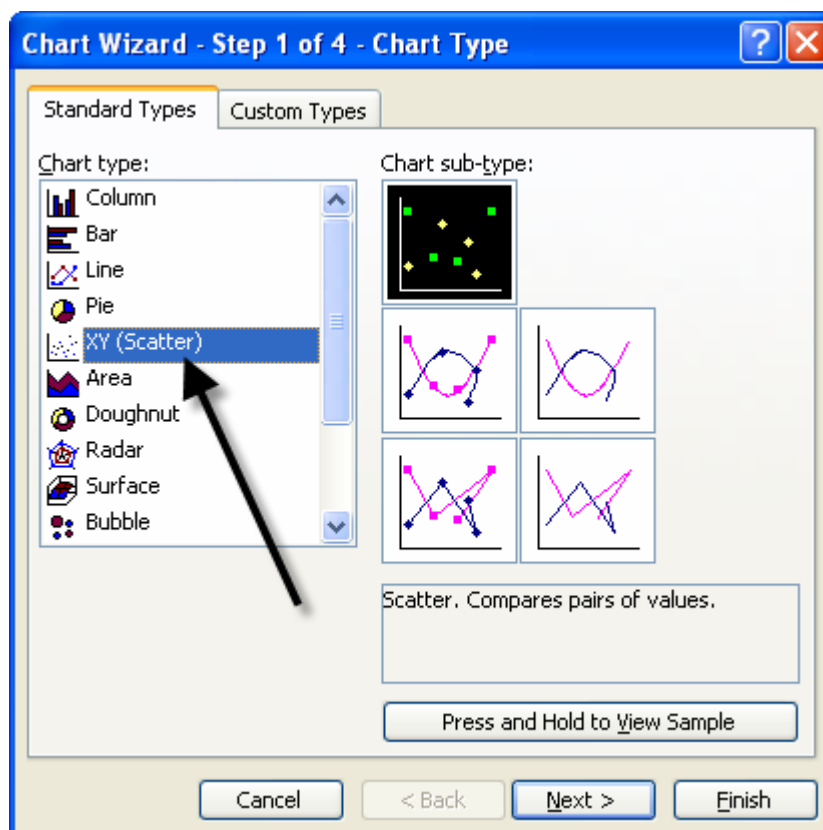
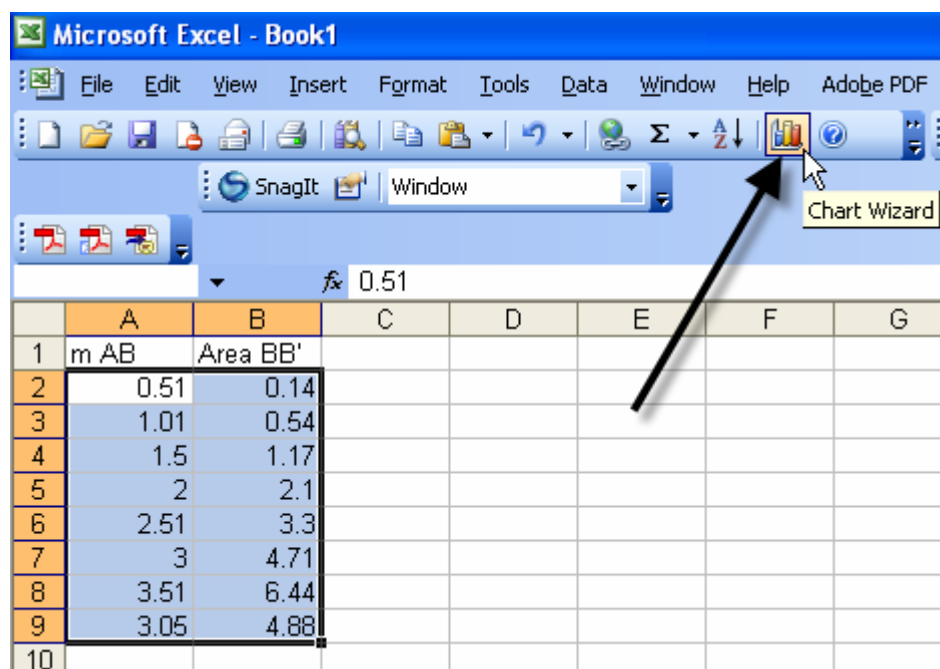
- Open a blank Spreadsheet and paste into the spreadsheet by using the **Edit** from the menu bar with the **Paste** option.



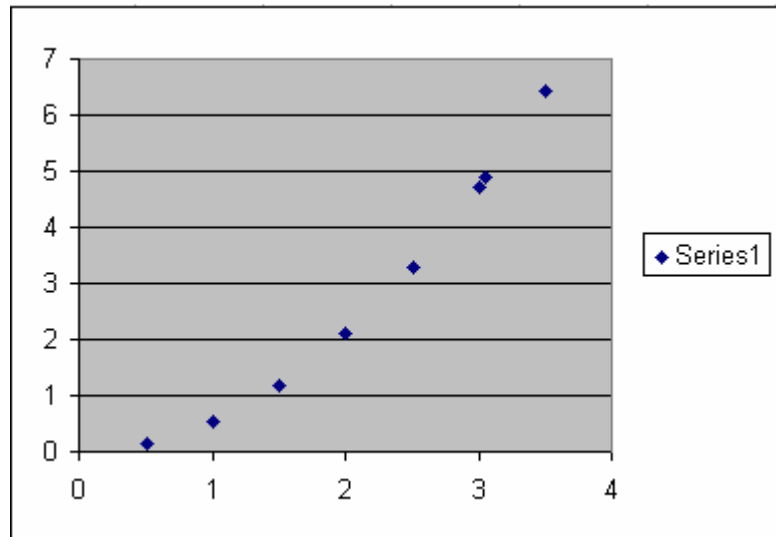
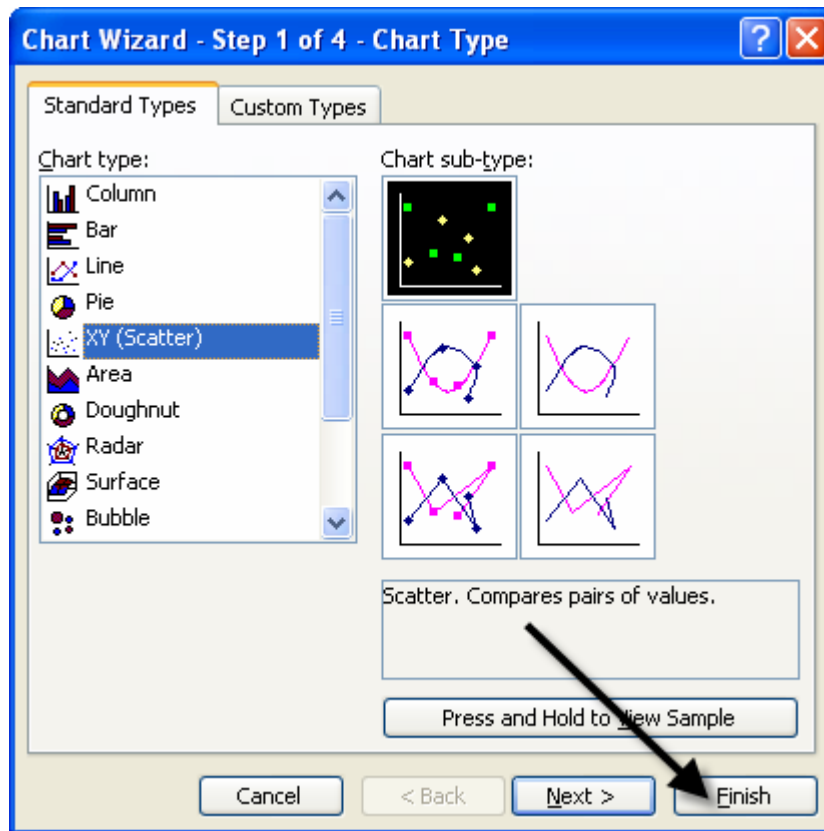
Microsoft Excel - Book1

	A	B
1	m \widehat{AB}	Area $\widehat{BB'}$
2	0.51	0.14
3	1.01	0.54
4	1.5	1.17
5	2	2.1
6	2.51	3.3
7	3	4.71
8	3.51	6.44
9	3.05	4.88

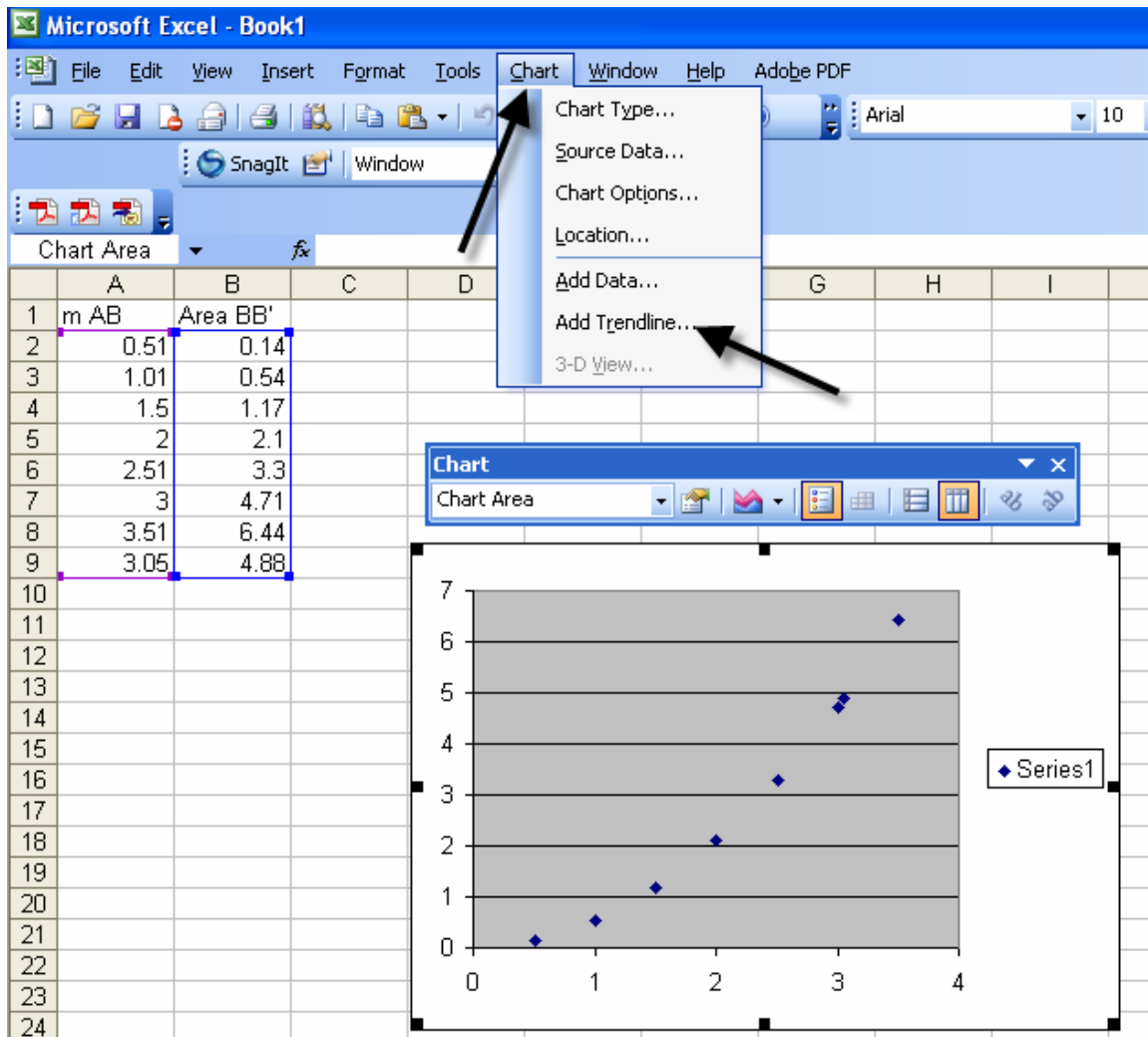
3. Highlight the data you want to graph, then click on the **Chart Wizard** icon. The Chart Wizard box will pop up on the screen. Select **XY (Scatter)**.



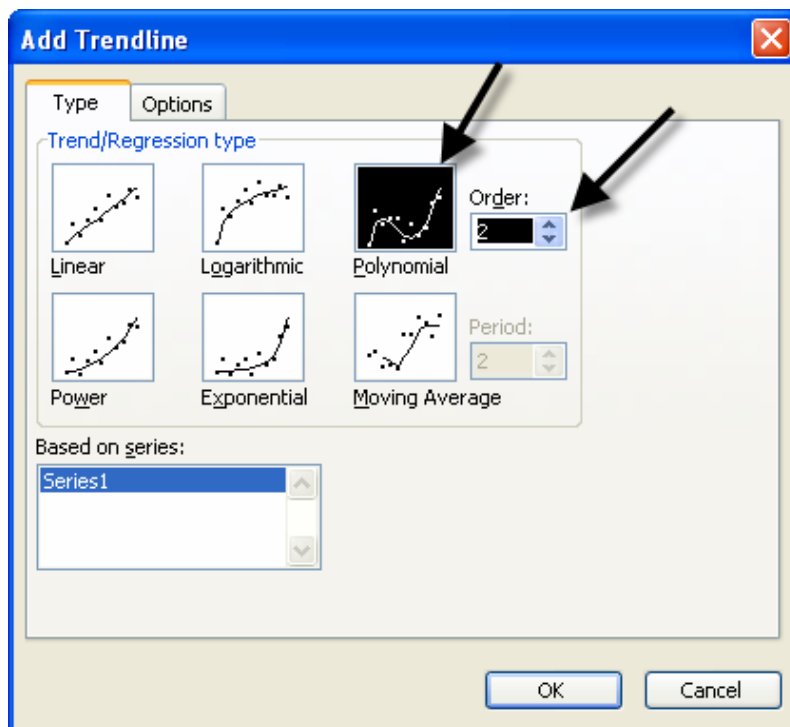
- Click **Finish** to view the graph.



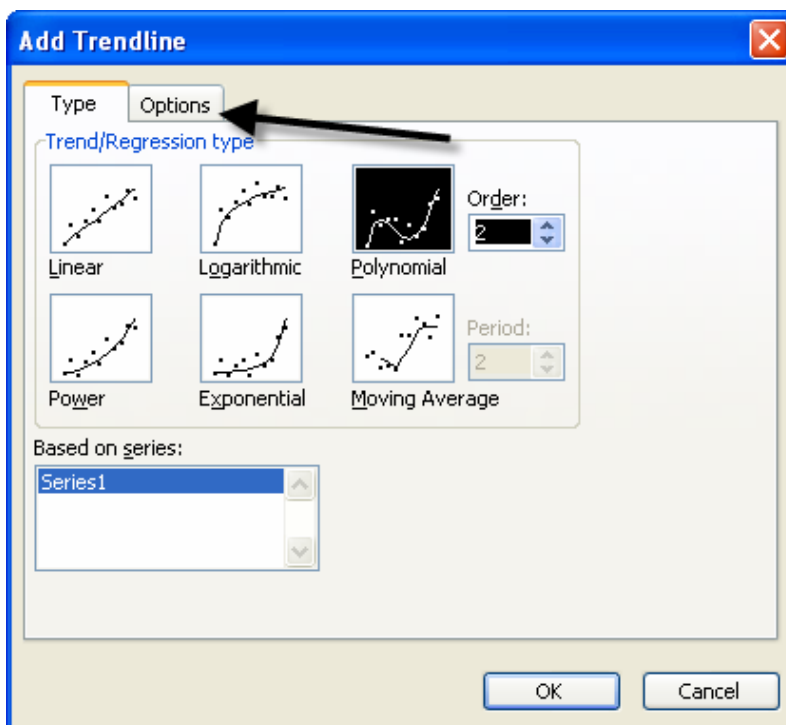
5. Select the graph, then use the Chart menu with the **Add Trendline** option.



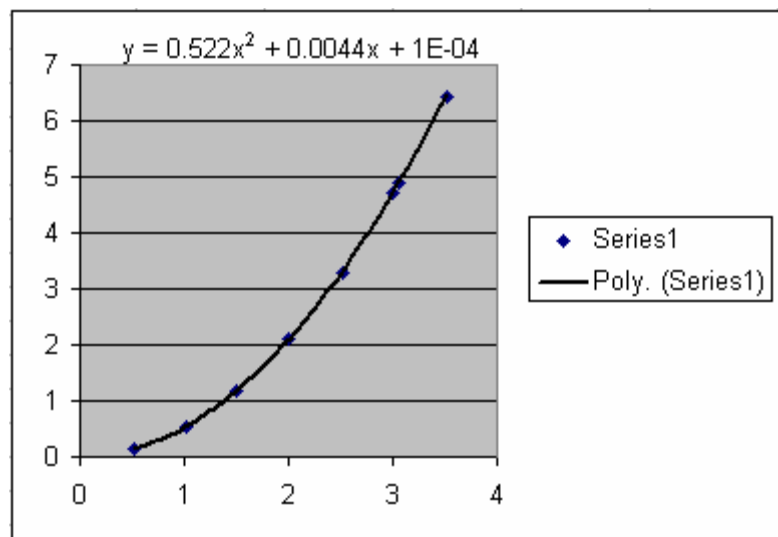
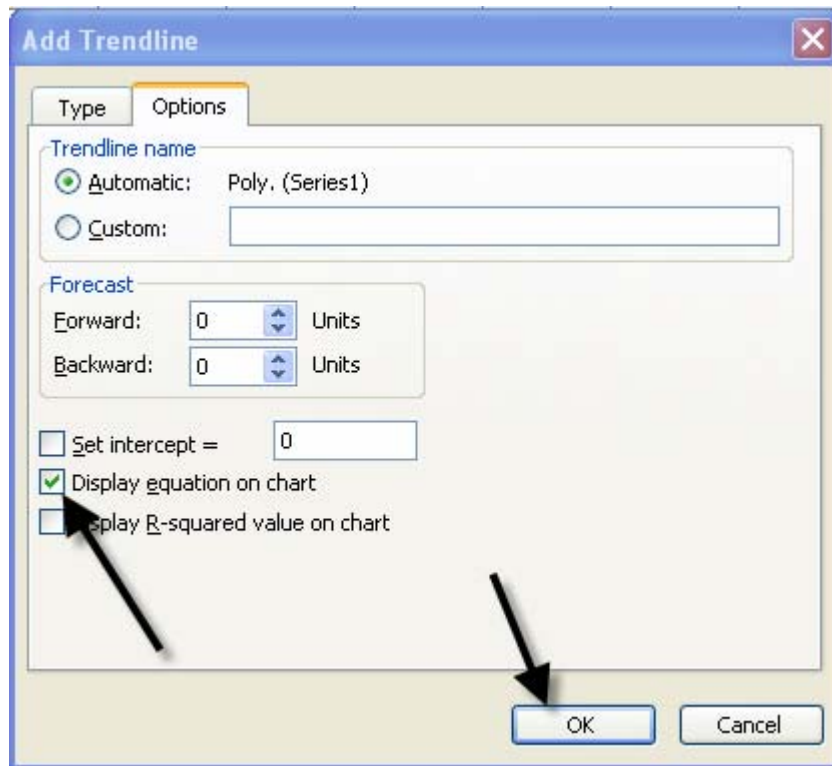
6. Since the scatterplot appears to be quadratic, select **Polynomial** order 2.



7. Click the **Options** tab.



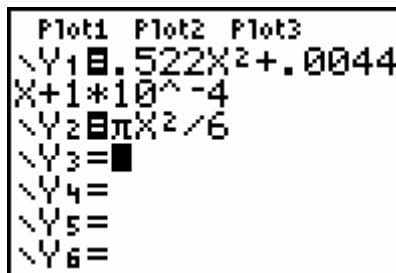
8. Check **Display Equation on Chart**, then click **OK**.



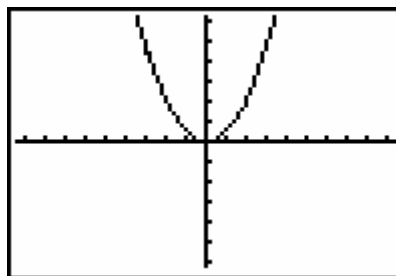
9. Use the graphing calculator to verify that the function that was developed by the spreadsheet is equivalent to $A_{sec} = \frac{\pi r^2}{6}$.

Press **[ON]**.

Enter both functions into **[Y=]**.



Press the **[GRAPH]** key. If the functions are equivalent, they will graph on top of each other and the graphing window will show what appears to be only one graph.

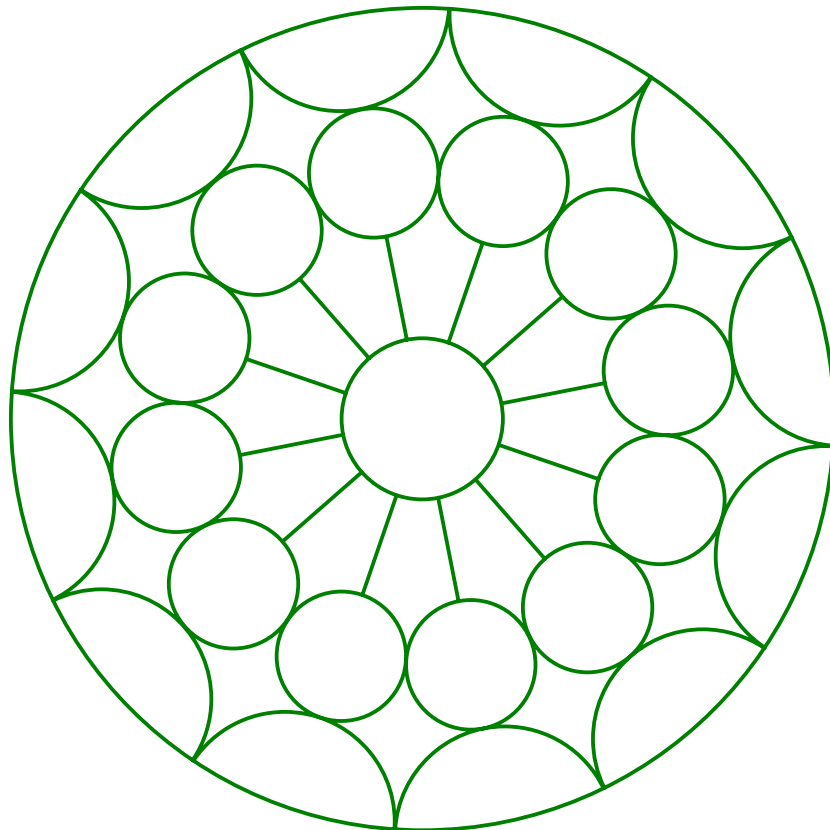
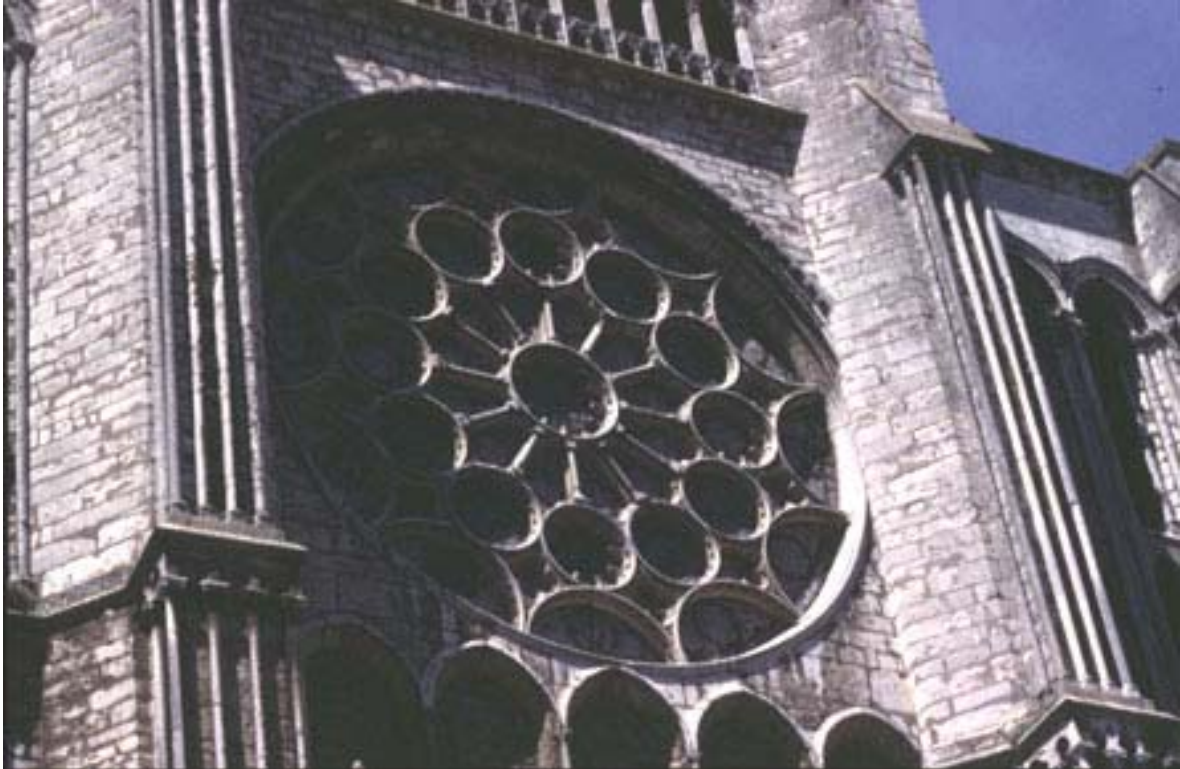


For further verification, press **[2nd]** **[GRAPH]** to examine the table values.

X	Y1	Y2
0	1E-4	0
1	.5265	.5236
2	2.0969	2.0944
3	4.7113	4.7124
4	8.3697	8.3776
5	13.072	13.09
6	18.819	18.85

X=0

Geometer's Sketchpad—Rose Construction



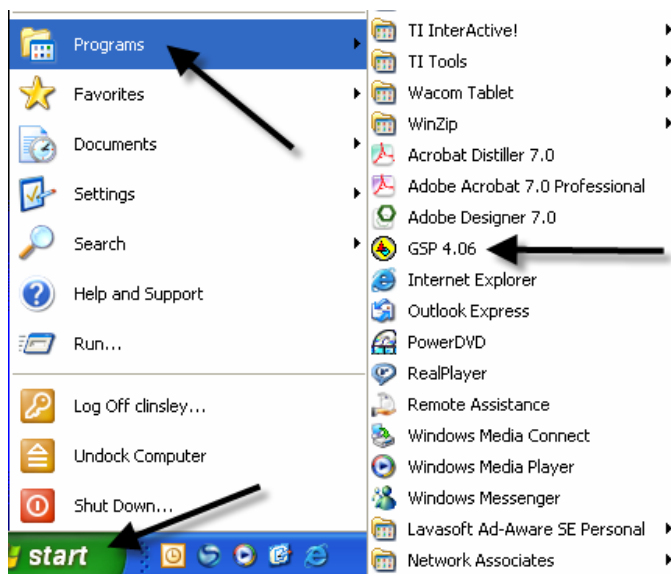
Opening a New Sketch

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

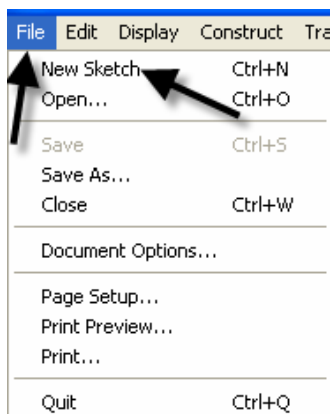


GSP 4.06.lnk

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

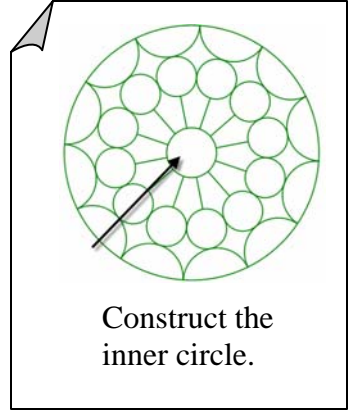
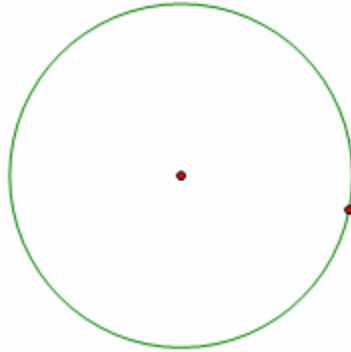
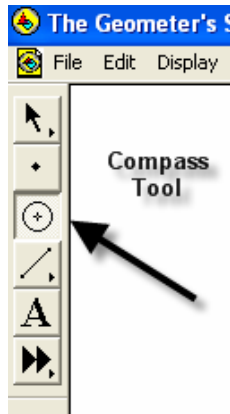


To open a **new sketch** in Geometer's Sketchpad, click on **File, New Sketch**.



Circle Construction

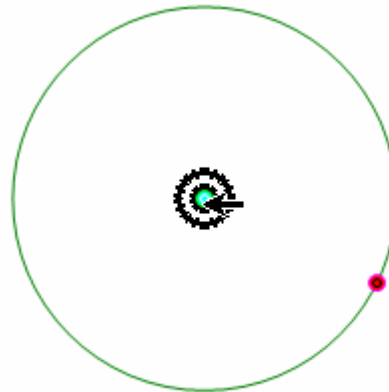
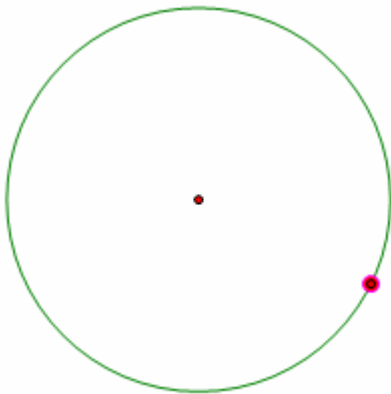
Construct a circle with the **Compass Tool**.



Angle Construction

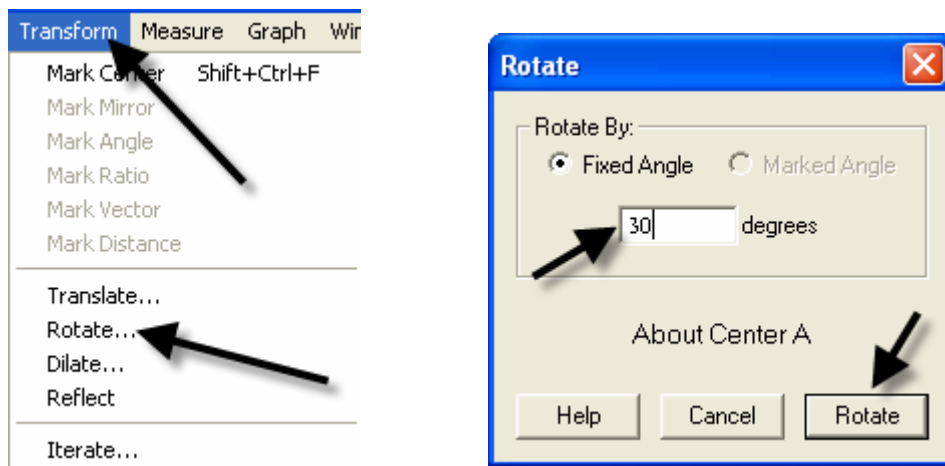
Construct a 30° angle by rotating a point on the circle.

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.

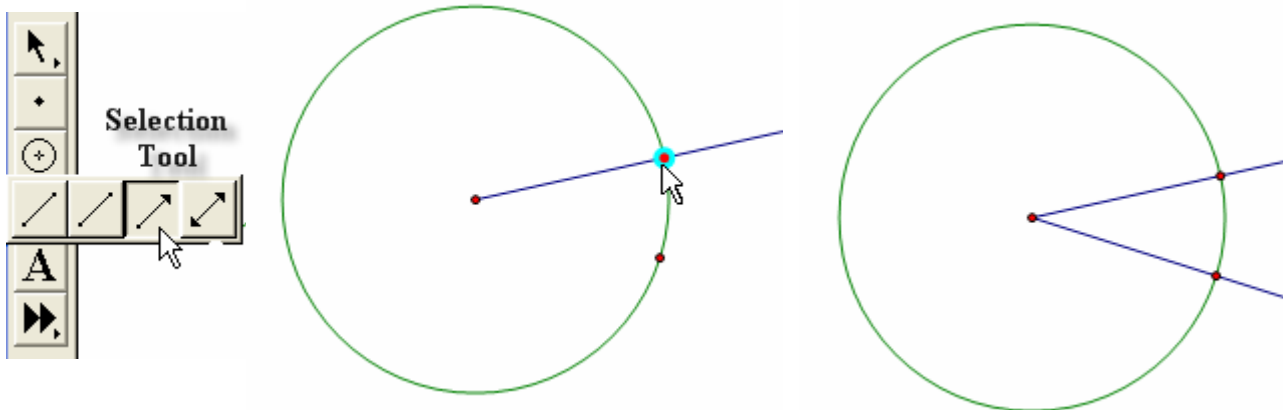


Since there are 12 congruent spokes in the rose, we can use 30 degree rotations in our construction.

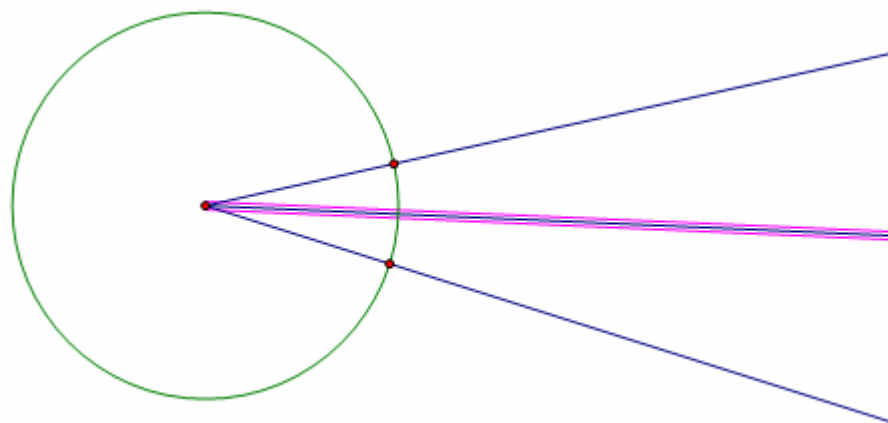
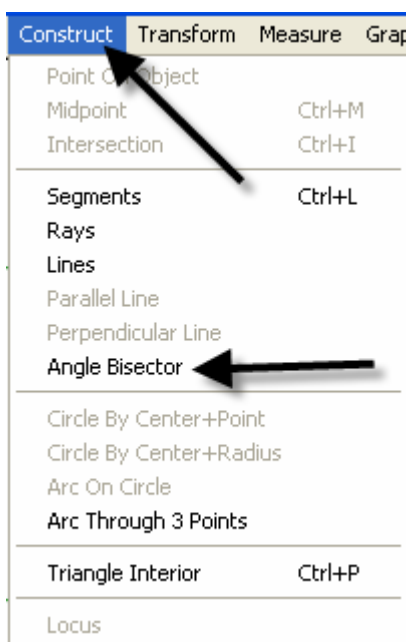
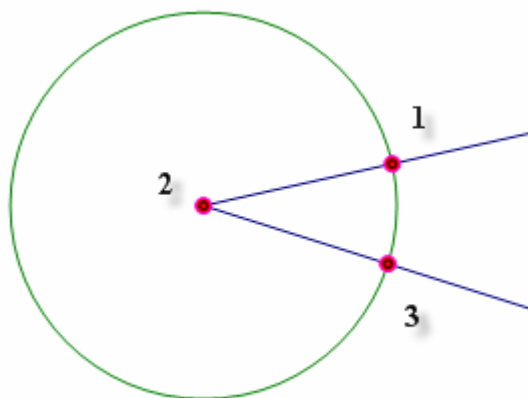
Use **Transform** from the menu bar with the **Rotate** option to rotate. Enter 30° in the window when the box pops up and click on **Rotate**.



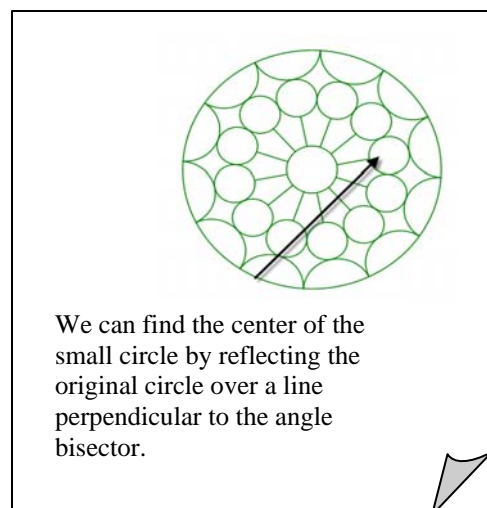
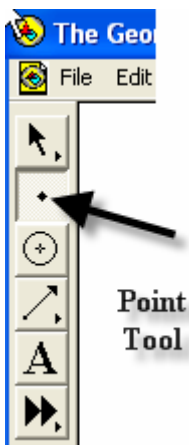
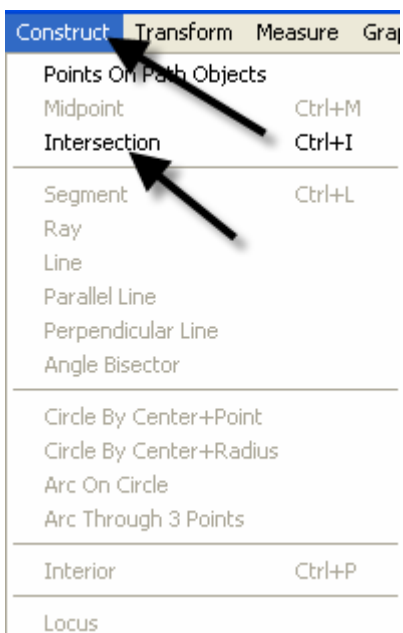
Construct an angle from the center of the circle through each point on the circle. Using the **Straightedge** tool, select the **Ray** option. Click on the center of the circle to attach the endpoint, and then line up the point of the ray on top of the point on the circle. Repeat for the second ray.



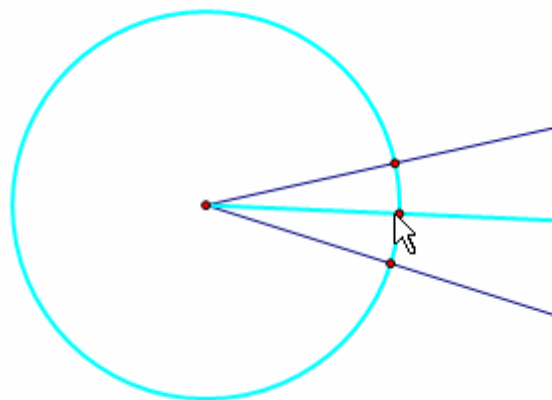
Construct the angle bisector by first selecting the three points of the angle, then using **Construct** from the menu bar with the **Angle Bisector** option.



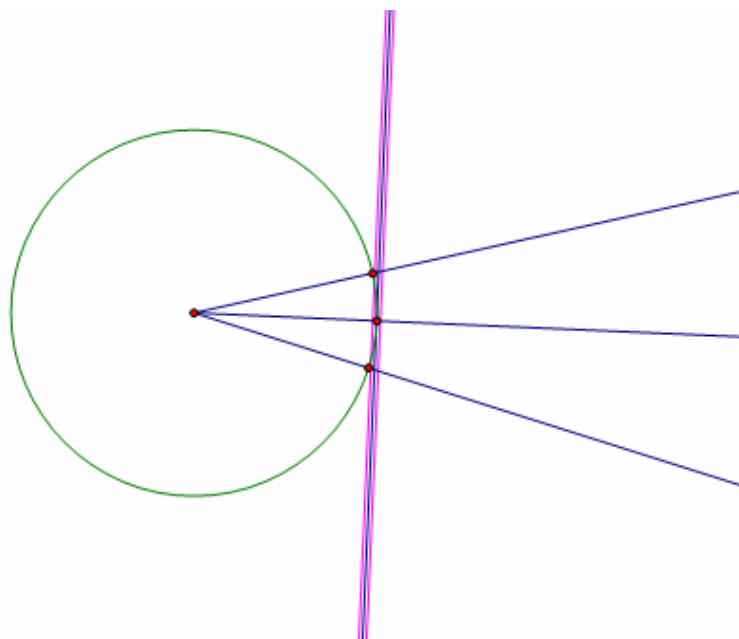
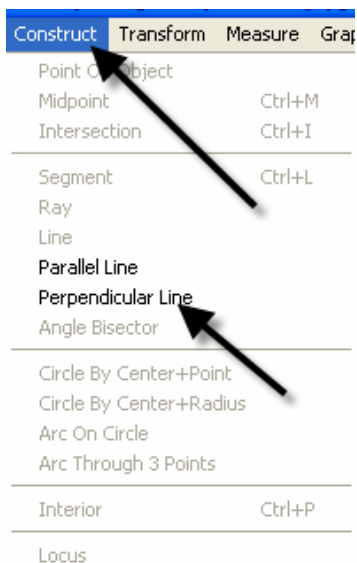
Construct a point where the angle bisector intersects the circle, either by selecting the angle bisector and the circle, then using **Construct** from the menu bar with **Intersection** option or by using the **Point** tool and placing the point on the intersection (You will know you are on the intersection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



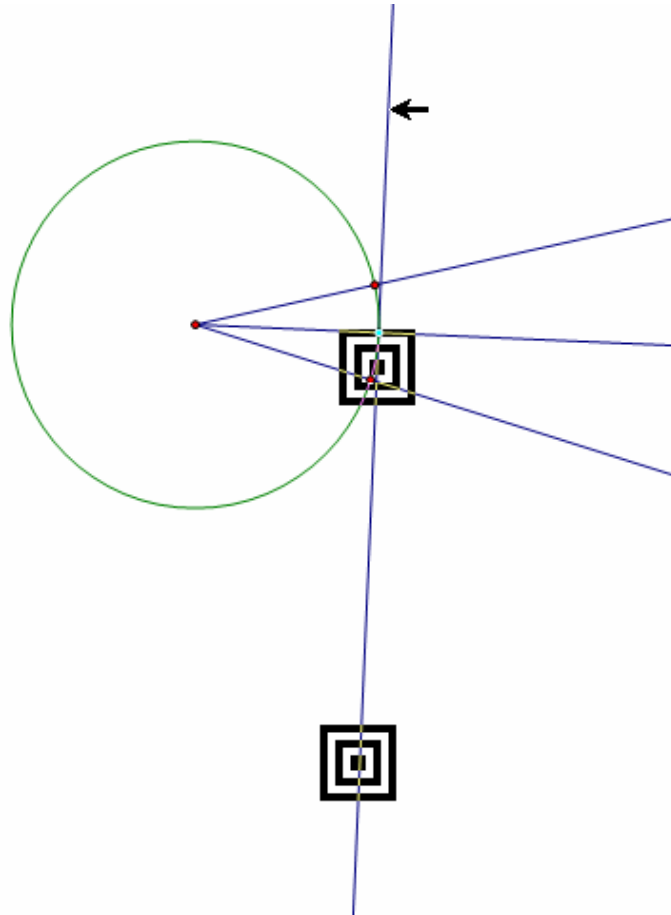
We can find the center of the small circle by reflecting the original circle over a line perpendicular to the angle bisector.



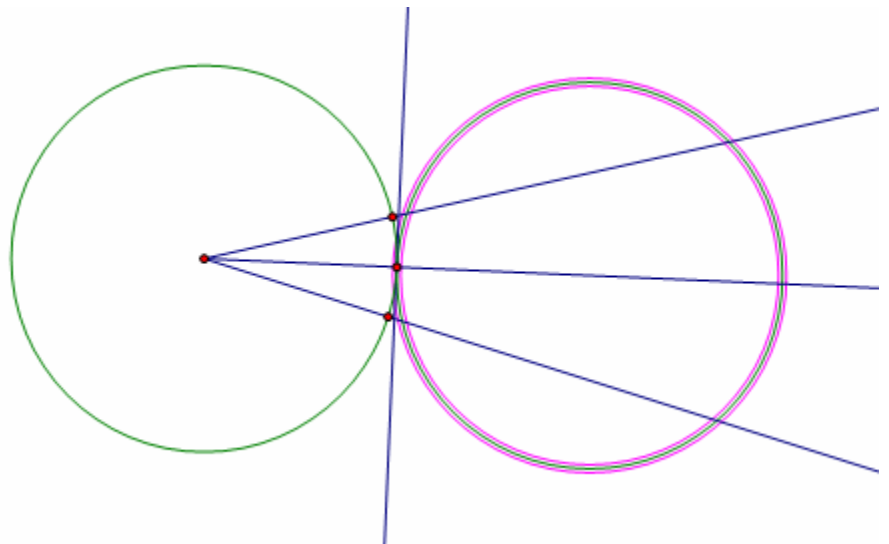
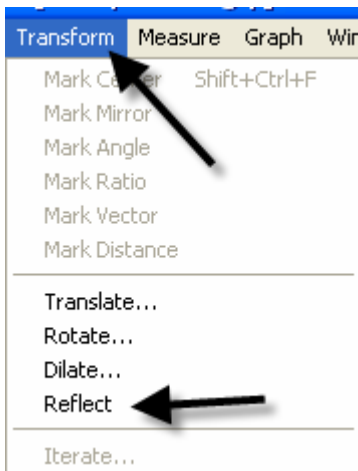
Construct a tangent to the circle through the point of intersection of the circle and the angle bisector by first selecting the point of intersection and the angle bisector, then using **Construct** from the menu bar with the **Perpendicular Line** option.



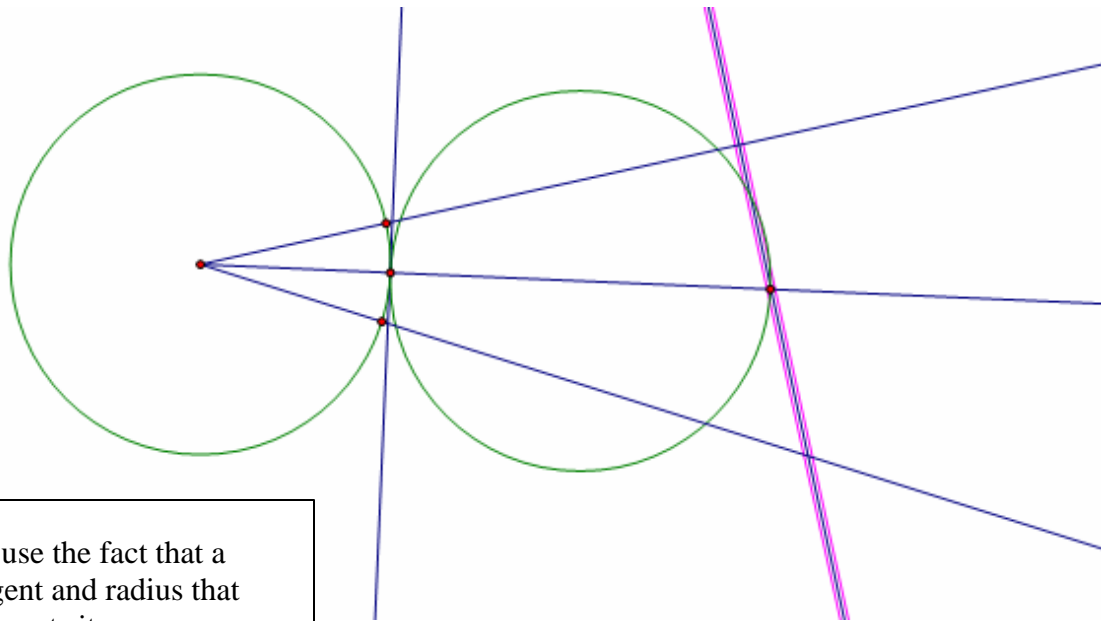
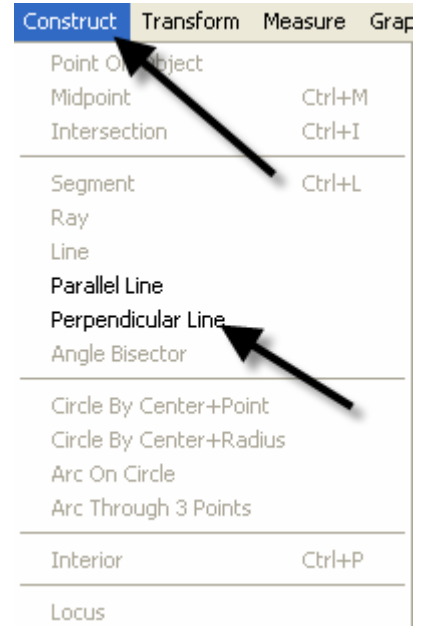
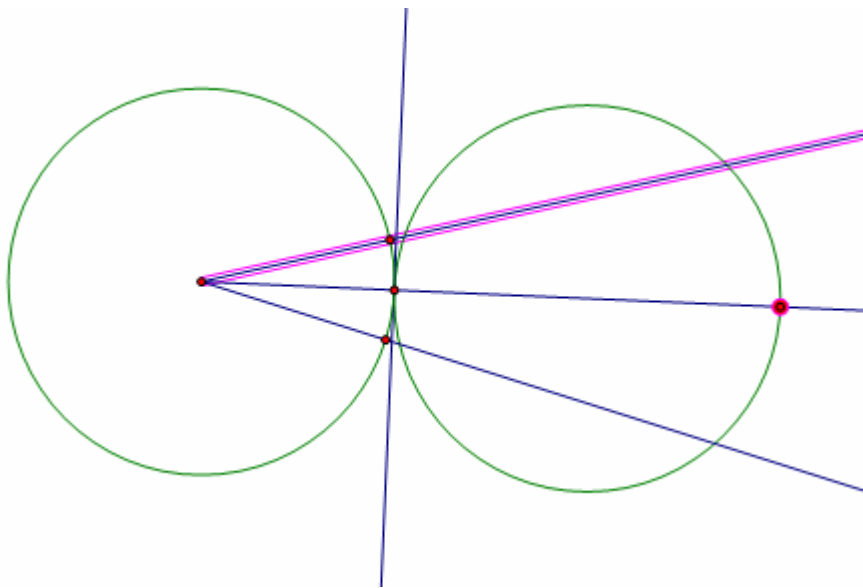
Mark the tangent line as a line of reflection by double clicking on the line. You will see a double set of concentric boxes flash as the line is being marked.



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

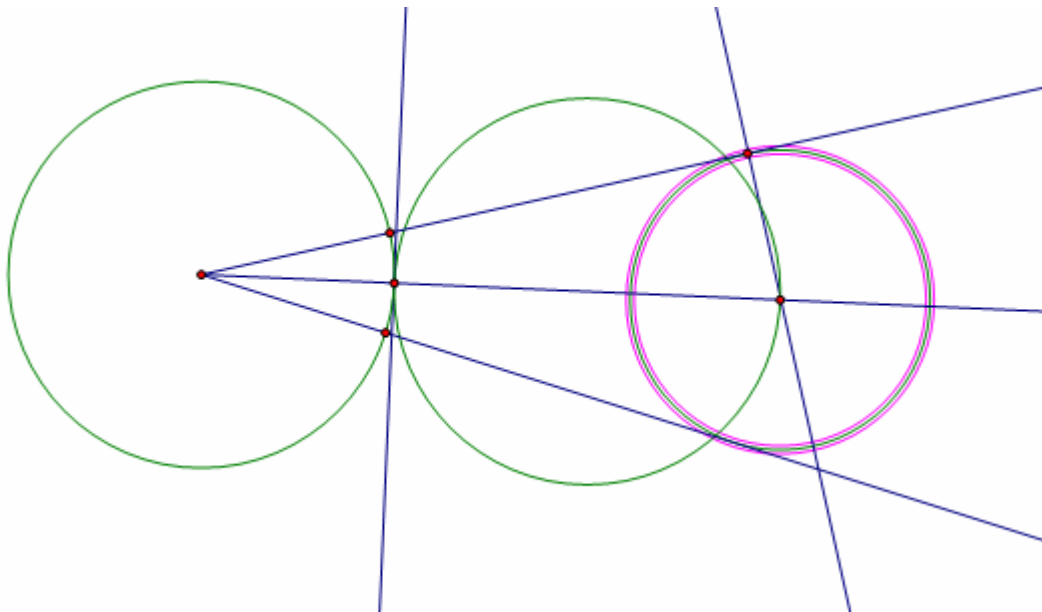
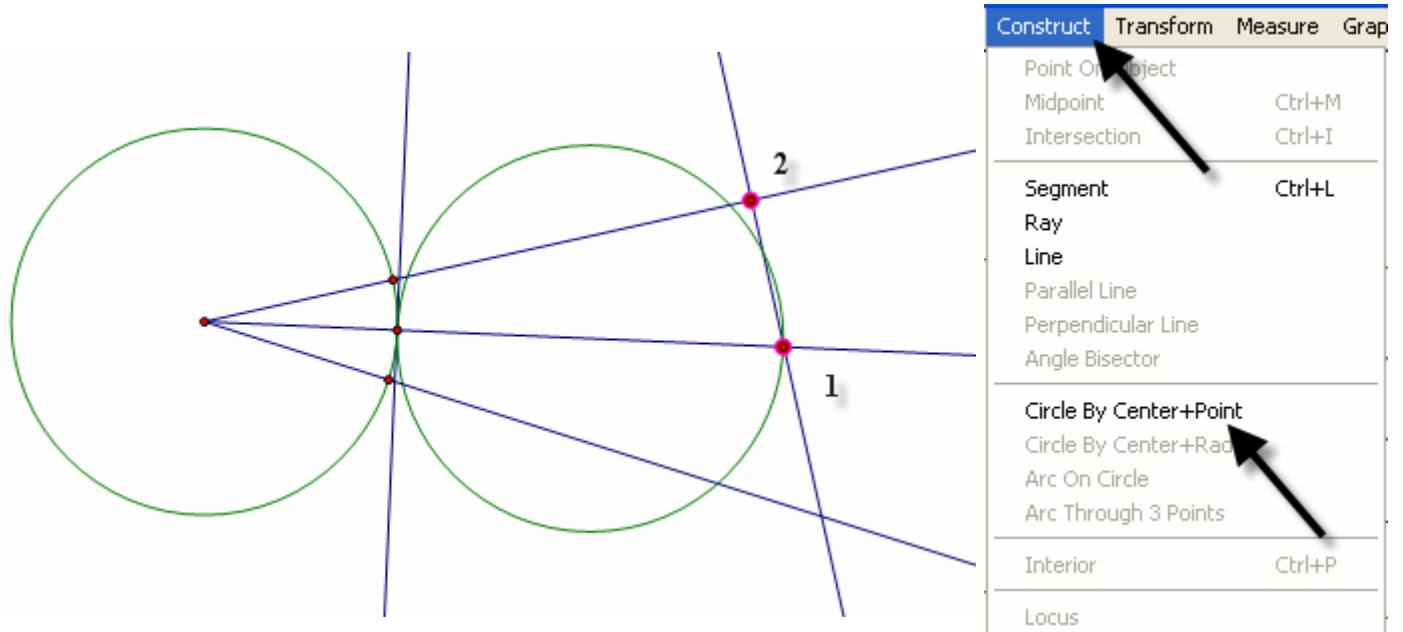


Construct the intersection of the angle bisector and the circle, then construct a line through it and perpendicular to one side of the angle. Select the point of intersection and the ray that forms one side of the angle, then use **Construct** from the menu bar with the **Perpendicular Line** option.

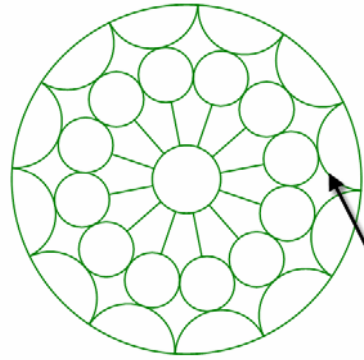


We use the fact that a tangent and radius that intersects it are perpendicular to construct a circle tangent to the rays.

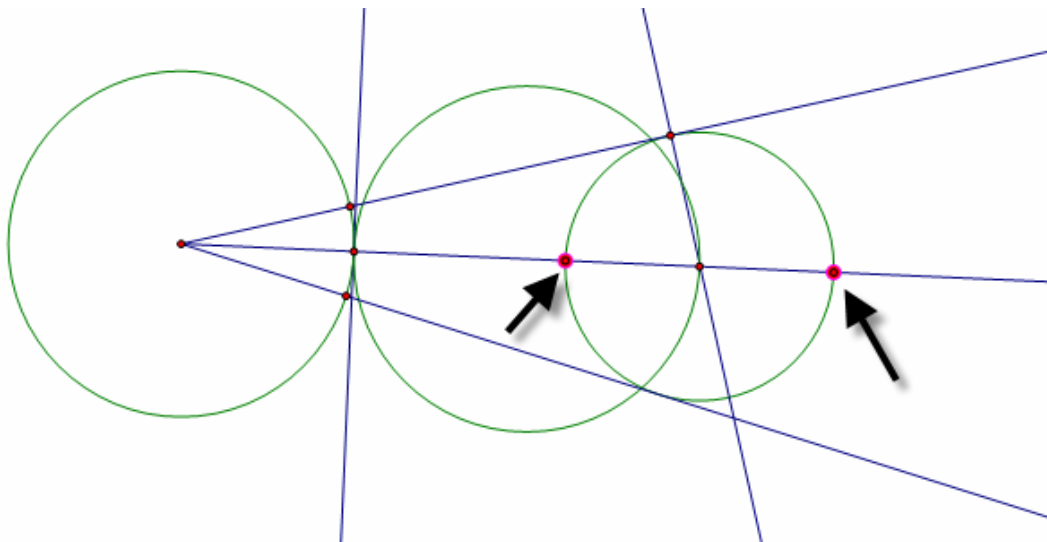
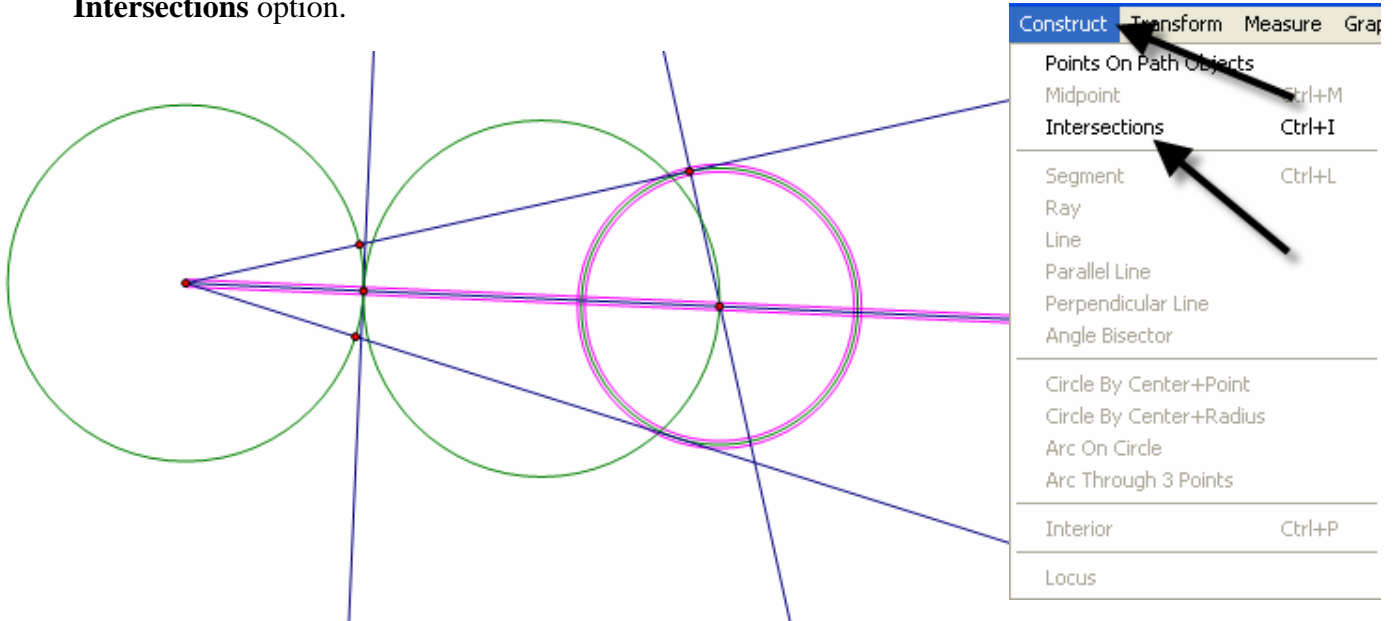
Construct the point of intersection with the new perpendicular line and the side of the angle. Select the points in the order shown below. Use **Construct** from the menu bar with the **Circle By Center+Point**.



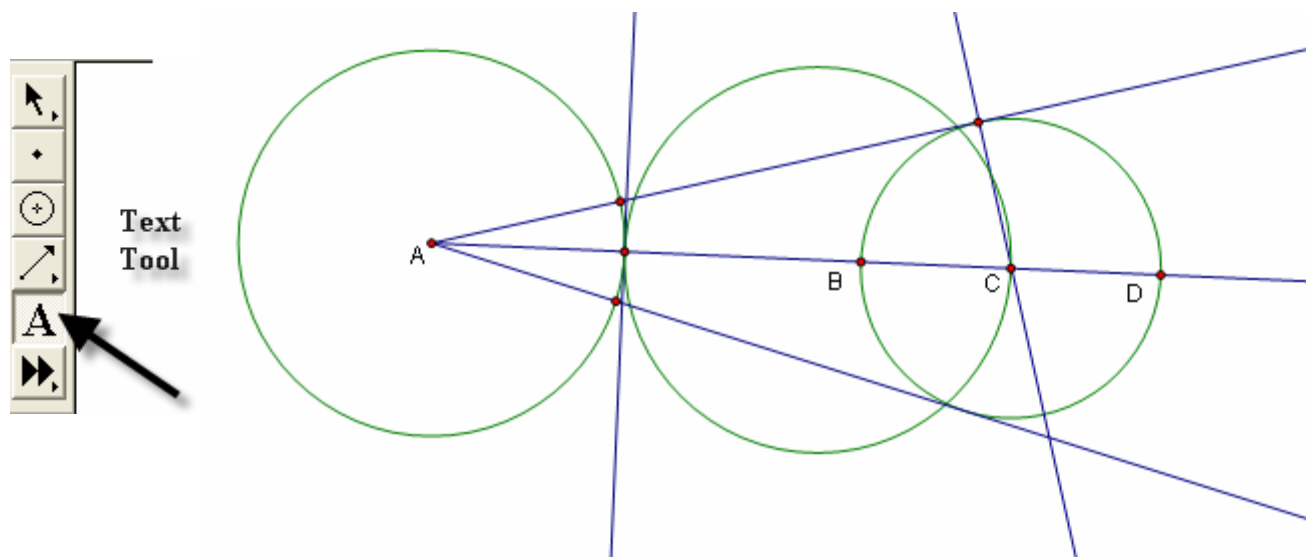
We need to construct an arc that is tangent to the rays that form the angle as well as tangent to the small circle. We will use proportional reasoning to determine the center of the circle the arc lies on.



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.

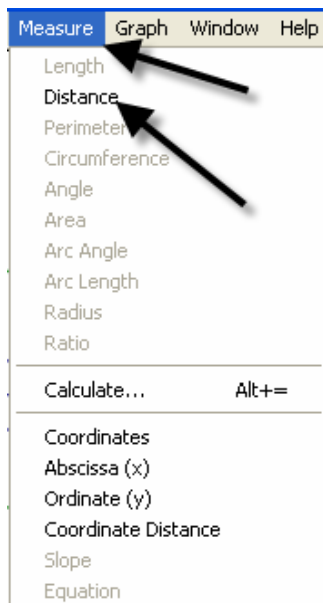


To use points to set up measures to use in the proportion, label points with the **Text** tool according to the sketch below.



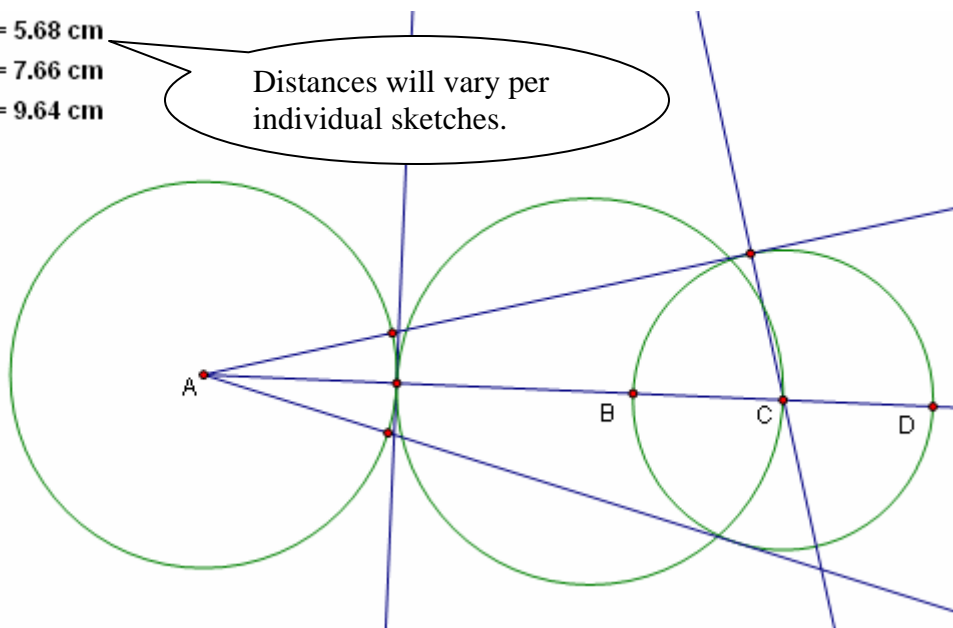
To set up the proportion, measure the following distances AB, AC and AD by selecting the endpoints of the segments and using **Measure** from the menu bar with the **Distance** option. The center of circle that will be tangent to the sides of the angle and tangent to the small circle at point D will have a proportional distance from A based on the following

proportion: $\frac{AB}{AD} = \frac{AC}{Ax}$ which can be rewritten as $Ax = \frac{AC \cdot AD}{AB}$.

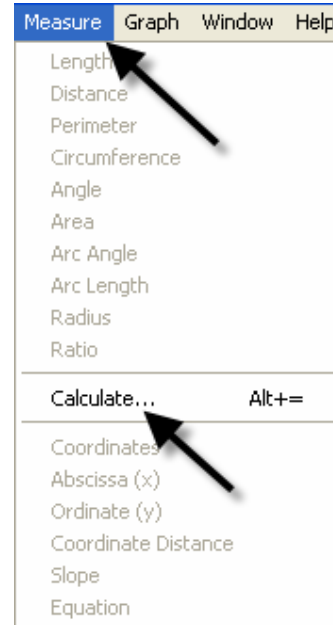


AB = 5.68 cm
AC = 7.66 cm
AD = 9.64 cm

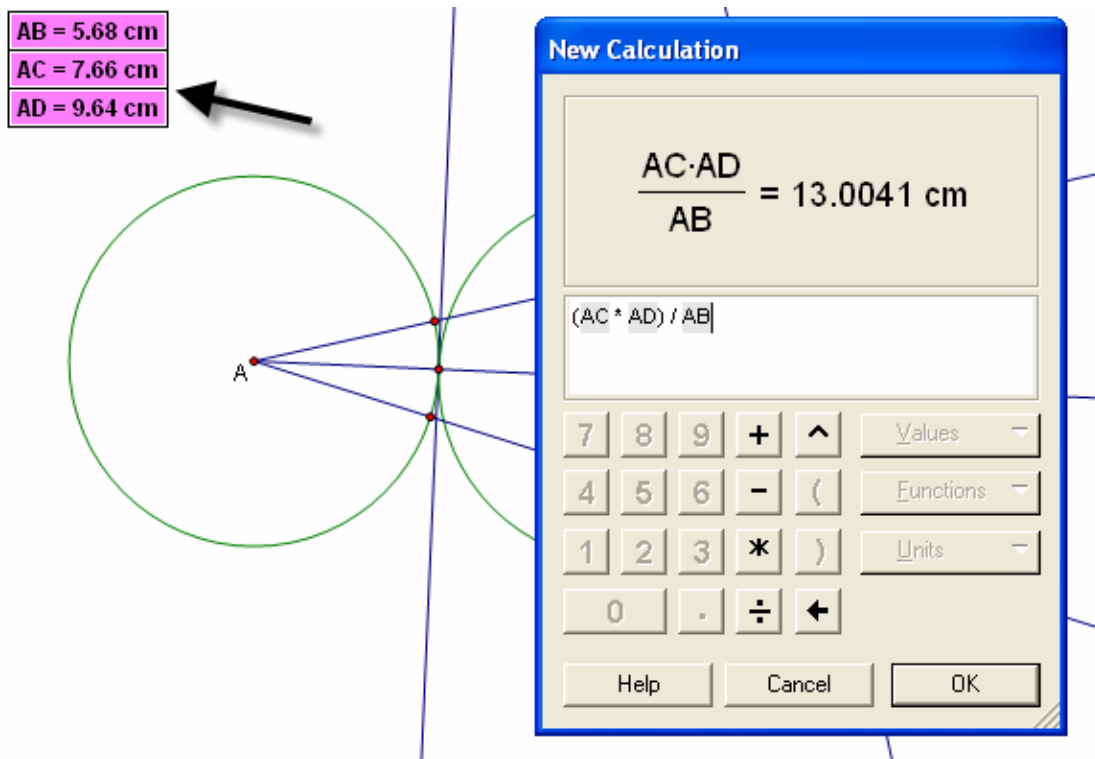
Distances will vary per individual sketches.



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**.



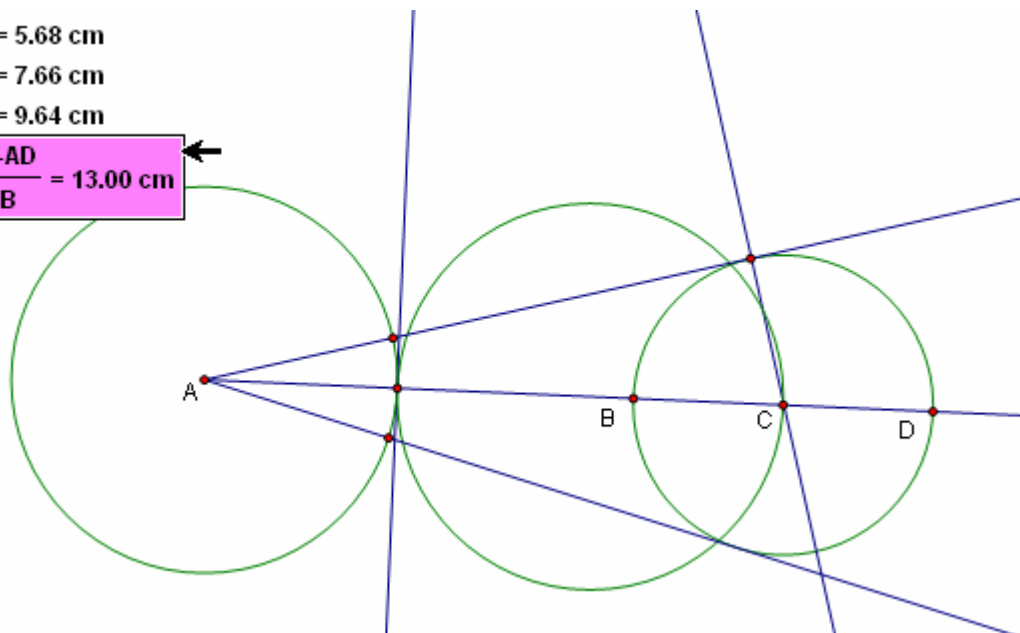
Select the solution for the distance of the new center from *A*.

$$AB = 5.68 \text{ cm}$$

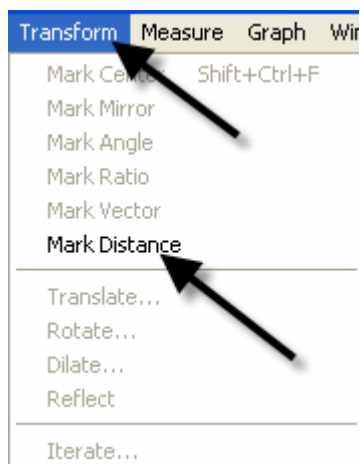
$$AC = 7.66 \text{ cm}$$

$$AD = 9.64 \text{ cm}$$

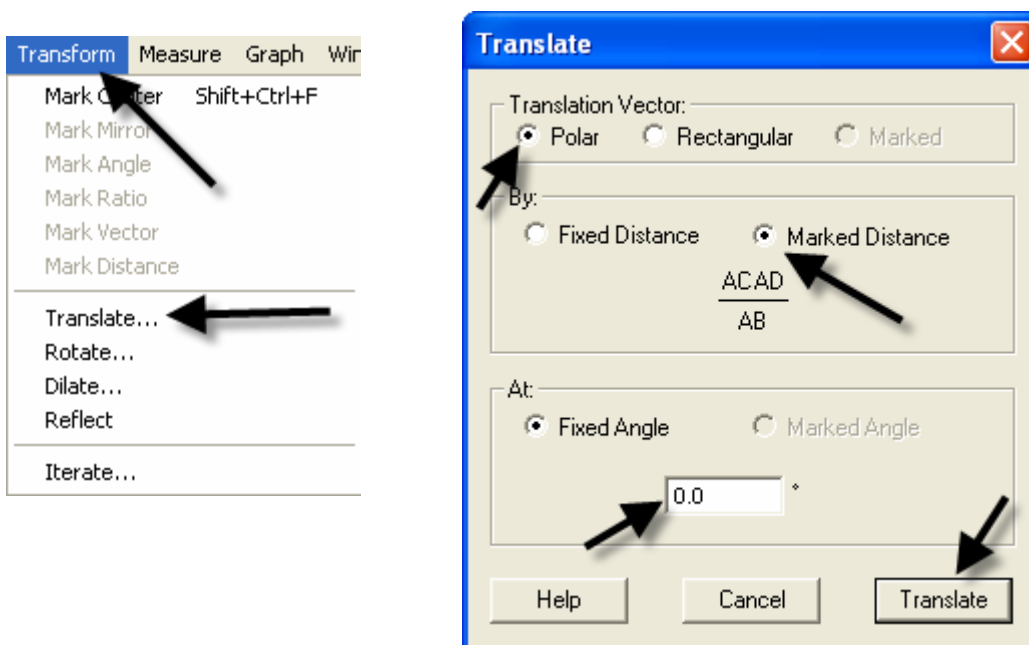
$$\frac{AC \cdot AD}{AB} = 13.00 \text{ cm}$$



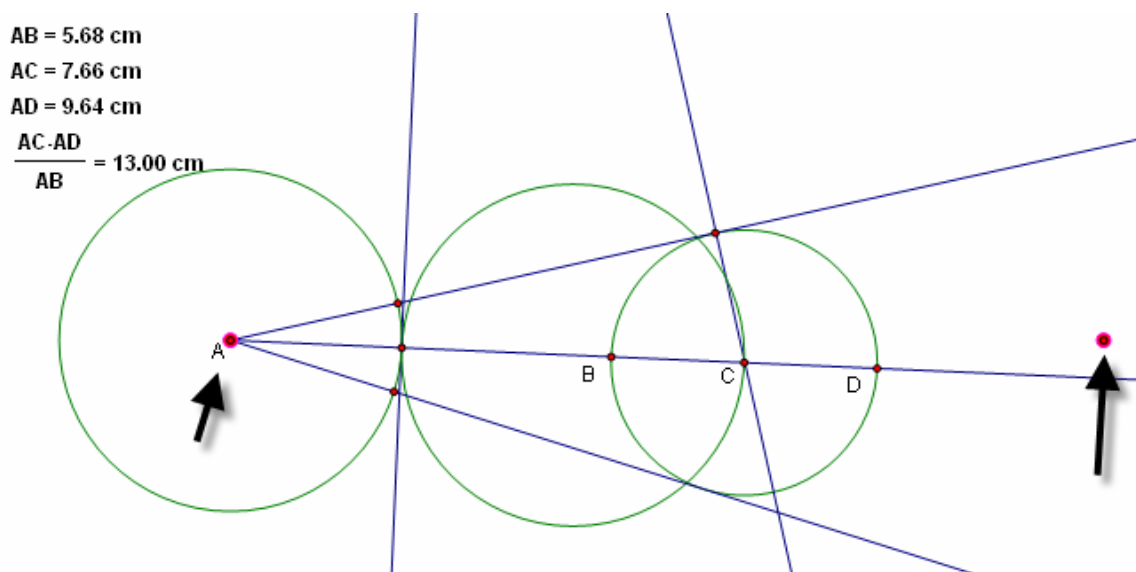
Use **Transform** from the menu bar with the **Mark Distance** option. The highlighted box with the solution in it will flash as it marked.



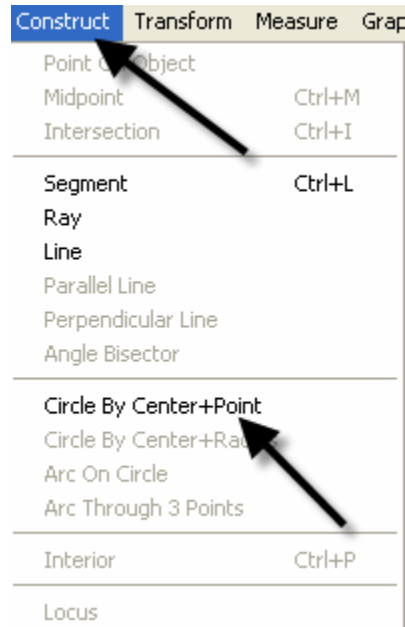
Select point **A** and use **Transform** from the menu bar with the **Translate** option. A pop-up box will appear that will allow you to select the following options.



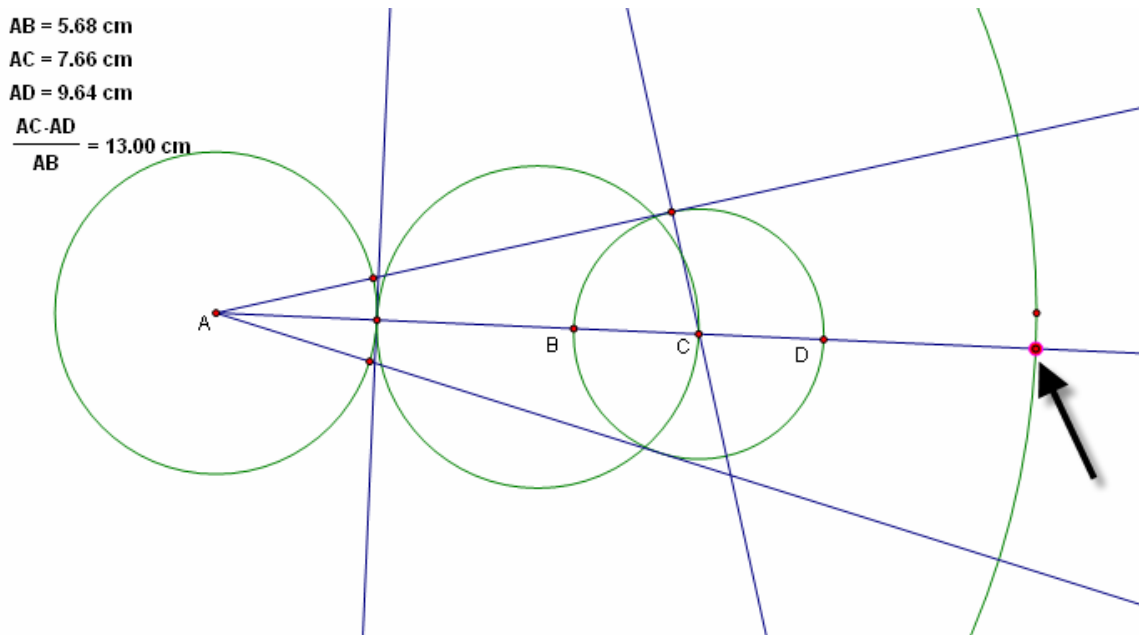
A new point will appear in the blank space of the sketch. In order, select point **A** followed by the newly translated point.



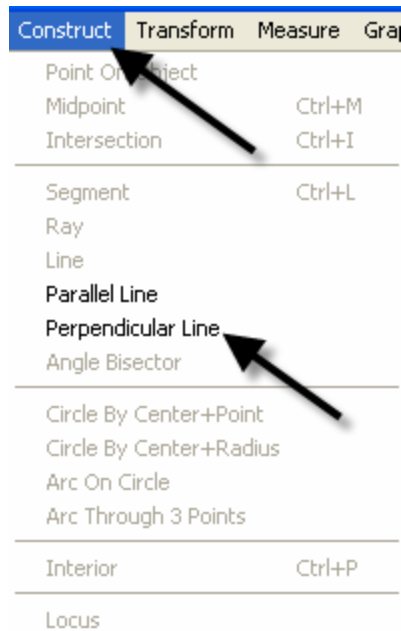
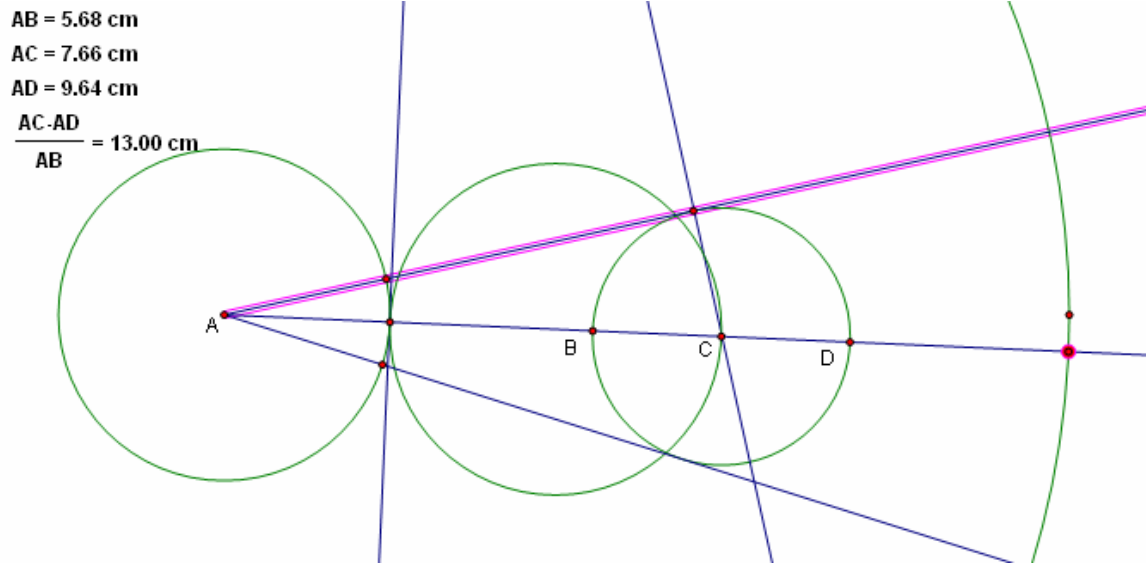
Use **Construct** from the menu bar with **Circle By Center+Point**.



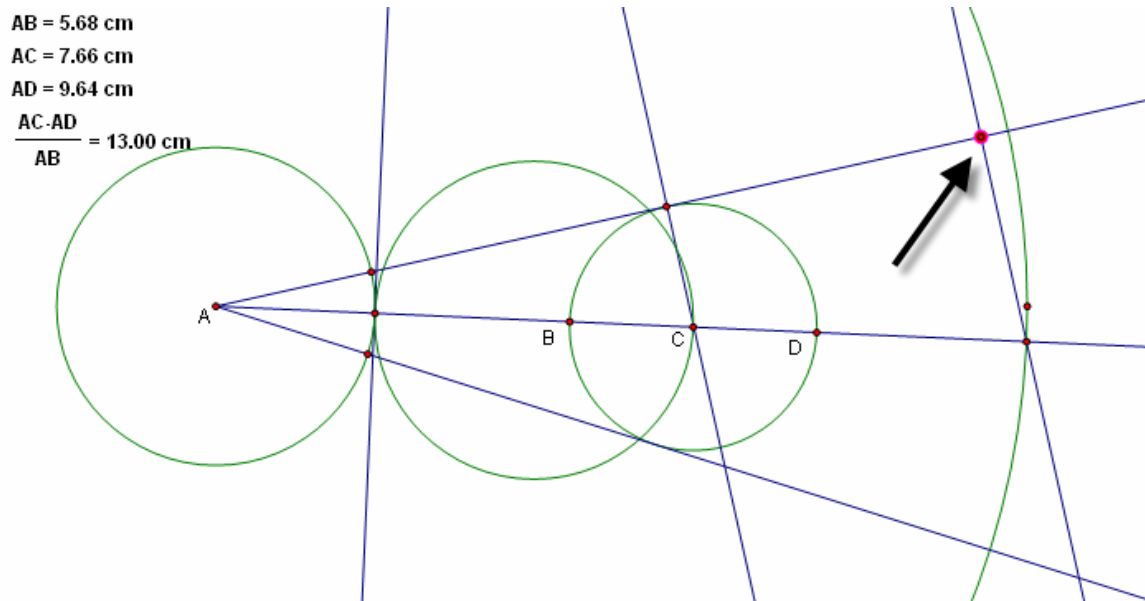
This will create a large circle whose point of intersection with the angle bisector will be the center of the new circle. Construct the intersection.



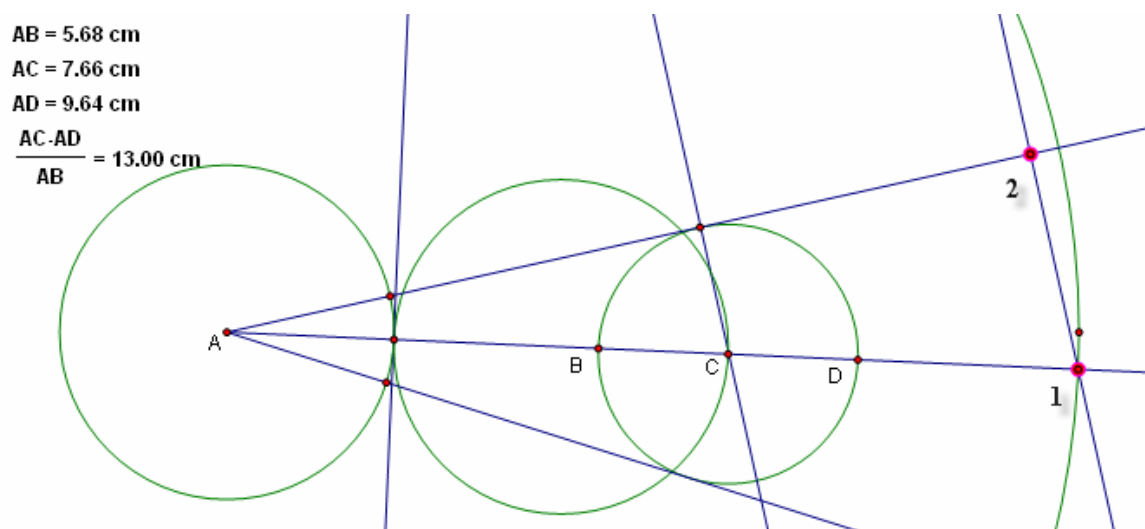
To find the radius of the circle, highlight the new point and the ray that makes the side of the angle. Then use **Construct** from the menu bar with the **Perpendicular Line** option.

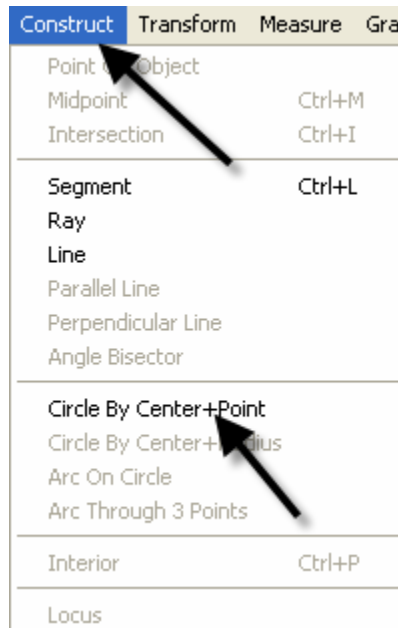


Construct a point of intersection where the new perpendicular line intersects with the side of the angle, then deselect it.

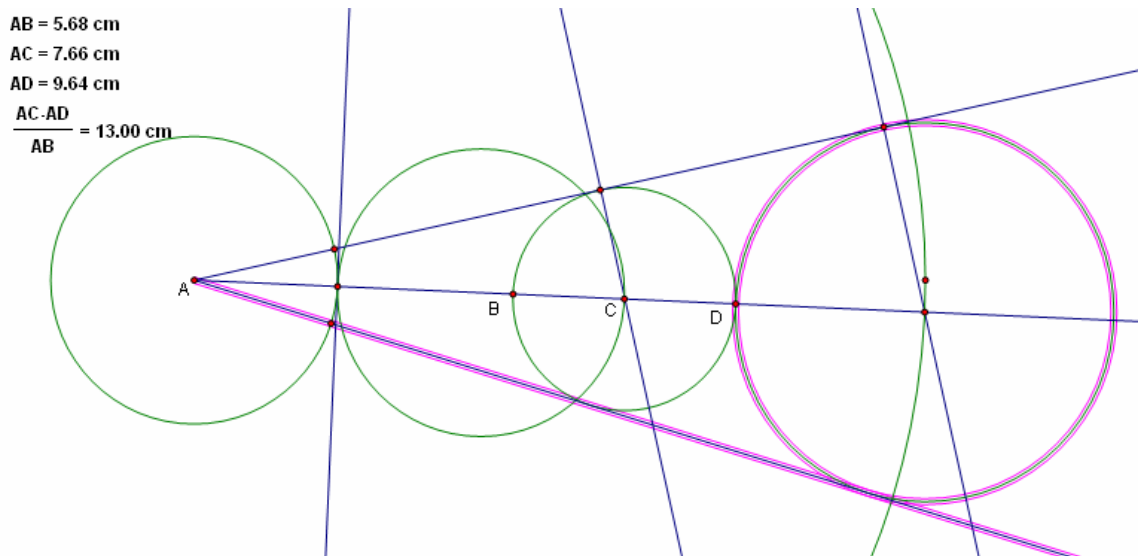


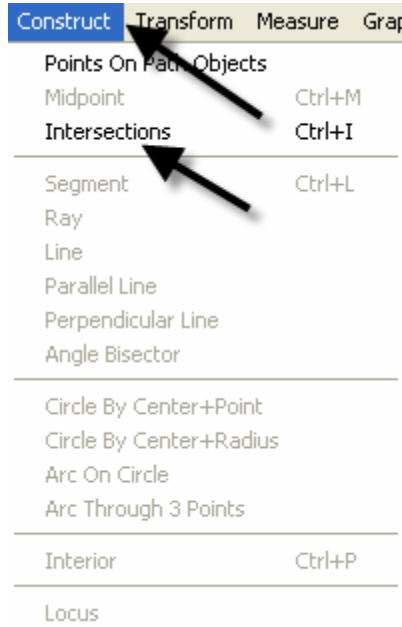
In order, select the new center point and the new point of intersection (see picture) and use **Construct** from the menu bar with the **Circle By Center+Point** option.



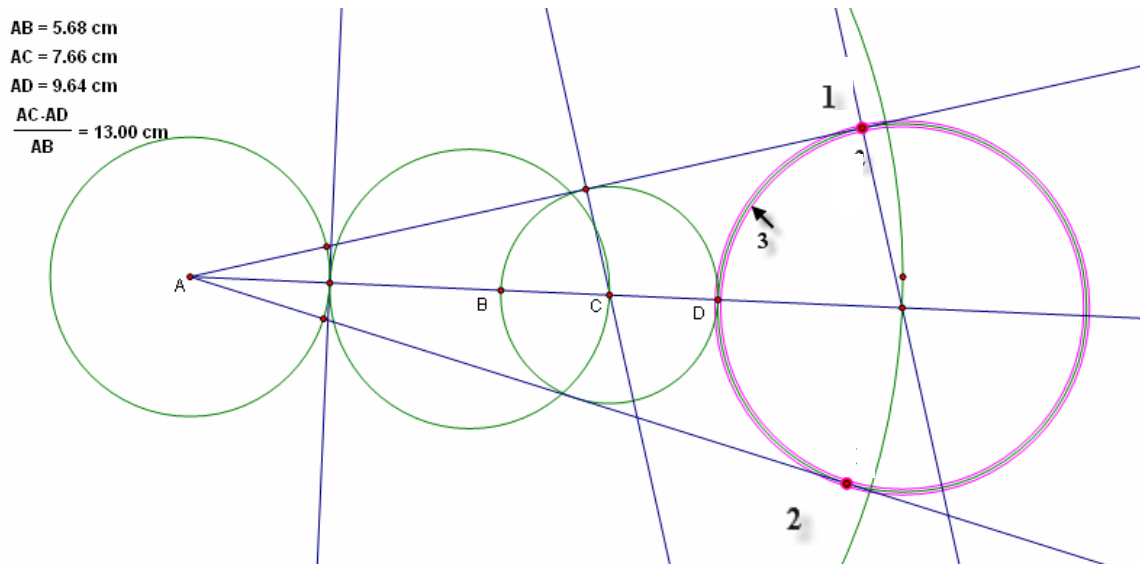


Select the new circle and the other ray that forms the angle. Use **Construct** from the menu bar with the **Intersection** option to create a point of tangency.

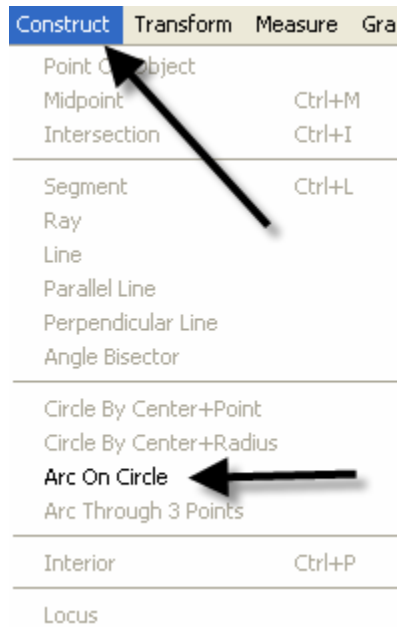




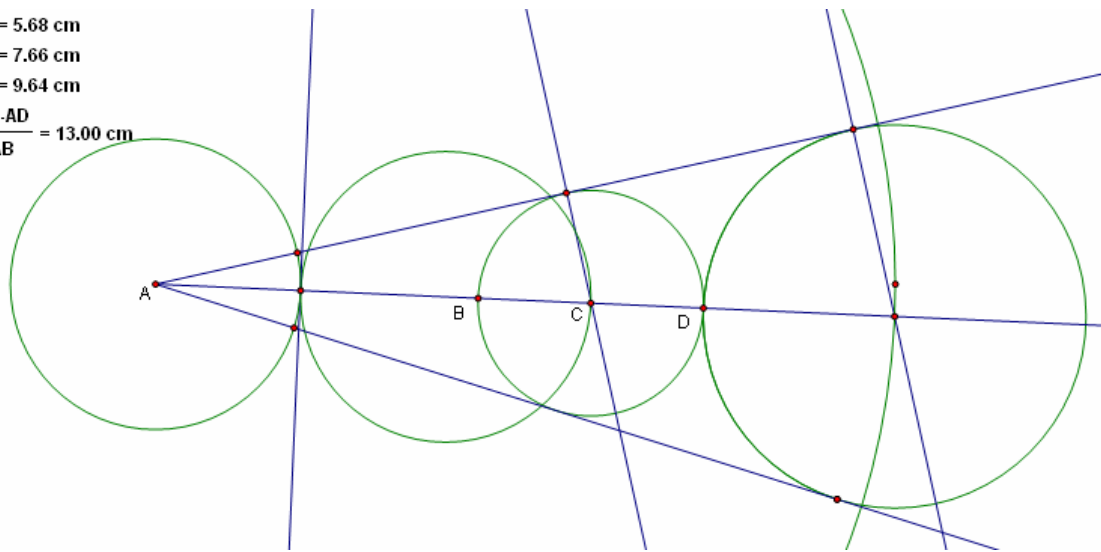
Construct the arc by selecting the points in a counter clockwise order, then selecting the circle.



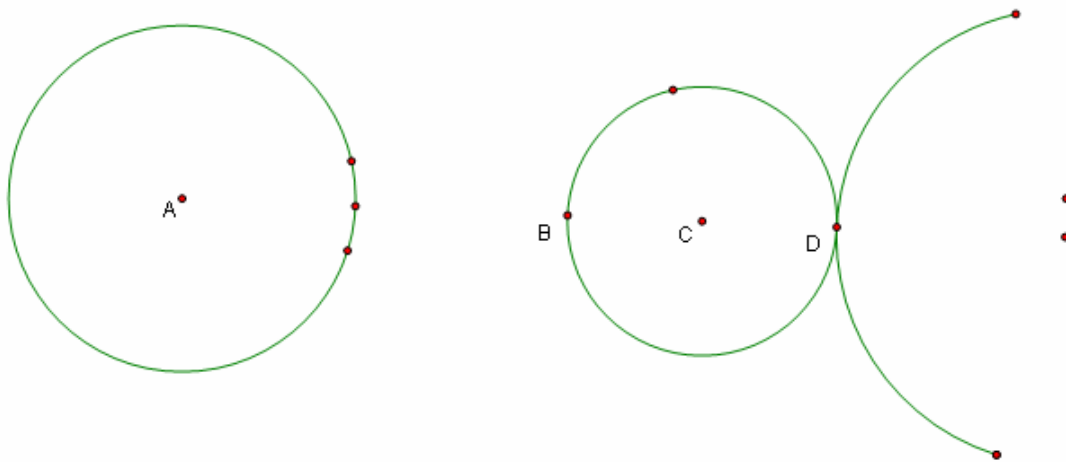
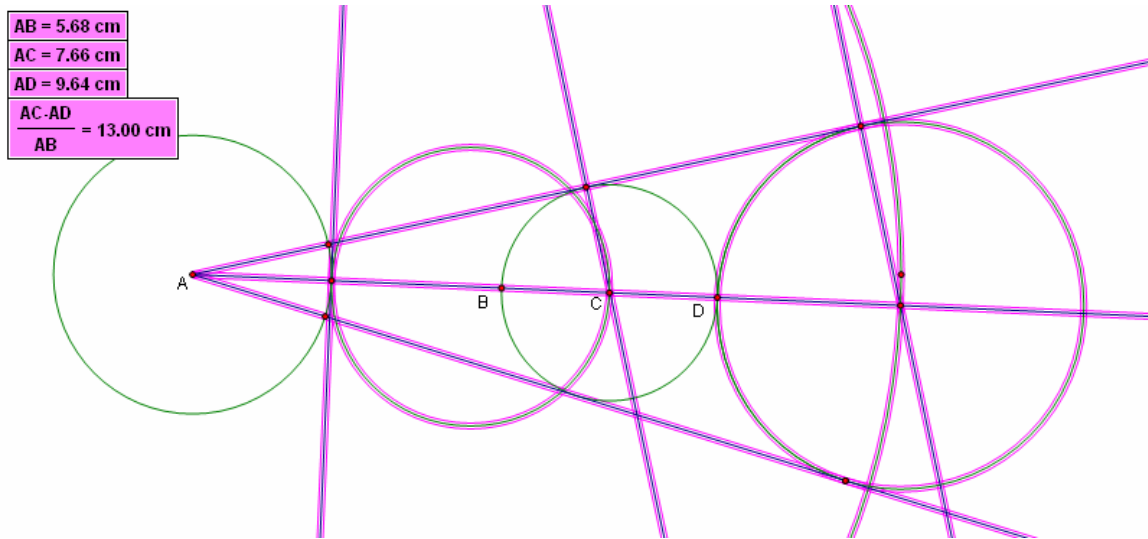
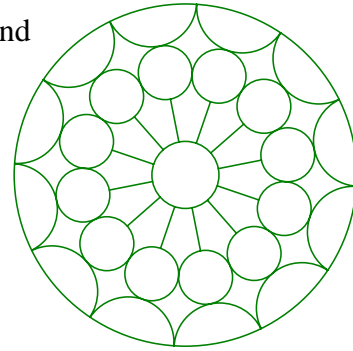
Next use **Construct** from the menu bar with the **Arc on a Circle** option.



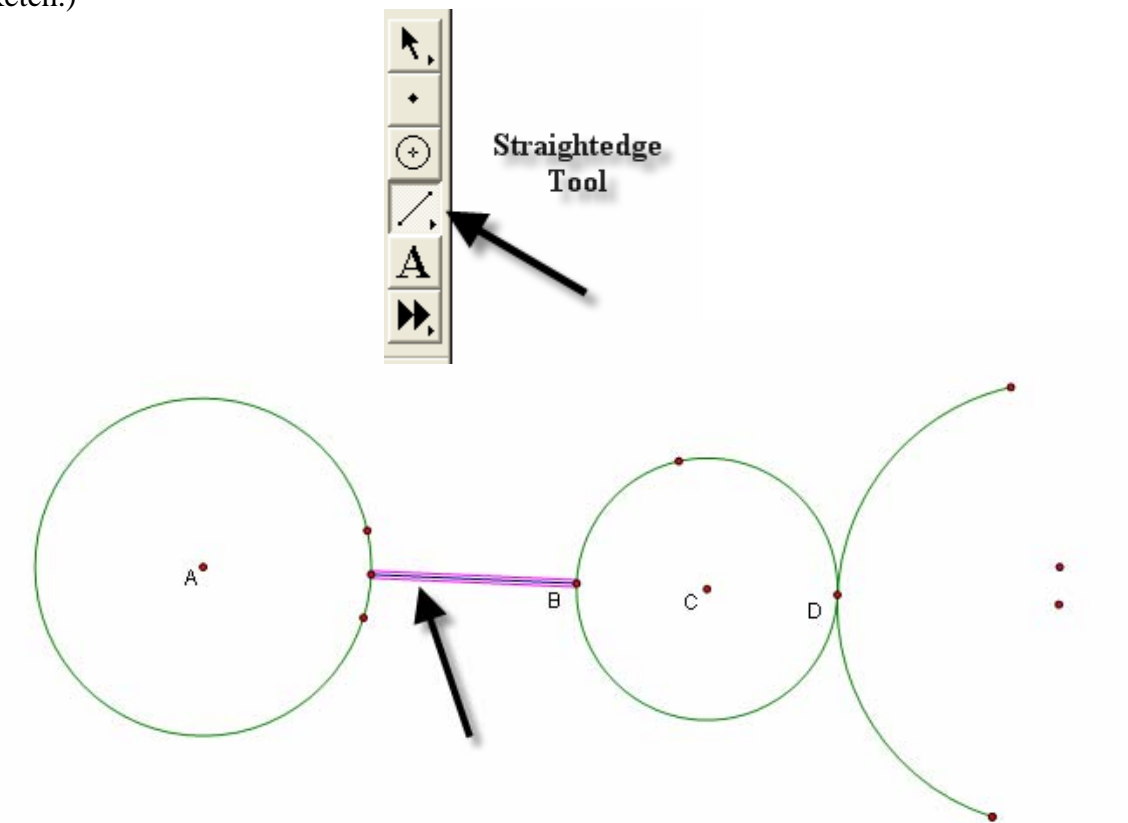
AB = 5.68 cm
 AC = 7.66 cm
 AD = 9.64 cm
 $\frac{AC \cdot AD}{AB} = 13.00 \text{ cm}$



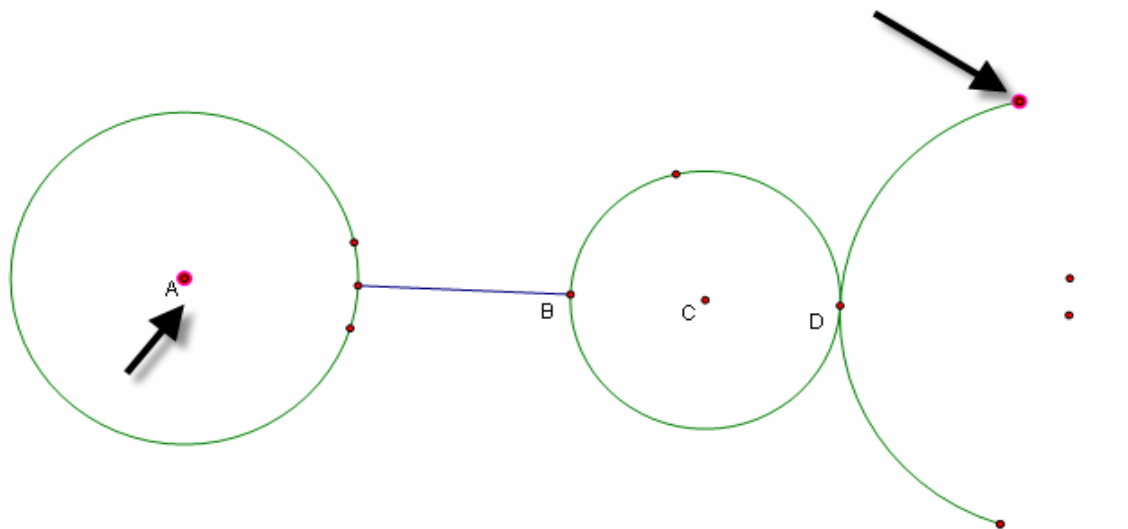
Hide all undesired parts of the construction by selecting them and using **Display** from the menu bar with the **Hide Path Objects** option.

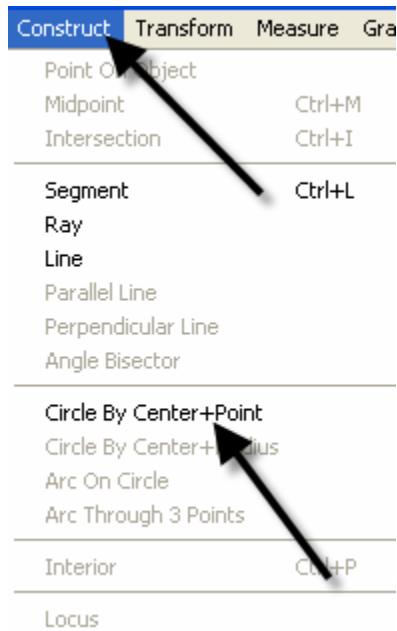


With the Straightedge Tool, construct a segment from the original circle to point **B** (See sketch.)

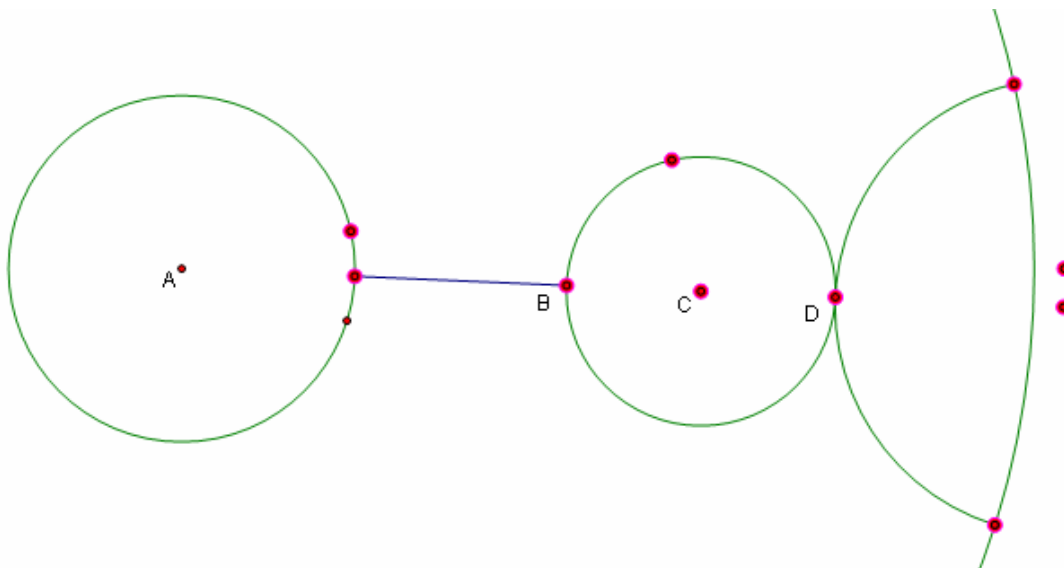


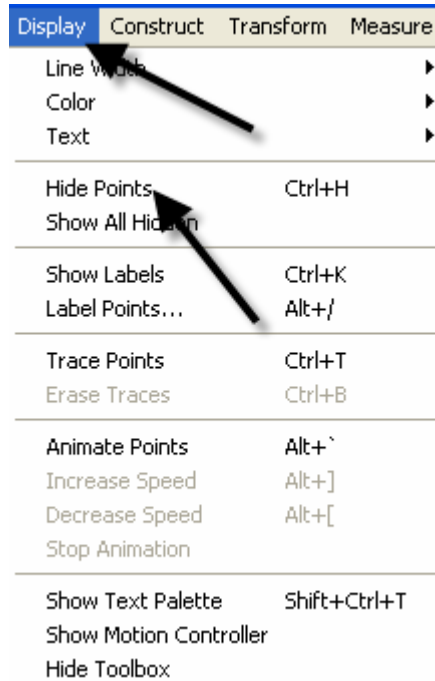
Select point **A** and one of the endpoints of the arc and use **Construct** from the menu bar with **Circle By Center+Point**.



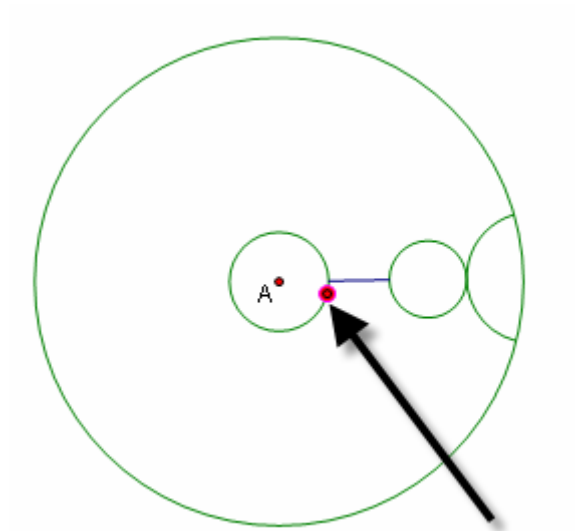


Hide the unnecessary points by first selecting them, then use Display from the menu bar with the **Hide Points** option.

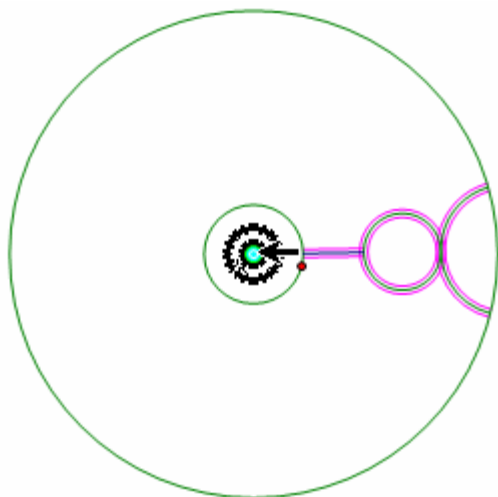




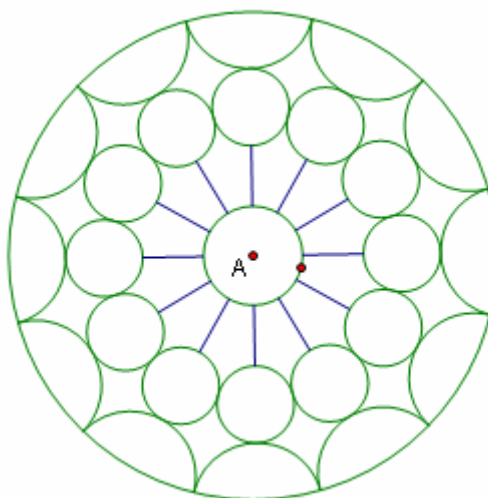
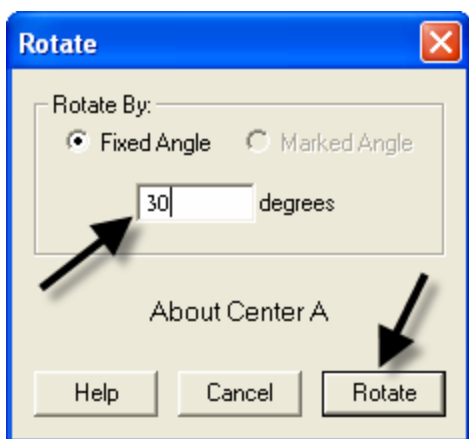
Shrink the construction by selecting the control point on circle A and moving it toward the center.



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° 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.

