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**.

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Fil	e Edit	Display	Construct	Tra	
4	New Ske	etch	Ctrl+N		
I	Open		Ctrl+O		
ų	Save	1	Ctrl+S		
	Save As				
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	Print				
	Quit		Ctrl+Q		

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.



TMT³ Geometry: Engage Technology Tutorial

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.

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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.

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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 curser. As the curser 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.

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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.

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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.



Geometry

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.

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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, $y = 6xtan(60^{\circ})$. The function will then graph verifying the plotted data.







Sketchpad Skills Investigation

Opening a New Sketch

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



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



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

File	Edit	Display	Construct	Tra	
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T٥	pen		Ctrl+O		
s.	ave		Ctrl+S		
S	ave As				
C	lose		Ctrl+W		
D	ocume	nt Option	s		
P	age Se	tup			
Pi	rint Pre	eview			
Pi	rint				
Q	uit		Ctrl+Q		



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.

le the Geometer's Sketchpare Sket	
 ▶, Straightedge Tool ✓ ✓	

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.

Properties of Segment j	×
Object Label	
Label	
ji	
✓ Show Label Style □ Use Label In Custom Tools	
Help Cancel OK	

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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.





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.

Construct	Transform	Measure (Gra
Point Or Midpoint Intersect	bject tion	Ctrl+M Ctrl+I	
Segment Ray Line Parallel L Perpendi	ine icular Line	Ctrl+L	
Circle By Circle By Arc On C Arc Thro	Center+Poi Center+Ra iircle ugh 3 Points	int dius	
Interior		Ctrl+P	
Locus			





- 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.

	Rotate
	Rotate By: Fixed Angle C Marked Angle
	150.0 degrees
	About Center A
	Help Cancel Rotate



4. 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.

		Construct Transform	Measure	Grap
		Points On Lines Midpoint	Ctrl+I	М
l	4	Intersection	Ctrl+)	I

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.

1. 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.



2. 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.

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



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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.



Explore Geometric Properties in the World

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Importing Pictures from the Internet

1. Position the cursor on the picture.



Open Link

Properties

Open Link in New Window

2. RIGHT click on your mouse and select COPY.



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



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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.



Ctrl+M

Ctrl+I

Ctrl+L



- 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**.

Rotate 🔀	
Rotate By: Fixed Angle C Marked Angle	
60 degrees	
About Center A	
Help Cancel 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**.

Construct	Transform	Measure	Graph	Window	Help
Point On Midpoint Intersec	tion	Ctrl+	M		
Segment Ray Line Parallel L Perpend Angle Bis	t Line licular Line sector	Ctrl+I	L		
Circle By Circle By Arc On C Arc Thro	/ Center+Poir / Center+Rac Circle ough 3 Points	nt dius	/		
Arc Inter	rior	1	•	Arc Sector Arc Segme	Ctrl+P ent

- 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.



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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.

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	Properties of Arc Sector Area	
•	Object Label Value	Arc Sector Area = 8.67 cm ²
Text Tool	Arc Sector Area	
	Use Label In Custom Tools	
	Help Cancel OK	

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.



6. Create a Table

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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.

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	Graph Window Help				
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L	Mark Coordinate System	1	Arc Secto	or Area = 4.88 cm²	
	Grid Form		m 🗚 = 3.	05 cm	
	Show Grid		m AB	Arc Sector Area	1 \
	Snap Points		3.05 cm	4.88 cm ²	
	Plot As (x, y)				· /
1	New Parameter	Shift+Ctrl+P		1	
	New Function	Ctrl+F			À
	Plot New Function	Ctrl+G		\	
	Derivative				
	Tabulate 🗲			\sim	
	Add Table Data				
	Remove Table Data				

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.



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





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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.

Display	Construct	Transform	Measure
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Color			•
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Hide P	lotted Point	Ctrl+ł	4
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Erase	Traces	Ctrl+E	3
Anima	te Plotted Po	oint Alt+	
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Decre	ase Speed	Alt+[
Stop A	Inimation		
Show	Text Palette	Shift+	-Ctrl+T
DHOW			
Show	Motion Cont	roller	
Show Hide T	Motion Cont oolbox	roller	



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.







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	Properties of Arc Segment Area	
τ,	Object Label Value	
•	Label	Arc Segment Area = 0.84 cm ²
Text Tool	Arc Segment Area	
	Use Label In Custom Tools	
	Help Cancel OK	



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.

Graph Window Help			
Define Coordinate System			
Mark Coordinate System			
Grid Form			
Show Grid			
Snap Points			
Plot As (x, y)			
New Parameter	Shift+Ctrl+P		
New Function	Ctrl+F		
Plot New Function	Ctrl+G		
Derivative			
Tabulate 🗲			
Add Table Data			
Remove Table Data			




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.







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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.

Display	Construct	Transform	Measure
Line V	Viden		•
Color			•
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Hide I	Plotted Point	Ctrl+	·H
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Anima	ate Plotted Po	oint Alt+	
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Decre	ease Speed	Alt+[
Stop	Animation		
Show	Text Palette	Shift	+Ctrl+T
Show	Motion Cont	roller	
Hide '	Toolbox		



1. Construct Triangle Interior

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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.

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Construct	Transform	Measure	Gra
Point On Midpoint Intersec	tion	Ctrl+N Ctrl+I	4
Segment Rays Lines	ts	Ctrl+L	
Parallel L Perpend	line icular Line		
Circle By	[,] Center+Poir	nt	
Circle By Arc On C Arc Thro	· Center+Rac Eircle Jugh 3 Points	dius	/
Triangle	Interior 🔺	Ctrl+F	>
Locus			



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.

Graph Window Help	
Define Coordinate Syste	em
Mark Coordinate System	1
Grid Form	-
Show Grid	
Snap Points	
Plot As (x, y)	
New Parameter	Shift+Ctrl+P
New Function	Ctrl+F
Plot New Function	Ctrl+G
Derivative	
Tabulate 🗲	
Add Table Data	
Remove Table Data	





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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.

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Graph Window Help	
Define Coordinate Syste Mark Coordinate System Grid Form	m
Show Grid Snap Points	
Plot As (x, y)	_
New Parameter	Shift+Ctrl+F
New Function Plot New Function	Ctrl+F Ctrl+G
Derivative	





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.

ersbid)	Construct	Transform	Measure
Line V Color	Mdth		+
Text			ŀ
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Function Rule Verification—Geometer's Sketchpad.

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- Arc Sector Area = 4.88 cm² Arc Segment Area = 0.84 cm² m AB = 3.05 cm m 🗚 Arc Segment Area 3.05 cm 0.84 cm² m AB Arc Sector Area 3.41 cm 1.05 cm² 3.05 cm 4.88 cm² 5.19 cm 2.44 cm² 3.41 cm 6.08 cm² **₿**:31 cm 3.61 cm² 5.19 cm 14.08 cm² 6.76 cm 4.14 cm² 6.31 cm 20.87 cm² 5 -6 8.08 cm 5.92 cm² 6.76 cm 23.95 cm² 8.98 cm 7.30 cm² 8.08 cm 34.21 cm² 9.77 cm 8.65 cm² 8.98 cm 42.21 cm² 3.05 cm 0.84 cm² 9.77 cm 49.97 cm² Þ 3.05 cm 4.88 cm² Area ∆B'AB = 4.04 cm² Area ∆B'AB m AB 3.05 cm 4.04 cm² 3.41 cm 5.03 cm² 5.19 cm 11.65 cm² 6.31 cm 17.26 cm² 6.76 cm 19.80 cm² 8.08 cm 28.29 cm² 8.98 cm 34.90 cm² 9.77 cm 41.33 cm² 3.05 cm 4.04 cm²
- 1. Using the existing sketch from the Dome Floor Dilemma Exploration, use **Graph** with the **Plot New Function** option.

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Graph	Window	Help	
Defi	ne zoordin	ate Syste	em
Mark	< Coordina	te System	
Grid	Form		
Hide	Grid		
Snap	o Points		
Plot	Points		
New	Paramete	r	Shift+Ctrl+P
New	Function.		Ctrl+F
Plot	New Fund	tion	Ctrl+G
Deri	vative		
Tabi	ulate		
Add	Table Dat	a	
Rem	ove Table	Data	



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.



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Function Rule Verification—TI-Interactive.

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

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

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File Edit Vie	w Insert Forr	nat Tools He	alp			
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File Edit View	Insert Format Li	st Data Help		-		
	2020			KI 👫 🔘	- 🚱 🖾	
TI Math	• 10 •	BI	1 🖹 🗐		<u>k</u> - 📥 - 🖂	国 🐝
listname formula	L1 L2 (} {}	L3 {} {	L4 L5 } {}	L6 {}		
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11 12 13						
11 12 13 14						



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.

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10						Replace		Ctrl+H
11								
12								
14								
 Ist 	t 🔨 Matrix	/ Spreads	heet /					

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

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7	3	4.71		
8	3.51	6.44		
9	4.07	8.67		
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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			
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4.2			

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

🛄 Data Ed	itor								
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listname formula	L1 {}	L2 {}	L3 {}	L4 {}	L5 {}	L6 {}			
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									



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.

🕮 Functions 🛛 🗙
f(x) Stat Plots
🗸 · · 📕 L1 🔗
L2
<u>∞</u>
Independent Variable:
Deselect All Copy All Close Help

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8. 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

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

Teaching Mathematics TEKS Through Technol

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

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TMT³ Geometry: Explore Explain 3 Technology Tutorial



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**).

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







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

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

Add Trendline	×
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7. Click the **Options** tab.

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







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spreadsheet is equivalent to $A_{sec} = \frac{\pi r^2}{6}$.

Press ON.

Enter both functions into Y=.

3



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
8 1 107508	1E-4 .5265 2.0969 4.7113 8.3697 13.072 18.819	0 .5236 2.0944 4.7124 8.3776 13.09 18.85
X=0		



Geometry

Geometer's Sketchpad—Rose Construction







Opening a New Sketch

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



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.





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° 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.

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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.



TMT3 Geometry: Elaborate Technology Tutorial



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.

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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**.

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13





Geometry



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





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



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 popup box will appear that will allow you to select the following options.

Transform Measure Graph Win	Translate 🔀
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	Help Cancel Translate

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





Transform Measure Grap Construct Point (Object Midpoint Ctrl+M Intersection Ctrl+I Segment Ctrl+L Ray Line Parallel Line Perpendicular Line Angle Bisector Circle By Center+Point Circle By Center+Ra Arc On Circle Arc Through 3 Points Ctrl+P Interior Locus

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.



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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.



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Construct Transfor	m Measure Gra		
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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.

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

AB

= 13.00 cm





TMT3 Geometry: Elaborate Technology Tutorial



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.



Geometry



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.

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Display	Construct	Transform	Measure	Graph	Windo	Display	Construct	Transform	Measure
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