

Calculator Project
22M:005
Due Friday, May 6
50 points possible

Instructions: Complete each of the following exercises and answer all questions (unless otherwise specified). For problems that ask you to do something with your calculator, your answers should include either a description of the process you used or the exact keystrokes you used to get your solution. Questions asking for a description or explanation should be answered in complete sentences.

Presentation: This project should be turned in on college ruled loose-leaf paper. You may write on both sides of the paper, but each question should start on a fresh side. The final project should be written clearly and legibly. Any project not meeting these criteria may be penalized up to 5 points.

1. Graph the unit circle on your calculator in polar mode, parametric mode, and function mode. Which has the simplest formula? How can you use these unit circles to determine the values of sine and cosine?
2. Verify the following trigonometric identities by hand, and then use your graphing calculator to verify them. (Hint: graph one side of the identity using a heavier line weight so you can tell the two graphs apart.)
 - a. $\sin 4x = 4 \sin x \cos x \cos 2x$
 - b. $\sin x + \cos x = \frac{\sin x}{1 - \frac{\cos x}{\sin x}} + \frac{\cos x}{1 - \frac{\sin x}{\cos x}}$
 - c. $\frac{1 + \cos x}{1 - \cos x} - \frac{1 - \cos x}{1 + \cos x} = 4 \cot x \csc x$
3. Consider the following “identity”.

$$\sin x + \cos x = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120} - \frac{x^6}{720}$$

Using a graphing window of

$$x_{\min} = -\frac{5\pi}{8} \quad x_{\max} = \frac{3\pi}{4} \quad y_{\min} = -2 \quad y_{\max} = 2$$

graph each side of the “equation”. How close are the graphs? Now graph both sides using a graphing window of

$$x_{\min} = -2\pi \quad x_{\max} = 2\pi \quad y_{\min} = -2 \quad y_{\max} = 2.$$

What happens? Is this an identity?

4. Solve each of the following trigonometric equations by hand over the interval $[0, 360^\circ)$. Then use the Solver feature of your graphing calculator to verify your solutions. In what format does your calculator display the solutions?
- $\sin 3x = 0$
 - $2 \sin \theta = 2 \cos 2\theta$
 - $4 \cos 2\theta = 8 \sin \theta \cos \theta$
5. Use your calculator to graph each of the following functions over an appropriate interval. For each function, you should turn in a sketch of the graph, a description of how you entered the function into your calculator, and an (if necessary) of why your calculator may not have graphed the function appropriately.
- $f(x) = \sec(2x)$
 - $g(x) = \tan^{-1}(\tan(x))$
 - $f(x) = \cot^{-1}(x)$
6. The following table contains hourly temperatures recorded in Iowa City on Friday, April 15th. Use your calculator to create a list-plot of this data. What shape does the data have? Have your calculator do a sinusoidal regression on this data. What is the equation your calculator gives you?

Time	Temp	Time	Temp
12:00 am	51°F	12:00 pm	67°F
1:00	47°F	1:00	69°F
2:00	42°F	2:00	70°F
3:00	42°F	3:00	72°F
4:00	45°F	4:00	72°F
5:00	44°F	5:00	71°F
6:00	40°F	6:00	69°F
7:00	47°F	7:00	65°F
8:00	52°F	8:00	56°F
9:00	56°F	9:00	53°F
10:00	60°F	10:00	51°F
11:00	65°F	11:00	48°F

7. Choose *one* of the following options:
- Write a calculator program that solves for the missing sides and angles of a triangle. The program should be able to solve SSS, SAS, ASA, and AAS triangles. You should be prompted for the known three pieces of information, and the program should return all angles and sides of the solved triangle.
 - Write a calculator program that performs vector addition and one that performs the quadratic equation. The vector addition program should prompt for the magnitude and direction of two vectors, and the program should return the resultant. The quadratic equation program should prompt for a , b , and c , and return the quantity $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
 - Write a two-page essay about the Sierpinski Triangle. Make sure you discuss what it is, how it's generated, and why it is mathematically significant. Use the following code to program your calculator to graph the triangle.

<pre>PROGRAM:SIERPINS :FnOff :ClrDraw :PlotsOff :AxesOff :0→Xmin:1→Xmax :0→Ymin:1→Ymax :rand→X:rand→Y :For (K,1,3000) :rand→N :If N≤1/3 :Then :.5X→X :.5Y→Y :End</pre>	<pre>:If 1/3<N and N≤2/3 :Then : .5 (.5+X) →X : .5 (1+Y) →Y :End :If 2/3<N :Then : .5 (1+X) →X : .5Y→Y :End :Pt-On (X,Y) :End :StorePic 6</pre>
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After you execute the program above, you can recall and display the picture with the instruction **RecallPic 6**.

For those interested in extra credit, you may choose to complete additional parts of exercise 7 for up to 10 additional points each.