CALCULUS A, LAB 1

These problems are mostly aimed just at making you comfortable with *Sage* and possibly with the Apple *Grapher.*

I'd like people to work in groups of 2 or at most 3, but you can work alone if you can't stand working with others. Each group should turn in a single solution set. Please alternate using the keyboard, so each person gets a chance to get an actual physical feel for the program. Next Tuesday, please turn in a writeup with the names of all the members of your group on it.

You might benefit by starting out reading and working through enough of *Tim's Sage Intro* that you feel comfortable with the software. We'll be using *Sage* enough that it will save time in the long run to get familiar with all or most of what's in that handout, either now or soon.

When you're comfortable enough, then answer the following questions.

1. Compute 20 digits of π, 20 digits of $\cos(37°)$, and 20 digits of $\sin(1.3 \text{ radians})$. It may help if you remember that π radians $= 180°$.

2. Plot $y = x^4 - 2x^2 + x$. Pick the ranges for the x and y axes so that you show whatever part of the graph of the function you think is most interesting.

3. Do the same thing with

$$y = x^3 + \frac{1}{(x-1)^2} - \frac{150}{1+(x+3)^4}.$$

Be sure you have the parentheses in the right places, so that you're plotting the right function. One way to do this if you're using *Sage* is to type the expression you think you want *Sage* to plot, and to have *Sage* evaluate and print it. If it looks right, then use cut-and-paste to plot it; if not, then get the parentheses right.

4. Do the curves $y = x^4 - 2x^2 + x$ and $y = 10x - 11$ intersect? If so, where? Can you get the coordinates of each intersection accurate to, say, 10 digits?

5. Using *Sage's* functions **factor** and **is_prime,** say something about when $2^n - 1$ is a prime. You'll be able to say something, but do not expect to get a complete criterion for exactly when $2^n - 1$ is prime.

6. The figures below show four functions. By messing about either with *Sage* or with the Apple *Grapher* or with any other tool you like, see if you can find possible equations for these functions.

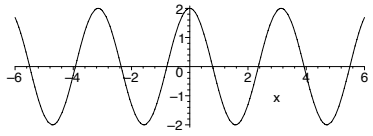

FIGURE 1. Problem 6 part (a)

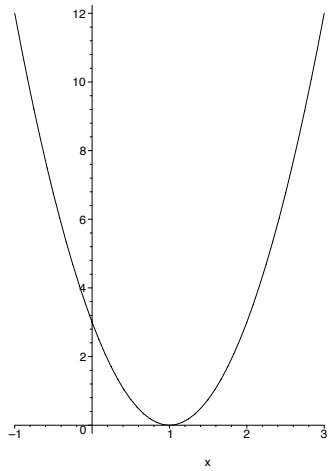

FIGURE 2. Problem 6 part (b)

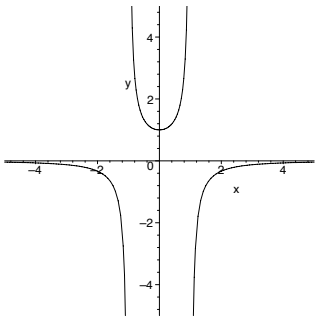

FIGURE 3. Problem 6 part (c)

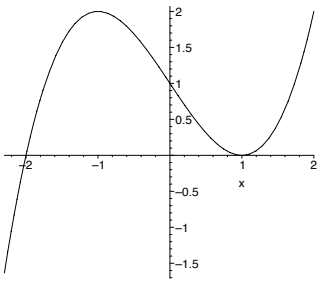

FIGURE 4. Problem 6 part (d)