Calculator Project
100 points possible
Due Friday, December 2

To complete this assignment you will need a graphing calculator—preferably a TI model. Each part of this assignment focuses on a certain aspect of calculator-aided mathematics. Some parts may take very little effort, while others will be very challenging. Your final solutions should be neatly written on loose-leaf paper and must be stapled together. Projects will be graded based on correctness, completeness, and on presentation.

# Part I

Perhaps the most important part of learning to use your graphing calculator is knowing how to appropriately input values. For some expressions, you will need to manually insert "implied" parenthesis. Evaluate each of the following expressions by hand, then re-evaluate them using your calculator.

**Expression 1:** $\dfrac{-3^2+5}{4+\sqrt{16}}$

**Expression 2:** $\dfrac{5+\dfrac{2}{\dfrac{3+2}{\dfrac{\sqrt{1+8}}{5}}}}{}\cdot 9-81$

**Expression 3:** $\left(\dfrac{8}{27}\right)^{-2/3}$

**Expression 4:** $\dfrac{5-\sqrt[5]{19+\sqrt{169}}}{2-\dfrac{-3}{9^{1/2}}}$

***To turn in:*** Show all work done in manually evaluating each expression. Then write each expression *exactly* as you entered it into the calculator.

# Part II

Frequently, you will need to evaluate a variable expression for many different values of a variable. For instance, you may wish to determine the value of an investment after 2, 5, 10, 50, and 100 months. Performing these calculations by hand would be tedious.

**Problem:** Find a simple method for using your calculator to evaluate each of the following expressions for the values 1, 2, 3, 4, 5, 10, 15, 20, and 25.

**Expression 1:** $x^3 - 15x^2 - 25x + 375$
**Expression 2:** $x^4 - 4x^3 - 161x^2 - 120x + 900$
**Expression 3:** $x^5 - 4x^4 - 12x^3 + 34x^2 + 11x - 30$
**Expression 4:** $0.02x^6 - 1.7x^4 + 35.28x^2$

***To turn in:*** Create a table displaying the values you find. Briefly explain the method you used to find the values.

# Part III

The solutions to all of the problems we'll look at depend directly upon the information we're given and the assumptions we make. Occasionally, it is helpful to observe how much solutions change when we change our assumptions.

**Problem 1:** A church building fund has invested some money in two ways: part of the money at 4% interest and four times as much at 3.5%. Find the amount invested at each rate if the total annual income from interest is $3600. What if the income from interest is $4000? $5000? $10,000?

**Problem 2:** How many gallons of pure alcohol should be mixed with 20 gallons of a 15% alcohol solution to obtain a mixture that is 25% alcohol? What if we have 25 gallons of the 15% solution? 30 gallons? 50 gallons?

**Problem 3:** A rectangular piece of metal is 10 inches longer than it is wide. Squares with sides 2 inches long are cut from the four corners, and the flaps are folded upward to form an open box. If the volume of the box is 832 cubic inches, what were the original dimensions of the piece of metal? What if the volume of the box is 500 cubic inches? 1000 cubic inches? 1500 cubic inches?

**Problem 4:** A square lawn has area 800 $ft^2$. A sprinkler placed at the center of the lawn sprays water in a circular pattern that just covers the lawn. What is the radius of the circle? What if the area of the lawn is 200 $ft^2$? 1800 $ft^2$? 3200 $ft^2$?

***To turn in:*** Solve each of the problems for each given value. Then write a general solution to each problem. That is, find the solution in terms of the value given.

# Part IV

The quadratic formula is the most important formula we've learned so far in this class. As you've no doubt seen in the assigned homework, we'll use the quadratic formula over and over again to solve quadratic equations. To simplify and expedite this task, we can teach our calculators to perform the quadratic formula calculations and give us back the answers.

**Problem:** Write a calculator program that takes input values *a*, *b*, and *c*, and outputs the roots of the quadratic equation $ax^2 + bx + c = 0$. Your program should be able to return all real roots of any quadratic equation.

***To turn in:*** Please turn in a type-written copy of your calculator program, along with a brief explanation of what each line of code does.

# Part V

For each of the given functions, use your graphing calculator to analyze the graph of the function. Be sure to set the window size appropriately so you can see your entire function. When asked to graph a function, use your calculator to generate a graph and sketch what you see. For each example, turn in your sketch along with answers to the questions.

1. Let $f(x) = x^5 + 6x^4 - 133x^3 - 78x^2 - 1740x - 1800$
   a. Graph *f* on your graphing calculator.
   b. Use your calculator to solve for all the zeros of *f*.
   c. Find the minimum value of *f* between 0 and 10.
   d. Find the maximum value of *f* between -5 and 5.

2. Let $f(x) = x^3 - 3x^2 - 64x - 60$,
   and let $g(x) = x^3 - 12x^2 - 208x + 960$
   a. Graph *f* and *g* on your graphing calculator.
   b. Use your calculator to solve for all zeros of *f* and *g*.
   c. Find the minimum value of *f* between 0 and 10.
   d. Find the maximum value of *f* between -5 and 5.
   e. Find the minimum value of *g* between 0 and 10.
   f. Find the maximum value of *g* between -5 and 5.
   g. Use your calculator to find the points at which the two functions intersect.

3. Let $f(x) = \begin{cases} x+2 \text{ if } x \le 2 \\ x-3 \text{ if } x > 2 \end{cases}$
   - Graph *f* on your graphing calculator.

4. Let $f(x) = \dfrac{x^2 + 2x + 1}{x - 1}$
   a. Graph *f* on your graphing calculator.
   b. Describe the asymptotes of *f*. What happens at x = 1?
   c. Find the zeros of each function.

5. Let $g(x) = \dfrac{x^2 + 2x + 1}{x + 1}$
   a. Graph *g* on your graphing calculator.
   b. Why are there no asymptotes in *g*?
   c. Rewrite the equation for *g* so that it is linear.

6. Let $h(x) = \dfrac{x^2 - 2}{x - 1}$

   a. Graph *h* on your graphing calculator.
   b. What is the equation for the vertical asymptote? What is the equation for the oblique asymptote?
   c. Set your window values so that *xmin* = -50, *xmax* = 50, *ymin* = -50, and *ymax* = 50. What does the function look like?

7. Let $k(x) = \dfrac{x^3 + 3x^2 + 3x + 1}{x - 1}$

   a. Graph *k* on your graphing calculator.
   b. What is the equation for the vertical asymptote? Use polynomial long division to determine the behavior of *k*(x) as x → infinity. What function does *k*(*x*) approach as x gets very large?
   c. Set your window values so that *xmin* = -10, *xmax* = 10, *ymin* = -10, and *ymax* = 10. What does the function look like? (Sketch it)
   d. Set your window values so that *xmin* = -20, *xmax* = 20, *ymin* = -10, and *ymax* = 20. What does the function look like? (Sketch it)
   e. Set your window values so that *xmin* = -40, *xmax* = 40, *ymin* = -10, and *ymax* = 1000. What does the function look like? (Sketch it)