Math 215: Calculus II
Extra credit problems.
This list will grow throughout the semester.

guidelines: When doing an extra credit problem, you should write up your solution carefully, though I will not collect your write up. When you are confident in your solution, come see me. You will need to talk me though whatever work you have.

You may present a partial solution to me for partial credit.

Feel free to ask me questions.

(1) There is a STEM (Science Technology Engineering Mathematics) Colloquium Friday March 6. Attend some of the talks and write me something about the topic of one talk.
(2) Let C be a cone of height h and radius r. Compute its volume using calculus.
(3) Select a geometric figure whose volume formula you might know. Use Calculus to derive the volume of this solid. (Full credit will be given for examples which are interesting and challenging.)
(4) Think about a **4-dimensional** sphere of radius r. It is given by the inequality $x^2 + y^2 + z^2 + w^2 \leq r^2$.
   - What range of values for w can occur in the 4-sphere? (Find a domain for integration.)
   - At any given w, What does the defining inequality day about x y and z. What is the w-cross-section? What is its 3-dimensional volume?
   - Integrate the 3-dimensional volume of cross sections to find the 4-dimensional volume. For full points explain the integration technique used. For partial credit, use a computer.
(5) This exercise will guide you through an approximation of π.
   (a) Compute $\displaystyle\int_0^1 \frac{1}{t^2+1}dt$. Does this have something to do with π?
   (b) Using Wolfram alpha, approximate $\displaystyle\int_0^1 \frac{1}{t^2+1}dt$ Use midpoint approximation and $n = 100$.
   (c) Use $n = 10000$
   (d) Use $n = 1000000$
   (e) If $f(t) = \dfrac{1}{t^2+1}$, then what are the maximum value and minimum values of $f''(t)$ on $[0, 1]$?
   (f) In the error bound on page 510 of the book, what value can you take for K?
   (g) How large must n be if you want an approximation with error less than 10^{-20}? Have wolfram alpha make this approximation.
(6) Section 7.8 problem 71.
(7) Plot the direction field for the differential equation $y' = \cos(x+y)$ and sketch a picture of the solution. Using Maple's online user's manual, or wolfram alpha's documentation, or else your own ingenuity, run Euler's Method to approximate the solution to $y' = \cos(x + y)$.