Please *write* this week's workshop while working completely by yourself. You can *think* with other people but you should not look at anyone else's written work. Also, please write your answer in complete English sentences. Helpful figures are always welcome.

Problem 6.1. (Stolen from Professor Greenfield's 291 second midterm.) Use Lagrange multipliers to find the maximum and minimum values of the function $f(x, y, z) = xy^2+z^4$ for points (x, y, z) in $\mathbb{R}^3$ satisfying $x^2 + y^2 + z^2 = 1$.

Problem 6.2. (Likewise.) Compute the triple integral of $\frac{1}{(x^2+y^2+z^2)^2}$ over the region in $\mathbb{R}^3$ which is in the first octant ($x \geq 0$ and $y \geq 0$ and $z \geq 0$) and which lies outside the unit sphere. (This is an *improper* integral – similar to Problem 5.3 on Workshop 5.)

Problem 6.3. Consider $E(a, b, c)$; the ellipsoid satisfying $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.

1. Write down, but do not solve, an integral which computes the surface area of $E(a, b, c)$.
2. Try to solve the integral. Describe the steps you take and any ideas you have.
3. Can you compute the integral in the special case $a = b$?
4. Suppose that the ellipsoid bounds a region of volume π. That is, suppose that $abc = 1$. What values of a, b, and c *minimize* the surface area of $E(a, b, c)$? (Hint: can you think of an easier problem to solve? Perhaps in one less dimension?)