Prof. Porter’s MAT251 Multivariable Calculus Project

1. You are asked to design a building that is over 15 stories tall with a square base and a sloping flat top with one corner the highest and one corner the lowest. Assume that each story is at least 10 feet. Identify the coordinates of at least three roof corner points, give the equation of the function for the roof, and then give the double integral that could be used to calculate the volume of the building.
2. Show the triple integral that could be used to find the volume of the building from the last full story to the top of the highest corner.
3. Because of gravity, the density of the building is higher at the base than the top. The density function is given by the formula δ(x,y,z)=100/(z+10) pounds per cubic foot. Give the integral that can be used to find total mass of your building.
4. Give the integral that can be used to evaluate how high is the center of gravity? A building is considered unstable if its center of gravity is higher than the length of the shortest side. Is your building unstable?
5. To cut corners (literally), you are asked to make the design of the building perfectly round at the base. Using the same roof design, what would the integral that yielded the new volume of the building look like?
6. You wonder if the volume of the cylindrical building would be easier to find in different coordinates. Give the integral for the volume if it was changed to cylindrical coordinates. Do not solve, but is it easier?
7. Instead of the flat top, you put a huge perfectly spherical top on top of your rounded building, set up the triple integral to find the volume of the sphere in both rectangular then spherical coordinates.
8. You decide to accent you building with a pure gold cover to the spherical roof. Give the integral that would tell how much surface area has to be covered with gold.