

1. Find all of the points where the function $f(x, y, z) = x^2 + y^2 + z^2$ achieves a maximal and minimal value over unit cone

$$\{(x, y, z) \mid 0 \leq z, z \leq 1 - \sqrt{x^2 + y^2}\}.$$

2. Find the cone with largest volume that has surface area 1.

3. Write definition for a function $f(x, y)$ to be differentiable at a point p . Then show by any means that the function

$$f(x, y) = \frac{3x^2y - y^2}{x^2 + y^2}$$

is not differentiable.

4. A right cone of height 100, with vertex at the origin, is intersected with a sphere of radius 1, which is centered at the origin. What is the volume of the intersection?

5. What is the surface area of $1 + 3x + 2y^2$ over the triangle with corners $(0,0)$, $(0,1)$, $(2, 1)$?

6. The tastiness density of a unit orange is given by a function $T(x, y, z)$. A half orange eighth is given by this drawn region below:

- Set up 3 integrals in Cartesian Coordinates that compute the tastiness of the half orange eighth.
- Set up 3 integrals in Cylindrical Coordinates that compute the tastiness of the half orange eighth.
- Set up 3 integrals in Spherical coordinates that compute the tastiness of the half orange eighth.