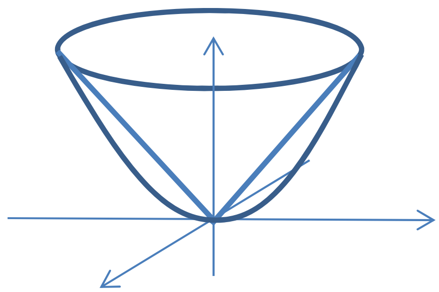
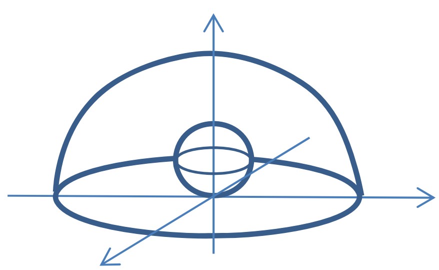
1. Sketch and use double integration in polar coordinates to find the area of one "petal" of a rose-shaped region bounded by the curve r = cos 3θ.

2. Set up limits on a triple integral over a volume enclosed in the first octant by the surface $z = 4 - x^2 - 2y$. Use three different orders of integration: dx dy dz, dy dx dz and dz dx dy

3. Use triple integration in cylindrical coordinates to find the mass of an object enclosed between the cone $z^2 = 4\left(x^2 + y^2\right)$ and the paraboloid $z = x^2 + y^2$. The density of the object equals $\delta\left(x, y, z\right) = x^2 z$



4. Use triple integration in spherical coordinates to find the centroid of an object enclosed between the sphere ρ = cos ϕ and the top half of the sphere ρ = 2, as shown in the Figure (hint: you only need to find $\bar{z}$, since it is clear that $\bar{x} = \bar{y} = 0$)



5. Region R in the xy−plane is bounded by lines y = −2x + 4, y =−2x + 7, y = x − 2, and y = x + 1. Make a transformation to the uv-plane for which this domain is rectangular, and evaluate the following integral:

$$\iint_R \left(y + 2x\right)^2 \left(y - x\right) dx\, dy$$