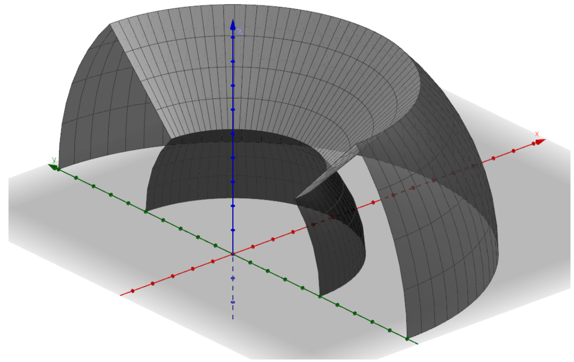
Exercise 1. This exercise serves as an introduction to Gauss' Theorem. Consider the solid region defined by $x \geqslant 0$ and $z \geqslant 0$, bounded by the surfaces

$$\begin{cases} \rho = 1 \\ \rho = 2 \\ z = r \end{cases}$$



The figure above illustrates the boundaries of the solid region. Assume a density function given by $f(\rho, \theta, \phi) = 3\rho^2$. Write down an integral which represents the mass of the solid using the provided density function.

Exercise 2. In this exercise, we will derive the surface area of a sphere of radius R, which is known to be $4\pi R^2$. Perform the following steps:

1. Sketch a sphere and label its radius R.
2. Write the parametrization of the sphere in spherical coordinates.
3. Calculate the tangent vectors of the parametrization.
4. Draw the tangent vectors on your sphere and specify the order of the cross product such that the resulting normal vector points outward.
5. Compute the cross product of the tangent vectors to obtain the normal vector, and find its magnitude.
6. Verify the surface area formula by setting up and evaluating the surface integral.