MATH 253 – WORKSHEET 31
CYLINDRICAL COORDINATES

Replace (x, y, z) with (r, θ, z) by using polar coordinates in the xy plane:

$$\begin{array}{lll} x = r\cos\theta & y = r\sin\theta & z = z \\ r = \sqrt{x^2 + y^2} & \tan\theta = \frac{y}{x} & z = z \end{array}$$

(1) Express the following surfaces in cylindrical coordinates.
   (a) The cylinder of radius 2 about the z-axis.

   (b) The paraboloid $z = x^2 + y^2$.

(2) A drill bit of diameter a is used to drill a hole through a ball of radius a. What is the volume of the remaining object?

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(3) Where is the center of mass of a right circular cone? Suppose the base has radius R and the cone has height H.