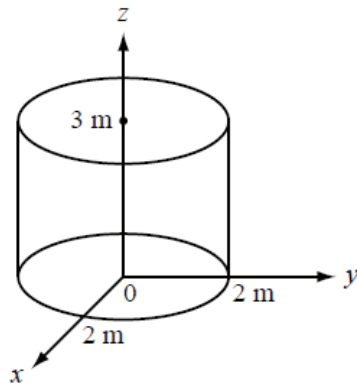


**4.1** Find the total charge contained in a cylindrical volume defined by  $r \leq 2$  m and  $0 \leq z \leq 3$  m if  $\rho_v = 30rz$  (mC/m<sup>3</sup>).

**Solution:** For the cylinder shown in Fig. P4.1, application of Eq. (4.5) gives

$$\begin{aligned}
 Q &= \int_{z=0}^3 \int_{\phi=0}^{2\pi} \int_{r=0}^2 30rz \, r \, dr \, d\phi \, dz \\
 &= \left( \frac{30}{6} r^3 \phi z^2 \right) \bigg|_{r=0}^2 \bigg|_{\phi=0}^{2\pi} \bigg|_{z=0}^3 = 720\pi \text{ (mC)} = 2.26 \text{ C.}
 \end{aligned}$$



**Figure P4.1** Cylinder of Problem 4.1.