

Problem 4.2 Find the total charge contained in a cylindrical volume defined by $r \leq 2$ m and $0 \leq z \leq 3$ m if $\rho_v = 20rz$ (mC/m³).

Solution: For the cylinder shown in Fig. P4.2, application of Eq. (4.5) gives

$$\begin{aligned} Q &= \int_{z=0}^3 \int_{\phi=0}^{2\pi} \int_{r=0}^2 20rz \, r \, dr \, d\phi \, dz \\ &= \left(\frac{10}{3} r^3 \phi z^2 \right) \bigg|_{r=0}^2 \bigg|_{\phi=0}^{2\pi} \bigg|_{z=0}^3 = 480\pi \text{ (mC)} = 1.5 \text{ C.} \end{aligned}$$

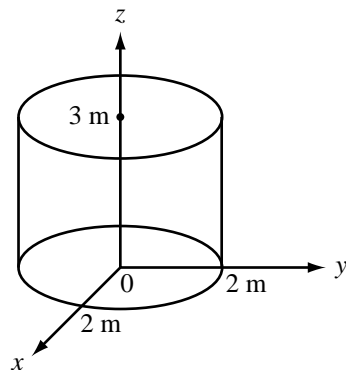


Figure P4.2: Cylinder of Problem 4.2.
