

**4.3** Find the total charge contained in a round-top cone defined by  $R \leq 2$  m and  $0 \leq \theta \leq \pi/4$ , given that  $\rho_v = 30R^2 \cos^2 \theta$  (mC/m<sup>3</sup>).

**Solution:** For the cone of Fig. P4.3, application of Eq. (4.5) gives

$$\begin{aligned} Q &= \int_{\phi=0}^{2\pi} \int_{\theta=0}^{\pi/4} \int_{R=0}^2 30R^2 \cos^2 \theta R^2 \sin \theta dR d\theta d\phi \\ &= \left( \frac{-6}{3} R^5 \phi \cos^3 \theta \right) \bigg|_{R=0}^2 \bigg|_{\theta=0}^{\pi/4} \bigg|_{\phi=0}^{2\pi} \\ &= 128\pi \left( 1 - \left( \frac{\sqrt{2}}{2} \right)^3 \right) = 260 \text{ (mC)}. \end{aligned}$$

