

4.8

$$\rho = \frac{\rho_0}{1+r^2} \left(\frac{C}{m^3} \right)$$

$$a) Q = \int \rho dv$$

$$= -\rho_0 \int \frac{r}{1+r^2} dr \int_0^{2\pi} d\phi \int_0^2 dz$$

$$= -\pi \rho_0 L \ln(1+r_0^2)$$

$$b) J = \rho u = -z \left(\frac{\rho_0 u}{1+r^2} \right)$$

$$I = \int J \cdot ds = - \int_{r=0}^{r_0} \int_{\phi=0}^{2\pi} \frac{\rho_0 u}{1+r^2} r dr d\phi = -2\pi u \rho_0 \int_0^{r_0} \frac{r dr}{1+r^2}$$

$$= -\pi u \rho_0 \ln(1+r_0^2) A$$