

4-29

a)

$$V(R) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho_l dl}{R} = \frac{1}{4\pi\epsilon_0} \int_0^{2\pi} \frac{\rho_l}{\sqrt{z^2 + a^2}} a d\phi = \frac{\rho_l a}{2\epsilon_0 \sqrt{z^2 + a^2}}$$

b)

$$E = -\nabla V = -\frac{\partial}{\partial z} \frac{\rho_l a}{2\epsilon_0 \sqrt{z^2 + a^2}} \hat{z} = -\frac{\rho_l a z}{2\epsilon_0 (z^2 + a^2)^{3/2}} \hat{z}$$