

57. (a) We use Eq. 25-18 to find the potential:

$$\begin{aligned}V_{\text{wall}} - V &= - \int_r^R E \, dr \\0 - V &= - \int_r^R \left(\frac{\rho r}{2\epsilon_0} \right) \\-V &= - \frac{\rho}{4\epsilon_0} (R^2 - r^2) .\end{aligned}$$

Consequently, $V = \frac{\rho}{4\epsilon_0} (R^2 - r^2)$.

(b) The value at $r = 0$ is

$$V_{\text{center}} = \frac{-1.1 \times 10^{-3} \text{ C/m}^3}{4(8.85 \times 10^{-12} \text{ C/V}\cdot\text{m})} ((0.05 \text{ m})^2 - 0) = -7.8 \times 10^4 \text{ V} .$$