22-64

\[ \Delta V = -\int E \cdot dA \]

\[ \phi = \phi E \cdot dA = \ldots = E(2\pi R) = \frac{q_m}{\epsilon_0} = \frac{Q}{\epsilon_0} \Rightarrow E = \frac{kR}{r^2} \]

between sphere and shell

(a) \[ \Delta V = -\int_{r_2}^{r_1} \frac{kR}{r^2} \, dr = + \frac{kR}{r} \bigg|_{r_1}^{r_2} = kR \left( \frac{1}{r_1} - \frac{1}{r_2} \right) \]

Numerically: \[ \Delta V = 2.7 \times 10^4 \text{ V} \]

(b) \( \Delta V \) remains the same since \( E \) remains the same between the sphere and the shell.

22-67

\[ \lambda = \frac{\alpha \lambda}{M} \quad r_1 = 2 \text{ mm} \quad r_2 = 10 \text{ mm} \]

\[ \phi = \phi E \cdot dA = \ldots = E(2\pi R) = \frac{q_m}{\epsilon_0} = \frac{1}{\epsilon_0} \Rightarrow E = \frac{2k\lambda}{r} \]

between wire and outer conductor

(a) \[ \Delta V = -\int_{r_2}^{r_1} \frac{2k\lambda}{r} \, dr = -2k\lambda \ln \frac{r}{r_2} \bigg|_{r_1}^{r_2} = -2k\lambda \ln \frac{r_1}{r_2} \]

So \[ \Delta V = +2k\lambda \ln \frac{r_2}{r_1} = 2170 \text{ V} \]

(b) \( \Delta V \) remaining the same since \( E \) remaining the same between the conductors.