1. Wolfson, Volume II, 2nd Edition, 22.48

Given

$r_1 = 2.0\,mm$

$r_2 = 1.6\,cm$

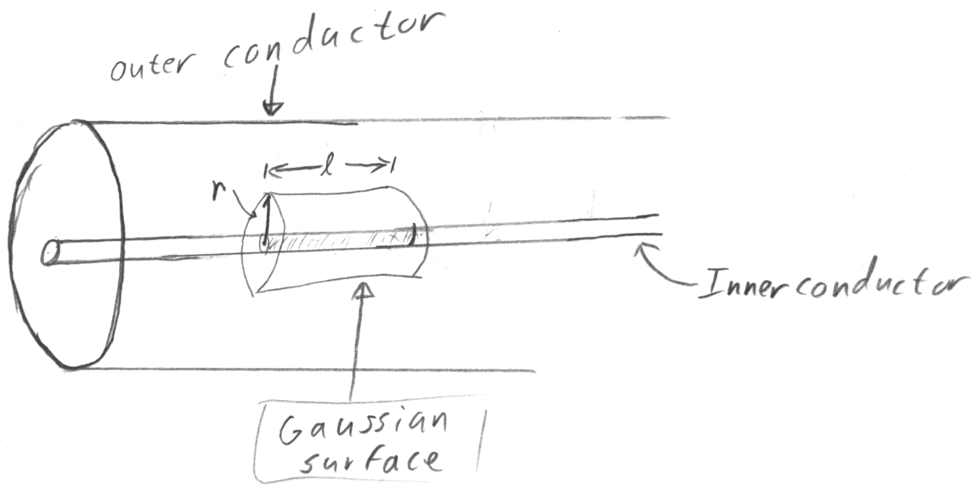
$\Delta V_{max} = 2kV$

$\lambda = \pm 62\,nC/m$

Want

$\Delta V < \Delta V_{max}$

So: $\Delta V = ?$



* Find $\vec{E}$ in region of interest

$$\Phi = \frac{Q_{enc}}{\epsilon_0} \Rightarrow E \cdot A_G = \frac{\lambda \ell}{\epsilon_0}$$

$$\Rightarrow E 2\pi r \cancel{\ell} = \frac{\lambda \cancel{\ell}}{\epsilon_0} \Rightarrow \boxed{\vec{E} = \frac{\lambda}{2\pi\epsilon_0 r}\hat{r}}$$

* Find ΔV between inner and outer conductors

$$\Delta V = -\int_{r_1}^{r_2} \vec{E} \cdot d\vec{s} = -\int_{r_1}^{r_2} \frac{\lambda}{2\pi\epsilon_0 r} dr = -\frac{\lambda}{2\pi\epsilon_0}\int_{r_1}^{r_2} \frac{1}{r} dr = \boxed{-\frac{\lambda}{2\pi\epsilon_0}\ln\left(\frac{r_2}{r_1}\right)}$$

$$\Rightarrow \boxed{\Delta V = -\frac{(62\times10^{-9}C)}{2\pi \cdot 8.8\times10^{-12}\left(\frac{C^2}{N\cdot m^2}\right)} \cdot \ln\left(\frac{1.6cm}{0.2cm}\right) = -2.3kV}$$

2. Wolfson, Volume II, 2nd Edition, 22.49

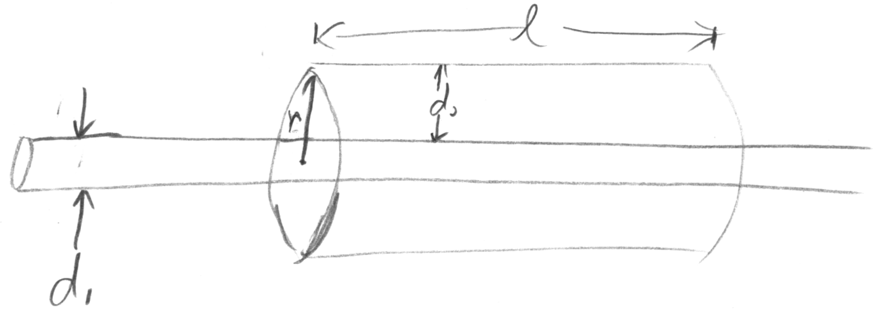
Given

$d_1 = 3.0\,cm$

$d_2 = 1.0\,m$

$\Delta V = 3.9\,kV$

$\lambda = ?$



* Find E outside wire

$$\Phi = \frac{Q_{enc}}{\epsilon_0} \Rightarrow E A_G = \frac{\lambda l}{\epsilon_0} \Rightarrow E\, 2\pi r l = \frac{\lambda l}{\epsilon_0}$$

$$\Rightarrow \boxed{\vec{E} = \frac{\lambda}{2\pi\epsilon_0 r}\hat{r}}$$

*Find ΔV from $\frac{1}{2}d_1$ to $\frac{1}{2}d_1 + d_2$

$$\Delta V = -\int \vec{E}\cdot d\vec{s} = -\int_{\frac{1}{2}d_1}^{\frac{1}{2}d_1 + d_2} \frac{\lambda}{2\pi\epsilon_0 r}\,dr = \boxed{-\frac{\lambda}{2\pi\epsilon_0}\ln\left(\frac{\frac{1}{2}d_1 + d_2}{\frac{1}{2}d_1}\right)}$$

$$\Rightarrow \boxed{\lambda = -2\pi\epsilon_0\,\Delta V \cdot \ln\left(\frac{\frac{1}{2}d_1 + d_2}{\frac{1}{2}d_1}\right)^{-1}}$$

$$\lambda = -2\cdot\pi(8.8\times10^{-12})(3.9\times10^{3})\cdot\ln\left(\frac{1.015\,m}{.015\,m}\right)^{-1}$$

$$\boxed{\lambda = -0.51\,nC/m}$$

3. Wolfson, Volume II, 2nd Edition, 22.64

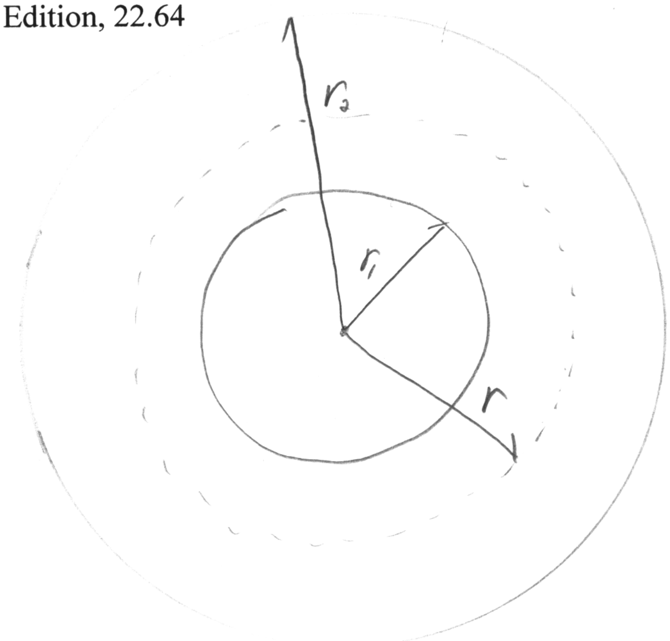
Given

$r_1 = 2.0\,cm$

$q_1 = 75\,nC$

$r_2 = 10\,cm$

$q_2 = -75\,nC$



* Find E

$$\Phi = \frac{Q_{enc}}{\epsilon_0} \Rightarrow E\,4\pi r^2 = \frac{q_1}{\epsilon_0} \Rightarrow \boxed{\vec{E} = \frac{q_1}{4\pi\epsilon_0 r^2}\hat{r}}$$

* Find V

$$\Delta V = -\int \vec{E}\cdot d\vec{s} = -\int_{r_1}^{r_2} \frac{q_1}{4\pi\epsilon_0 r^2}\,dr = -kq_1\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\boxed{\Delta V = -kq\left(\frac{1}{r_1} - \frac{1}{r_2}\right)}$$

$$\Delta V = -(9\times10^9)(75\times10^{-9}C)\left(\frac{1}{2\times10^{-2}m} - \frac{1}{10\times10^{-2}m}\right) = \boxed{-2.7\times10^4\,V}$$

4. Wolfson, Volume II, 2nd Edition, 22.65

Given

R

$\vec{E} = E_0 \left(\frac{r}{R}\right)^2 \hat{r}$

Let's integrate from center to surface. Then surface to center is the opposite sign.

$$\Delta V = -\int \vec{E} \cdot d\vec{s} = -\int_0^R E_0 \left(\frac{r}{R}\right)^2 dr$$

$$= -\frac{E_0}{R^2} \int_0^R r^2 dr = -\frac{E_0}{R^2} \left(\tfrac{1}{3} r^3\right)\Big|_0^R$$

$$\Delta V = -\tfrac{1}{3} E_0 R \quad - \quad 0 \rightarrow R$$

So: $\boxed{\Delta V = \tfrac{1}{3} E_0 R}$