

3. Suppose the charge on the sphere increases by Δq in time Δt . Then, in that time its potential increases by

$$\Delta V = \frac{\Delta q}{4\pi\epsilon_0 r} ,$$

where r is the radius of the sphere. This means

$$\Delta q = 4\pi\epsilon_0 r \Delta V .$$

Now, $\Delta q = (i_{\text{in}} - i_{\text{out}}) \Delta t$, where i_{in} is the current entering the sphere and i_{out} is the current leaving. Thus,

$$\begin{aligned} \Delta t &= \frac{\Delta q}{i_{\text{in}} - i_{\text{out}}} = \frac{4\pi\epsilon_0 r \Delta V}{i_{\text{in}} - i_{\text{out}}} \\ &= \frac{(0.10 \text{ m})(1000 \text{ V})}{(8.99 \times 10^9 \text{ F/m})(1.0000020 \text{ A} - 1.0000000 \text{ A})} = 5.6 \times 10^{-3} \text{ s} . \end{aligned}$$