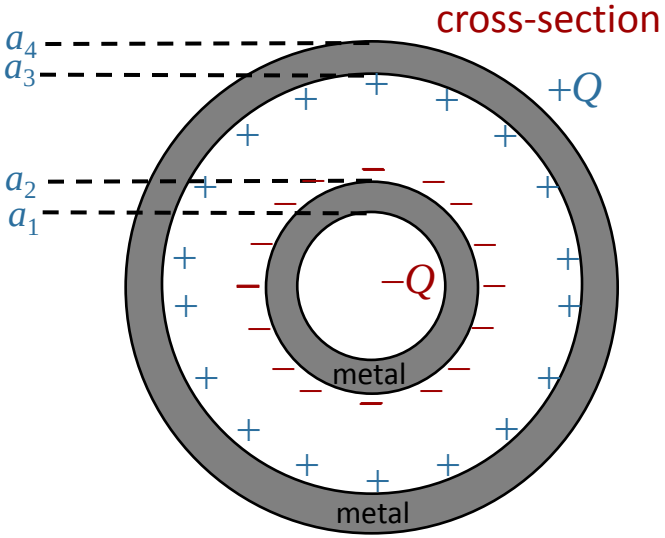
Calculation



A capacitor is constructed from two conducting cylindrical shells of radii a_1, a_2, a_3, and a_4 and length L ($L >> a_i$).

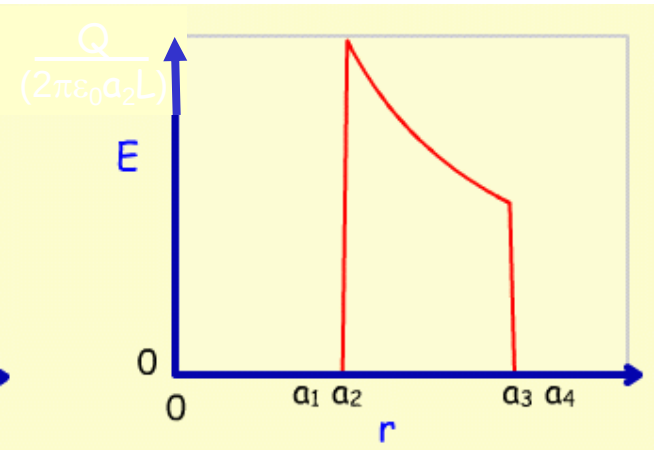
What is the capacitance C of this capacitor ?

$$C \equiv \frac{Q}{V} \qquad a_2 < r < a_3: \quad E = \frac{1}{2\pi\varepsilon_0}\frac{Q}{Lr}$$

What is $V \equiv V_{outer} - V_{inner}$?

$$\frac{Q}{2\pi\varepsilon_o L}\ln\frac{a_1}{a_4} \quad \text{(A)} \qquad \frac{Q}{2\pi\varepsilon_o L}\ln\frac{a_4}{a_1} \quad \text{(B)}$$

$$\boxed{\frac{Q}{2\pi\varepsilon_o L}\ln\frac{a_3}{a_2} \quad \text{(C)}} \qquad \frac{Q}{2\pi\varepsilon_o L}\ln\frac{a_2}{a_3} \quad \text{(D)}$$



$$V = -\int_{a_2}^{a_3}\frac{-Q}{2\pi\varepsilon_o L}\frac{dr}{r} \rightarrow V = \frac{Q}{2\pi\varepsilon_o L}\int_{a_2}^{a_3}\frac{dr}{r} \rightarrow V = \frac{Q}{2\pi\varepsilon_0 L}1n\frac{a_3}{a_2}$$

V proportional to Q, as promised

$$\rightarrow \quad C \equiv \frac{Q}{V} = \frac{2\pi\varepsilon_0 L}{1n(a_3/a_2)}$$