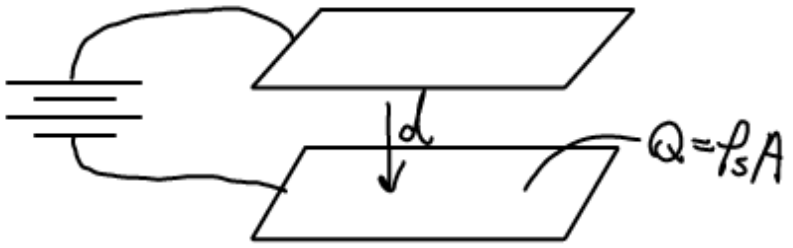
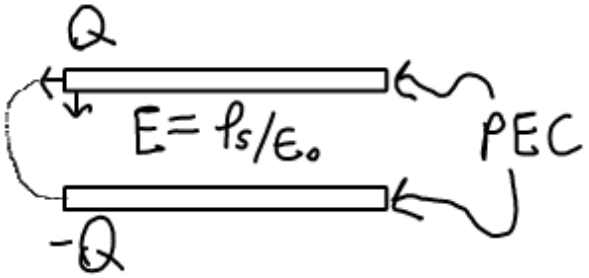
Capacitance

$$Q = CV$$

$$C = \frac{Q}{V}$$





$$C = \frac{Q}{V} \qquad V = Ed$$

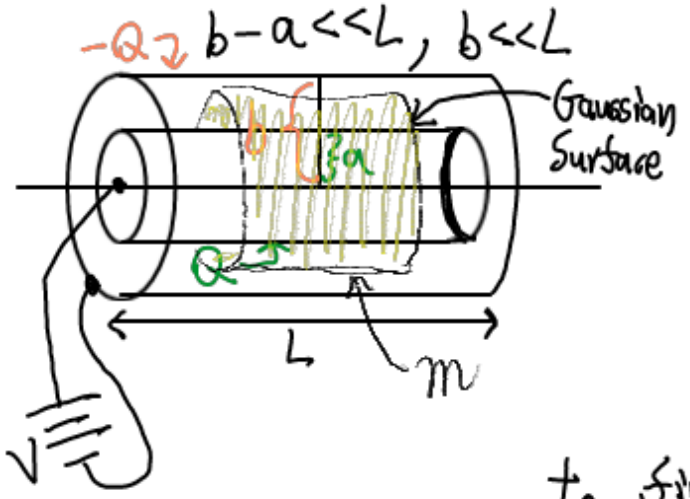
$$= \frac{Q}{Ed} \quad \text{since } d \text{ is small}$$

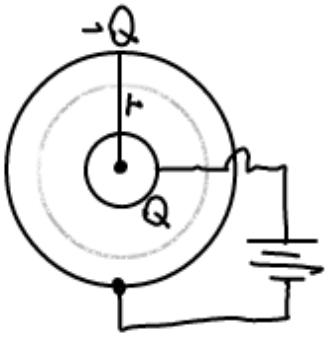
$$\therefore C = \frac{A\epsilon_0}{d}$$

$$= \frac{Q\epsilon_0}{\rho_s d}$$

$$= \frac{\rho_s A \epsilon_0}{\rho_s d}$$

$$= \frac{A\epsilon_0}{d}$$





to find $\vec{E}$ G.S. $\int \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

$\rho = \frac{Q}{m} \Rightarrow E = \frac{\rho}{2\pi\epsilon_0 r}$ $\Rightarrow |E| \int dA = \frac{Q}{\epsilon_0}$

$E 2\pi r m = \frac{Q}{\epsilon_0}$

$E = \frac{\rho_L}{2\pi\epsilon_0 r}$

Q given

outer cond.

$$V = \int \vec{E} \cdot d\vec{l}$$

inner cond.

$$= \int_{r=a}^{b} \frac{\rho_l}{2\pi\epsilon_0 r} dr = \boxed{\frac{\rho_l}{2\pi\epsilon_0} \ln\left(\frac{b}{a}\right)} \qquad Q = \rho L$$

$$C = \frac{Q}{V} \Rightarrow \quad C = \frac{2\pi\epsilon_0 L}{\ln(b/a)}$$