

1973 Em 1

$$a. \quad C = \frac{\epsilon_0 A}{d} = \frac{\epsilon_0 A}{x} = \epsilon_0 A x^{-1}$$

$$\frac{dC}{dx} = \epsilon_0 A [-1x^{-2}] = \frac{-\epsilon_0 A}{x^2}$$

$$b. \quad U = \frac{Q^2}{2C} = \frac{Q^2}{2} C^{-1}$$

$$\frac{dU}{dC} = \frac{Q^2}{2} [-1C^{-2}] = \frac{-Q^2}{2C^2}$$

$$\begin{aligned} \frac{dU}{dx} &= \frac{dU}{dC} \cdot \frac{dC}{dx} = \left[\frac{-Q^2}{2C^2} \right] \cdot \left[\frac{-\epsilon_0 A}{x^2} \right] \\ &= \frac{\epsilon_0 A Q^2}{2C^2 x^2} \end{aligned}$$

$$c. \quad F = -\frac{dU}{dx} = \frac{-\epsilon_0 A Q^2}{2C^2 x^2} \quad \text{WHERE} \quad C = \frac{\epsilon_0 A}{x}$$

$$F = \frac{-\epsilon_0 A Q^2}{2x^2 \left[\frac{\epsilon_0 A}{x} \right]^2} = \frac{-Q^2}{2A\epsilon_0}$$

1974 EM 2

a. $\Delta V = -\int E \cdot ds$

$$\Delta V = -E \int ds = -E \cdot b$$

$$|E| = \frac{V}{b}$$

b. $C = \frac{\epsilon_0 A}{d} = \frac{\epsilon_0 A}{b}$

$$Q = C \cdot V$$

$$= \left[\frac{\epsilon_0 A}{b} \right] V$$

c. $\Delta V = -\int E \cdot ds$

$$= -E \int ds = -E(b-a)$$

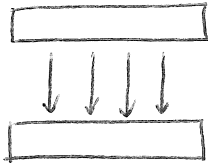
$$|E| = \frac{V}{b-a}$$

d.

$$\frac{C_{\text{WITH COPPER}}}{C_{\text{ORIGINAL}}} = \frac{\frac{\epsilon_0 A}{b-a}}{\frac{\epsilon_0 A}{b}} = \frac{b}{b-a}$$

1980 EM 2

a.



b. $Q_{enc} = \epsilon_0 \oint \mathbf{E}$

$$\sigma \cdot l^2 = \epsilon_0 E \cdot l^2$$

$$E = \frac{\sigma}{\epsilon_0}$$

c. THE NET ELECTRIC FIELD IS LESS THAN BEFORE. THE PLATES POLARIZE THE DIELECTRIC, CREATING A FIELD OPPOSITE THE INITIAL FIELD.

1981 Em 1

a. $Q_{\text{enc}} = \epsilon_0 \Phi_E$

$$Q = \epsilon_0 E \cdot 4\pi r^2$$

$$E = \frac{Q}{4\pi\epsilon_0 r^2}$$

b. $\Delta V = - \int_b^a E \cdot dR = \int_a^b \left(\frac{Q}{4\pi\epsilon_0 r^2} \right) dR$

$$= \frac{Q}{4\pi\epsilon_0} \int_a^b r^{-2} \cdot dR = \frac{Q}{4\pi\epsilon_0} \left[\frac{-1}{r} \right]_a^b$$

$$= \frac{Q}{4\pi\epsilon_0} \left[\frac{1}{a} - \frac{1}{b} \right]$$

$$C = \frac{Q}{\Delta V} = \frac{Q}{\frac{Q}{4\pi\epsilon_0} \left[\frac{1}{a} - \frac{1}{b} \right]} = \frac{4\pi\epsilon_0}{\frac{1}{a} - \frac{1}{b}}$$

c. $C = \frac{1}{2}C_0 + 4 \left[\frac{1}{2}C_0 \right]$

$$= \frac{5C_0}{2}$$

1984 EM 2

a. $E_1 a = E_2 b$

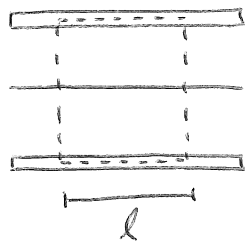
$$\frac{E_1}{E_2} = \frac{b}{a}$$

b. $Q_{\text{enc}} = \epsilon_0 \Phi_E$

$$\sigma A = \epsilon_0 A [E_1 + E_2]$$

$$E_1 + E_2 = \frac{\sigma}{\epsilon_0}$$

c.



$$Q_{\text{enc}} = \epsilon_0 \Phi_E$$

$$x \cdot l^2 + \sigma \cdot l^2 = \epsilon_0 \cdot 2l^2 \cdot 0$$

$$x = -\sigma$$

d.

$$E_1 + E_2 = \frac{\sigma}{\epsilon_0}$$

$$\frac{b}{a} \cdot E_2 + E_2 = \frac{\sigma}{\epsilon_0}$$

$$E_2 \left(1 + \frac{b}{a}\right) = \frac{\sigma}{\epsilon_0}$$

$$\frac{V}{b} \left(1 + \frac{b}{a}\right) = \frac{\sigma}{\epsilon_0}$$

$$V = \frac{\sigma \cdot ab}{(a+b) \epsilon_0}$$

1985 EM 1

a. $Q_{\text{ENC}} = \epsilon_0 \oint E$

$$Q = \epsilon_0 E \cdot 2\pi r \cdot L$$

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

b. $\Delta V = -\int_b^a E \cdot dr = \int_a^b \left(\frac{Q}{2\pi\epsilon_0 L r} \right) dr$

$$= \frac{Q}{2\pi\epsilon_0 L} \int_a^b r^{-1} dr = \frac{Q}{2\pi\epsilon_0 L} \ln \left[\frac{b}{a} \right]$$

c. $C = \frac{Q}{\Delta V} = \frac{Q}{\frac{Q}{2\pi\epsilon_0 L} \cdot \ln \left[\frac{b}{a} \right]} = 2\pi\epsilon_0 L \cdot \ln \left[\frac{a}{b} \right]$

d. $C = \frac{2}{3} C_0 + 2 \left(\frac{1}{3} C_0 \right)$

$$= \frac{4}{3} C_0$$