1973 Em I

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

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

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

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

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

$$= \frac{\epsilon_0 A Q^2}{2C^2 x^2}$$

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

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

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

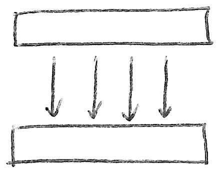
$= -E \int ds = -E(b-a)$

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

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. $Q_{ENC} = \epsilon_0 \Phi_E$

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

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

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. $Q_{ENC} = \epsilon_0 \Phi_E$

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

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

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. $E_1 a = E_2 b$

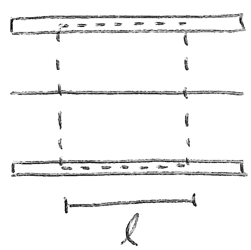
$$\frac{E_1}{E_2} = \frac{b}{a}$$

b. $Q_{ENC} = \epsilon_0 \Phi_E$

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

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

c.



$Q_{ENC} = \epsilon_0 \Phi_E$

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

$$x = -\sigma$$

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. $Q_{ENC} = \epsilon_0 \Phi_E$

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

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

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

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