

$$Q_1) \quad P = d \cdot T_j \rightarrow \frac{F}{A} \quad S_j = d \cdot j E_i$$

$$P = \frac{Qq}{V} = \frac{Q}{A} \quad P = dT = \frac{dF}{A}$$

$$V = \frac{Q}{C} = \frac{AP}{C} = \frac{AP}{\frac{\epsilon_0 \epsilon_r A}{L}} = \frac{LP}{\epsilon_0 \epsilon_r} = \frac{L d F}{\epsilon_0 \epsilon_r}$$

$$= \frac{d L F}{A \epsilon_0 \epsilon_r}$$

$$\therefore F = \frac{\epsilon_0 \epsilon_r V A}{d L} = \frac{(8.85 \times 10^{-12} + 1000) \pi (1.5 \times 10^{-3})^2 (3500)}{(250 \times 10^{-12}) (10 \times 10^{-3})} = 87.6 \text{ N}$$

Q₂)

$$C_1 = \frac{k_1 A/2 \epsilon_0}{d}$$

$$C_2 = \frac{k_2 \epsilon_0 A/2}{d/2} = \frac{k_2 \epsilon_0 A}{d}$$

$$C_3 = \frac{k_3 A/2 \epsilon_0}{d/2} = \frac{k_3 A \epsilon_0}{d}$$

$$C = C_1 + \left[\frac{1}{C_2} + \frac{1}{C_3} \right]^{-1}$$

$$= \frac{k_1 \epsilon_0 A/2}{d} + \frac{\epsilon_0 A}{d} \left(\frac{k_2 k_3}{k_2 + k_3} \right)$$

$$= \frac{\epsilon_0 A}{d} \left(\frac{k_1}{2} + \frac{k_2 k_3}{k_2 + k_3} \right)$$



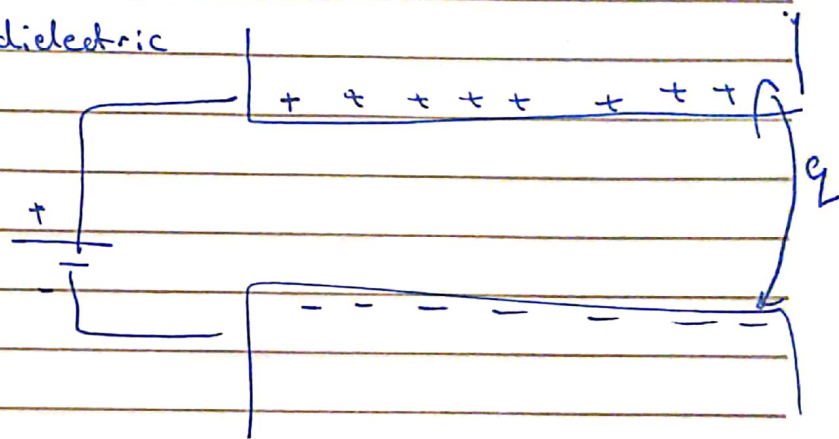
Q3) a) When no dielectric \rightarrow Gauss Law

with no dielectric

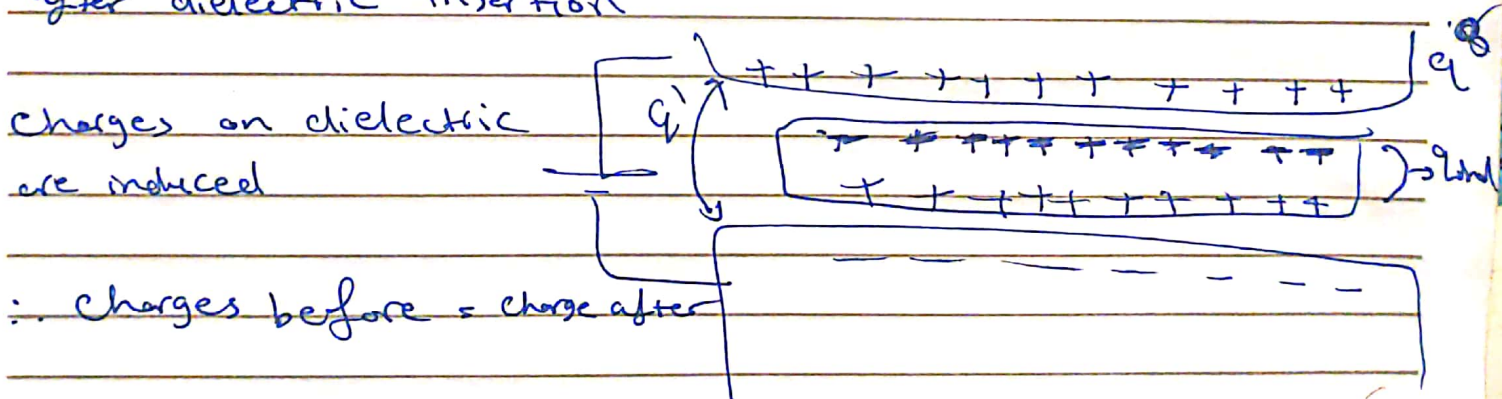
$$E_0 = \frac{\oint \vec{E} \cdot d\vec{A}}{\epsilon_0} = \frac{Q}{A \epsilon_0} = 1.01 \times 10^7 \text{ and } E = \frac{Q}{A \epsilon_0 \epsilon_r}$$

$$\therefore \epsilon_r = \frac{E_0}{E} = \frac{1.01 \times 10^7}{1.4 \times 10^6} = 7.2$$

b) before insertion of dielectric



after dielectric insertion



$$\therefore Q_{\text{before}} = Q_{\text{after}}$$

$$890 = Q' + Q_{\text{induced}}$$

$$E = \frac{Q}{A \epsilon_0 \epsilon_r} \quad \therefore Q = 1.4 \times 10^{-6} \text{ A} \times \epsilon_0 \epsilon_r = 124 \text{ nC}$$

$$\therefore Q_{\text{induced}} = 890 - 124 = 766 \text{ nC}$$

ROX