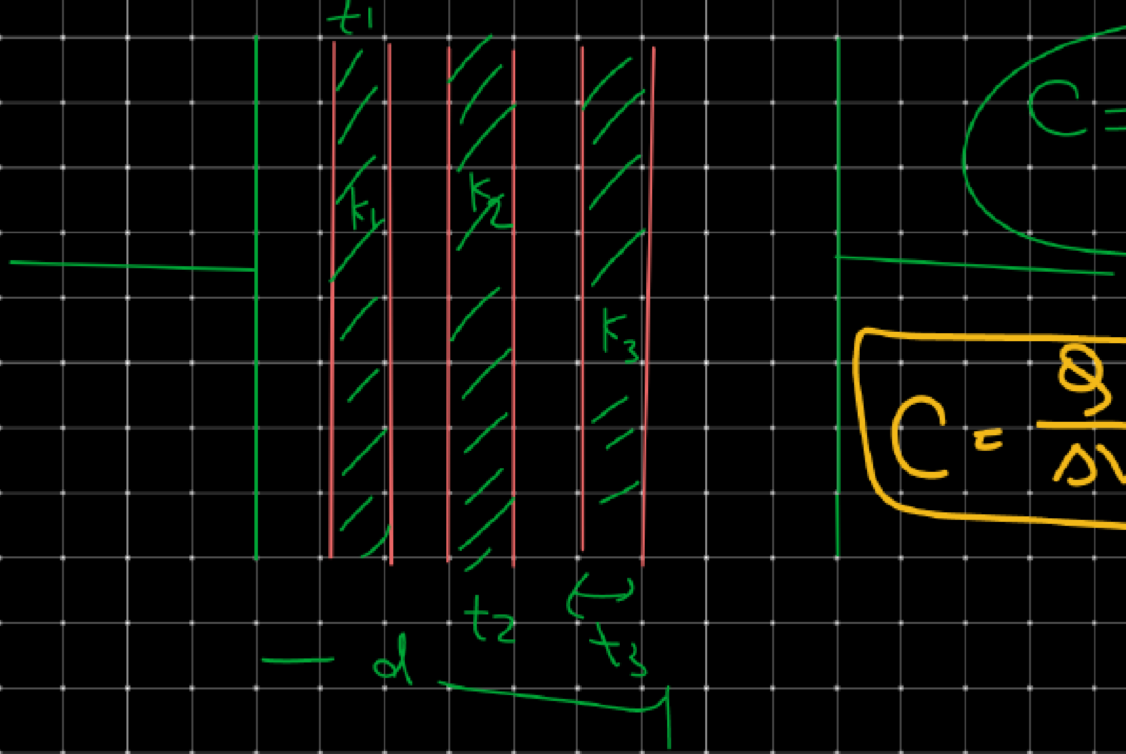
⇒ dielectric inside PPC :

$$C = \frac{A\varepsilon_0 K}{d}$$

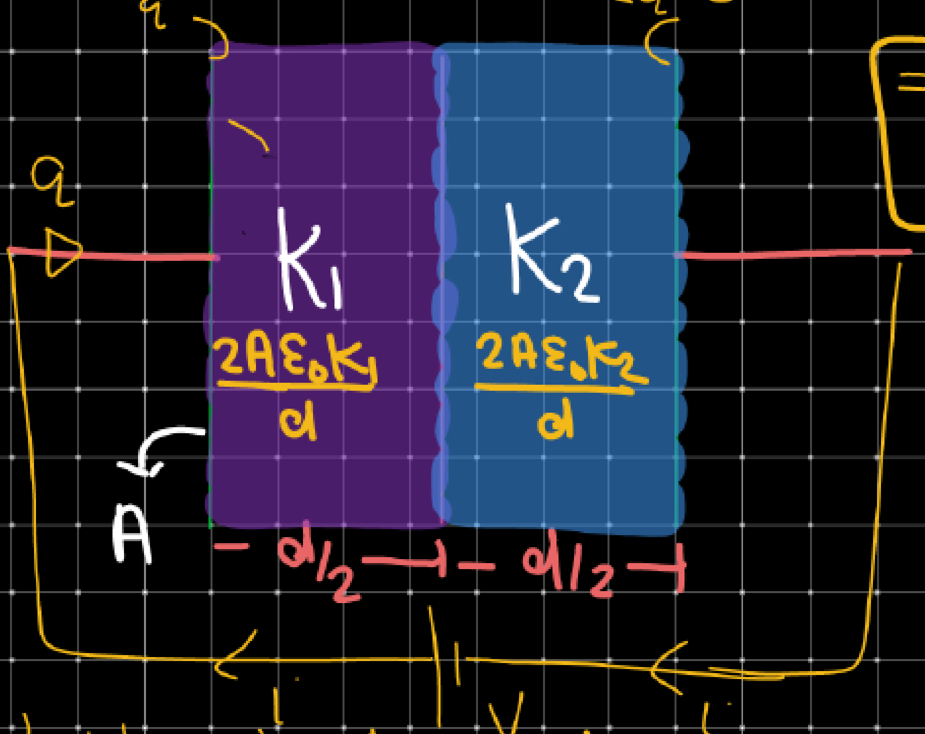
⇒ Partial (OR) different-2 dielectric part inside ppc



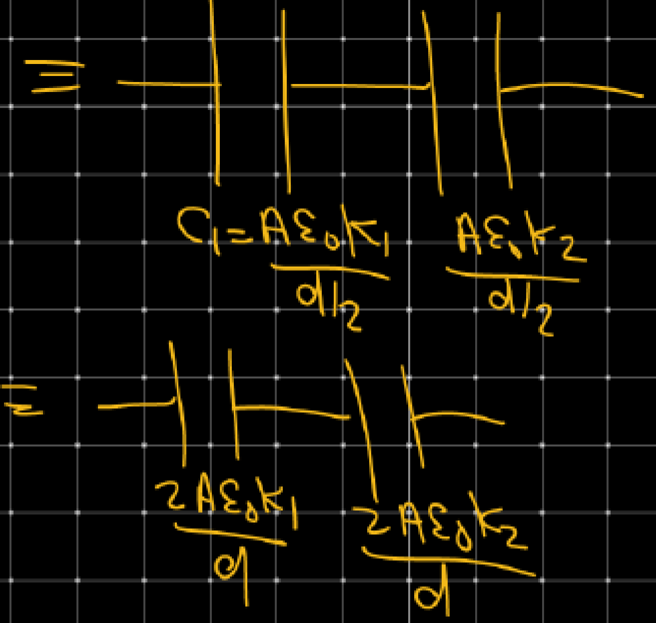
$$C = \frac{A\varepsilon_0}{(d - t_1 - t_2 - t_3) + \frac{t_1}{K_1} + \frac{t_2}{K_2} + \frac{t_3}{K_3}}$$

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

Equivalent Capacitance of different PPC System :-



⇒ In Series bcz charge flow on both are same.



$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} \Rightarrow \frac{1}{C_{eq}} = \frac{d}{2A\varepsilon_0 K_1} + \frac{d}{2A\varepsilon_0 K_2}$$

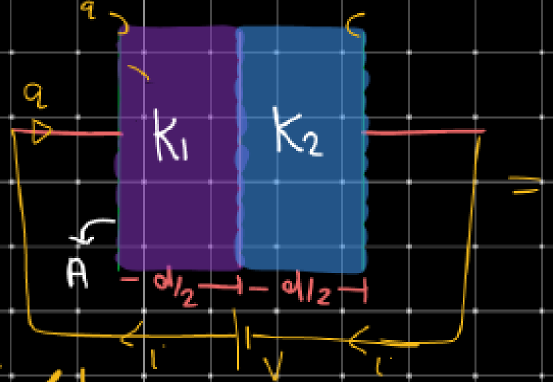
$$\frac{1}{C_{eq}} = \frac{d}{2A\varepsilon_0 K_1} + \frac{d}{2A\varepsilon_0 K_2}$$

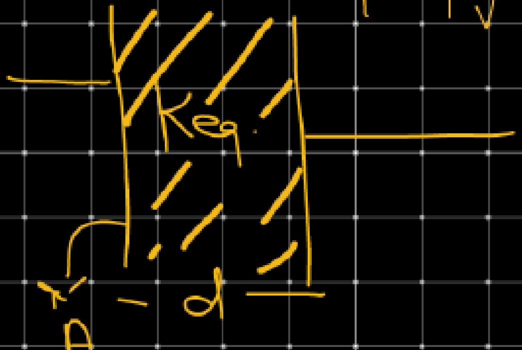
$$\frac{1}{C_{eq}} = \frac{d}{2A\varepsilon_0}\left[\frac{1}{K_1} + \frac{1}{K_2}\right]$$

$$\frac{1}{C_{eq}} = \frac{d}{2A\varepsilon_0}\left[\frac{K_2 + K_1}{K_1 K_2}\right]$$

$$C_{eq} = \frac{2A\varepsilon_0}{d}\left[\frac{K_1 K_2}{K_1 + K_2}\right]$$

$$K_{eq} = \frac{2K_1 K_2}{K_1 + K_2}$$





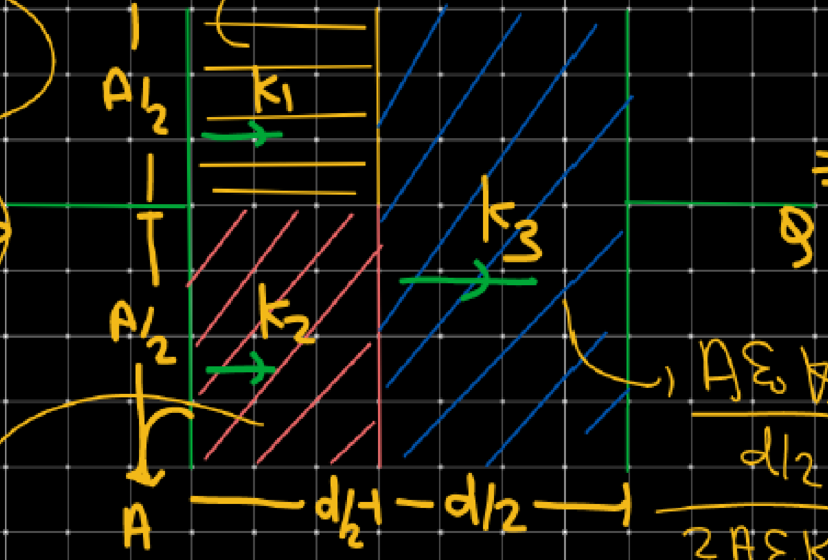
$$\frac{A\varepsilon_0 K_{eq}}{d} = \frac{2A\varepsilon_0}{d}\left[\frac{K_1 K_2}{K_1 + K_2}\right]$$

Find C_{eq} & K_{eq}

$$\frac{\frac{A}{2}\varepsilon_0 K_1}{d/2} = \frac{A\varepsilon_0 K_1}{d}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

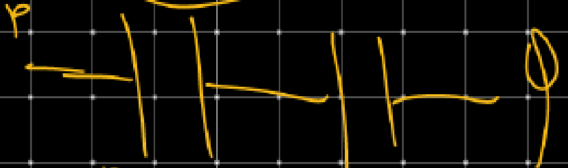
$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$



$$\frac{A\varepsilon_0 K_3}{d/2} = \frac{2A\varepsilon_0 K_3}{d}$$

$$\frac{\frac{A}{2}\varepsilon_0 K_2}{d/2} = \frac{A\varepsilon_0 K_2}{d}$$

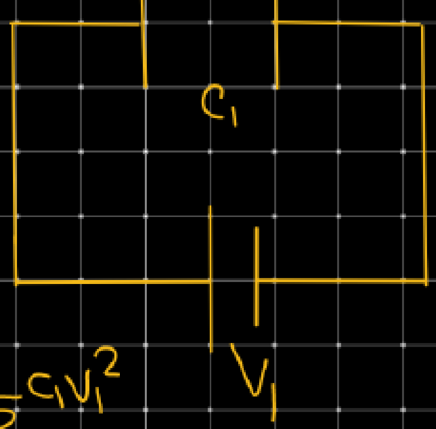
$$C_{eq} = C_1 + C_2 = \frac{A\varepsilon_0 K_1}{d} + \frac{A\varepsilon_0 K_2}{d}$$



$$\frac{A\varepsilon_0}{d}(K_1 + K_2) \qquad \frac{2A\varepsilon_0 K_3}{d}$$

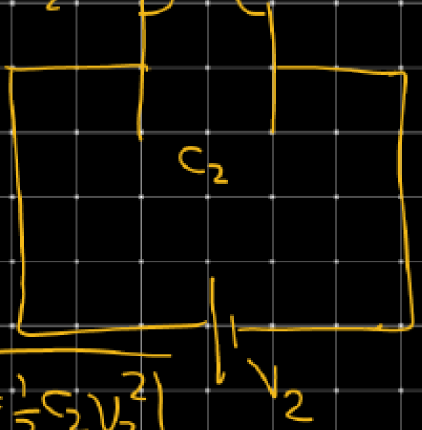
Connection of Capacitors:

$Q_1 = C_1V_1$ $\leftarrow$ $= C_1V_1$



$U_{1i} = \frac{1}{2}C_1V_1^2$

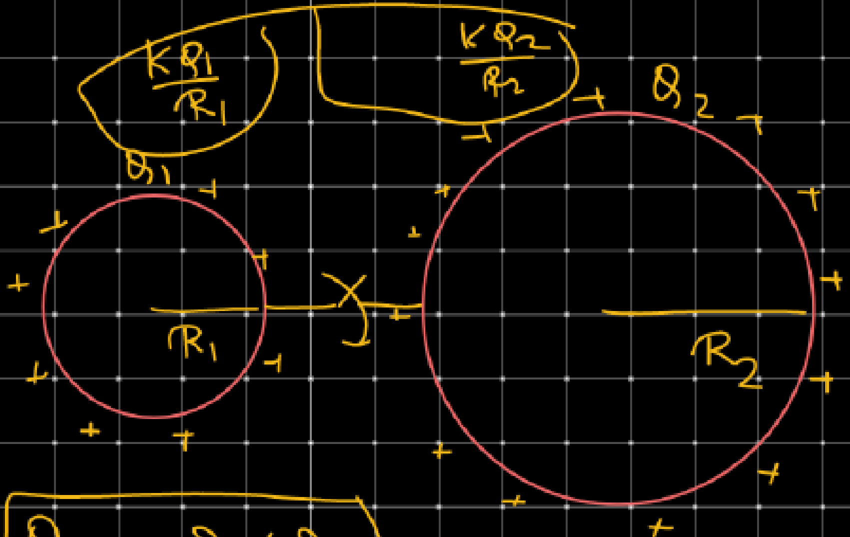
$Q_2 = C_2V_2$ $\leftarrow$ $= C_2V_2$



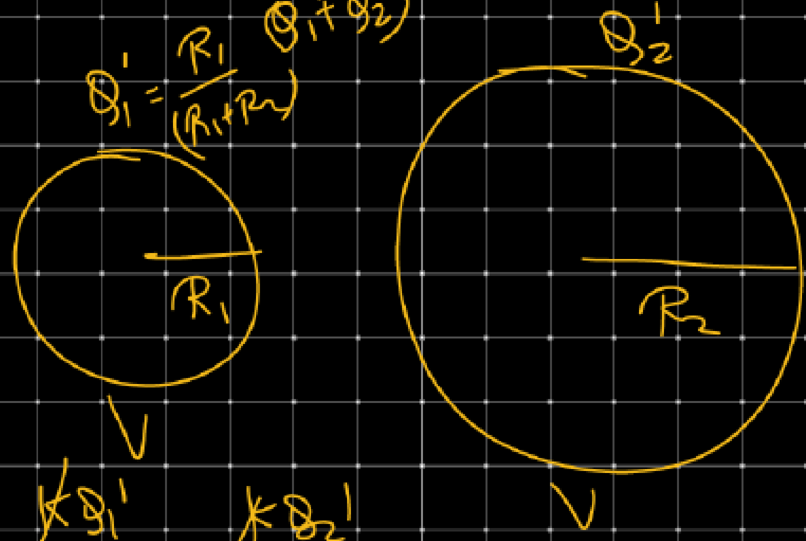
$U_{2i} = \frac{1}{2}C_2V_2^2$

≡

$$U_T = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2$$



$$Q_1' = \frac{R_1}{(R_1+R_2)}(Q_1+Q_2)$$



$$Q_{1T} = Q_1 + Q_2$$

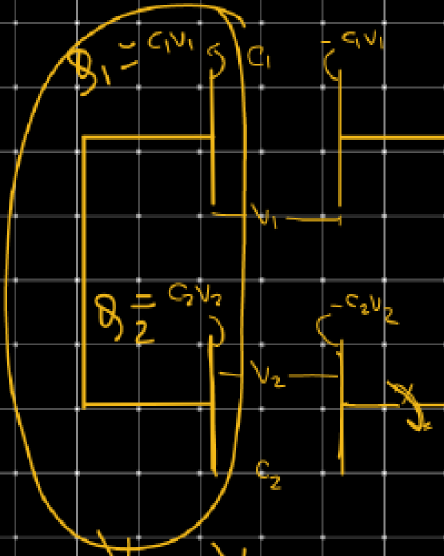
$$Q_1 + Q_2 = Q_1' + Q_2'$$

$$Q_1 + Q_2 = \frac{Q_2' R_1}{R_2} + Q_2'$$

$$Q_2' = \left(\frac{R_2}{R_1+R_2}\right)(Q_1+Q_2)$$

$$\frac{KQ_1'}{R_1} = \frac{KQ_2'}{R_2}$$

$$Q_1' = \frac{Q_2' R_1}{R_2}$$



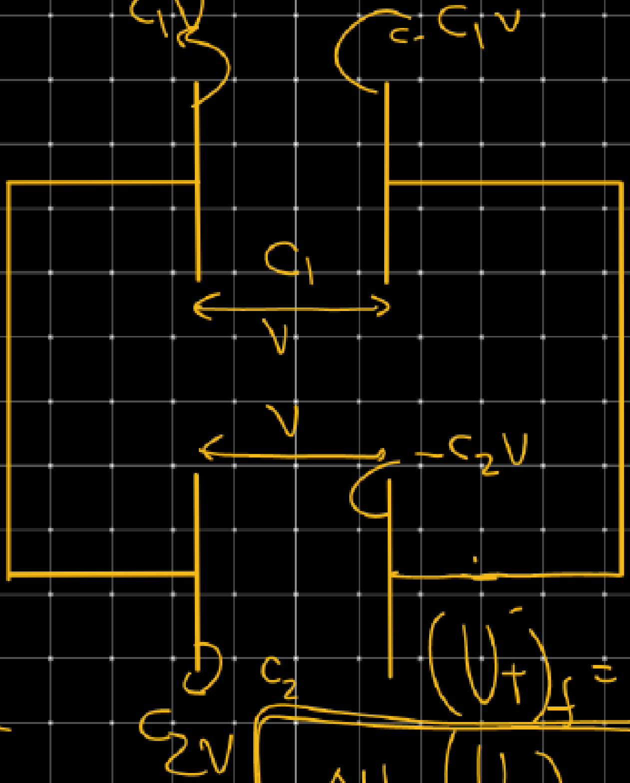
V V_2

$V_1 < V_2$

$$Q_1 + Q_2 = C_1V_1 + C_2V_2$$

$$C_1V_1 + C_2V_2 = C_1V + C_2V$$

$$(U_T)_i = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2$$



$$C_1V + C_2V$$

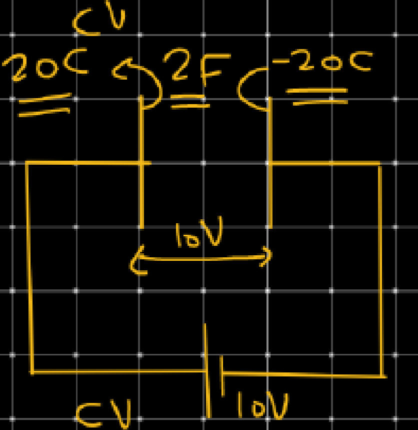
$$V_{common} = \frac{C_1V_1 + C_2V_1}{C_1 + C_2}$$

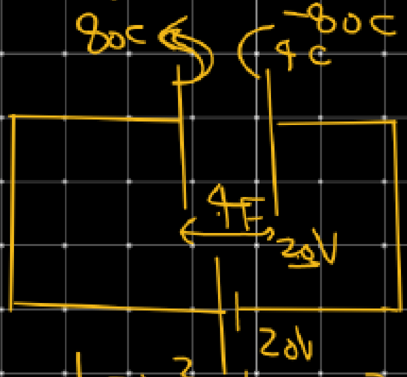
$$V_{comm} = \frac{Q_1 + Q_2}{C_1 + C_2}$$

$$(U_T)_f = \frac{1}{2}C_1V^2 + \frac{1}{2}C_2V^2$$

$$\Delta H = (U_T)_i - (U_T)_f$$

Q1) +ive plate of capacitor ① is connected with +ive plate of capacitor 2.
(i) find V_{common} (ii) ΔH. (iii) final charge on capacitors.



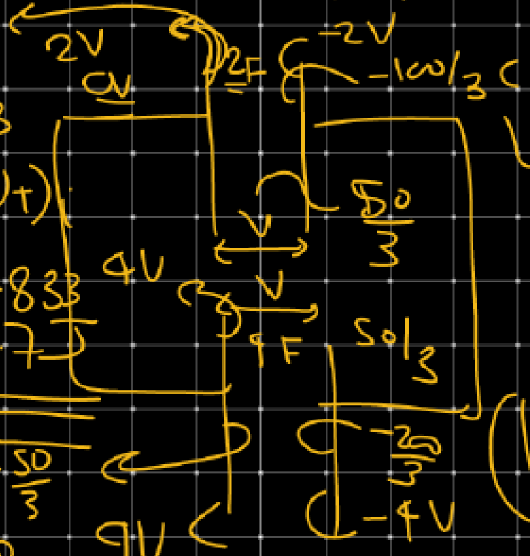


$(U_T)_i = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2$

$= \frac{1}{2}\times 2\times 10^2 + \frac{1}{2}\times 4\times 20^2$

$= 100 + 2\times 400 = 900\,J$

$\frac{50}{3}\times 2 = 100/3$



$4\times\frac{50}{3} = \frac{200}{3}$

$\Delta H = (U_T)_i - (U_T)_f$

$= 900 - 833$

$= 67.7$

$20 + 80 = 2V + 4V$

$100 = 6V$

$V = \frac{100}{6} = \frac{50}{3}$ Volt

$(U_T)_f = \frac{1}{2}C_1V^2 + \frac{1}{2}C_2V^2$

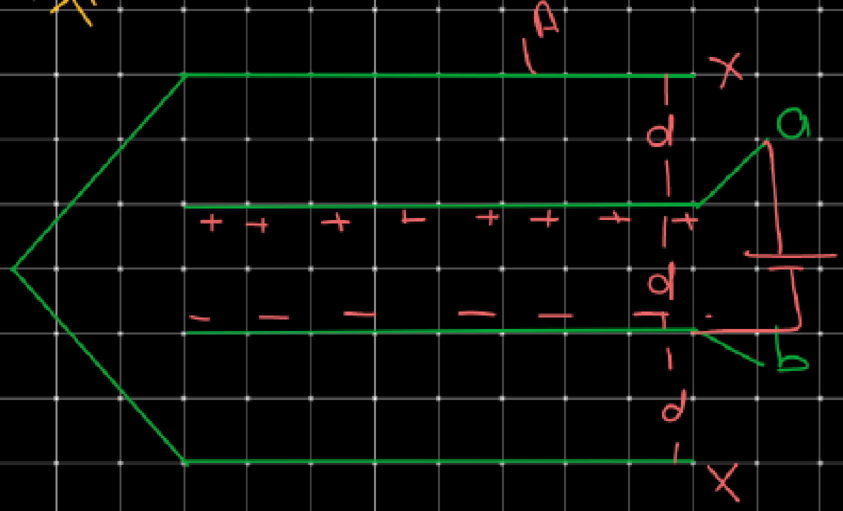
$= \frac{1}{2}(C_1+C_2)V^2$

$= \frac{1}{2}\times 6\times\left(\frac{50}{3}\right)^2$

$= 3\times\frac{2500}{9} = 833.33\,J$

Equivalent Capacitance:-

find Ceq b/w a & b.



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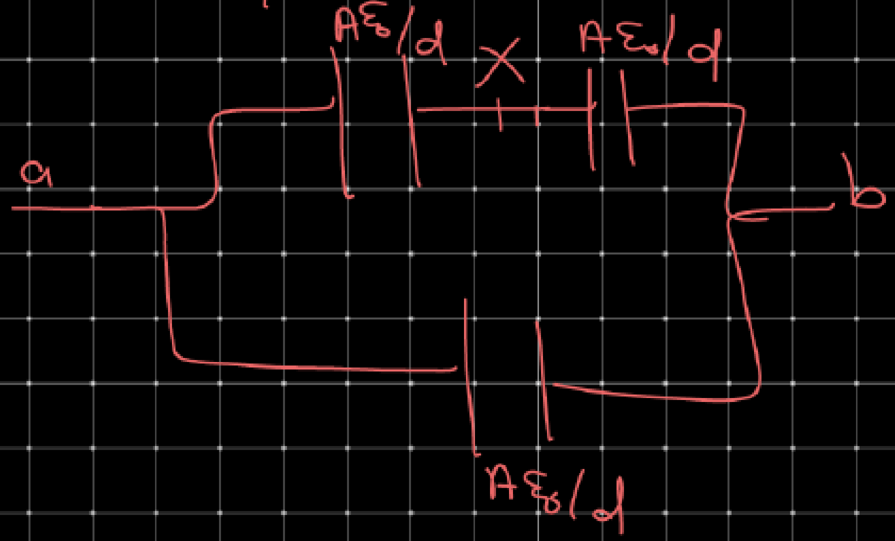
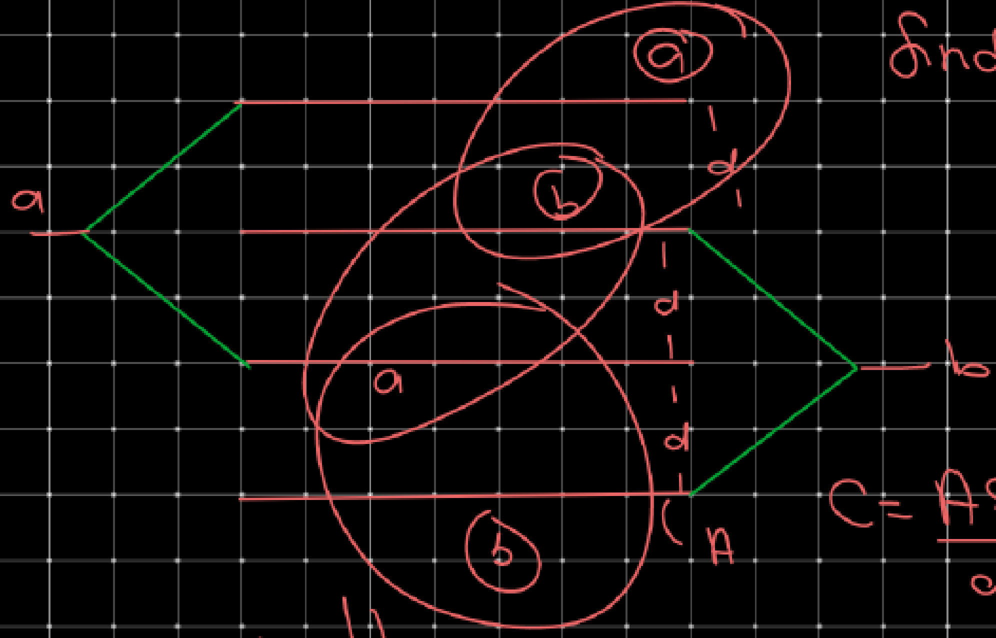
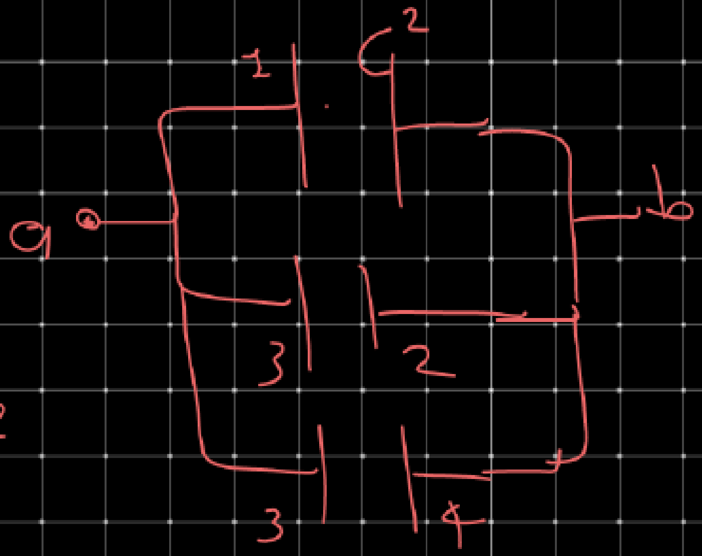
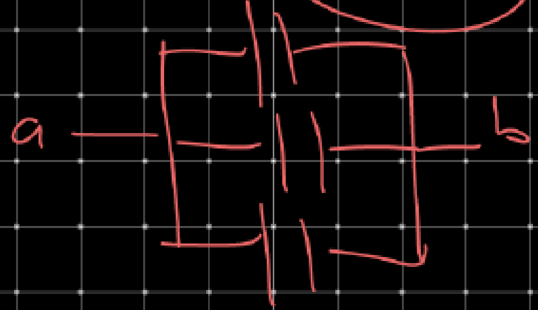


find C_{eq} b/w a & b.



$$C = \frac{A\varepsilon_0}{d}$$





$$C_{eq} = C_1 + C_2 + C_3$$

$$\boxed{C_{eq} = \frac{3A\varepsilon_0}{d}}$$