LAKSHYA JEE

LAKSHYA KO HAR HAAL ME PAANA HAI

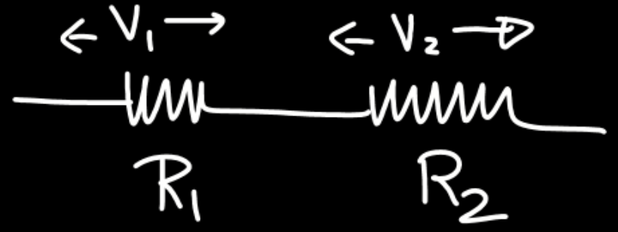
Electric Potential & Capacitance

-Er. Rohit Gupta

Today's GOALS!

Capacitors

Series combination

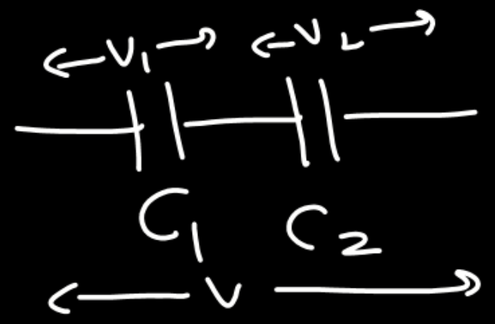


$$R_{eq} = R_1 + R_2$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$V_1 = \frac{R_1 V}{R_1 + R_2}$$

$$V_2 = \frac{R_2 V}{R_1 + R_2}$$



$$V = V_1 + V_2$$

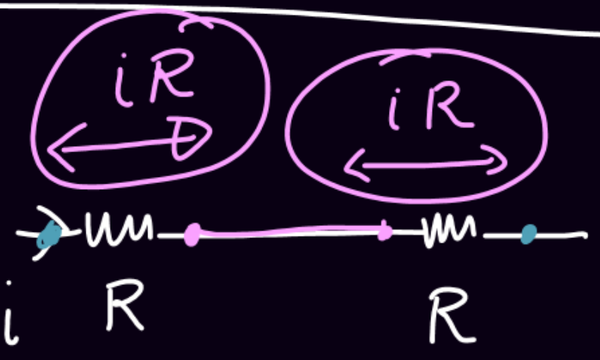
$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{V_1}{V_2} = \frac{C_2}{C_1}$$

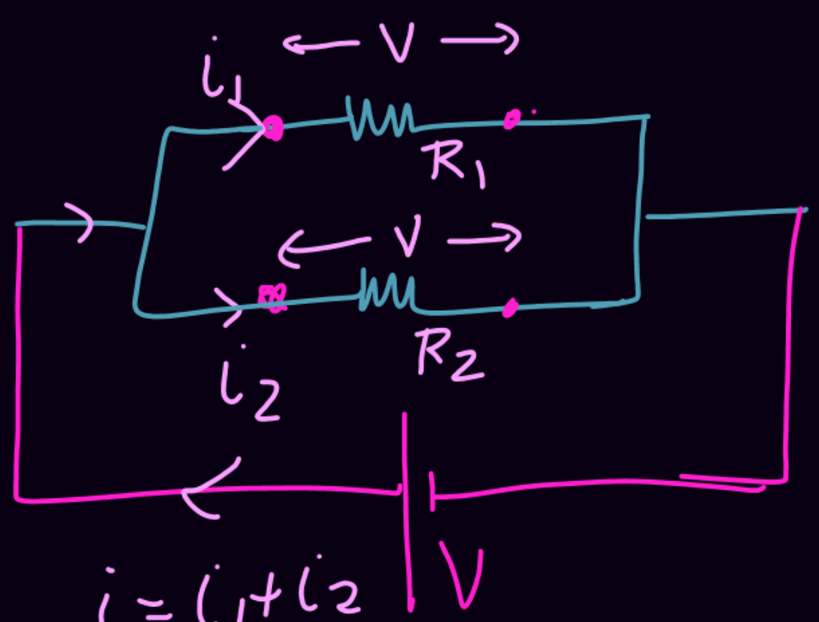
$$V_1 = \frac{C_2 V}{C_1 + C_2}$$

$$V_2 = \frac{C_1 V}{C_1 + C_2}$$

Parallel combination (Same potential drop. Same terminals)

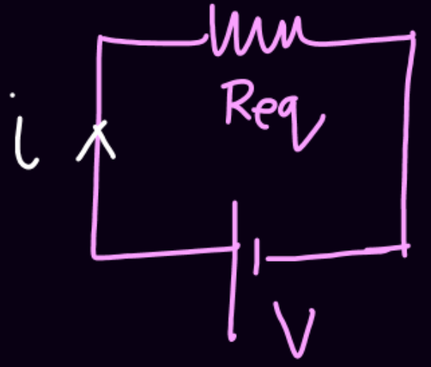


$V = iR$



$i = i_1 + i_2$

$$i_1 = \frac{V}{R_1} \; ; \; i_2 = \frac{V}{R_2}$$



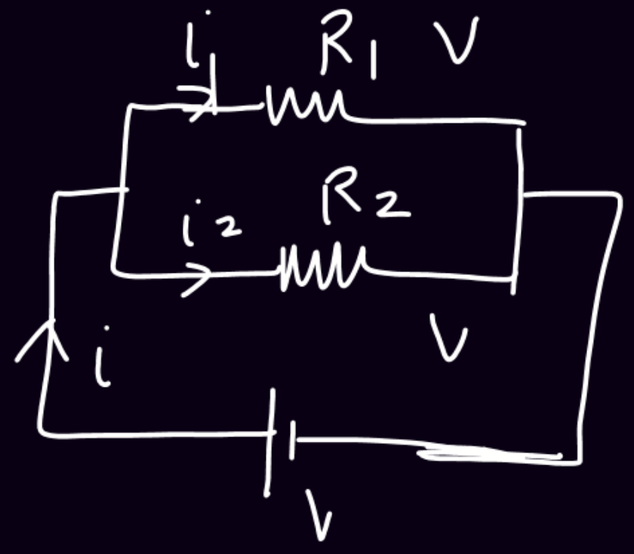
$$i = \frac{V}{Req}$$

$$\frac{V}{Req} = \frac{V}{R_1} + \frac{V}{R_2}$$

$$\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$Req = \frac{R_1 R_2}{R_1 + R_2}$$

Parallel combination devides current / charge



$$i_1 = \frac{V}{R_1}$$

$$i_2 = \frac{V}{R_2}$$

$$\frac{i_1}{i_2} = \frac{R_2}{R_1}$$

$$i \propto \frac{1}{R}$$

$$i = i_1 + i_2$$

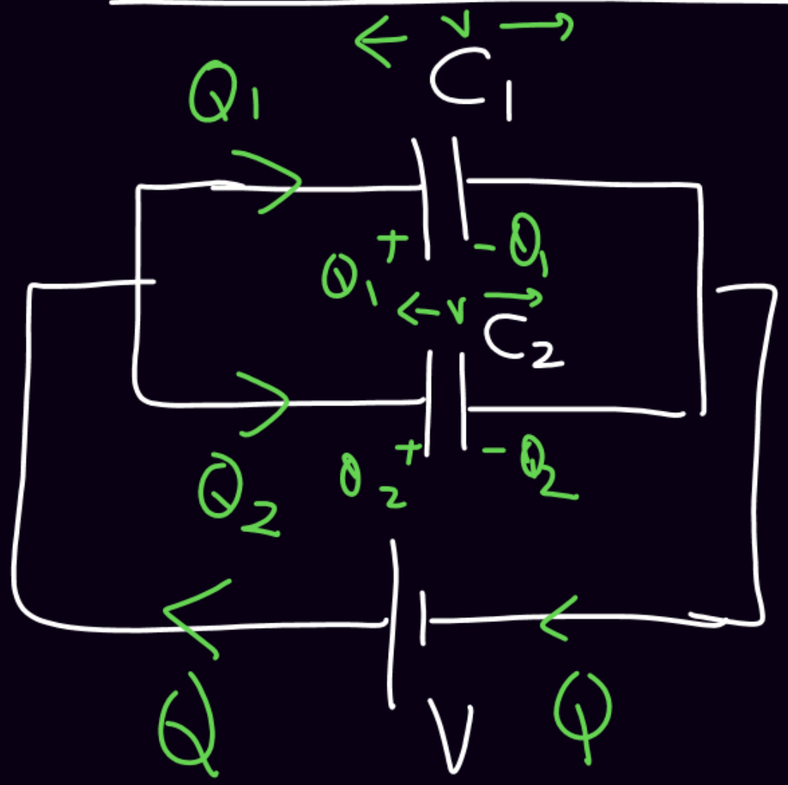
$$i = i_2\left(\frac{i_1}{i_2} + 1\right)$$

$$i = i_2\left(\frac{R_2}{R_1} + 1\right)$$

$$i_2 = \frac{R_1\, i}{R_1 + R_2} \quad *$$

$$i_1 = \frac{R_2\, i}{R_1 + R_2}$$

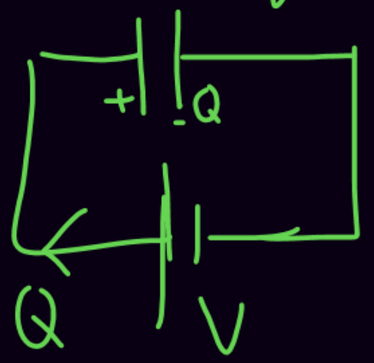
Parallel combination of capacitors



$Q = CV$

$Q_1 = C_1 V$

$Q_2 = C_2 V$



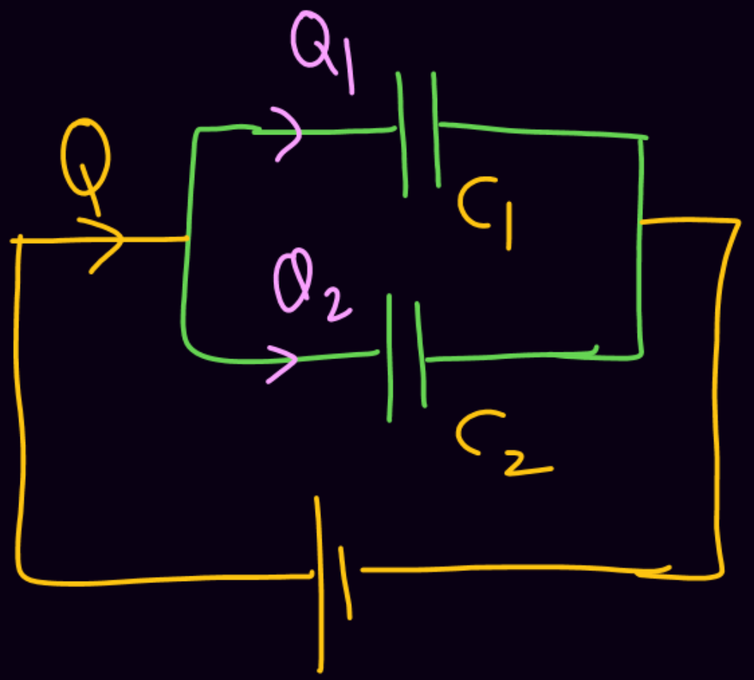
$Q = C_{eq} V$

$Q = Q_1 + Q_2$

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

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

Parallel combination of capacitor divides the charge



$$Q_1 = C_1 V$$

$$Q_2 = C_2 V$$

$$\frac{Q_1}{Q_2} = \frac{C_1}{C_2}$$

$$Q = Q_1 + Q_2$$

$$Q = Q_2\left(\frac{Q_1}{Q_2} + 1\right)$$

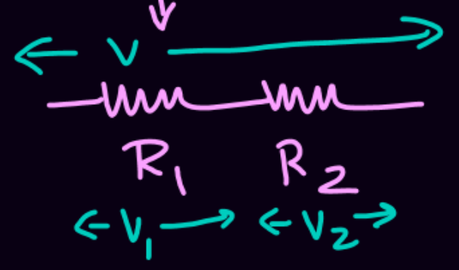
$$Q = Q_2\left(\frac{C_1}{C_2} + 1\right)$$

$$Q_2 = \frac{C_2}{C_1 + C_2} Q \quad ✡✡$$

$$Q_1 = \frac{C_1 Q}{C_1 + C_2}$$

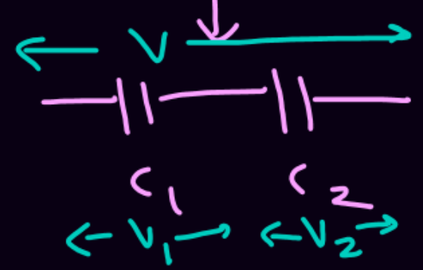
Summary

Series



$$R_{eq} = R_1 + R_2$$

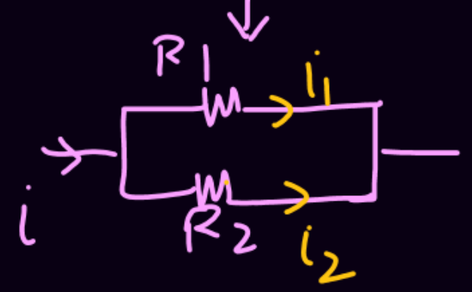
$$V_1 = \frac{R_1 V}{R_1 + R_2}$$



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

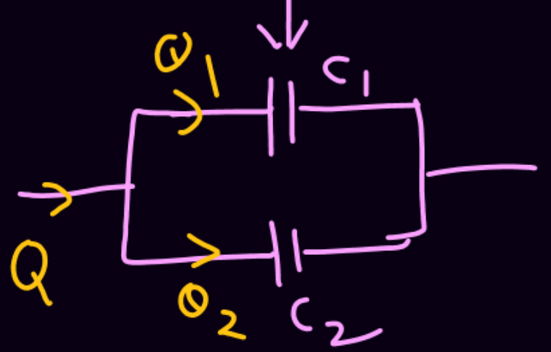
$$V_1 = \frac{C_2 V}{C_1 + C_2}$$

Parallel



$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

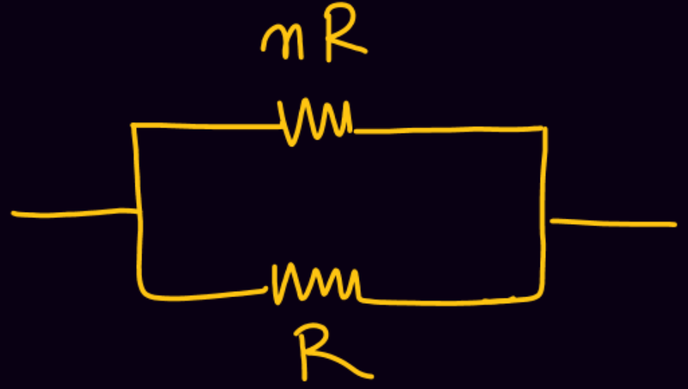
$$i_1 = \frac{R_2 i}{R_1 + R_2}$$



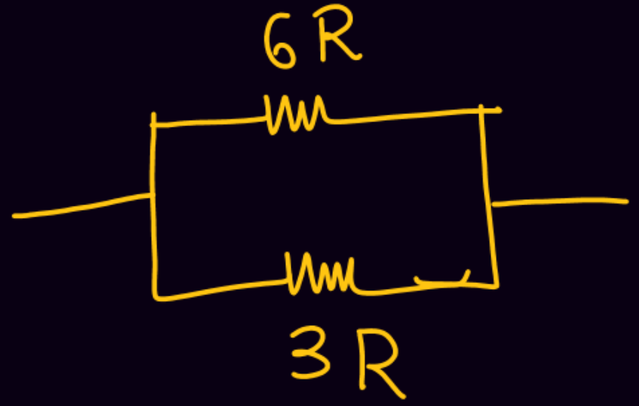
$$C_{eq} = C_1 + C_2$$

$$Q_1 = \frac{C_1 Q}{C_1 + C_2}$$

Q



Find Req $= \frac{nR \times R}{nR + R} = \frac{nR}{n+1} =$ Bade wala resistance / $n+1$



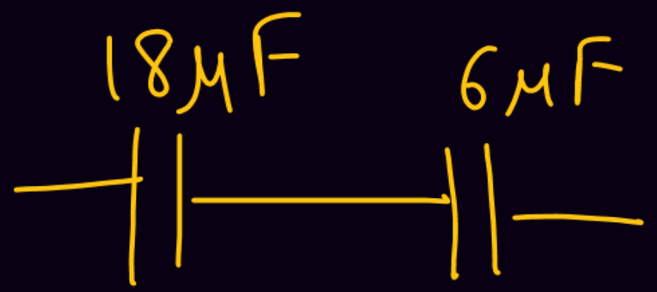
$Req = \frac{6R}{3} = 2R$

50

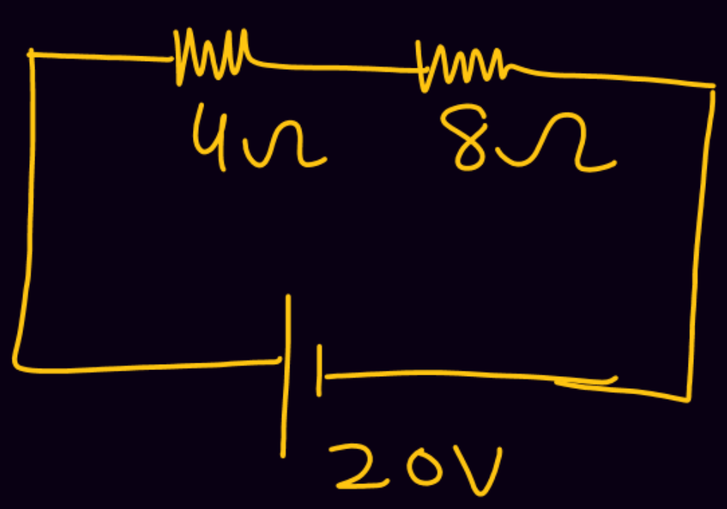
$\frac{100}{3}\Omega$

$C_{eq} = ?$

$\frac{12}{3} = 4\,\mu F$



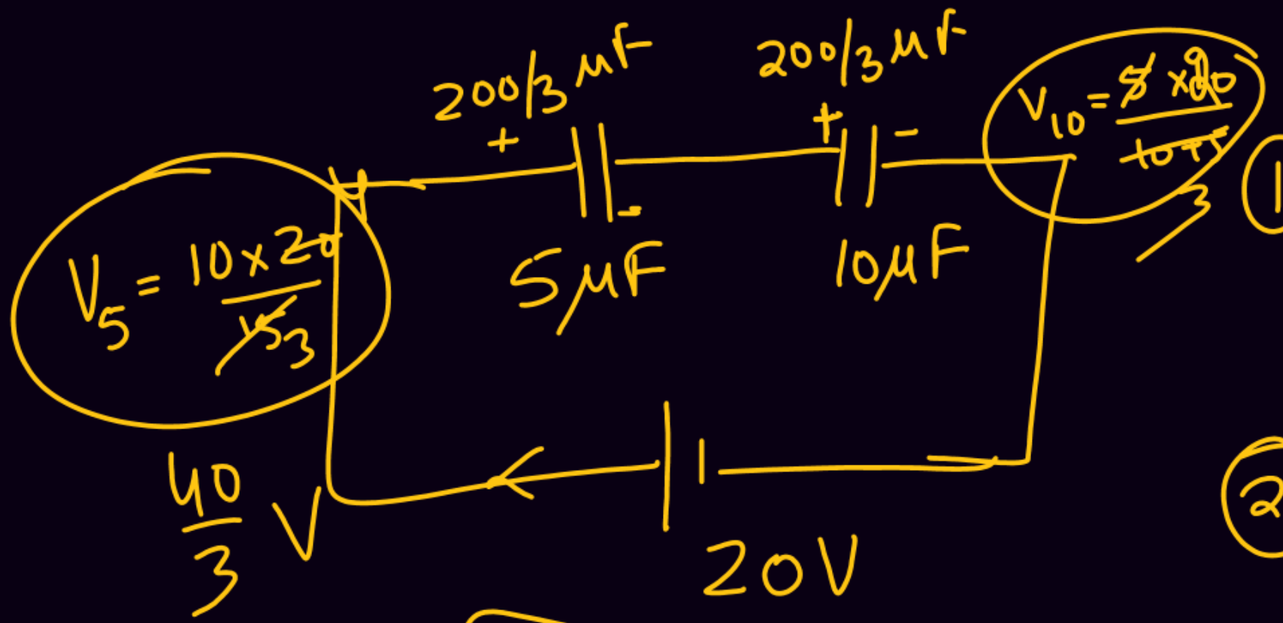
$$C_{eq} = \frac{18}{4} = \frac{9}{2} = 4.5\,\mu F.$$



Find $V_4 = \frac{4 \times 20}{4+8} = \frac{4 \times 20}{12} = \frac{20}{3}$

$V_8 = \frac{8 \times 20}{4+8} = \frac{8 \times 20}{12}$

$= \frac{40}{3}$



① Find charge on both the capacitors.

② find potential drop on both the capacitors.

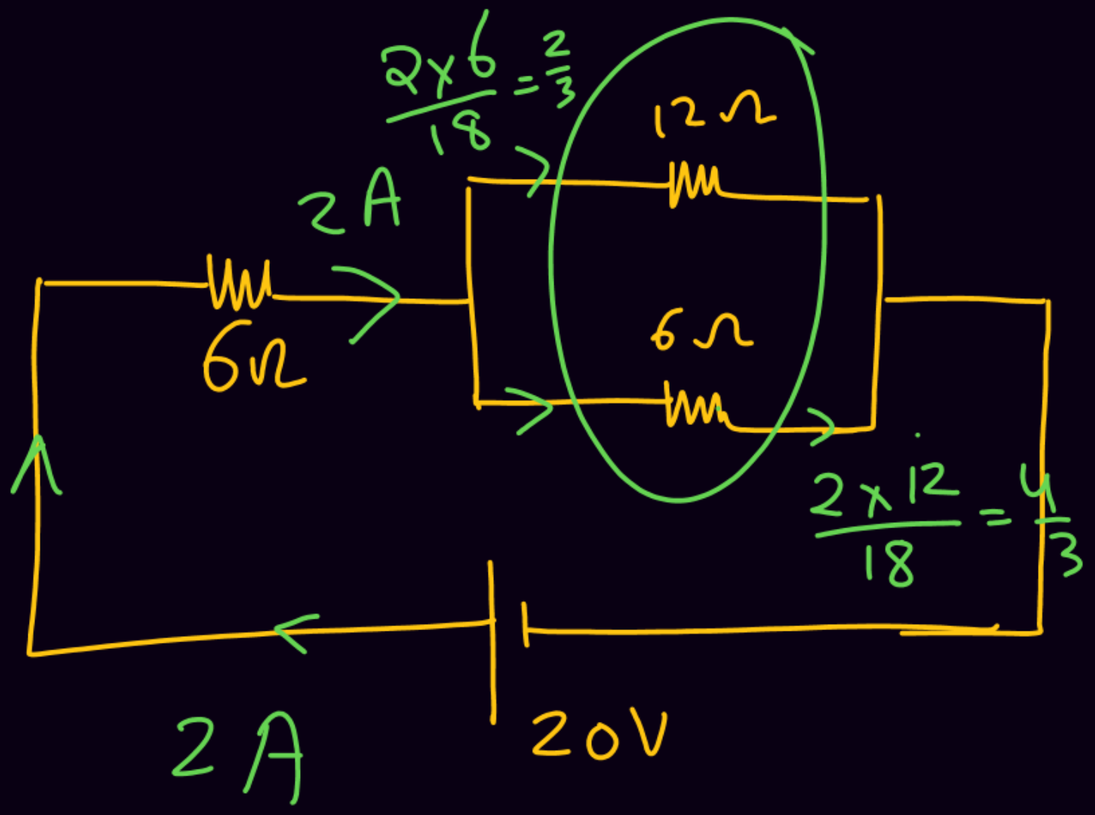
$$C_{eq} = \frac{10}{3}\ \mu F$$

$$Q = C_{eq} V$$
$$= \frac{10}{3}\ \mu F \times 20\ V$$
$$= \frac{200}{3}\ \mu C$$

For boards

The given 5μF & 10μF capacitors are in series.

We know that for series combination of capacitors $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} \Rightarrow \frac{1}{C_{eq}} = \frac{1}{5\mu F} + \frac{1}{10\mu F}$



find i in all the branches

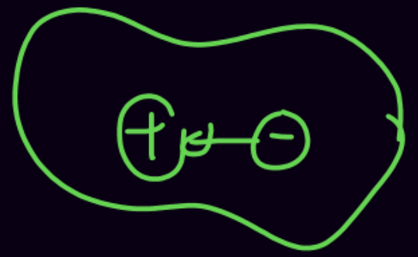
$R_{eq} = 10\Omega$

$i = \frac{20}{10} = 2A$

Dielectrics (Insulators)

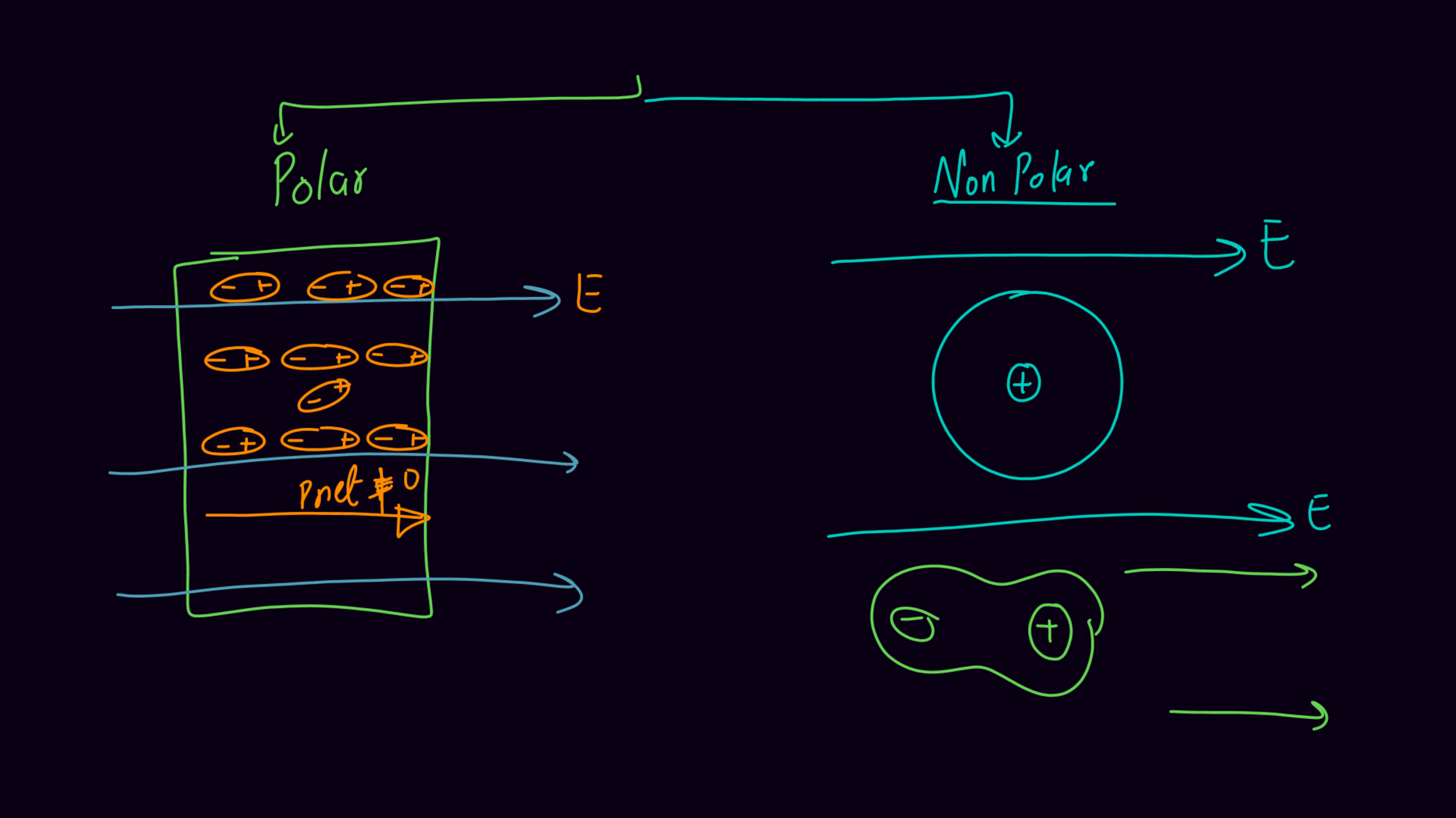
Polar

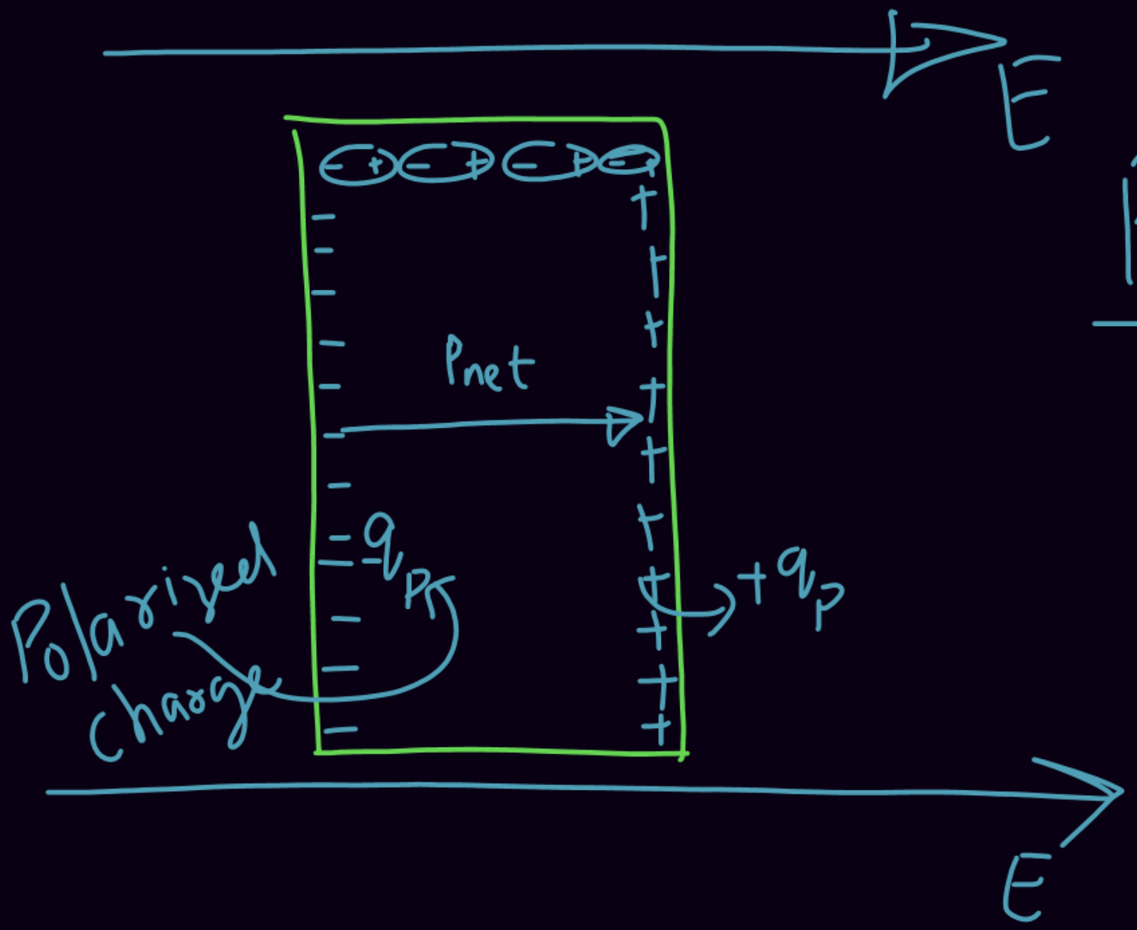
$P_{net} = 0$.



Non Polar

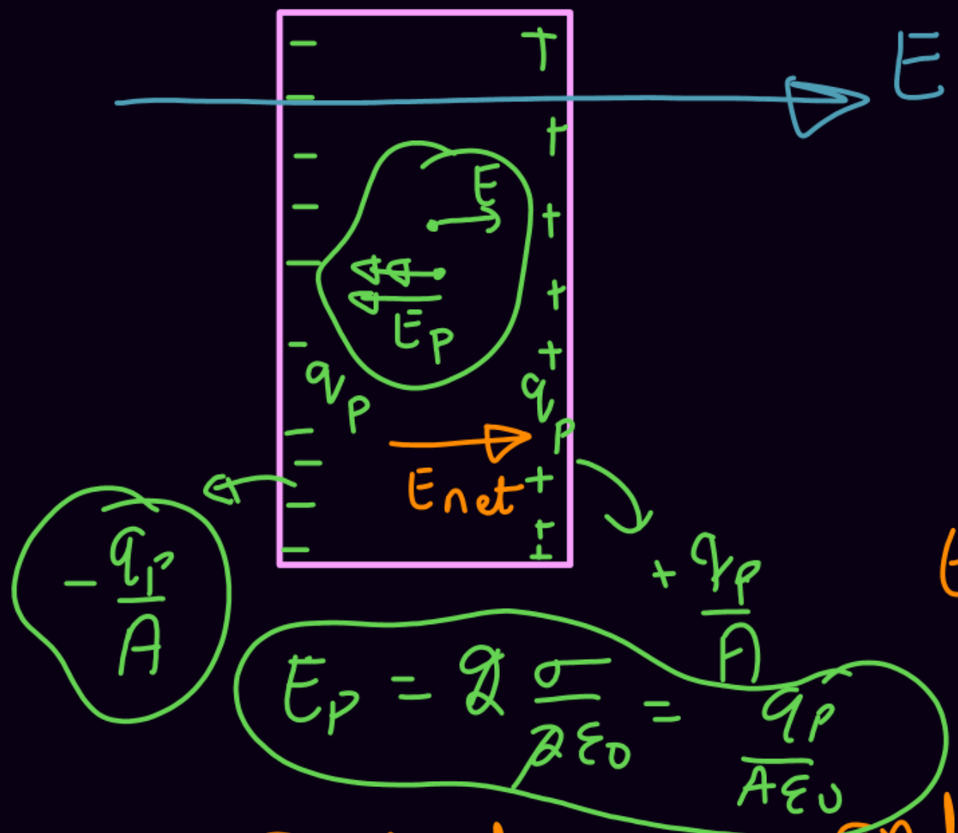
No dipoles


Polar
Non Polar
E
Pnet ≠ 0
E



Polarization :- Generation of

net dipole moment in a dielectric in the presence of external field is called polarization.



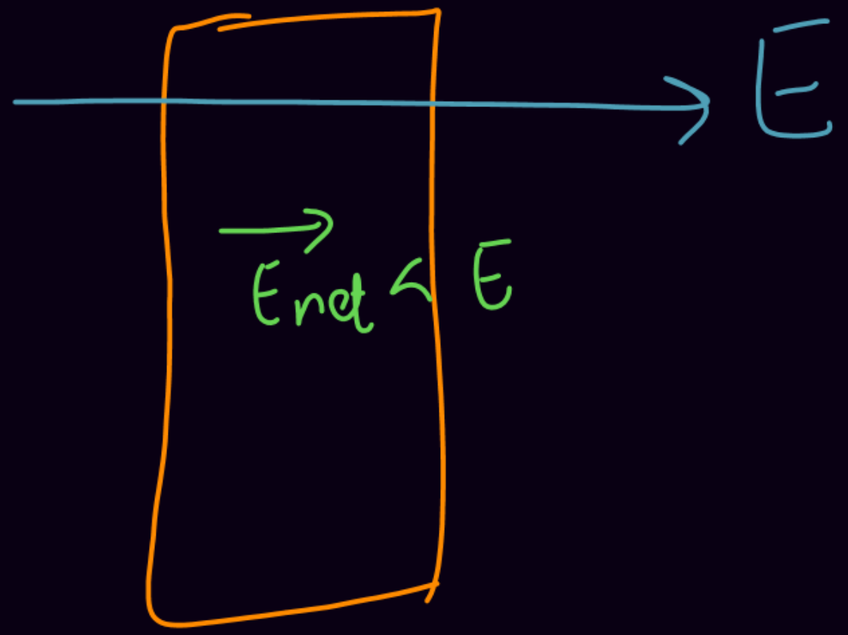
dielectric ke ander polarization ki vajah se jo electric field aa raha h wo ext. field ka ulta hai.

$E_{net} = E - E_p$.

$E_{net} < E$

Dielectric apne ander field ko कम karne की koshish kar रहा है।

Dielectric constant is the factor by which a dielectric reduces the electric field inside it.



$E_{net} = \frac{E}{K}$ ← $K \geq 1$

D dielectric const.

$E - E_p = \frac{E}{K}$

$E_p = E\left(1 - \frac{1}{K}\right)$ ⇒ $\frac{q_p}{A\varepsilon_0} = E\left(1 - \frac{1}{K}\right)$

Thank You Lakshyians