Nishant Jindal

CURRENT ELECTRICITY

(&)

$$\boxed{I = neAv_d} \quad -(1)$$

$$\boxed{J = \frac{I}{A} = nev_d} \quad -(2)$$

$$\boxed{v_d = \left(\frac{eE}{m}\tau\right)} \quad -(3)$$

From (1) and (3)

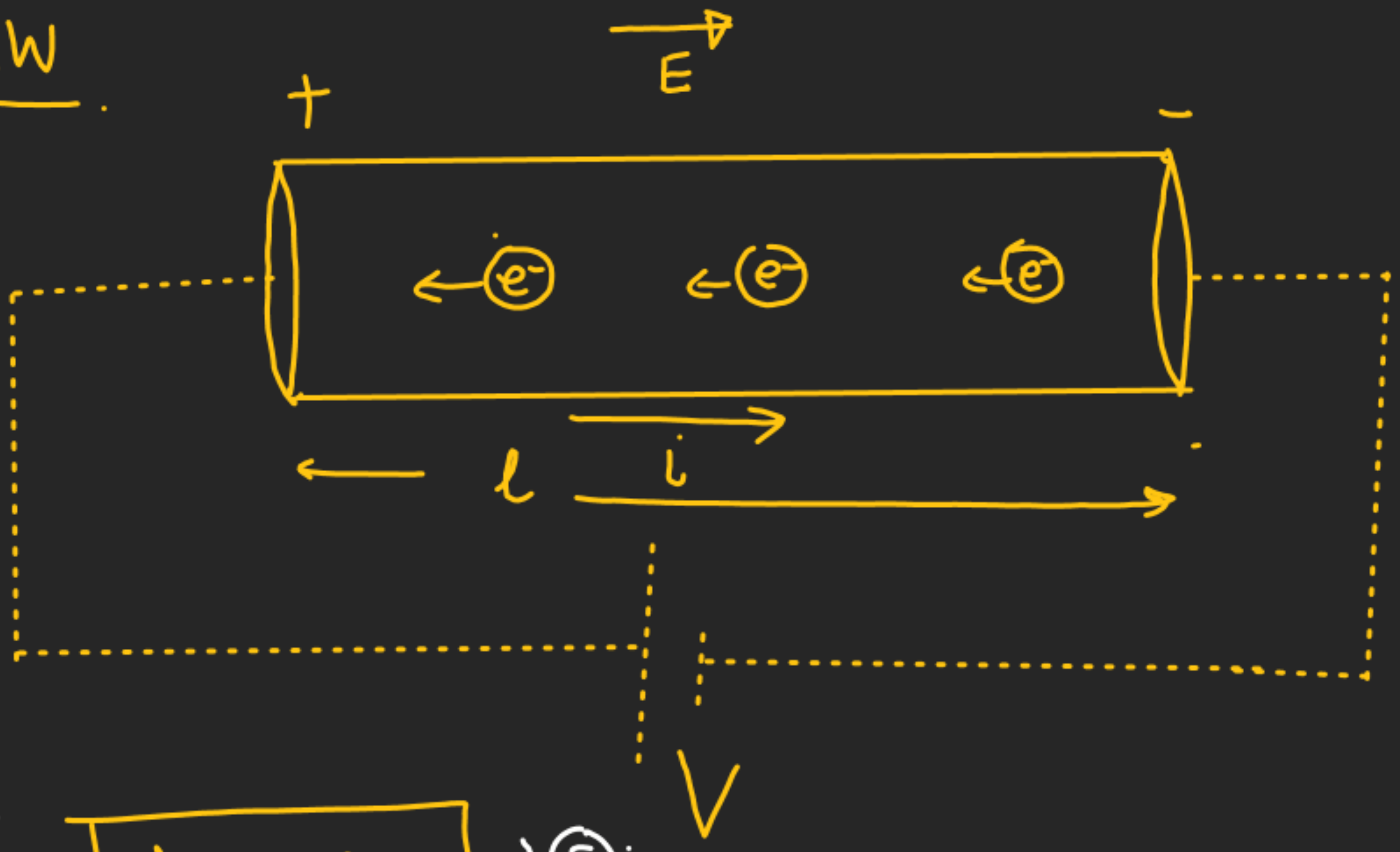
$$I = (neA)\left(\frac{e\tau}{m}\right)E$$

$$I = \left(\frac{ne^2\tau}{m}\right)AE \quad -(4) \quad (**)$$

$$\frac{I}{A} = \left(\frac{ne^2\tau}{m}\right)E \Rightarrow \boxed{\vec{J} = \sigma\vec{E}}$$

$$\rho = \frac{m}{ne^2\tau}, \quad \left(\sigma = \frac{1}{\rho} = \frac{ne^2\tau}{m}\right)$$

OHM'S LAW



From (4) and (5)

$$I = \left(\frac{ne^2\tau}{m}\right)\left(\frac{A}{l}\right)V$$

$$\boxed{V = El} \rightarrow (5)$$

$$E = \left(\frac{V}{l}\right)$$

$$V = \left[\left(\frac{m}{ne^2\tau}\right)\left(\frac{l}{A}\right)\right]I$$

$\Downarrow$ ρ = (Resistivity)

$$\boxed{V = \left(\frac{\rho l}{A}\right)I}$$

$$\boxed{V = IR} \leftarrow \text{ohm's Law}$$

$R \rightarrow$ Resistance

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$\boxed{R = \rho \frac{l}{A}}$

Depends on :- 1. geometrical Configuration ✓

2. Temperature.

S.I → ohm [Ω].

$\boxed{G = \frac{1}{R}}$ G → Conductance → [mho] → [Ω^{-1}].

[α ⇒ Temperature cofficient of resistance]

[ρ → Resistivity

$\sigma = \frac{1}{\rho}$ → Conductivity.]

→ Depends only one

→ Nature of material

→ Temperature.

Temperature dependency for conductor

$$\boxed{R = R_0(1+\alpha\Delta T).}$$

$$\boxed{\rho = \rho_0(1+\alpha\Delta T).}$$

R_0 → Resistance at 0°C.

R → Resistance at any t°C.

α →.

** $R - R_0 = R_0\alpha\Delta T$

$$\frac{\Delta R}{\Delta T} = R_0\alpha$$

$$\boxed{\frac{dR}{dt} = R_0\alpha}$$

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$\rho = \frac{m}{ne^2 \tau}$

Ohm's Law :- $[\vec{J} = \sigma \vec{E}]$ $\boxed{V = IR}$

↳ ① Current density is directly proportional to applied electric field. provided temperature must be Constant.

↳ ② Current across any Conductor is directly proportional to applied potential difference. provided temperature must be Constant

Note ⇒ If temperature increases →
- τ → decreases.
- ρ → increases.
- σ → decreases.

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★★ K.V.L and K.C.L

K.V.L :→ [Krichhoff's Voltage Law]

↳ (Depends on energy conservation)

→ Sum of all the potential drop across any closed loop is zero

Sign-Convention

direction of movement in the loop.

① [Crossing the battery from – ve terminal to +ve terminal Considered as potential rise.

(+V)

② 

→ (– V) → [Crossing the battery from +ve terminal to –ve terminal Considered as potential drop.

direction of movement in the loop.

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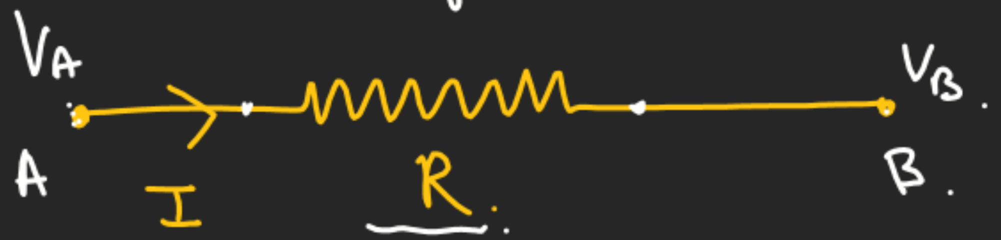
For resistance

Sign-Convention → ① If direction of movement in the loop is along the Current flow then potential drop.

$$\boxed{\Delta V = -IR}$$

direction of movement



$$V_A - IR = V_B$$

$$\boxed{V_A - V_B = IR}$$

direction of movement

$$\boxed{V_B + IR = V_A}$$

↳ While moving opposite to Current flow in the resistance potential across the resistance Considered as potential rise

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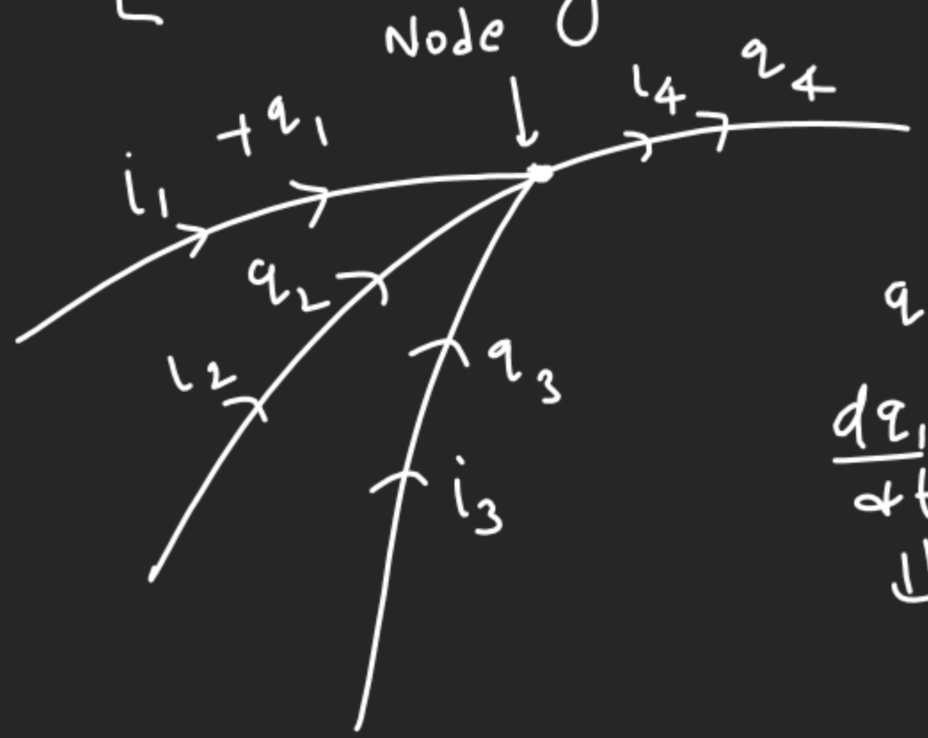
K.C.L :→ Krichhoff's Current Law [Conservation of Charge].

↳ Sum of incoming Current is equal to Sum of outgoing Current across any node or junction



$$q_1+q_2+q_3=q_4$$

$$\frac{dq_1}{dt}+\frac{dq_2}{dt}+\frac{dq_3}{dt}=\frac{dq_4}{dt}$$

$$\Downarrow$$

$$\boxed{i_1+i_2+i_3=i_4}$$

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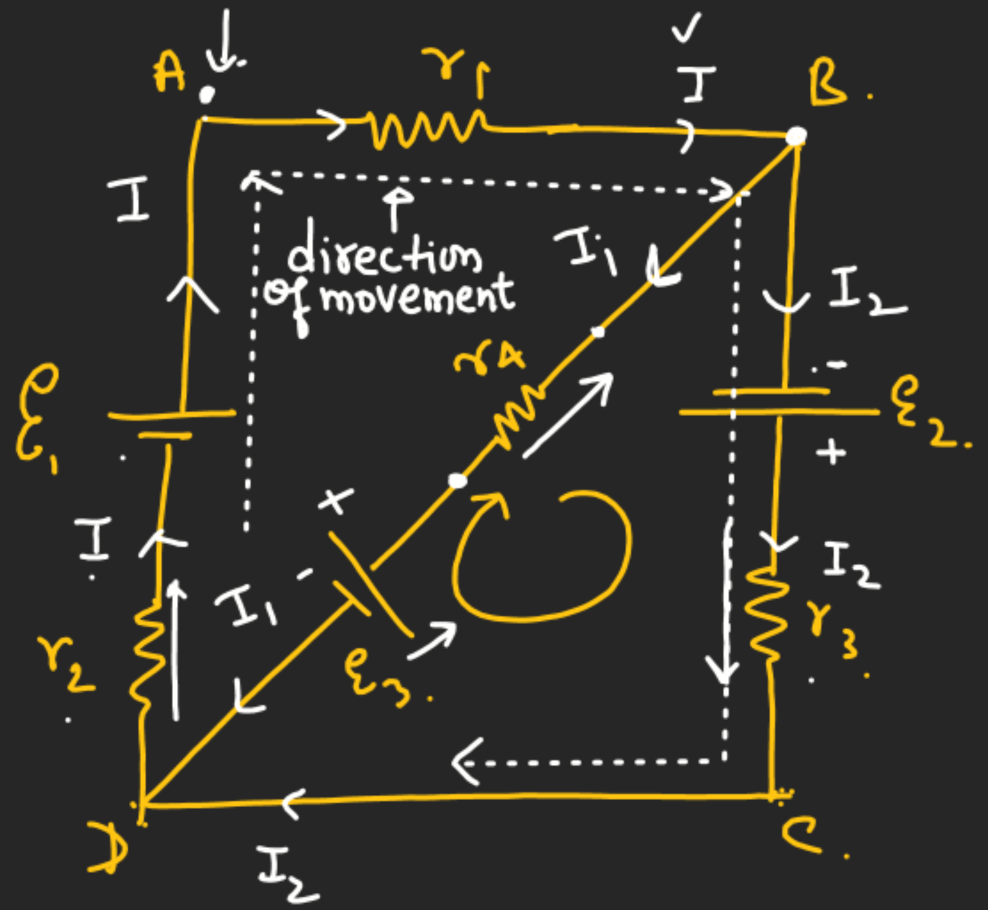
CURRENT ELECTRICITY

#



K.V.L in the loop ABCDA.

$$\left[-Ir_1+\varepsilon_2-I_2r_3-Ir_2+\varepsilon_1=0\right]$$

K.V.L in the loop BCDB.

$$\left[+\varepsilon_2-I_2r_3+\varepsilon_3+I_1r_4=0\right]$$

K.C.L at B

$$\left[I=I_1+I_2\right]$$

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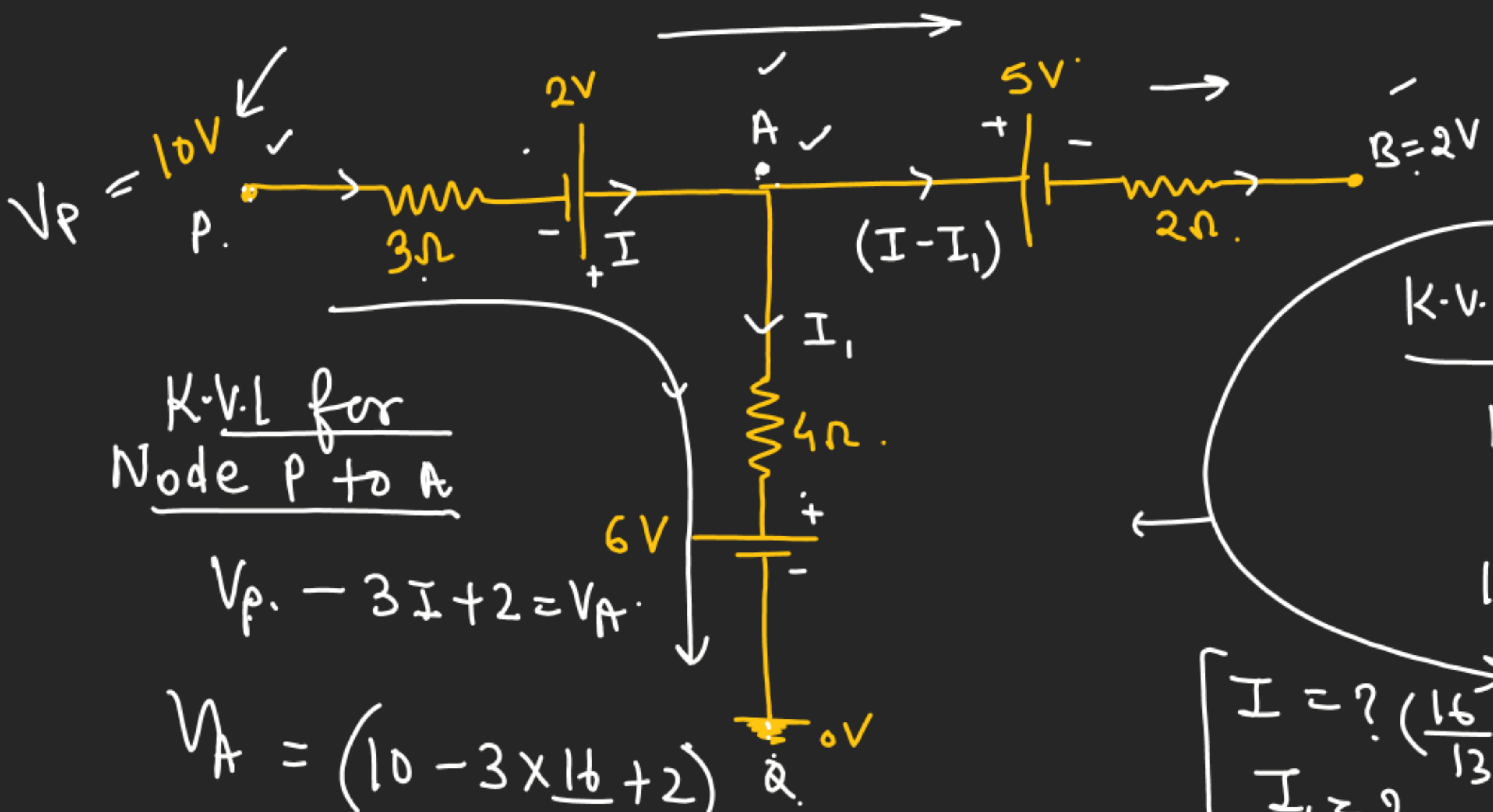
\# Find, $V_A = ?$, $V_B = ?$



K.V.L for Node P to A

$V_P - 3I + 2 = V_A$

$V_A = \left(10 - 3 \times \frac{16}{13} + 2\right)$

$V_A = (\quad)$

$I = I_1 + I_2$

K.V.L from Node P to Q.

$10 - 3I + 2 - 4I_1 - 6 = V_Q = 0$

$6 - 3I - 4I_1 = 0$ — (1)

K.V.L for the path P → B

$10 - 3I + \cancel{2} - 5 - 2(I - I_1) = V_B = \cancel{2V}$

$10 - 3I - 5 - 2I + 2I_1 = 0$

$5 - 5I + 2I_1 = 0$ — (2)

$I = ?\ \left(\frac{16}{13}\right)$??

$I_1 = ? = (15/26)$??

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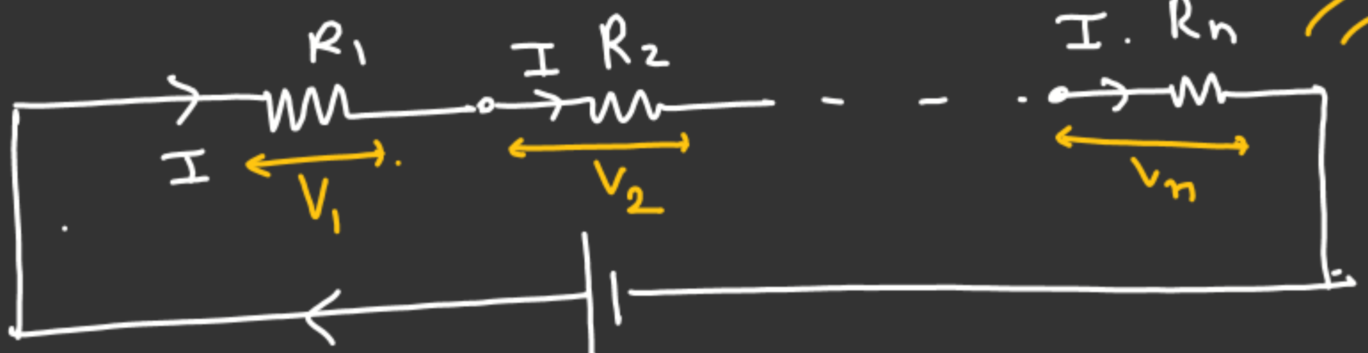
Series and parallel Combination

Series Combination

↳ Current in all resistance is Same.



$R_{eq} = ??$

$V = I R_{eq}$

$$\left[\begin{array}{l} V_1 = I R_1 \\ V_2 = I R_2 \\ \vdots \\ V_n = I R_n \end{array}\right.$$

$$V_1 + V_2 \cdots + V_n = V$$

$$I\,(R_1 + R_2 \cdots + R_n) = I R_{eq}$$

$$\boxed{R_{eq} = R_1 + R_2 \cdots + R_n}$$

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Parallel Combination

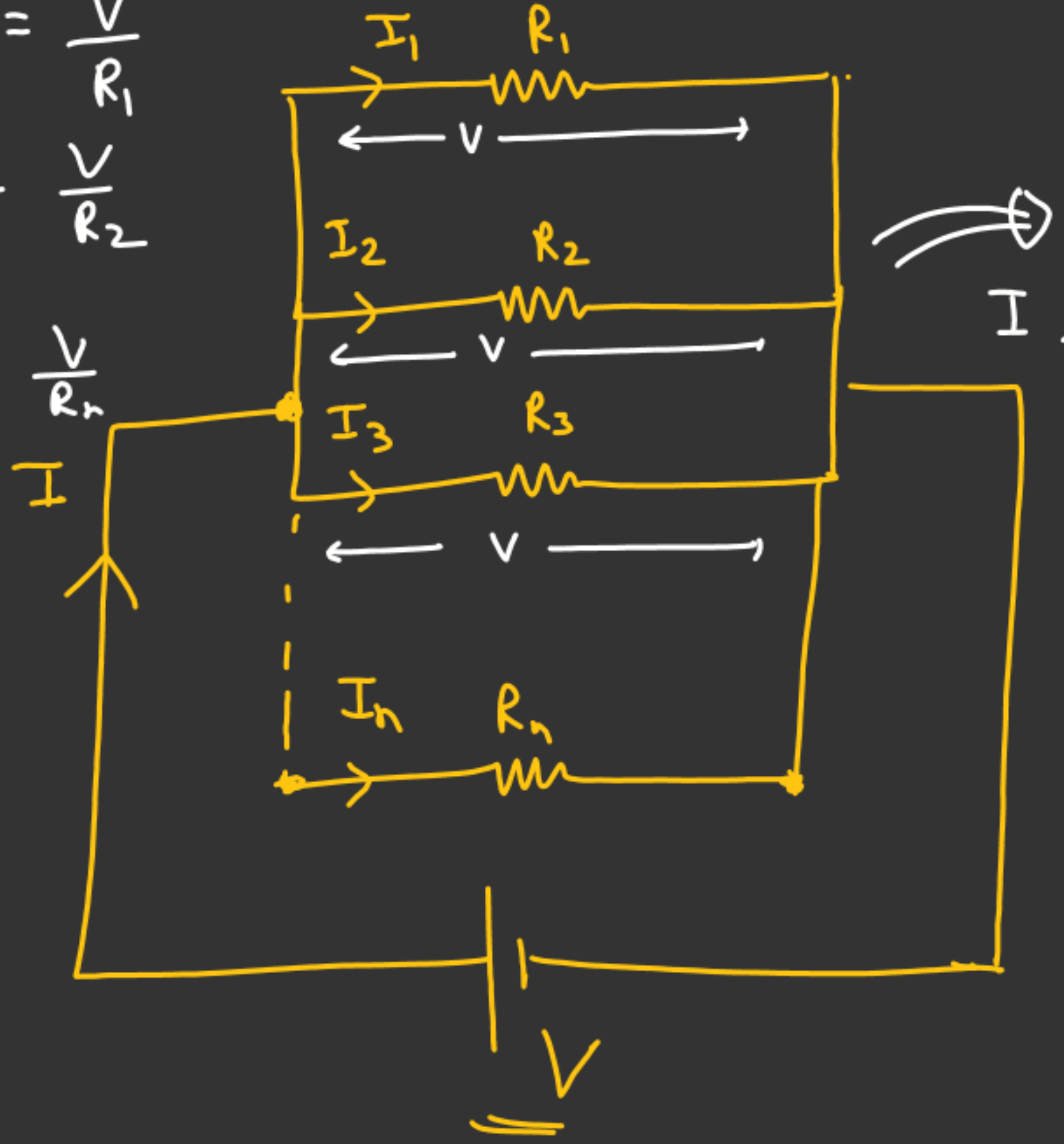
↳ Potential drop across each Capacitor is Same.

$I_1 = \frac{V}{R_1}$

$I_2 = \frac{V}{R_2}$

$\vdots$

$I_n = \frac{V}{R_n}$



$I = I_1 + I_2 \dots I_n.$

$I = \frac{V}{R_{eq}}.$

$\therefore$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} \dots + \frac{V}{R_n}$$

$$\boxed{\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \dots + \frac{1}{R_n}} \quad **$$