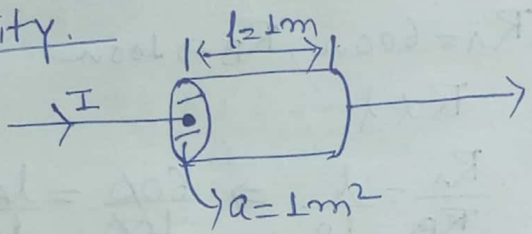
Lec 2 2/8/2021

(1) Laws of Resistance :→ It depend upon following factor

$$R = \rho \frac{l}{a}$$

- directly prop. to the length
- Inversely prop. to area of Cross Section
- Nature of material
- Temp. of wire (Cond.)

Here ρ → is a Constant, depending on nature of material of Conductor called as Specific resistance or Restivity.



$R = \rho$

Hence, the resistance offered by one metre length of wire, having an area of Cross-Section of one square metre Called Restitivity of material

$$\boxed{\text{Unit } \rho = \frac{Ra}{l} \Rightarrow \frac{\text{ohm} \times m^2}{m} \rightarrow \text{ohm-m}}$$

- Conductance → denoted by (G)

$$G = \frac{1}{R} = \frac{a}{\rho l} = \sigma \frac{a}{l}$$

$\boxed{\text{unit} \rightarrow (\mho)\ \text{mho}}$

Conductivity / Specific Conductance → Basically it is property of material due to which it allow the Current to flow through it.

$$\sigma = \frac{Gl}{a} = \frac{\text{mho} \times m}{m^2} \Rightarrow \boxed{\text{mho/m}} \leftarrow \text{SI unit}$$

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(Q) The wire A and B of same material but of different length L and 2L, have radius r and 2r, Then Ratio of specific resistance $\boxed{(b)}$

(a) 1:4 (b) 1:1

(c) 1:8 (d) 1:2

$R = \frac{\rho l}{a}$ $\rho = \frac{Ra}{l} \Rightarrow \frac{}{l_1}$

(Q) Two wire A and B have same cross section are made of same material. $R_A = 600\Omega$, $R_B \rightarrow 100\Omega$. The no. of time A is longer than B

Given. $R_A = 600\Omega$, $R_B \rightarrow 100\Omega$

$R \propto l$

$\frac{R_A}{R_B} = \frac{l}{l_B} \Rightarrow \frac{6\cancel{00}}{1\cancel{00}} = \frac{l_A}{l_B}$

$l_A = 6 l_B$

(Q) Find the restivity of a material (Ω-cm) of wire whose resistance is 5Ω. Length of wire is 16 m, diameter of wire is 0.15 cm

Sol. Given $\rightarrow R \rightarrow 5\Omega$,

$L \rightarrow 15m \rightarrow 1500cm$

$A \rightarrow \pi r^2 \Rightarrow \pi \times \left(\frac{0.15}{2}\right)^2$

$R = \rho \frac{l}{a} = 5$

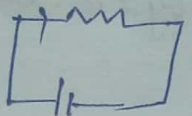
$\rho = \frac{Ra}{l}$

$\Rightarrow 5.87 \times 10^{-5} \Omega$-cm

(Q) The

(Q) W

Ohm's law.



At Const. temp I flowing b/w any two pt. of Conductor (wire) is directly prop. to potential diff across them

$$\frac{V}{I} = R \Leftarrow I \propto V$$

But experimentally we have observed, the resistance of of metallic Conductor vary with temp.

$$R_{T_2} = R_{T_1}[1 + \alpha \Delta T)$$

$\Delta T \to T_2 - T_1$

$R_{T_1} \to$ resistance at tem T_1

$R_{T_2} \to$ " " tem T_2

$\alpha \leftarrow$ Tem. Coefficient of Resistance

(Q) At 20 degree Celsius, aluminium wire has resistance of 30Ω. The temp. Coefficient of resistance is 0.00305 per degree Celsius. What is approx. resistance of wire (Ω) at 30 degree Celsius

$$R_{T_2} = R_{T_1} [1+\alpha \Delta T]$$

$R_{T_1} \to 30\Omega$

$\alpha \to 0.0305$

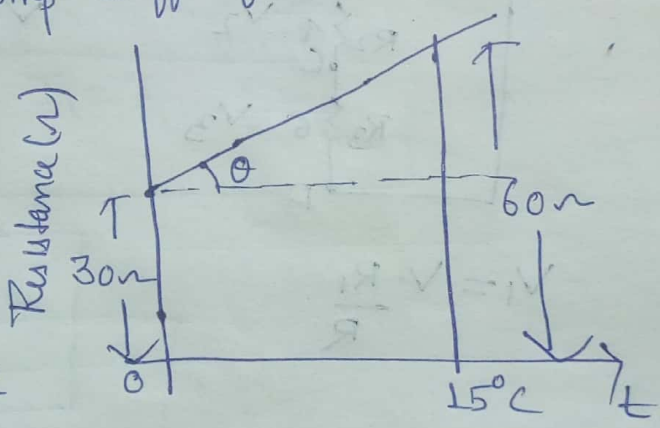
$\Delta T = T_2 - T_1$

$\Rightarrow 30 - 20$

$\Rightarrow 30 [1 + 0.305 (10)]$

$\Rightarrow 31\Omega$

(Q) Find the value of temp. coeff. of resistance



We know

$R_{T_2} = R_{T_1} [1+\alpha T]$

$R_1 \to 30\Omega, T_1 \to 0°C$

$R_2 \to 60\Omega, T_2 \to 15°C$

$60 = 30 [1 + a(15)]$

$2 = 1 + a(15)$

$a \Rightarrow \frac{1}{15} \Rightarrow 0.066 (°C)$

(2) Resistance in Series

(a) Same Current through all Conductor

(b) Voltage drop is defferent

(c) Sum of three voltage drop is equal to voltage applied across the three Conductor.

(d) Resistance are additive

Resistance in Parallel

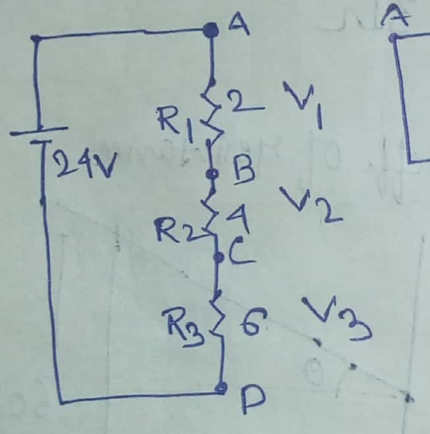
(a) P.d Same

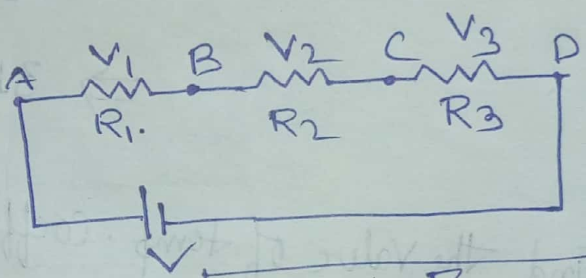
(b) Current defferent

(c) I

(d) Conductance are additive

Voltage division Rule





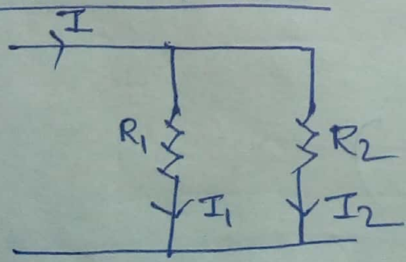
$$V_1 = V \cdot \frac{R_1}{R}$$

$$\boxed{V_1 = V \cdot \frac{R_1}{R_{Total}}}$$

V_2

V_3

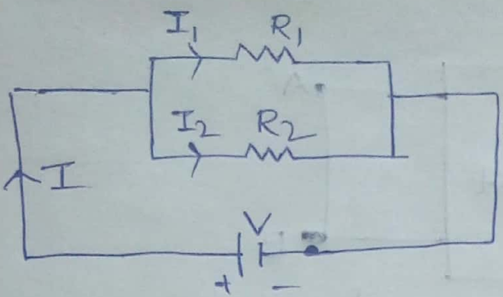
Current division Rule.



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

$$\boxed{I_1 = \frac{I}{R_1 + R_2} \cdot R_2}$$

(i)



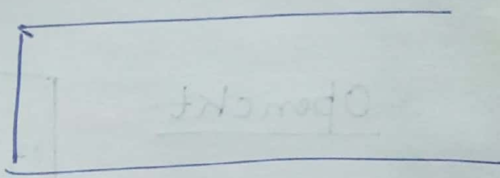
$V = I_1 R_1 = I_2 R_2$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

∴ From this we observe Branch of parallel ckt is inversely prop. to resistance,

$V = I_1 R_1 = I_2 R_2 = IR$

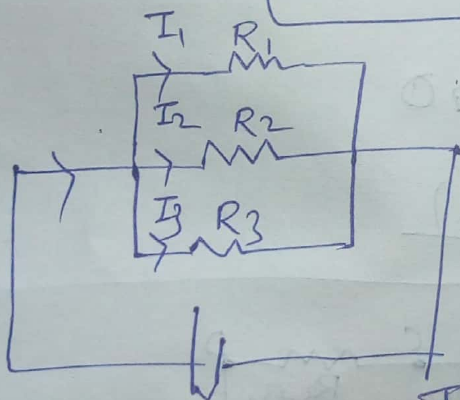
IR



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

$$I_1 R_1 = IR = I \frac{R_1 R_2}{R_1 + R_2}$$

$$\boxed{I_1 = I \frac{R_2}{R_1 + R_2}}$$



*

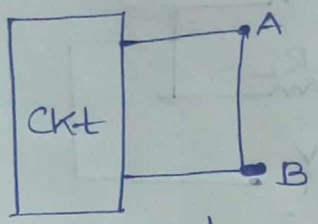
$I_1 R_1 = I_2 R_2 = I_3 R_3 = IR = V$

$$Req = \frac{\cancel{R_1+R_2}\ R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

$$I_1 R_1 = IR = I \times \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

$$I_1 = I \times \frac{R_3 R_2}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

(3) Short ckt. →



When two terminal are Connected by thick metallic wire then, there will be short ckt

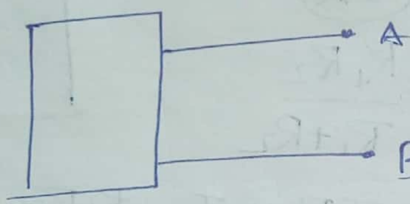
$R = 0$

$V \to ?$

$V = I \times 0 \Rightarrow 0$

Current will be very large (α)

Openckt.



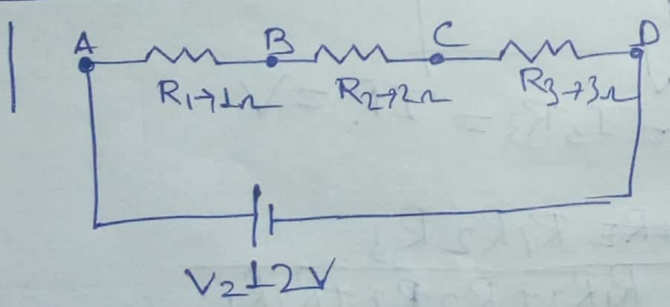
When two terminal ~~are~~ have no direct Connection b/w them.

$R \Rightarrow \alpha$

$\cancel{\Rightarrow}$ $I \Rightarrow 0$

$V(\alpha)$

(Q)



$V \to 12$, $R_{eq} \to 6\Omega$, $I \to \frac{12}{6} \Rightarrow 2A$

$P = I^2 R \Rightarrow 2^2 \times 6 = 24\,W$

Now, CD is short ckt

$R_{eq} = 3\Omega$

$I = \frac{12}{3} \rightarrow 4A$

$P \rightarrow I^2 R_{eq}$

$P \Rightarrow 16 \times 3$

$= 48 W$

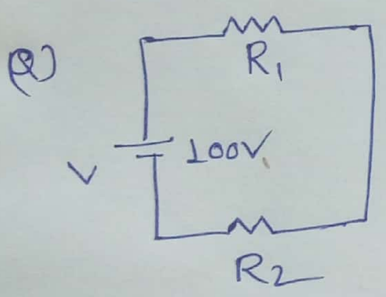
* Power is rate of change of energy

$$P = \frac{dw}{dt}$$

$$= \frac{dv}{dq} \cdot \frac{dq}{dt}$$

$$P = V(t) \cdot i(t).$$

Q)



→ If ckt is open

$R \rightarrow \infty$

$I \rightarrow 0$

then there will be no Voltage drop