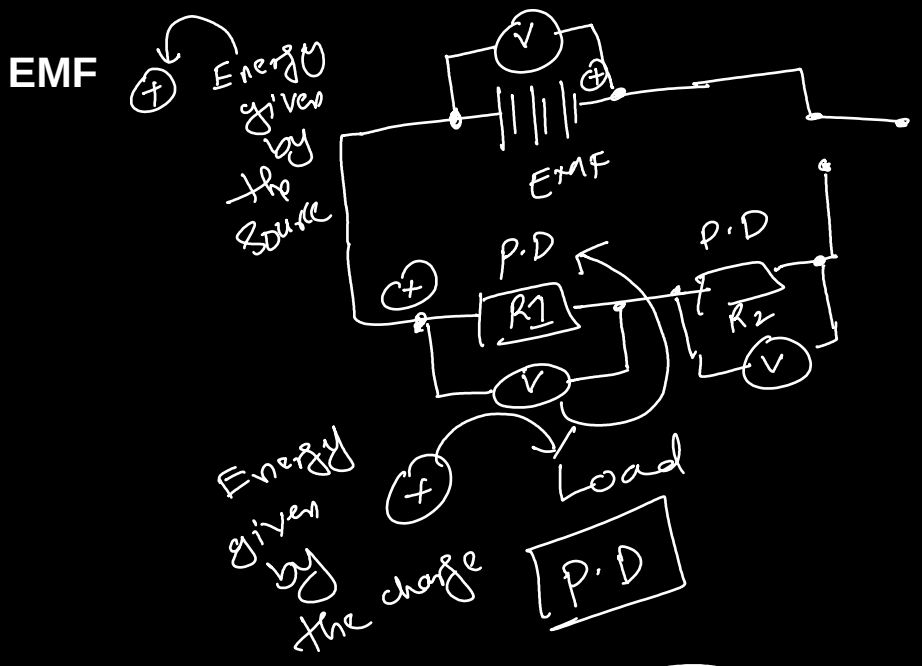
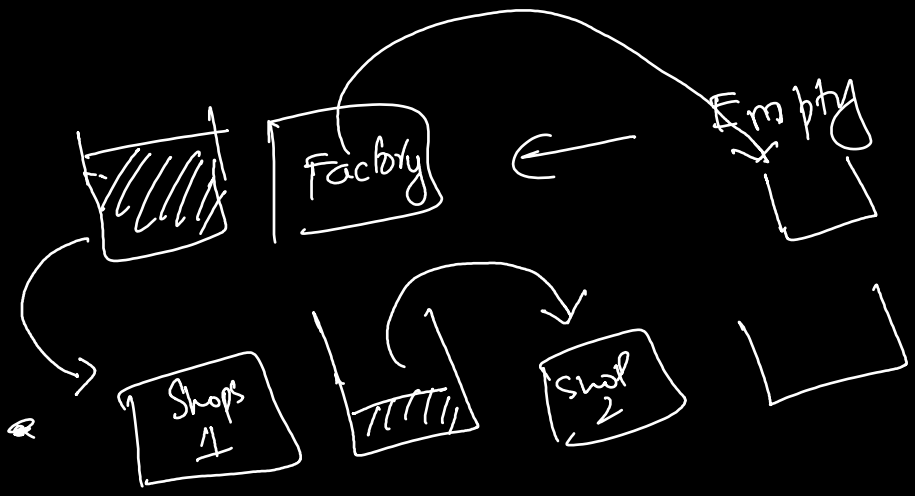
5054 – O Level Physics

Recap of previous lesson

EMF





4.2.4 Resistance

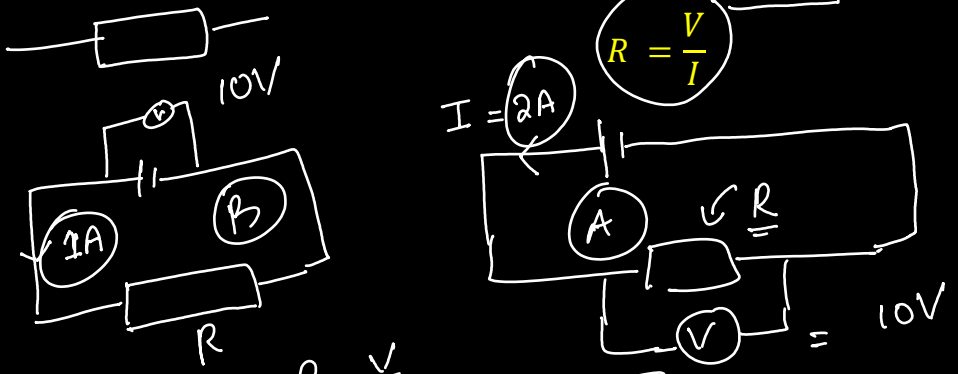
Resistance = consumer of Energy of charge

Hinderance in the flow of charge.

Resistance is the ratio of potential difference and current.

$$Resistance = \frac{p.d.}{current}$$

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



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

$$\frac{10}{2} = R$$

$$5\Omega = R$$

$$R = \frac{V}{I} = \frac{10}{1} = 10\Omega$$

$$\uparrow R \propto \frac{1}{I} \downarrow$$

$$V = IR$$

Unit of Resistance

ohm Ω

Define ohm

$$ohm = \frac{Volts}{Ampere}$$

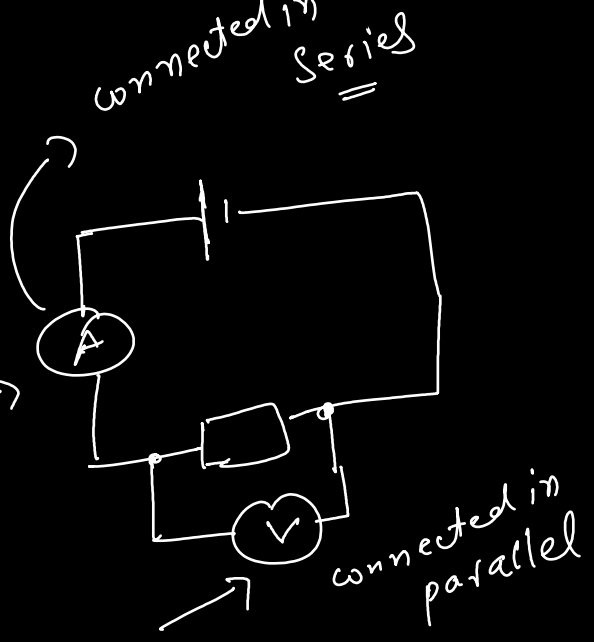
If one volt of p.d. produces a current of 1 ampere then resistance is 1 ohm.

Experiment to determine resistance

↳ Instruments
↳ their usage

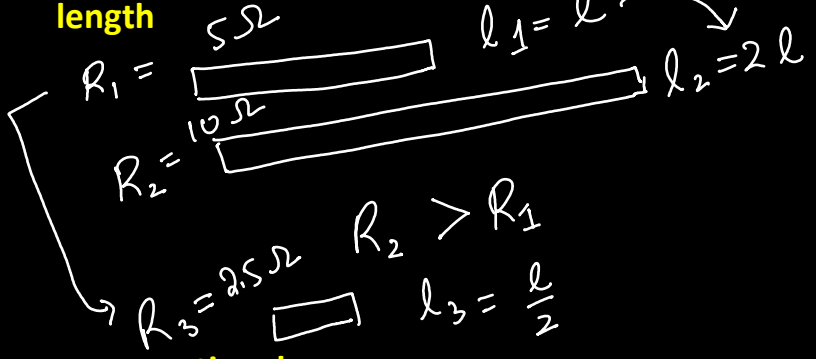
$R = \frac{V}{I}$ → Voltmeter
= Ammeter

ratio of readings from the voltmeter and the Ammeter →



Factors affecting Resistance of a wire of a filament

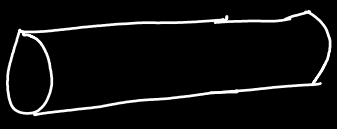
i. **length**



$R \propto l$

ii. **cross-sectional area**

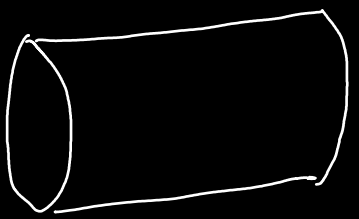
$R_1 = 30\Omega$ $A_1 = A$



A↓ R↑

$R_2 = \frac{30}{3}$ $A_2 = 3A$

$R_2 = 10\Omega$



A↑ R↓

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

Wire X has resistance *R*.
Wire Y is made from the same material and has same cross-sectional Area.
Wire Y has double the length of the wire X.
What will be its resistance in terms of *R*.

double the l
" " R

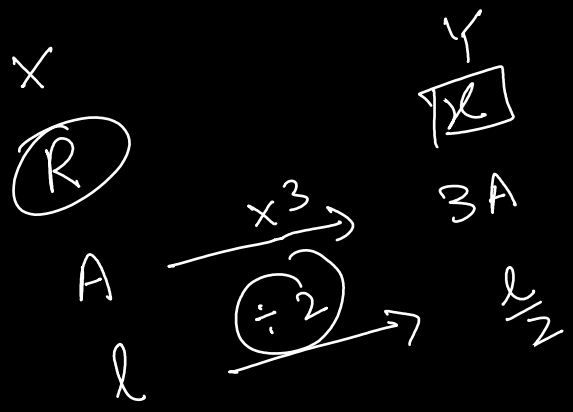
$2R$

Wire X has resistance *R*.
Wire Y is made from the same material and same length.
Wire Y has three times the cross-sectional Area of the wire X.
What will be the resistance of wire Y in terms of *R*.

A inc by 3 times
R dec " 3 times
↳ ÷

$\frac{R}{3}$

Wire X has resistance *R*.
Wire Y is made from the same material.
Wire Y has three times the cross-sectional Area of the wire X and half the length of Wire X
What will be the resistance of wire Y in terms of *R*.



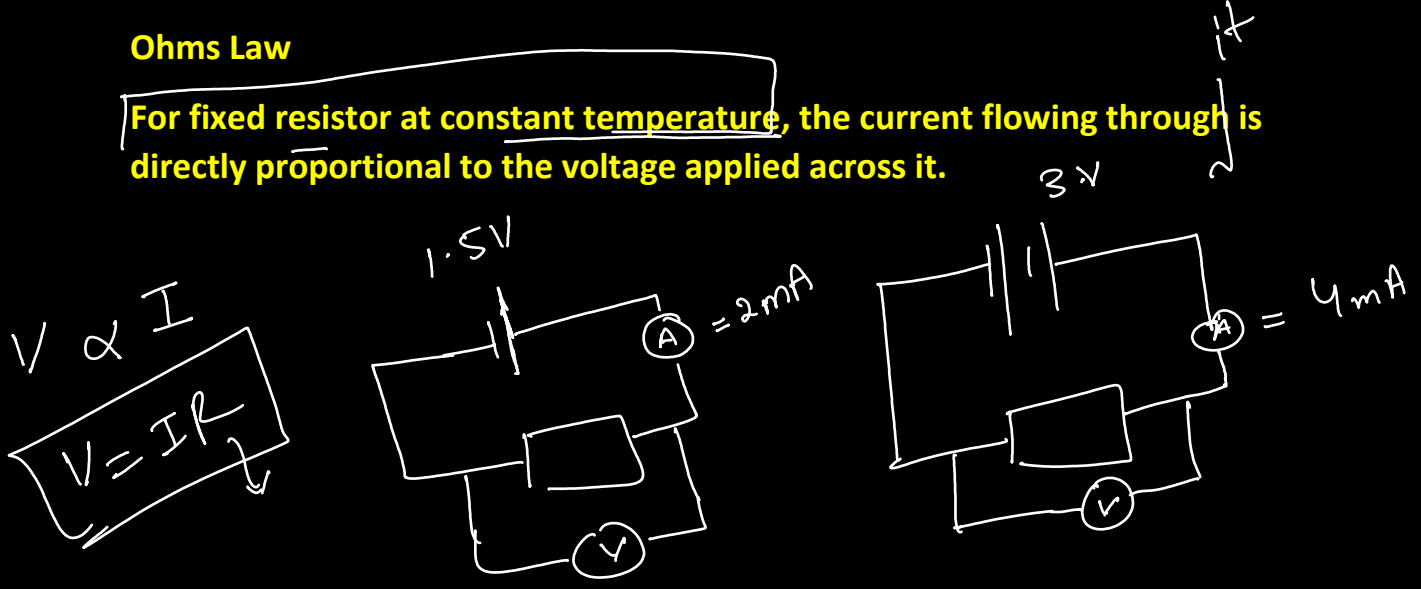
$\frac{R}{3} \div 2$

$\frac{R}{3} \times \frac{1}{2}$

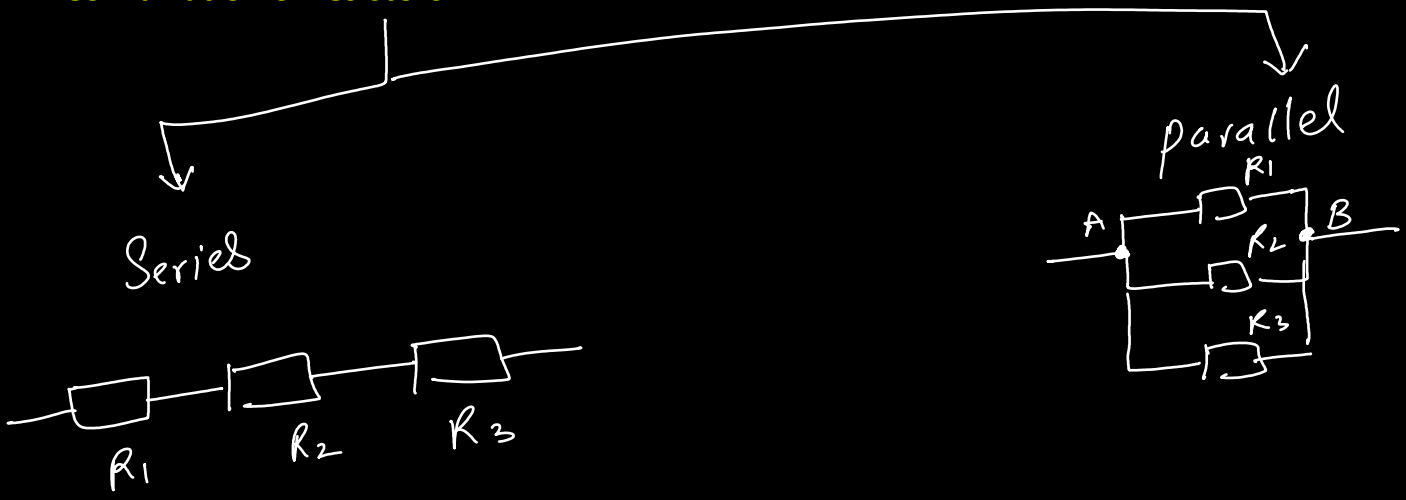
$\frac{R}{6}$

Ohms Law

For fixed resistor at constant temperature, the current flowing through is directly proportional to the voltage applied across it.



Combination of resistors

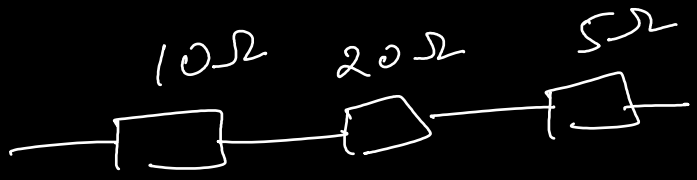


Equivalent Resistance

A single resister that gives the same effect as of the individual resistances joined together.

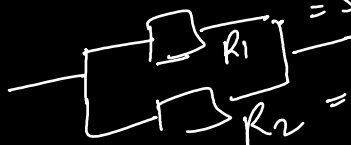
Series circuit

$$R_e = R_1 + R_2 + R_3$$



$$R_e = 10 + 20 + 5 = 35\,\Omega$$

Parallel circuit



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

$$\frac{1}{R_e} = \frac{1}{5} + \frac{1}{10}$$

$$= \frac{10+5}{50}$$

$$= \frac{15}{50} = \frac{3}{10}$$

$$\frac{1}{R_e} = \frac{3}{10}$$

$$R_e = \frac{10}{3}\,\Omega$$

Short cut formula for finding equivalent resistance of parallel combination

$$R_e = \frac{\text{Product}}{\text{Sum}}$$

$$R_e = \frac{50}{15} = \frac{10}{3}\,\Omega$$