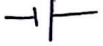
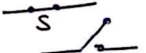
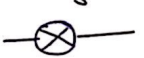
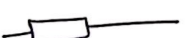
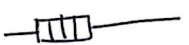
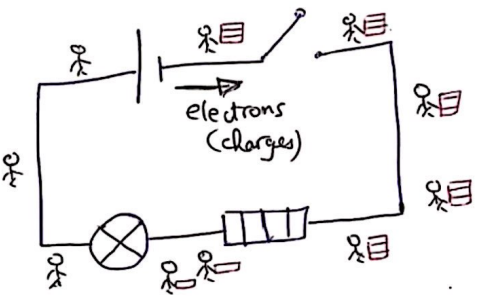
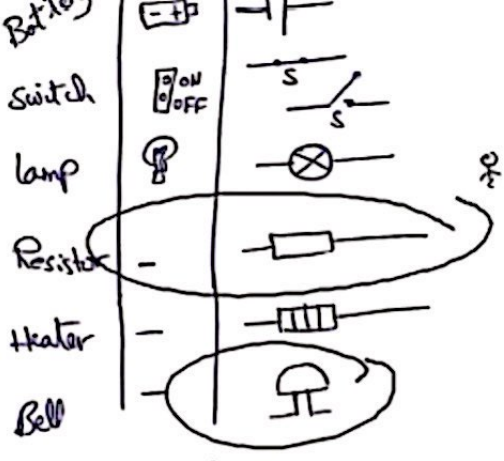
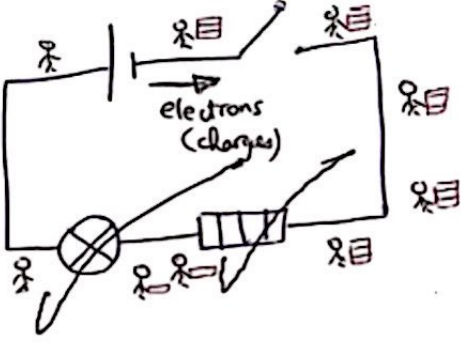
Electric Circuits

Component	Real shape	Symbol
Battery		
Switch		
lamp		
Resistor	–	
Heater	–	
Bell	–	





(I)



A) Electric current: - The amount of charge flowing per second

- units: Ampere (A)
- opposite to direction of electrons.

$$I = \frac{Q}{t}$$

Current (A) ← I; Q → charge (Coulomb) C; t → time (s)

B) Volt: (V)

- Electromotive force "emf": amount of energy gained by each unit charge.
- potential difference: amount of energy lost by each unit charge.

$V = \frac{E}{Q}$ ← V; E → J; Q → C

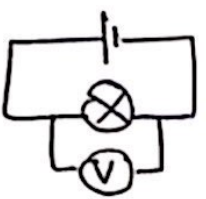
C) Resistance: it's a measure of the difficulty to pass electricity

- units: ohms (Ω)

Measuring Devices

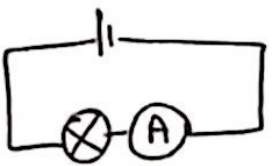
Voltmeter (V)

- measures Volt
- units: V, KV, mV
- Connected in parallel



Ammeter (A)

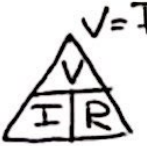
- measures current
- units: A, KA, mA
- Connected in series



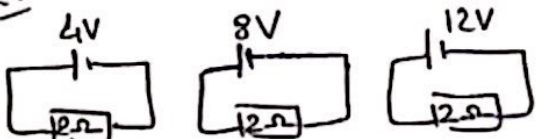
Ohm's law:

$V = I \times R$

$I = V/R$ $\quad R = V/I$



Ex.



$I =$ $\quad I =$ $\quad I =$

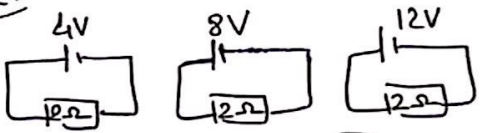
* for constant 'R',
V and I are ------
V ↑

$V = I \times R$

Ohm's law

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

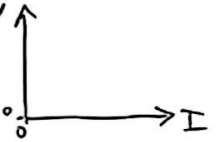
Ex.



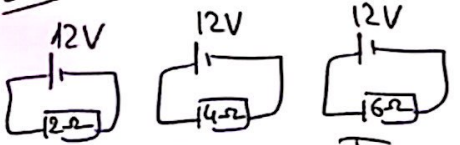
$I =$ $I =$ $I =$

* for constant 'R',

V and I are ------



Ex.



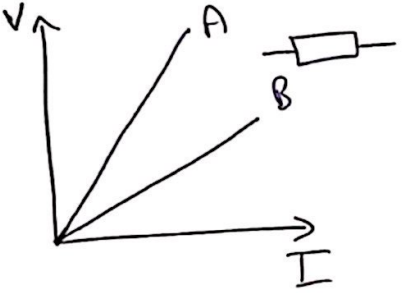
$I =$ $I =$ $I =$

* for constant 'V',

I and R are.....

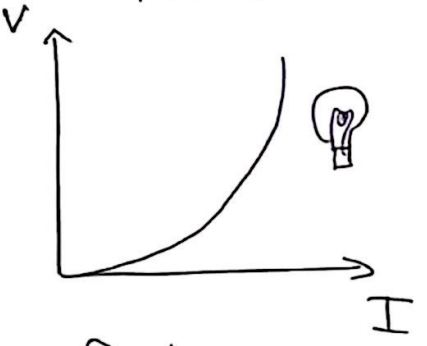
V-I relationship:

* Constant Resistance



- Slope =
- Resistance is constant
- Higher Resistance
  ↳ closer to volt axis

* filament lamp



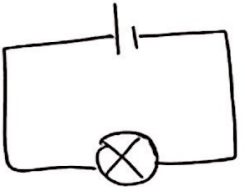
- Resistance increases
- because temperature increases
- bends towards Volt axis

- Slope =
- Resistance is constant
- Higher Resistance
  ↳ closer to volt axis

- Resistance increases
- because temperature increases
- bends towards Volt axis

* Describe How to measure the Resistance of lamp?

* Power:



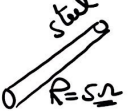
$P = IxV$, I^2xR, $\frac{V^2}{R}$

P → watt

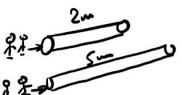
* $Energy = P \times t$

Energy → J, P → Watt, t → Sec.

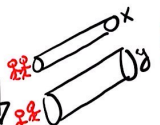
* factors affecting Resistance of wire :-



1) Material Resistivity (ρ) ($R \propto \rho$)

2) length 

($R \propto L$) $20\Omega \xrightarrow[R\times 2]{L\times 2} 40\Omega$

3) Cross-sectional Area. 

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

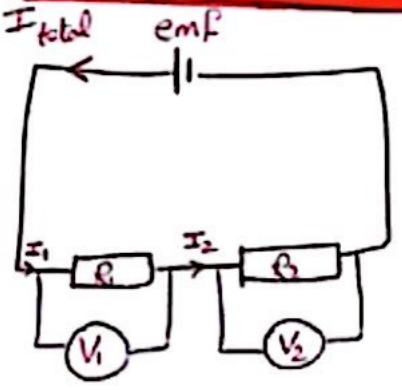
$A \uparrow \; R \downarrow$

$20\Omega \xrightarrow[R\div 2]{A\times 2} 10\Omega$

4) Temp. $\uparrow$ ($T \uparrow \; R \uparrow$)

Types of Connections

Series



1) $I_{total} = I_1 = I_2$

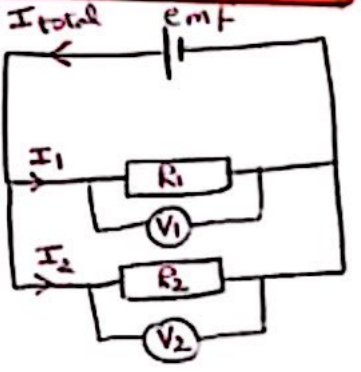
- Current is same

2) $EmF = V_1 + V_2$

- Volt is divided
- Component with more 'R' gets more 'V'

3) $R_{total} = R_1 + R_2$

parallel



1) $I_{total} = I_1 + I_2$

- Current is divided
- branch with more 'R' gets less 'I'

2) $EmF = V_1 = V_2$

- Volt is the same

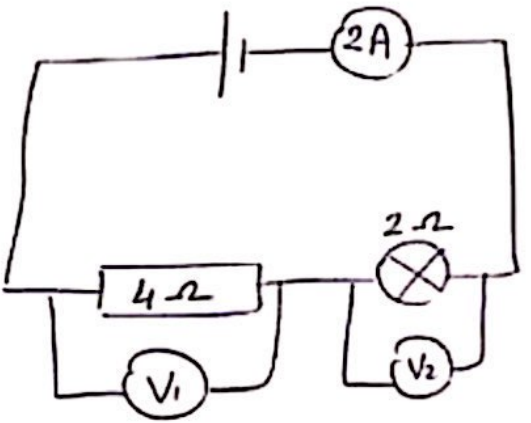
3) R_{total}

$\frac{R_1 \times R_2}{R_1 + R_2}$ ⇒ for 2 Resistors

$\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]^{-1}$

⇒ General Rule

Ex:



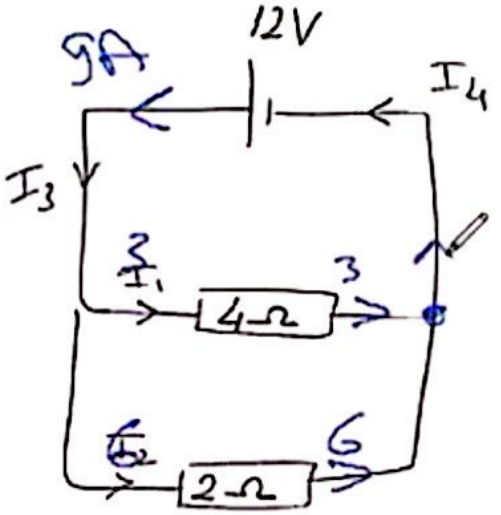
a) V_1 =

b) V_2 =

c) emf =

d) R_{total} =

Ex9



a) $I_1 =$

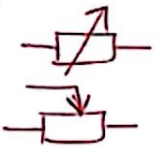
c) $I_3 =$

b) $I_2 =$

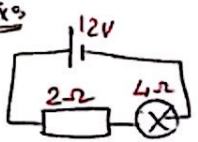
d) $I_4 =$

e) $P_{total} =$

Variable Resistor (Rheostat)

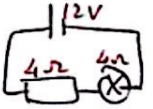


Ex:



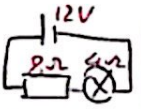
$I =$

$V_{lamp} =$



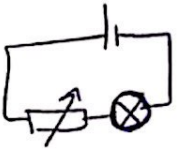
$I =$

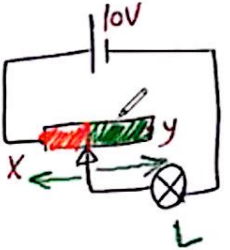
$V_{lamp} =$



$I =$

$V_{lamp} =$



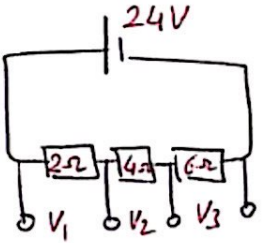


* Summary:-

- If you want to increase the brightness of lamp, put it in series to smaller Resistance.

potential divider

Fixed | Variable

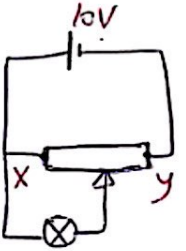


$I =$

$V_1 =$

$V_2 =$

$V_3 =$



* Summary:-

- If you want to increase the brightness of the lamp, put it in parallel to larger Resistance.

House (Mains) Electricity -

Hazards of over-current:

1- overheating / Melting of wires
2- Firing
3- Damage of Devices (Appliances)

* How to avoid → use thicker cables
→ Fuse / Circuit breaker

Fuse

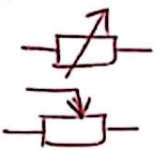
- every Fuse has a Rating (ex: 10A)
- it melts if current exceeds this rating

Circuit breaker

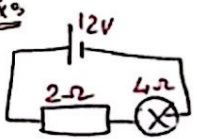
- Contains Electromagnet
- Re-usable.

How to Control Brightness of lamp? (Current in Circuit)

Variable Resistor (Rheostat)

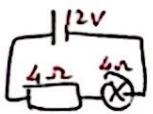


Eg:



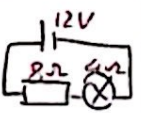
$I =$

$V_{lamp} =$



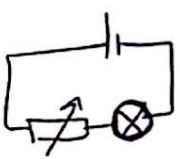
$I =$

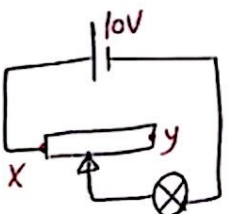
$V_{lamp} =$



$I =$

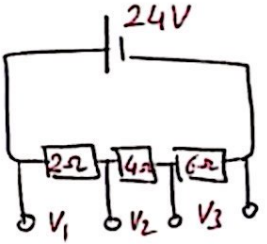
$V_{lamp} =$





Potential divider

Fixed



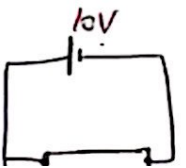
$I =$

$V_1 =$

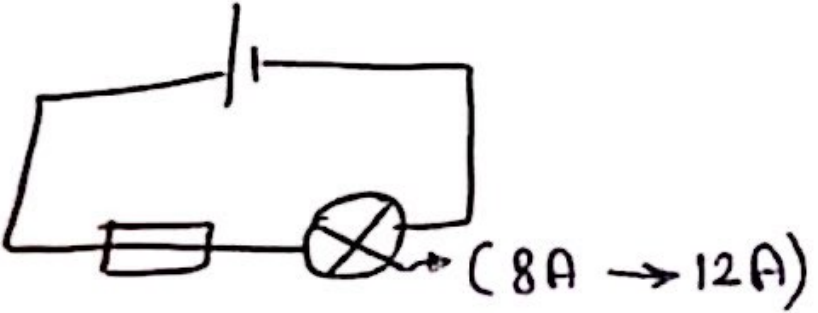
$V_2 =$

$V_3 =$

Variable



Ex:

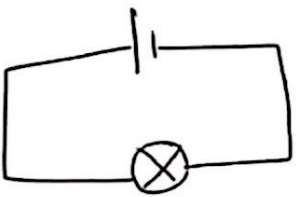


(5A, 10A, 15A)

types of power sources

Direct Current "D.C"

- Current flows in one direction.



Alternating Current "A.C."

- Reverses direction of current every cycle.