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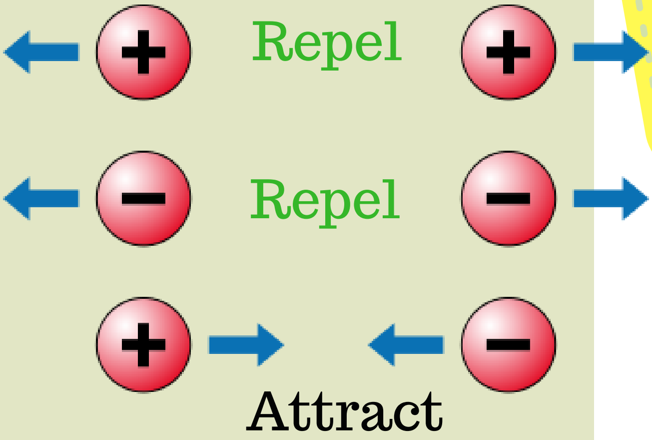
Electricity

CHAPTER 2

Charge of 1 electron = -1.6×10^{-19} C
Charge of 1 proton = $+1.6 \times 10^{-19}$ C



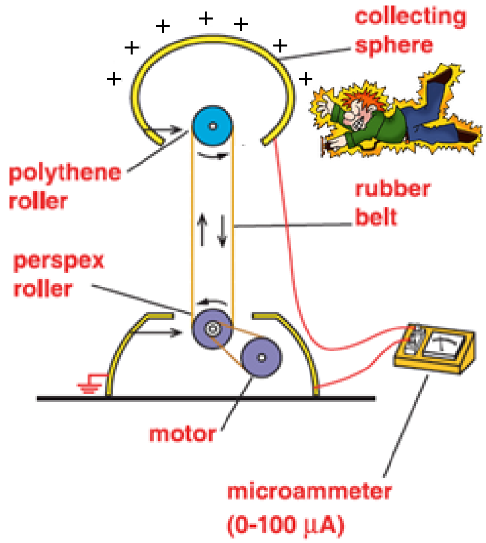
SUM OF CHARGE = number of charge particles × charge of 1 particle

$$Q = ne$$

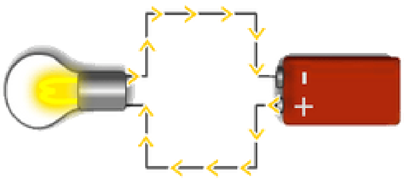
Current = the rate of flow of charge

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

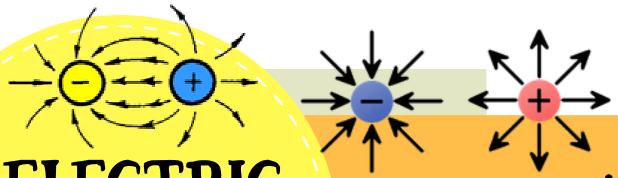
How the Van de Graaff works?



- When the motor of the Van de Graaff generator is switched on, it drives the rubber belt.
- This causes the rubber belt to against the roller and hence becomes charged.
- The charge is then carried by the moving belt up to the metal dome where it is collected.
- A large amount of charge is built up on the dome.
- Positive charges are usually produced on the dome of the generator.
- A deflection of the pointer of the meter.
- This indicates an electric current flow.



+ve → -ve



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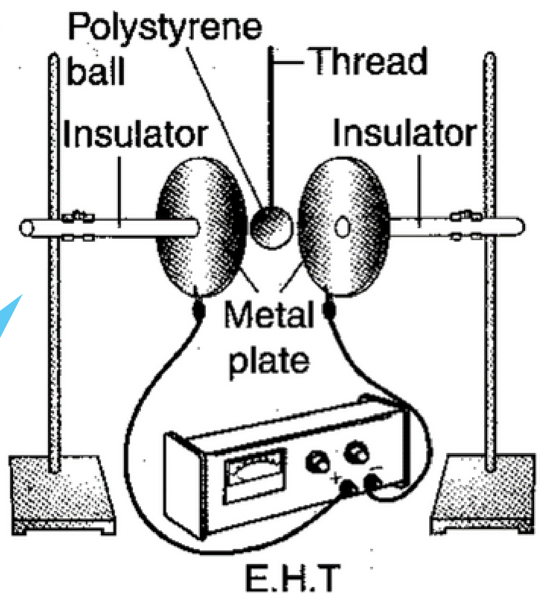
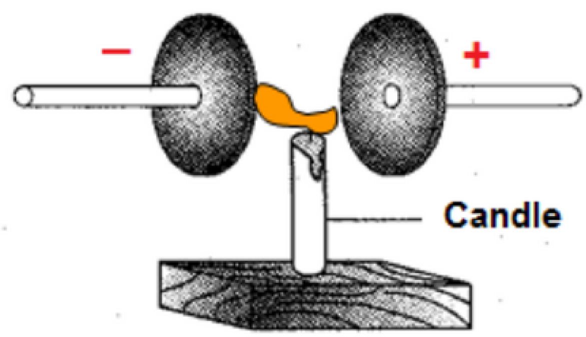
ELECTRIC FIELD

a region in which an electric charged particle experiences an electric force

- When the polystyrene ball touches the positively charged plate, the ball positively charged and experiences a repulsive force.
- The ball will then pushed to negatively charged plate.
- When the polystyrene ball touches the negatively charged plate, the positive charges are neutralized by the negative charges.
- The ball then negatively charged and repels towards positive plate.
- The ball oscillate between positive and negative plate.



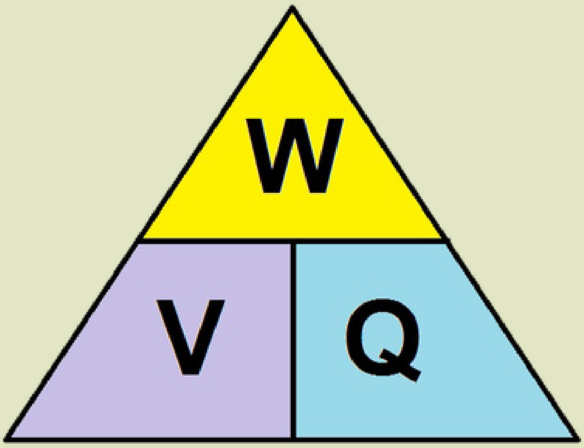


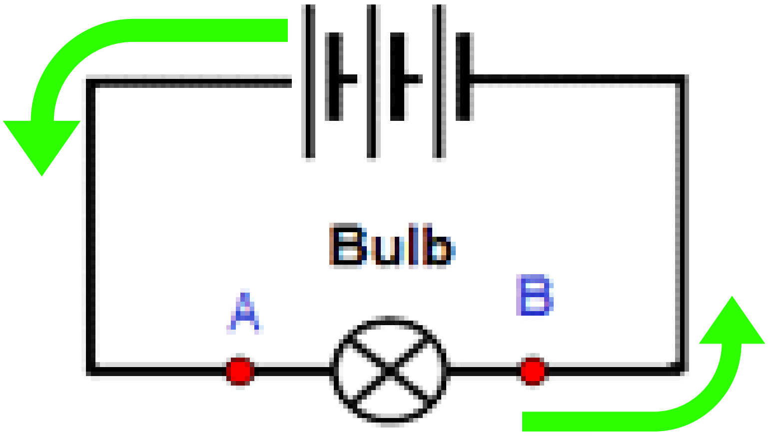
- The heat of the flame ionizes the air molecules to become positive and negative charges.
- The positive charges are attracted to the negative plate while the negative charges are attracted to the positive plate.
- The flame is dispersed in two opposite directions but more to the negative plate.
- The positive charges are heavier than the negative charges.

ANALYSING THE RELATIONSHIP BETWEEN ELECTRIC CURRENT AND POTENTIAL DIFFERENCE

Potential Difference

the work done in moving 1 Coulomb of positive charge from 1 point in an electric field to another point.



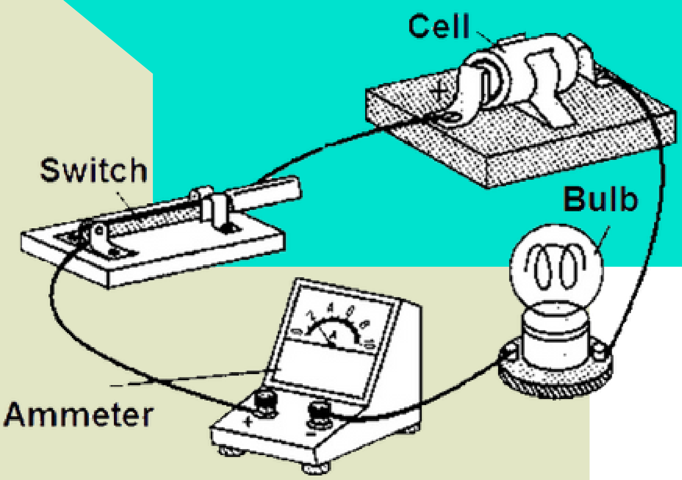


$$V = \frac{W}{Q} = \frac{E}{ne} = \frac{E}{It}$$

W or E=work done

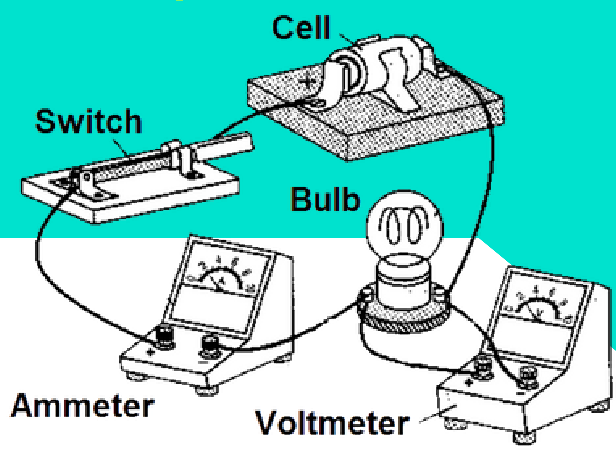
Q=charge flow

Measurement of current



Ammeter use to measure current flow.
Ammeter is connected in series in electrical circuit

Measurement of potential difference

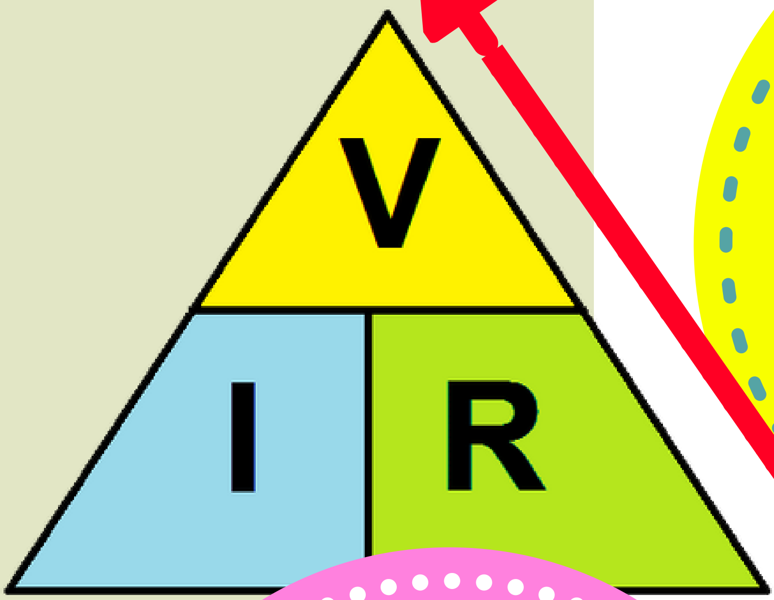


Voltmeter use to measure potential difference or voltage.
Voltmeter is connected in parallel in electrical circuit

PHYSICS made EASY alina iman arif

OHMS'S LAW

The electric current, I flowing through a conductor is directly proportional to the potential difference, V across the ends of the conductor if temperature and other physical conditions remain constant



$$V = IR$$

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

Resistance is defined as the ratio of the potential difference across the conductor to the current, I flowing through the conductor.

FACTORS AFFECTING RESISTANCE

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

where

ρ=resistivity

l=length of wire

A=cross-sectional area

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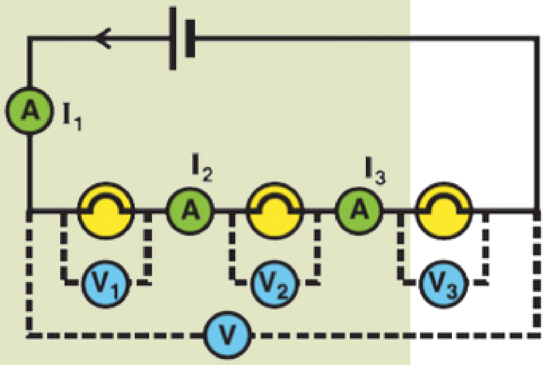
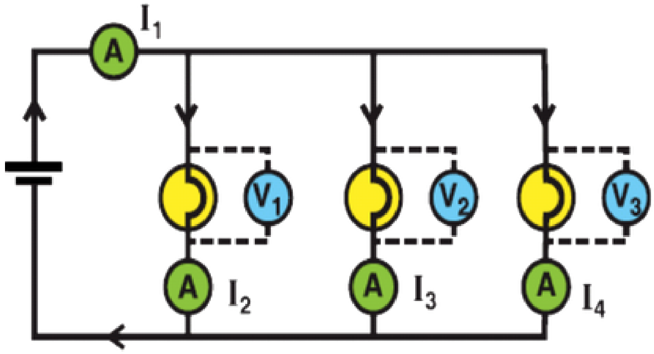
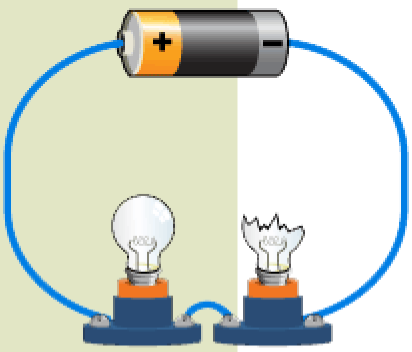
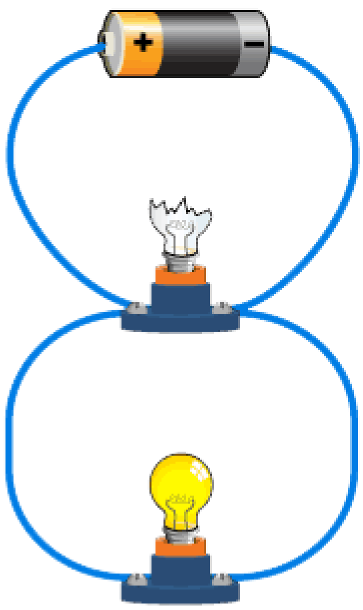
CURRENT FLOW AND POTENTIAL DIFFERENCE IN SERIES AND PARALLEL CIRCUIT

	SERIES	PARALLEL
		
Current flow	$I = I_1 = I_2 = I_3$	$I = I_1 + I_2 + I_3$
Potential difference	$V = V_1 + V_2 + V_3$	$V = V_1 = V_2 = V_3$
Resistance	$R = R_1 + R_2 + R_3$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
		

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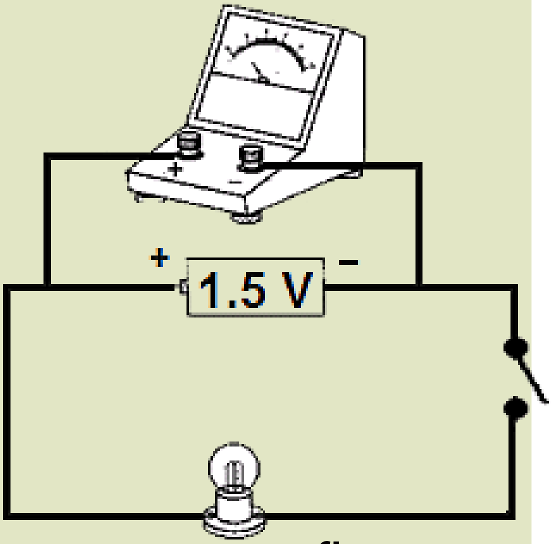
EMF VERSUS POTENTIAL DIFFERENCE

EMF

Work done by a source in driving 1 C charge in a complete circuit



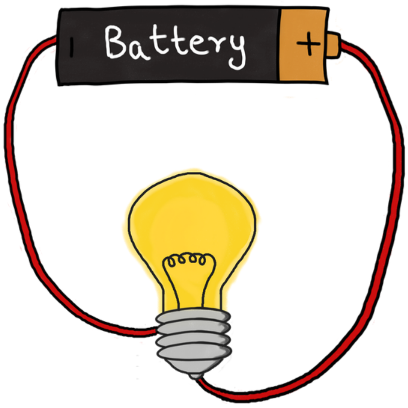
No current flow
(opened circuit)

The bulb does not light up

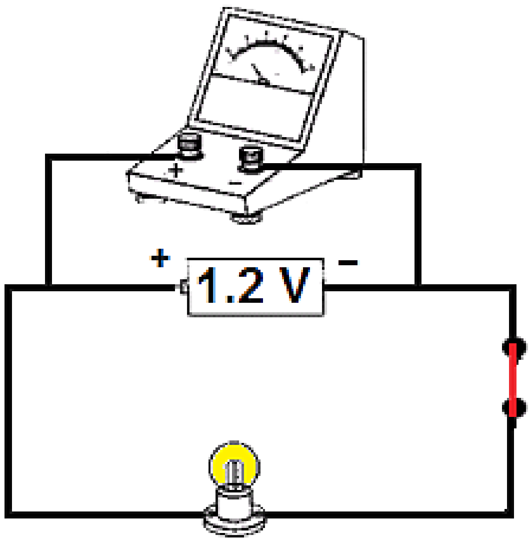
Transmission of energy:

Chemical energy → Electrical energy

POTENTIAL DIFFERENCE



Work done in moving 1 C charge from 1 point in an electric field to another point



Current flow
(closed circuit)

The bulb light up

Transmission of energy:

Electrical energy → Heat energy

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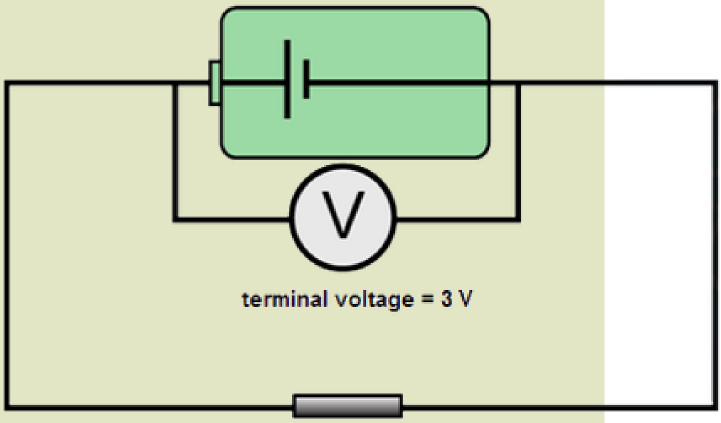
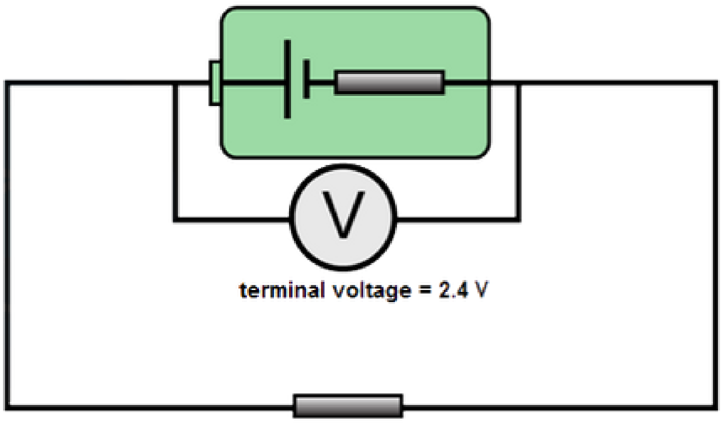
internal resitance

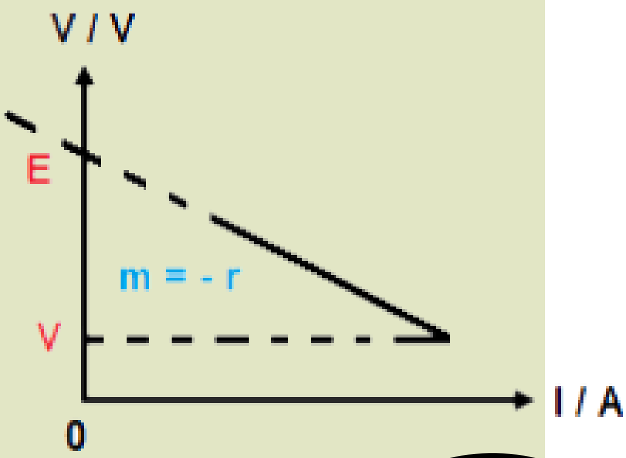


Without internal resistance
e.m.f = V



With internal resistance
e.m.f > V

$E = V + Ir$ or $E = IR + Ir$



Where:
- E = e.m.f.
- V = terminal potential difference
- I = current flows in the circuit
- r = internal resistance
- R = the load resistance

1. V decrease as I increase.
2. When I = 0 A,
   V is the reading of e.m.f.
3. E is e.m.f and V is voltage drop.
4. The gradient of the graph is
   internal resistance.

   $m = -r$

$$m = -r$$
$$= -\left(\frac{E - V}{I}\right)$$

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Electrical Energy

$$E = VQ$$

$\uparrow$ $Q = It$

$$E = \frac{V^2 t}{R} \xleftarrow{I = \frac{V}{R}} \boxed{E = VIt} \xrightarrow{V = IR} E = I^2 R t$$

Electrical Power

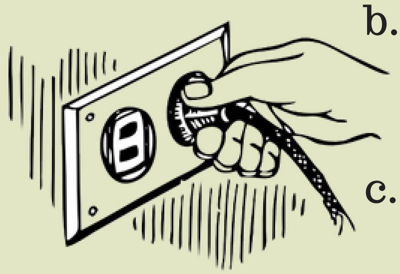
$$P = \frac{E}{t}$$

$\uparrow$ $V = \frac{E}{It}$

$$P = \frac{V^2}{R} \xleftarrow{I = \frac{V}{R}} \boxed{P = VI} \xrightarrow{V = IR} P = I^2 R$$

Steps to Save Electricity

1. Use efficient lighting
2. Buy efficient electric appliances.
3. Use appliances with automatic power off function.
4. Choose electrical appliances of sizes and features which best suit your needs.
5. Proper utilization of all electrical appliances
   a. Defrost refrigerators regularly
   b. Run your washing machine only when it is fully loaded & Iron your clothes only when you have at least a few pieces to iron.
   c. Regular cleaning of air filters in air-condition units and clothes dryers.



$$\text{Electrical Efficiency} = \frac{\text{Output power} \times 100\,\%}{\text{Input power}}$$

$$= \frac{P_{out} \times 100\,\%}{P_{in}}$$