

What is Electric charge?

It is basic property of the matter carried by some elementary particles, that governs how the particles behave in electric or magnetic field.

Atoms consists of three basic particles --Electrons, Proton and neutron.

The electron has negative charge, the proton has positive charge and the neutron has no charge.

In atom Number of electrons =Number of protons, so atom is charge neutral

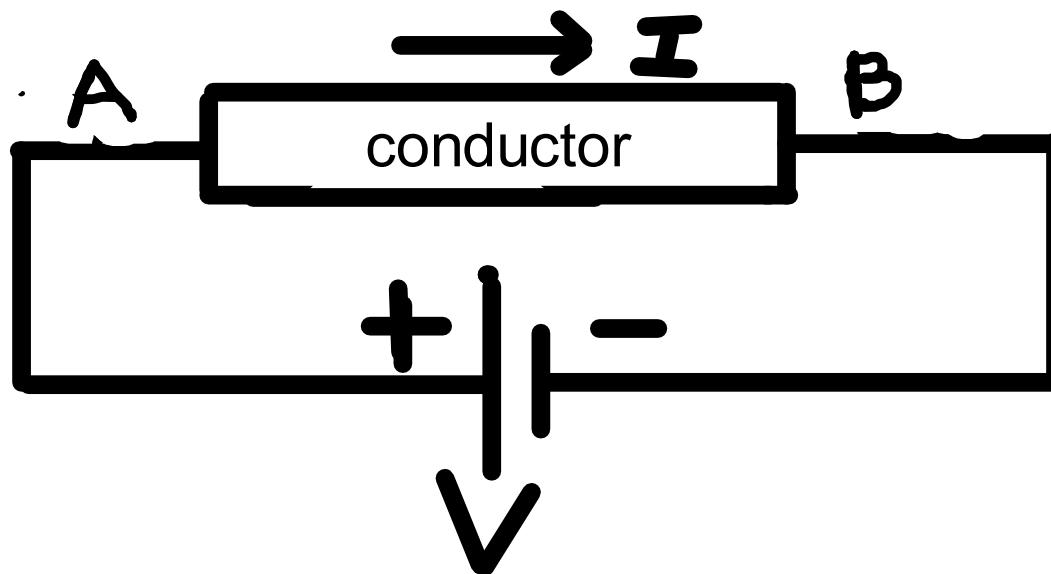
If an atom loses one or more electron, it is positively charged and is referred to as a positive ion.

If an atom loses one or more proton, it is positively charged and is referred to as a negative ion.

The unit of charge is Coulomb (C).

Electric charge can be positive or negative, occurs in discrete natural units and is neither created nor destroyed.

What is Drift Velocity?



Before connecting battery, free electrons in the conductor were in random motion.

After battery in action, an electric field is established.

The free electrons will experience force ($-eE$) in direction B to A.

The electrons in the conductor are accelerated in this direction.

There is collisions of electrons with each other and also with positive ions in the conductor.

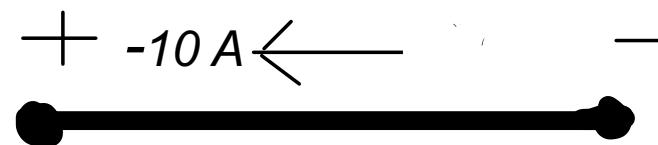
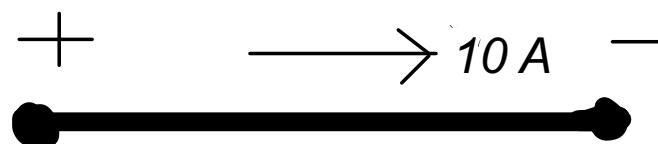
There is loss of momentum due to collisions. Backward force on electrons due to collisions is called collision drag.

The net effect of collisions is that electrons drift slowly with a constant average velocity in the direction of E .

The Drift velocity is a vector average velocity of charge carriers moving under the influence of electric field.

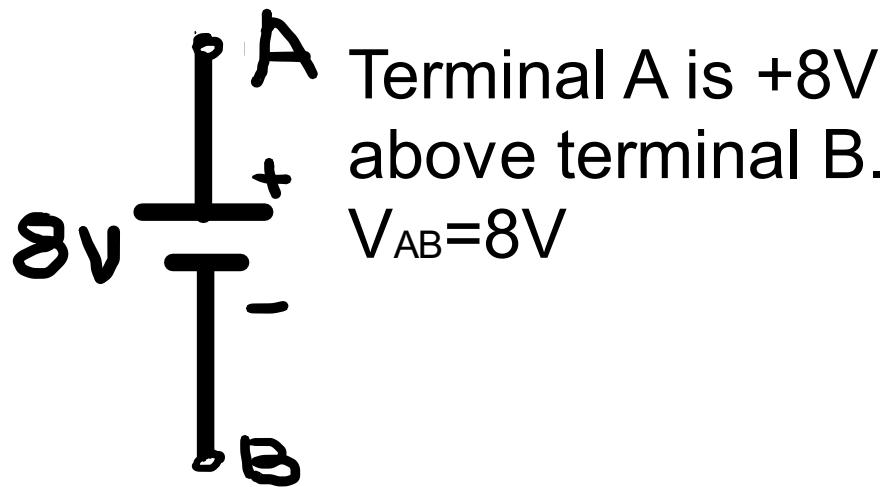
What is Current?

- > Current is rate of flow of charge through conductor.
- > If a total charge Q passes a given point in the conductor during a time t (if rate of flow of charge is constant) then $I=Q/t$,
unit : $I=coulomb/second =Ampere$
- >If rate flow of charge is not constant, instantaneous value of current is $I=dq/dt$.

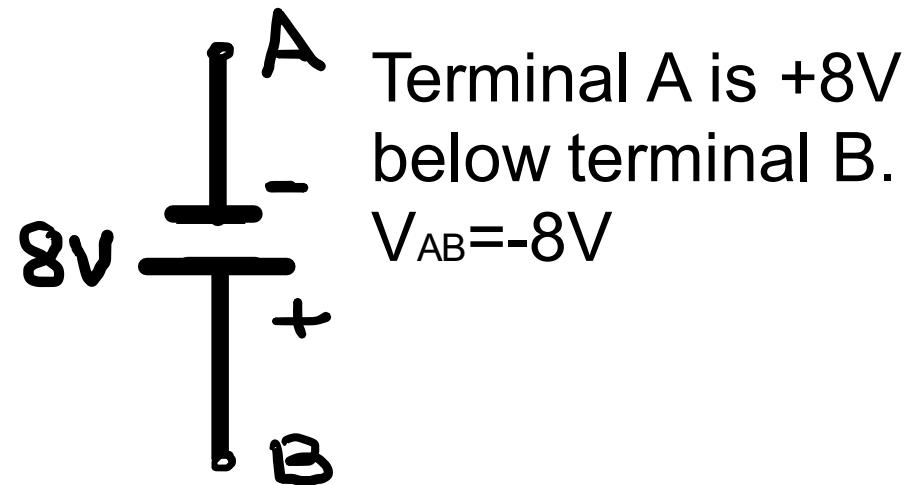


What is Voltage?

- > It is energy required to move a charge from one point to another.
- > If W joules of energy is required to move a charge Q from the point a to b , the voltage V between point a and b is given by
 $V=W/Q$ (J/C) or Volt.



Terminal A is +8V
above terminal B.
 $V_{AB}=8V$



Terminal A is +8V
below terminal B.
 $V_{AB}=-8V$

What is Energy?

- > It is work to be done to transfer a charge through an elements.
- > The polarity of the voltage and direction of the current is important to know whether energy is being supplied to the element or by the element to the rest of the circuit.
- > If the current enters the positive terminal or leaves the negative terminal then external force must drives the current. It means external force delivers energy to the element. (Fig. (a) and (b))
- > If the current enters the negative terminal or leaves the positive terminal then the element is delivering energy to the external circuit. (Fig. (c) and (d)).

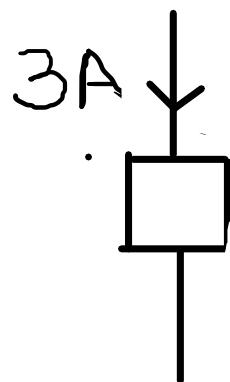
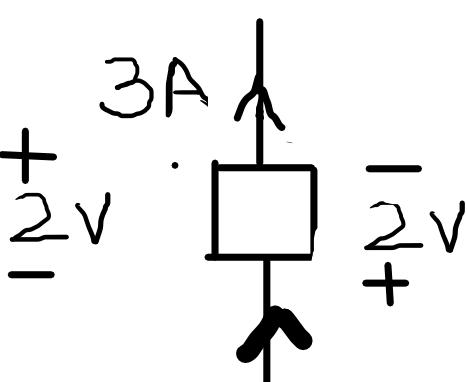


Fig.(a)



Fig(b)

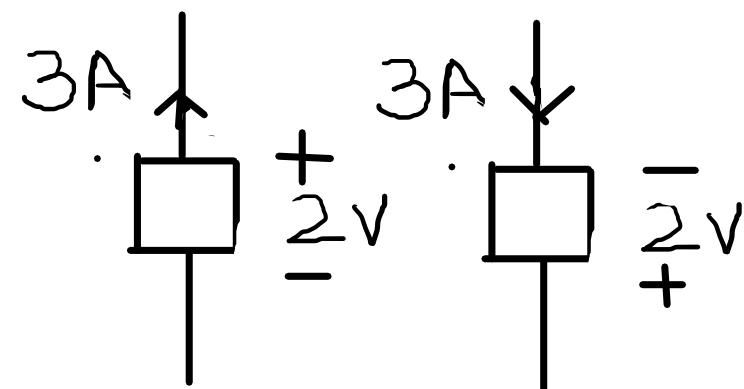
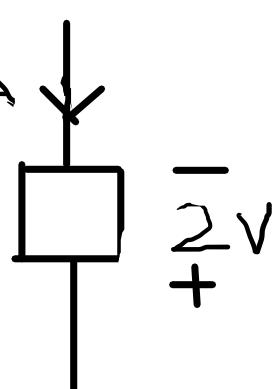


Fig.(c)



Fig(d)

What is Power?

--> power is work done per unit time.

$$\text{power} = \frac{\text{Energy}}{\text{time}}$$

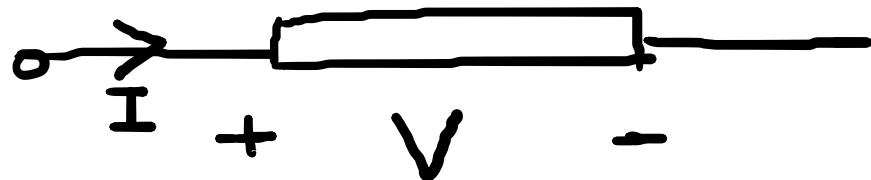
$$= \frac{W}{t}$$

$$= \frac{W}{Q} \cdot \frac{Q}{t}$$

$$= V \cdot I \text{ (watts)}$$

Ohms Law

The current flowing through a conductor is directly proportional to the potential difference between its two ends, provided that the temperature and other physical parameter of the conductor remain unchanged.

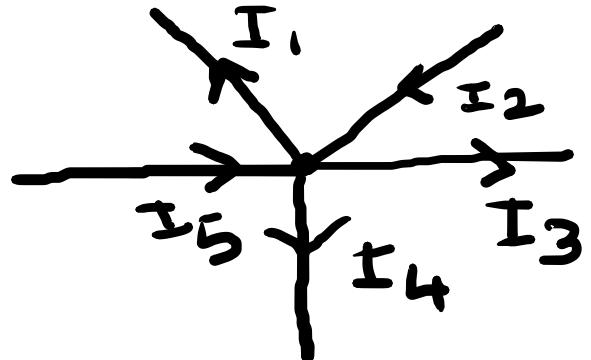


$$V \propto I \quad V = R \cdot I \quad \text{OR} \quad R = \frac{V}{I} \text{ Ohm} (\Omega)$$

If one ampere of current flows through a conductor and the voltage between two ends of conductor is one volt, the resistance of the conductor is said to be one ohm.

Kirchhoff's Laws

Kirchhoff's Current Law (KCL): The algebraic sum of the currents entering or leaving a junction in an electric circuit at any instant is zero.

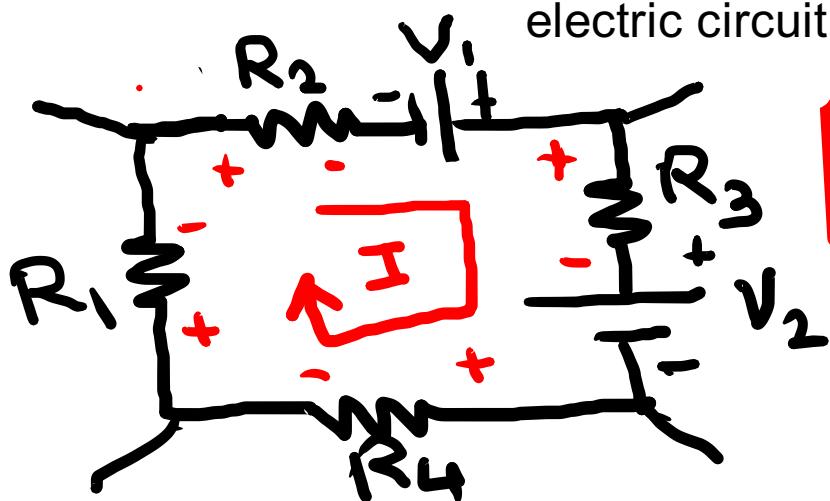


$$I_1 + (-I_2) + I_3 + I_4 + (-I_5) = 0$$

$$I_1 + I_3 + I_4 = I_2 + I_5$$

- Outgoing currents = incoming currents

Kirchhoff's Voltage Law (KVL): The algebraic sum of the Voltages in any closed path in an electric circuit at any instant is zero.



$$-IR_1 - IR_2 + V_1 - IR_3 - V_2 - IR_4 = 0$$