R.C.Patel College Of Engineering & Polytechnic, Shirpur

Department of Applied Sciences and Humanities

Course Title- Basic Science

Course Code - 311305

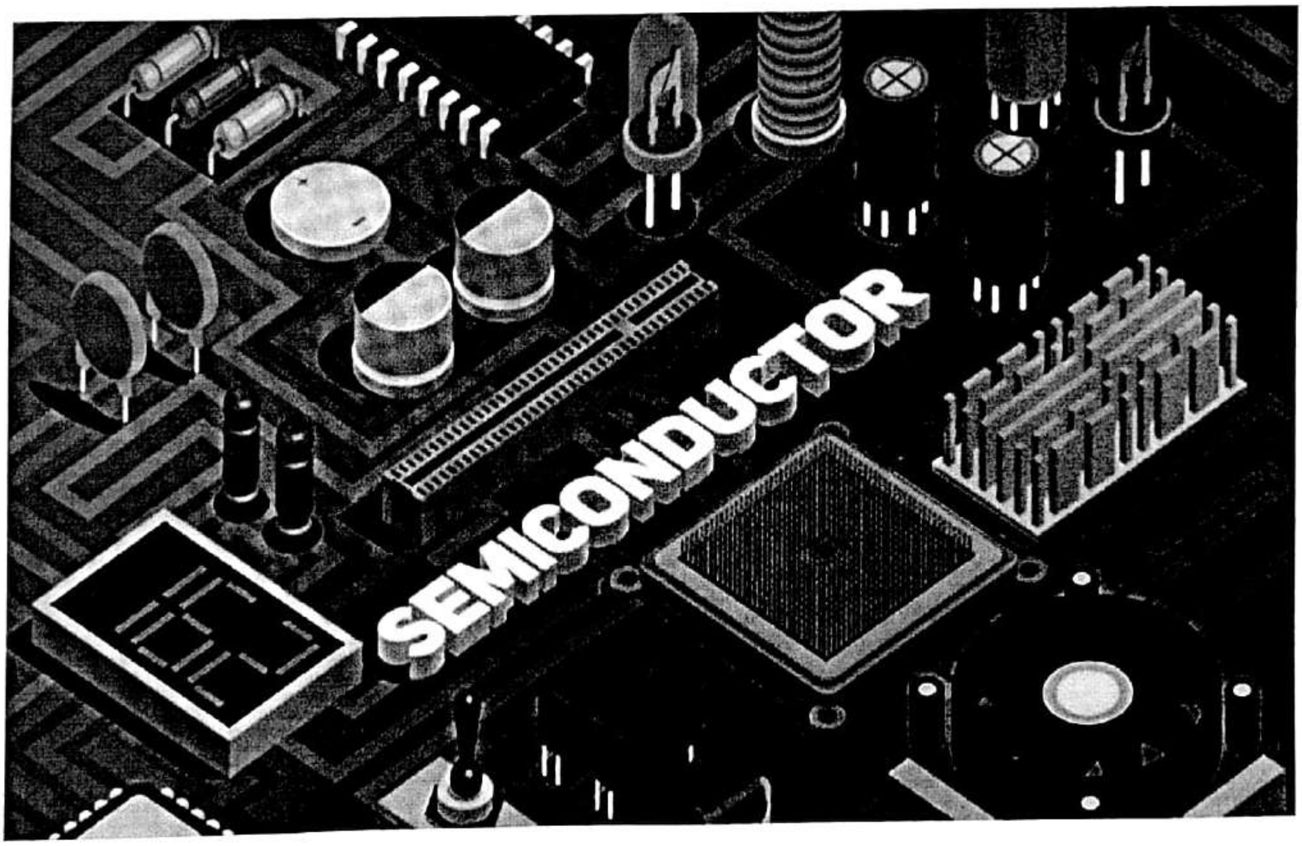
Department Name – Applied Sciences

Semester- First

Subject Teacher: Prof Swapnil. S. Tayade

Prof Praful. C. Mundake

Unit	Title	COs	Learning hours	R Level	U Level	A Level	Total Marks
2	Electricity, Magnetism and Semiconductor	CO2	13	03	05	06	14



Unit 2:- Electricity, Magnetism & Semiconductor

(14M, 13Hr)

* Concept of charge:-

Charge is the fundamental quantity of electricity. It is the property associated with matter due to which it produces & experiences electrical & magnetic effect. The access or deficiency of an electron in a body gives the concept of charge.

The property of particle which produces electrical influence around it is called as "charge".

* Types of charges:-

a) Positive charges (+ve) ie Proton

b) Negative charges (−ve) ie Electron

The total charge of the system remains constant.

S.I unit of charge is Coulomb's (C)

Forces between two charges

a) +, + ie two positive charges } will repel each other.
b) −, − ie two negative charges

c) +, − ie positive & negative charges } will attract each other.
d) −, + ie Negative & positive charges

e) Two equal number of positive & negative charges is electrically neutral.

The proton & Electron creates electric fields which exerts a force called " Coulomb's Force".

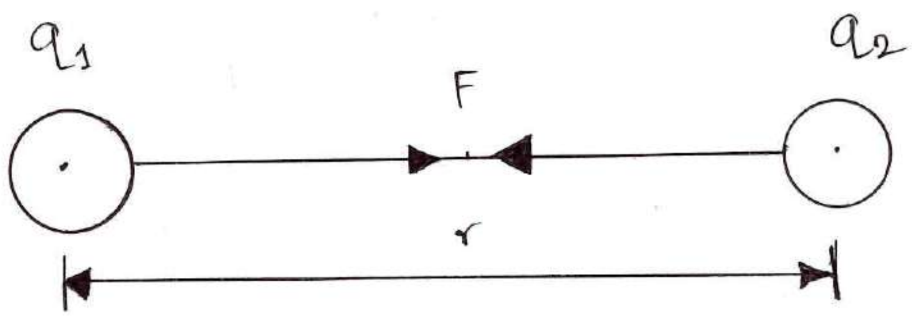
* Coulomb's Inverse Square Law :-

Statement :-

The force of attraction or repulsion between two charges at rest is

a) Directly proportional to the product of two charges.

b) Inversly proportional to the square of the distance between them.



Consider the two point charges ie q_1 & q_2 are seperated by a distance "r". The force between these two charges (q_1 & q_2) is given by.

$$F \propto \frac{q_1 q_2}{r^2}$$

$$F = K \frac{q_1 q_2}{r^2}$$

where K is constant.

where $K = \frac{1}{4\pi\varepsilon_0}$, $\frac{1}{4\pi\varepsilon_0 K}$

$\varepsilon_0 = \varepsilon_0 K$ = Permitivity of medium.

ε_0 = permitivity of vaccum of free space.

$K = \varepsilon/\varepsilon_0$ Dielectric Constant.

$$\boxed{F = \frac{1}{4\pi\varepsilon_0 K} \cdot \frac{q_1 . q_2}{r^2}}$$

but $\frac{1}{4\pi\varepsilon_0 K} = 9\times10^9 \ Nm^2/C^2$

$$\boxed{\therefore F = 9\times10^9 \ \frac{q_1 q_2}{r^2}}$$

* Factors affecting on force between two electric charges:-

a) Charge (Q or q)

b) Distance between two charges (r or d)

c) Dielectric constant of the medium (K)

d) Permitivity of the medium (ε)

Defination's:-

a) Dielectrics:- The substance which does not allows current to flow to flow through them but shows electrical effects are called dielectric (for eg:- Insulator, glasses, wood, paper, etc)

b) Permitivity:- The ability or property of dielectric medium to permit electric lines of forces to pass through it, is called as permitivity of medium.

$K = 1$, for air $K > 1$ for other medium

$K = \infty$ for metals.

* One Coulomb's (1C):- 1C charge is that charge which when placed in vaccum or air at a distance of 1m from an equal & similar charge experiences a repulsion force of $9\times10^9 N$

$$F = 9\times10^9 \frac{q_1 q_2}{r^2}$$

If $q_1 = q_2 = 1$, $K = 1$, $r = 1$

then $F = 9\times10^9$ N

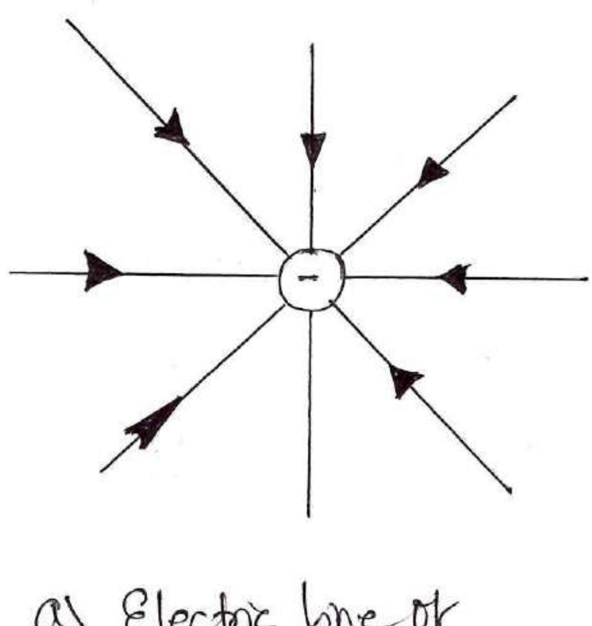
* Electric field (defn):- The space surrounding a point charge where it's effect such as force of attraction or repulsion can be experienced.

The space surrounding an electric charge in which any other charges experiences a force is called electric field of that charges.

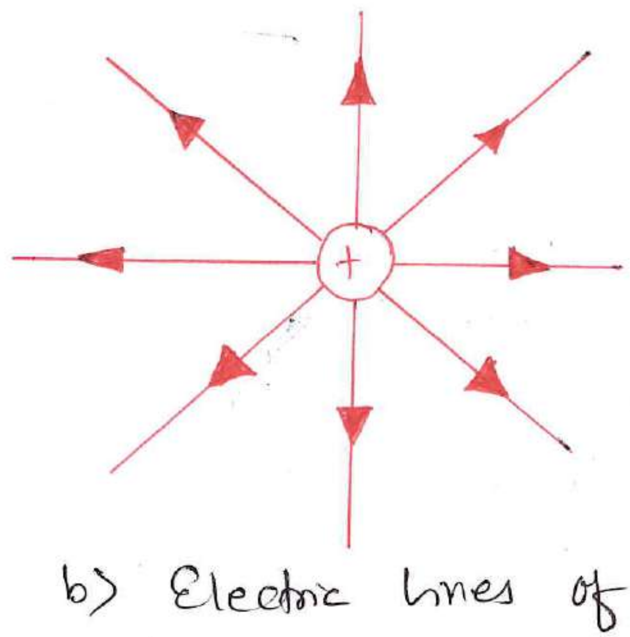
In non uniform electric field, force various from point to point in magnitude & direction

In uniform electric field force is same everywhere.

Electric lines of forces:- Electric lines of forces are the imaginary lines around a charge which indicates electric field around a charge.



a) Electric line of forces of -ve charges



b) Electric lines of forces of +ve charges

Fig :- Electric lines of forces

If a unit positive charges is placed very closed to a given positive charge "Q" then the force of repulsion act on it. This force pushes away. The unit charge. The path of this unit charge is along the line joining position of two charges. the path is called Electric lines of forces of charge "+Q".

Similarly if a unit positive charge is placed on the boundary of electric field of negative electric charge "-Q", then the force of toward "-Q". The path of unit charge is along the line joining position of two charges. This path is called an electric lines of force of charge "-Q".

* Electric lines of forces:- The electric lines of forces of a charge is defined as a path along which a unit positive charge will move, when placed in the electric field of the charge.

* properties or characteristics of Electric lines of forces:-

a) Electric lines of force starts from positive charge & ends at negative charge.

b) Electric lines of forces never intersects each other as electric intensity has only one direction at a given point, only one line passes through a given point.

c) Electric lines of forces because of two charges are curved in nature.

d) The direction of electric field at a point is given by tangent drawn to the electric lines of the forces at that point.

e) The electric lines of force always normal to the surface of charged body

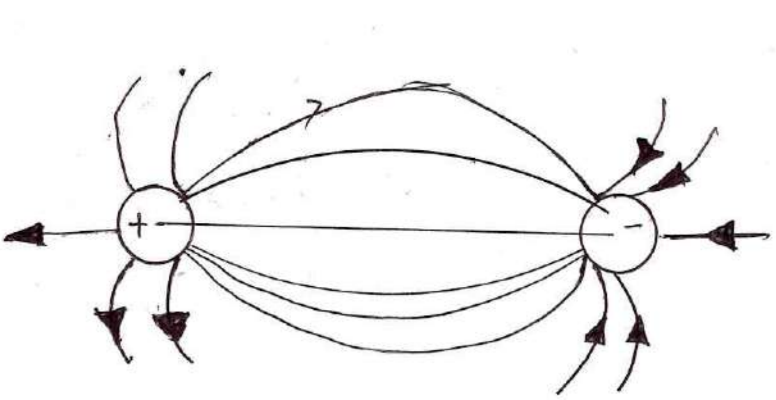
f) The electric lines of forces are present only on the outer surface of charged body because of force of repulsion between them therefore electric lines of forces are not present inside the body.

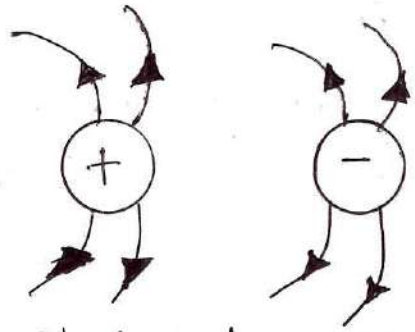
i) Electric lines of forces can pass through an insulator and cannot passes through conductor. It simply means that there is no electric field inside.

j) Electric lines of forces are closer to each other in the region where intensity "E" is large ie near the charge.

k) Electric lines ore forces are less crowded in the region where intensity "E" is minimum.

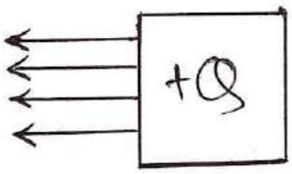
l) Electric lines of forces have tendency to contract in length & to expand laterally.





b) Electric lines of forces

* Electric flux: (Ψ): The total electric lines of force which flow outward from a +ve charge is called as "Electric flux".



$$\Psi = Q$$

* Electric ~~field~~ field Intensity or Intensity of Electric field (E): The intensity of electric field at a point due to a point charge is defined as the electrostatics force acting on a unit "+ve" charge is placed at ~~a~~ that point.

$$E = \frac{F}{Q}$$

If the strength of charge is more then its field will be more.

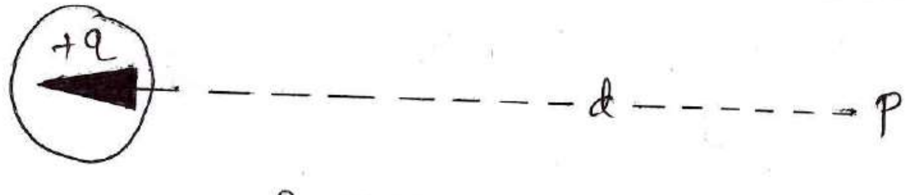


fig B

we have

$$F = 9\times10^{9}\ \frac{Q_1 Q_2}{Kr^2} \quad (r = d = \text{distance})$$

$$(Q_1 = Q\ ,\ Q_2 = 1\ ,\ \text{then } F = E)$$

$$E = 9\times10^{9}\ \frac{Q}{Kr^2}$$

also intensity

$$E = \frac{1}{4\pi\epsilon_0}\ \frac{Q}{Kr^2}$$

M.K.S unit of E is N/C or V/m

C.G.S unit of E is dyne / stat coulomb's

Dimension of $E = [L^1 M^1 T^{-3} I^{-1}]$

* Physical Significance of Equation $E = 9\times10^{9}\frac{Q}{Kr^2}$

a) Electric intensity is not same at all the points inside the electric field.

b)

b) Electric intensity E is maximum near the charge & it goes on decreasing with distance away from the charge.

c) Electric intensity "E" of a charge depends the strength of the charge.

d) Electric intensity "E" depends on medium which the charge is placed.

* Electric Flux density at a point :-

Electric flux density is defined as the number of Electric lines of forces crossing unit area held perpendicular to the electric lines of forces which passes through the centre of area.

D = flux density ... C/m2
(Coulombs / meter^2)

near the charge "D" is maximum also E is maximum.

Electric intensity E at point is defined as the force acting on unit positive charge placed at a point

$$D \propto E$$

$$\mathcal{D} = \varepsilon_0 K \cdot E$$

we have ∴ $E = \frac{Q}{4\pi\varepsilon_0 K d^2}$

If $d = r$ then

$$E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{Kr^2} \quad \text{------} \quad (\mathrm{I})$$

Total flux out of a closed surface is equal to the net charge within that surface

$$Q = 4\pi r^2 D$$

$$\mathcal{D} = \frac{Q}{4\pi r^2} \quad \text{------} \quad (\mathrm{II})$$

Comparing eq^n I & II, we get

$\boxed{\mathcal{D} = \varepsilon_0 K E}$ or $\boxed{\mathcal{D} = \varepsilon_0 E}$

* Electric Potential (V) :- It is defined as the work done per unit positive charge in bringing that charge from infinity to that point without acceleration.

$$V = \frac{W}{q}$$

V - Electric potential
W - workdone
q - charge.

It's S.I unit is "Volts" or J/C

Its dimension is $[L^2, M^1 T^{-3} I^{-1}]$

One volt(1V):.

$$1V = \frac{1J}{1C} \quad , \quad V = \frac{W}{q}$$

Electric potential at a point is said to be One volt if 1 Joules of work done is displaced a charge of 1 coulombs from infinity to that point against the direction of dielectric intensity.

* Electric potential difference (P.D):.

It is defined as potential difference between two point is defined as the amount of work done in carrying a unit positive charge from one point to the other point against the electric field.

$$V_{AB} = V_A - V_B = W_{AB}$$

$$V_{AB} = \frac{W_{AB}}{Q}$$

The unit of electric potential is "volts"(V)

Important Formulae:-

a) $F = 9\times10^9 \dfrac{Q_1 Q_2}{kd^2} = \dfrac{1}{4\pi\varepsilon_0} \dfrac{Q_1 Q_2}{kd^2}$

b) $E = \dfrac{\text{Force}}{\text{Charge}} = \dfrac{1}{4\pi\varepsilon_0} \dfrac{Q}{kd^2} = 9\times10^9 \dfrac{Q}{kd^2}$

c) $D = \varepsilon_0 k E$ or $D = \dfrac{\psi}{A} = \dfrac{Q}{A}$

d) $V_{AB} = 9\times10^9 \dfrac{Q}{K}\left[\dfrac{1}{d} - \dfrac{1}{D}\right]$

e) $V = 9\times10^9 \dfrac{Q}{Kx}$

f) $V_{sph} = 9\times10^9 \dfrac{Q}{Kr}$.

Examples:-

1] An electron is placed in an electric field of intensity 8×10^2 N/C. Calculate the force acting on the ~~electric~~ electron

Ans:- Given :- $E = 8\times10^2$ N/C
$e = 1.6\times10^{-19}$ C

Formula → Electric Intensity $= \dfrac{\text{Force}}{\text{Charge}}$

Force = Electric Intensity × charge

Force = 8×10^2 N/C $\times 1.6\times10^{-19}$ C

Force on electron $= 12.8 \times 10^{-17}$ N

for extra examples take the value of

a) $E = 6 \times 10^{2}$ N/C & $e = 1.6 \times 10^{-19}$ C

b) $E = 6.8 \times 10^{2}$ N/C & $e = 1.6 \times 10^{-19}$ C

c) $E = 7.6 \times 10^{2}$ N/C & $e = 1.6 \times 10^{-19}$ C

2] Two like charges each of 10 μC are placed 10 cm apart in a medium of dielectric const 2.5 Find the force between them ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2)

Ans:- Given :-

$Q_1 = Q_2 = 10\,\mu C = 10 \times 10^{-16}$ C

$d = 10$ cm, $= 0.1$ m, $K = 2.5$

Formulae :-

$$F = \frac{1}{4\pi \varepsilon_0 K} \frac{Q_1 Q_2}{d^2}$$

$$F = \frac{1}{4 \times 3.14 \times (8.85 \times 10^{-12})^2 \times 2.5 \, \frac{C^2}{Nm^2}} \times \frac{(10 \times 10^{-16} \times 10 \times 10^{-16}) \, C^2}{(0.1)^2 \, m^2}$$

$$\boxed{F = 35.96 \text{ N}}$$

Q2 a) Two like charges each of 15 μC are placed 12 cm apart in a medium dielectric constant is 2.5. Find the force between them ($\varepsilon_0 = 8.85 \times 10^{-12} \, C^2/Nm^2$)

b) Two like charges each of 13 μC are placed 8 cm apart in a medium dielectric constant is 2.5. Find the force between them ($\varepsilon_0 = 8.85 \times 10^{-12} \, C^2/Nm^2$)

Q3 Two charges each of one coulomb's are placed at a distance of 0.3 m apart in air. Calculate the force between them?

Ans:- Given :- $Q_1 = Q_2 = 1C$, $d = 0.3m$, $K = 1$, $F = ?$

Formula :-

$$F = 9 \times 10^9 \frac{Q_1 Q_2}{Kd^2}$$

$$F = 9 \times 10^9 \frac{(1) \times (1)}{1 \times (0.3)^2}$$

$$F = 10^{11} \, N$$

a) Two charges each of 3 c are placed at a distance of 0.8m apart in air. Calculate the force between them?

b) Two charges each of 2c are placed at a distance of 1m apart in air. Calculate the force between them?

c) Two charges one of 6c & another one of 1.5c are placed at a distance of 2m apart in air. Calculate the force between them?

Q4] Calculate the intensity of electric field at a point 50cm from a charge of 4.8×10^{-6} C in a medium of dielectric constant. 3.6

Ans:- Given:- $d = 50\ cm = 0.50m$, $Q = 4.8 \times 10^{-6} C$

$K = 3.6 \quad E = ?$

Formula:-

$$E = 9 \times 10^{9} \frac{Q}{Kd^2}$$

$$E = 9 \times 10^{9} \frac{4.8 \times 10^{-6}}{3.6 \times (0.50)^2}$$

$$E = 48 \times 10^{3}\ N/C$$

a) Calculate the intensity of Electric field at a point 40 cm from a charge of 3.7×10^{-6} c. in a medium of dielectric constant 2.5.

b) Calculate the intensity of electric field at a at point 10 cm from charge of 5.6×10^{-6} C in a medium of dielectric constant 2.8.

Q5] Calculate the potential at a point 20cm away from the point charge "+1C"

Ans Given:- $d = 20cm = 0.2m$

$Q = +1C$, $K = 1$

Formula:-

$$\text{"}V\text{"} = 9 \times 10^{9} \times \frac{Q}{Kd^2}$$

$$V = 9\times10^{9}\times\frac{1}{1\times(0.2)^2}$$

$$V = 2.25\times10^{11}\ \text{Volts.}$$

a) Calculate the potential at a point 15cm away from the point charge "+2C".

b) Calculate the potential at a point 12cm away from the point charge "+4C".

Q6] An electric charge of $3\times10^{-3}\ \mu C$ is placed at a point in the medium of dielectric constant "1.08". Find its potential at point 20cm away from it.?

Ans: Given:- $Q = 3\times10^{-3}\ \mu C$ convert it into "C"

$= 3\times10^{-3}\times10^{-6}\ C$

$= 3\times10^{-9}\ C$, $K = 1.08$

$d = 20cm, \Rightarrow m$, $20cm = 0.2m$.

Formula:-

$$V = 9\times10^{9}\times\frac{Q}{Kd^2}$$

$$V = 9\times10^{9}\times\frac{3\times10^{-9}}{(1.08)\times(0.2)^2}$$

$$V = 125\ \text{volts}$$

a) Calculate the force between two point charges of 2 ~~coulo~~ coulomb each seprated by a distance of 2cm in vaccum (F → 9×10^{9} N)

b) Calculate the potential due to a point charge of 1.6 μC at a point 40 cm away from the charge when placed in air ($V = 36\times10^{3}$ V)

Q7] Calculate the force of repulsion between two unit charges placed unit distance apart in air.

Ans:- Given:- $q_1 = q_2 = 1C$, $d = 1m$, $K = 1$ for air

Formula

$$F = 9\times10^{9}\ \frac{q_1 q_2}{r^2}$$

$$F = 9\times10^{9}\ \frac{(1)(1)}{(1)^2}$$

$$F = 9\times10^{9}\ N$$

a) Calculate the force of repulsion between two unit charges placed at 2 m apart in air.

b) Calculate the force of repulsion between two unit charges placed at 4m apart in air..

* Magnetism *

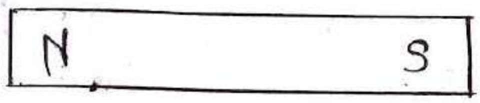
Introduction:-

Certain form of iron are called as magnetism, has a property of attracting iron. This ore is known as Magnetic oxide of iron (Fe_3O_4). The pieces of magnetite are known as Natural magnet.

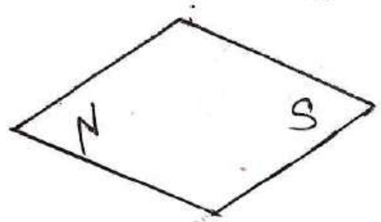
Metals such as iron, nickel, cobalt, can be magnetized by different methods which are called "Artificial Magnet".

Artificial magnets are prepared in different shapes such as

a) Bar magnets, b) Magnetic needle, c) Horse shoe magnet, d) Cylindrical magnet, e) Circular magnet.



a)



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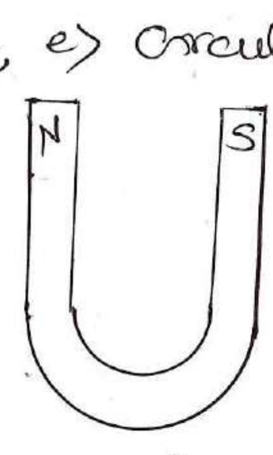
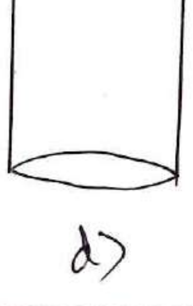


c)



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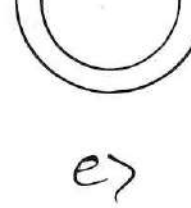


e)

Artificial magnets are stronger than natural magnets its strength can be increased & can be moulded in different shapes.

* properties of magnets:-

a) It attracts iron, nickel, cobalt, steel, etc.

b) Magnet always rests in N-S direction when suspended freely.

c) Like poles of magnet repel each other

ie N-N & S-S

& unlike poles of magnet attracts each other

ie N-S & S-N

d) Magnetic poles exist in pair (dipole, ie di- means -2)

If bar magnet is broken into pieces then each piece has north pole & South pole.

e) Magnet can magnetize another piece of iron.

* Magnetic field & Magnetic field intensity:-

Magnetic field:- It is a space surrounding the magnet where its effect can be detected

OR

It is a space around the magnet force of attraction or repulsion is present.

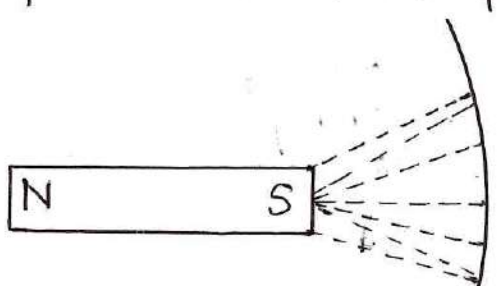
The strength of the magnetic field at a given point depends on its distance from the magnet. Near the magnet strength is more & as we go away from magnet, its strength goes on decreasing.

Strength of magnetic field at a point is inversly proportional to its square of distance from the magnets

$$M \propto \frac{1}{r^2}$$

* Magnetic field Intensity (H) :-

It is defined as force acting on a unit north pole placed at that point



S.I unit is Netwon / Weber.
(N / Wb)

Magnetic Force (F) $= \frac{1}{4\pi\mu_0\mu_r} \times \frac{m_1 m_2}{d^2}$

$m_1 = m$, $m_2 = 1$.

Magnetic Intensity $= \frac{\text{Magnetic force}}{M}$

$$H = \frac{1}{4\pi\mu_0\mu_r} \times \frac{m}{r^2} \qquad \frac{\text{Newton}}{\text{Weber}}$$

m_1 & m_2 = magnetic pole strength.

μ_0 = permeability of air,

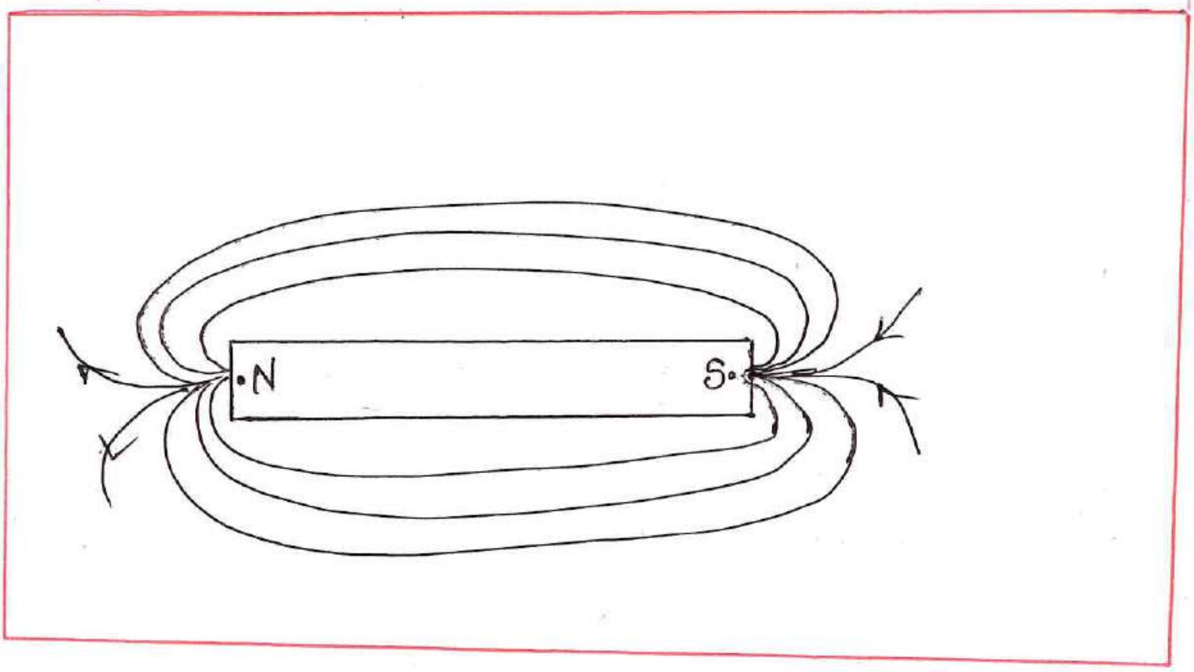
μ_r = relative permeability

d = distance between two poles

* Magnetic lines of forces :-

Magnetic lines of forces are defined as a path (curved) along which the unit north pole will move in the magnetic field.

Place a bar magnet horizontally on a table & put card board on the bar magnet. Now spread some iron fillings ores the cardboard. Now tap on the cardboard. Iron fillings get magnitized & arranged themselves in curved shape



* Properties of Magnetic lines of forces :-

a) Magnetic lines of force are closed curve. They starts from North pole and ends at south pole. outside the magnet.

b) The tangent drawn to curved part of line of force at any point gives the direction of the magnetic field at that point.

c) Magnetic lines of forces ~~are~~ form a closed loop.

d) Magnetic lines of forces never intersects each other.

e) Magnetic lines of forces has tendency to contract along length & expanded later
ie they have longitudinal tension & lateral pressure.

f) Magnetic lines of forces in the same direction repels each other.

g) Magnetic lines of forces are not affected by non-magnetic material (ie in paper)

i) Magnetic lines of forces are more contracted in magnetic material.

j) In uniform magnetic field, lines of forces are straight lines parallel to each other & they are equidistance.

k) Magnetic lines of forces are an imaginary lines representing the distance of the magnetic field.

* Magnetic flux (ϕ):- The total number of magnetic lines of forces which flows outward from North pole of a magnet is called Magnetic flux

Magnetic flux = Magnetic field x Area

$$\phi = B \times A$$

S.I unit of Magnetic flux (ϕ) = Weber (Wb)

C.G.S unit of Magnetic flux (ϕ) = Maxwell.

1 Maxwell = 1 line

1 Weber = 10^8 Maxwell

Dimension = $[L^2 M^1 T^{-2} A^{-1}]$

1 Tesla = 1 Wb/ m^2

Magnetic flux density or Magnetic Induction (B):-

Magnetic flux density is defined as "Magnetic flux per unit area at that point

$$\text{Magnetic flux density (B)} = \frac{\text{Magnetic flux}}{\text{Area}}$$

$$(B) = \frac{\phi}{A}$$

S.I unit of Magnetic flux density = Wb/meter^2 or Tesla

1 Tesla = 1 Wb/m^2

Relation between magnetic flux density (B) & Magnetic field intensity (H):-

Magnetic field intensity (H) is because of magnetic flux density (B) ie more is the magnetic flux density (B) more is the magnetic field intensity (H)

$$B \propto H$$

$$B = \text{constant} \times H$$

$$\frac{B}{H} = \text{constant}$$

$$\boxed{\therefore\ B = \mu \times H}$$

or $\boxed{B = \mu_0 \mu_r \times H}$

where μ_0 = permeability of air.
μ_r = Relative permeability.

* Electric Current, Ohm's Law, Specific resistance Laws of series & parallel combinations of resistance heating effect of electric current.

* Electric Current :- The rate of flow of charge (Q or q) across the area of conductor is called the electric current (I).

$$\text{Electric Current (I)} = \frac{\text{charge}}{\text{time}}$$

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

S.I unit of Current(I) = Ampere (A) or C/sec
Dimension (I) = $[L^0 M^0 T^0 A^1]$

* One ampere :-

we know that $I = \frac{q}{t}$

$$1A = \frac{1C}{1s}$$

Defination :- The current flowing through the conductor. is said to be one ampere (1A) if one coulombs (1C) charge flows through the conductor in one second.

* Ohm's Law :-

Statement :- If the physical state (material, dimension & temperature) (Length, cross - sectional area & temperature) of a conductor remains same the electric current (I) flowing through the conductor is directly propotional to the potential difference (V) between the ends of conductor.

ie

$$V \propto I$$

$$V = \text{Constant} \times I$$

$$V = R \cdot I$$

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

where R - constant called as Resistance of the conductor.

Resistor:- It is an electronic device used in a circuit in order to resist the flow of electric current.

symbol of Resistor

Resistance:- It is defined as opposition to the flow of electrons in a conducters. or

It is the ratio of potential difference across the conductor to current flowing through it

$$\text{Resistance} = \frac{\text{P.D}}{\text{Current}}$$

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

S.I unit of R = Ohm (Ω)

Dimension of R = $[L^2 M^1 T^{-3} I^{-2}]$

One Ohm's :- $1R = 1V / 1I$

When one volts potential difference is applied across the condeecter & one amper current flows through a condeector then the resistance of a conducter is said to be one ohm's (Ω)

* Specific resistance or Resistivity (ρ) :-

The resistance of conductor depends on its

a) Material, b) Length, c) Area of cross section, d) Temperature.

" The resistance of conductor is directly proportional to its length (L) & inversly proportional to its area of cross sectional (A)

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

$$R = \text{constant} \times \frac{L}{A} \qquad (\therefore \text{constant} = \rho)$$

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

$$\rho = \frac{RA}{L}$$

Defination of Resistivity (ρ) :-

we know that $\rho = \frac{RA}{L}$

If $A = 1\ m^2$, $L = 1m$ & $\rho = R$

Specific resistance of a material is defined as the resistance of material of unit length & unit area of cross-section.

S.I unit of ρ - Ωm.

* Factors affecting resistance of conducting material:-

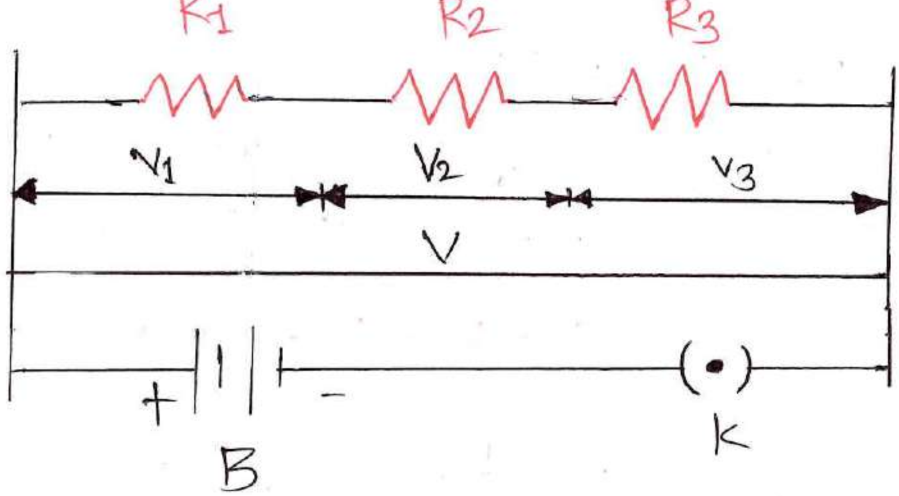
a) Material, b) Length of conductor, c) Area of Conductor.

d) Temperature.

* Laws of Series & Parallel combination of resistance:-

a) Series combination of resistance:-

If number of resistors are connected one after another (end to end) such an arrangment is called as Resistance in series.



Consider the three resistance ie R_1, R_2, R_3 are connected in a series between the point A & B as shown in figure. A cell is connected between these two points.

Let I - current flowing through the circuit & V_1, V_2 & V_3 be the potential difference across the resistance R_1, R_2 & R_3 respectively

$$V = V_1 + V_2 + V_3 \quad \text{---- (i)}$$

According to ohm's Law

$$V_1 = IR_1, \quad V_2 = IR_2, \quad V_3 = IR_3$$

$$V = IR_s \quad \text{--- (ii)}$$

where R_s is effective resistance of series combination.

from eq^n (i) & (ii), we get.

$$IR_s = IR_1 + IR_2 + IR_3$$

$$IR_s = I(R_1 + R_2 + R_3)$$

$$\frac{\cancel{I}R_s}{\cancel{I}} = R_1 + R_2 + R_3$$

$$R_s = R_1 + R_2 + R_3$$

In general if n^{th} resistance $R_1, R_2, R_3, \ldots, R_n$ are connected in series. then,

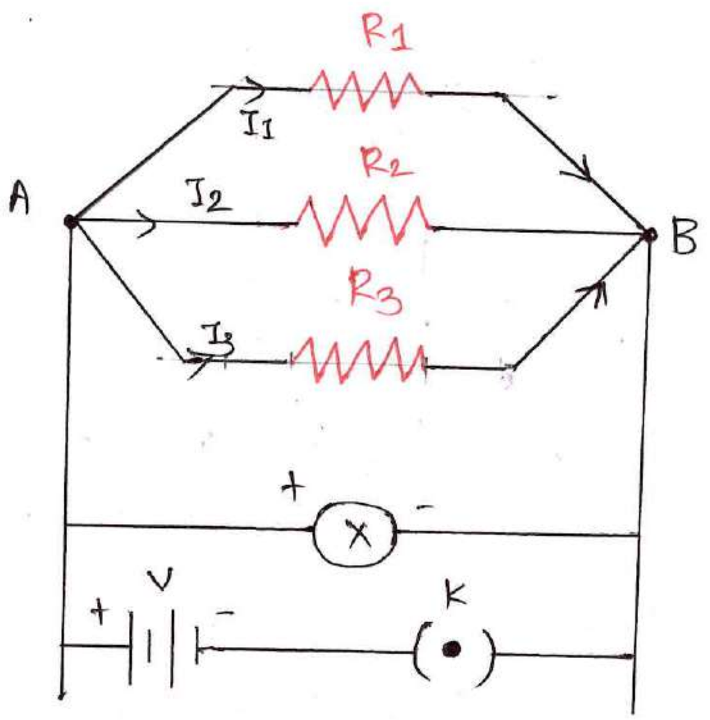
$$\boxed{R_s = R_1 + R_2 + R_3 + \ldots R_n}$$

The effective resistance of series combination of resistance is equal to the sum of individual resistance.

This combination is used to increase the resistance in a circuit.

* Parallel combination of resistance:-

If number of resistance are connected between two common point, such an arrangment is called ~~res~~ resistance in parallel.



Consider the 3 resistance ie R_1, R_2 & R_3 are connected in parallel between the point A & B as shown in figure. A cell is connected between the point A & B.

Let V is potential difference between the point A & B & I_1, I_2, I_3 be the current flowing through the resistance. ie R_1, R_2 & R_3 respectively.

$$I = I_1 + I_2 + I_3 \quad \dots (i)$$

According to ohm's Law

$$I = \frac{V}{R_P}, \quad I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3} \dots (ii)$$

where R_p - Effective resistance of parallel combination.

from eqn (i) & (ii) we get.

$$\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{V}{R_p} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\frac{\cancel{V}}{R_p \cancel{V}} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}.$$

In general if "n" resistance $R_1, R_2, R_3, \ldots, R_n$ are connected in parallel. then

$$\boxed{\therefore \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}}$$

The effective resistance of parallel combination of resistance is equal to the sum of reciprocal of the individual resistance.

This combination is used to ~~the~~ decrease the resistance in the circuit.

$$J = \frac{V^2 t}{RH} \qquad (\therefore I = VR)$$

* Conductance (G):- Conductance is defined as the reciprocal of resistance.

$$G = 1/R$$

S.I unit of Conductance is $1/\Omega$
or Siemens.
or mho or $\mho$

* Conductivity:- It is defined as the reciprocal of resistivity.

or

It is ~~reci~~ defined as the reciprocal of specific resistance

$$\sigma = \frac{1}{\text{Resistivity}} = \frac{1}{\rho}$$

S.I unit is $1/\Omega m$.
or Siemens/m.

* Heating Effect of Electric Current:-

When electric current passes through a conductor, the electron collide with the ions & transfer its energy to ions & atoms.

This increasing average energy of ions as well as the temperature of conductor. It is termed as heating effect of electric current. This phenomenon was studied by the scientist "Joules". Therefore effect is also known as "Joules heating effect".

Joules Law:- It states that amount of heat generated (H) due to flow of electric current through a resistance is directly proportional to

a) Square of the current (I^2)
b) Resistance (R)
c) Time for which current flow (t)

Hence,

$$H \propto I^2 R t$$

$$H = \text{constant} \times I^2 R t$$

$$H = \frac{1}{J} \times I^2 R t.$$

where J = Joule's constant

= 4200 J/kcal

= 4.2 J/cal

$$J = \frac{\text{work}}{\text{heat}}$$

$$J = \frac{I^2 R t}{H} \qquad \text{put } IR = V$$

$$J = \frac{V \cdot I \cdot t}{H}$$

* Important formulae:-

a) $I = \frac{Q}{t}$ b) $V = I.R$ c) $R = \frac{\rho L}{A}$ d) $G = \frac{1}{R}$

e) Conductivity $(\sigma) = \frac{1}{\rho}$ f) $R_s = R_1 + R_2 + R_3$

g) $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ h) $J = \frac{I^2Rt}{H}$

i) $J = \frac{VIt}{H}$ j) $J = \frac{V^2t}{RH}$

Examples:-

Q1] A current of 0.5A is flowing through a bulb for 10 minutes. Find the charge flowing through the circuit?

Ans:- Given: $I = 0.5A$, $t = 10$ min $= 600$ second. $q = ?$

Formula → $I = \frac{q}{t}$

$$\therefore q = I \cdot t$$

$$q = 0.5 \times 600$$

$$q = 300\ C$$

Q2] A battery of e.m.f 12 volts is connected across a resistance of 10 Ω. Calculate the current flowing through the resistance.

Ans:- Given:- $V = 12$ volts, $R = 10\ \Omega$, $I = ?$

Formula:- $V = IR$

$$I = V/R$$

$$I = \frac{12}{10}$$

$$\boxed{I = 1.2A}$$

Q3] A charge of 600C is flowing through a ~~resistance~~ circuit for 5 minutes. Find the current in the circuit.?

Ans:- Given $q = 600C$, $t = 5\ min = 300\ sec$.

$I = ?$

Formula $I = \frac{q}{t}$

$I = \frac{600}{300}$

$I = 2\ A$

Q4] A current of 0.6A flows through a resistance of 25Ω. Calculate the voltage across it?

Ans:- Given:- $I = 0.6A$, $R = 25\Omega$, $V = ?$

Formula $V = IR$

$V = 0.6 \times 25$

$V = 15$ volts.

Q5] A current of 0.8A flows through a resistance if battery of e.m.f 12 volts is connected across it, calculate the resistance.

Ans:- Given:- $I = 0.8A$, $V = 12$ volts, $R = ?$

Formula:- $R = V/I$, $R = \frac{12}{0.8}$

$R = 15\ \Omega$

Q6] An electric heater draws a current 4A when connected across 220volts supply. What current it draws when connected across 180V supply?

Ans:- Given:- $I_1 = 4A$, $V_1 = 220V$,

Formula:- $R = \frac{V}{I}$, $R_1 = \frac{V_1}{I_1}$

$$R_1 = \frac{220V}{4A} = 55\,\Omega$$

$$\boxed{R_1 = 55\,\Omega}$$

$I_2 = ?$, $V_2 = 180$ V.

Now Formula - $R_2 = \frac{V_2}{I_2}$

$$I_2 = \frac{V_2}{R} = \frac{180}{55}$$

$$\boxed{I_2 = 3.27A}$$

Q7] If a potential difference of 50V appears across a resistor of $5\,\Omega$, Calculate the current flowing through resistor

Ans:- Given:- $V = 50V$, $R = 5\,\Omega$, $I = ?$

According to Ohm's

$$I = \frac{V}{R} = \frac{50}{5} = 10A$$

$$\boxed{I = 10A}$$

Q8] A 6m long copper wire has diameter 0.45mm. If its resistance is 0.6 Ω, Calculate its resistivity & conductivity.

Ans Given - $L = 6m$, $d = 0.45\,mm = 0.45 \times 10^{-3}\,m$

$r = \frac{d}{2} = 0.225 \times 10^{-3}\,m$, $R = 0.6\,\Omega$

$\rho = ?$, $\sigma = ?$

a) Resistivity = $\rho = \frac{R(A)}{L}$

$$\rho = \frac{R \times (\pi r^2)^2}{L}$$

$$\rho = \frac{0.6 \times 3.14 \times (0.225 \times 10^{-3})^2}{6}$$

$$\rho = 2 \times 10^{-8}\,\Omega\,m.$$

b) Conductivity, $\sigma = \frac{1}{\rho}$

$$\sigma = \frac{1}{2 \times 10^{-8}}$$

$$\sigma = 5 \times 10^{7}\ S/m$$

Q9] A 10m long wire has a cross sectional area equal to 0.5 cm². Find the specific resistance of the wire if the resistance of the wire 2Ω.

Ans $\rho \to 10^{-5}\ \Omega m$

Q10] The specific resistance of the material of a cable is $2.81 \times 10^{-7}\ \Omega m$. If the resistance of the cable is 2.1Ω & its radius is 0.8 mm calculate the length of cable.

Ans:- Given - $\rho = 2.81 \times 10^{-7}\ \Omega m$, $R = 2.1\ \Omega$

$r = 0.8\ mm = 0.8 \times 10^{-3} m$, $L = ?$

we have

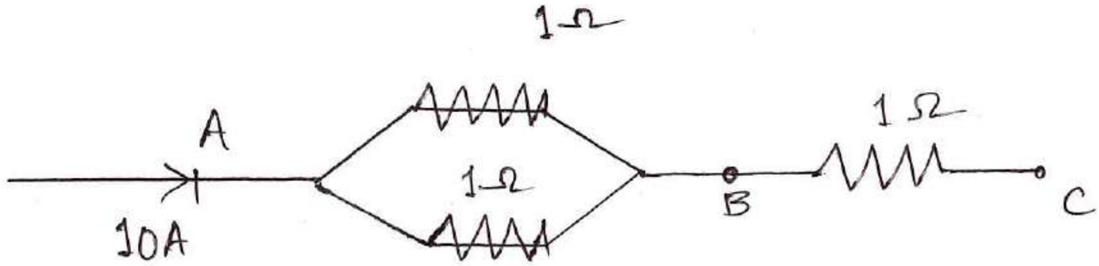
Formula - $R = \frac{\rho L}{A}$, $L = \frac{RA}{\rho}$

$$L = \frac{R(\pi r^2)}{\rho}$$

$$L = \frac{2.1 \times (3.14 \times (0.8 \times 10^{-3})^2)}{(2.81 \times 10^{-7})}$$

$L = 15.03m$

Q11] Two resistance of 1ohm each are connected in parallel, then 1ohm is connected in series with the group, Find the resultant resistance. If the current of 10A passes through the electric. What is the P.D across each resistance?



Ans:- Let resistance across AB is R_p

$$\frac{1}{R_p} = \frac{1}{1} + \frac{1}{1} = \frac{2}{1}.$$

$$R_p = 0.5\,\Omega$$

Let resistance across AC is R_s

$$R_s = 0.5 + 1$$

$$R_s = 1.5\,\Omega$$

$$V_1 = V_2 = I \times R_{AB}$$

$$= I \times (R_p) = 10 \times 0.5$$

$$V_1 = V_2 = 5V$$

$$V_3 = I \times R$$

$$V_3 = 10 \times 1$$

$$V_3 = 10 \text{ volts}$$

Total P.D across the combination

$$V = V_1 + V_3 = 15 \text{ volts}$$

Semiconductor

- Conductors, Insulators & Semiconductors; Energy bands, Intrinsic & Extrensic semiconductor.

- P-N Junction diode, I-V characteristics of P-N Junction, Applications of P-N Junction diode.

* Introduction :→

Materials like Copper, Silver, aluminium etc are good conductor of electricity because they contain large number of free ~~electrons~~ electrons. If the potential difference is applied across conducting wire, the electric current flows through it. The specific resistance of good conductors is about $10^{-3}\Omega$ to $10^{-8}\Omega m$.

Materials like ebonite, glass, mica, wood do not contains free electrons, so the electric current can not pass through them, they are called insulators. The specific resistance of insulators is about 10^{8} to $10^{-13}\Omega m$

Third category of materials which are neither good conductors nor insulators at room temperature. Such materials are called semiconductor.

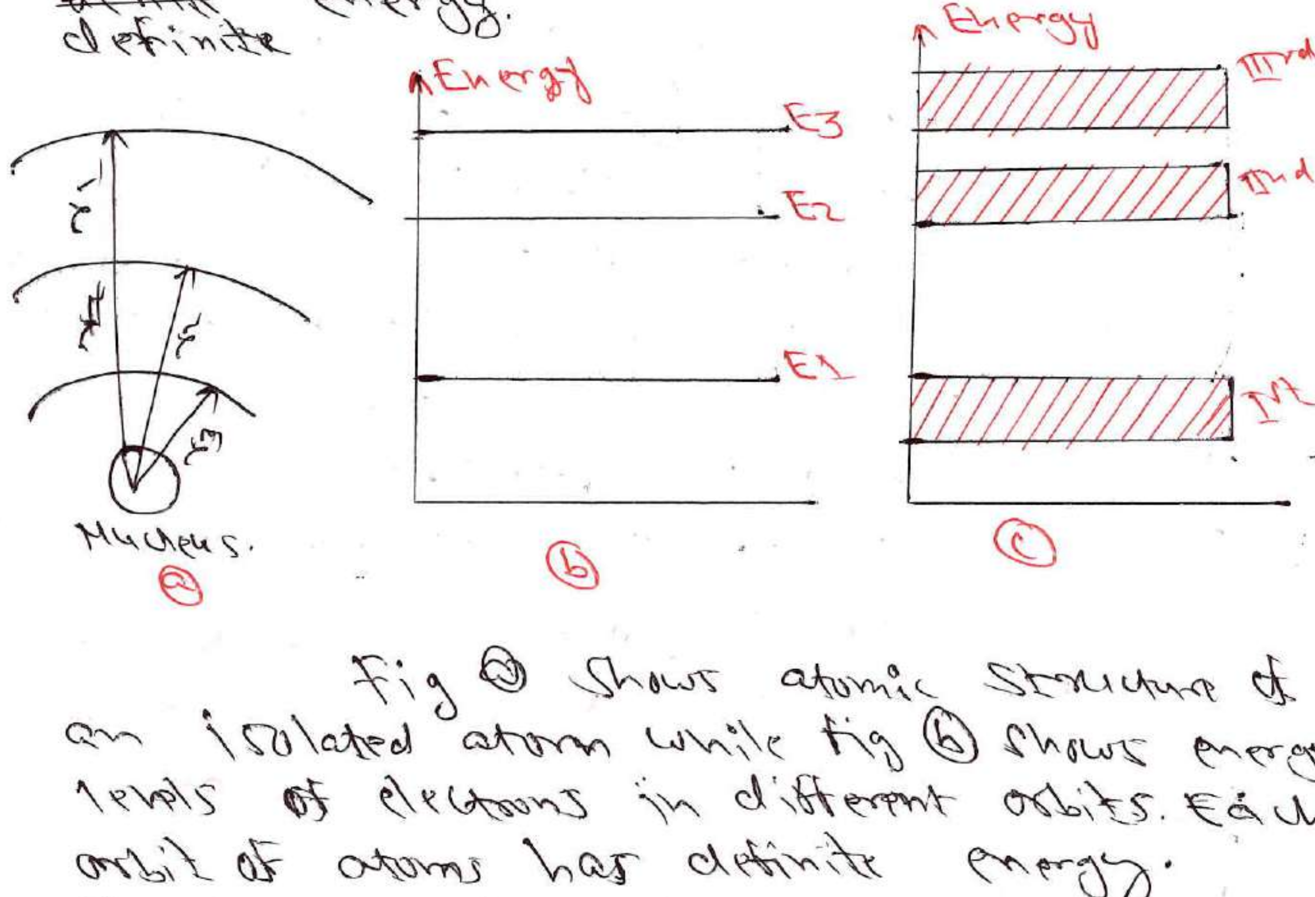
Ex :→ Germenium (Ge), Silicon (Si), lead (Pb) Carbon (C) etc.

The specific resistance of semiconductor is about 1 to $10^5 \Omega m$, semiconductors have some useful properties & are extensively used in electric circuits.

Conductivity of a materials depends on atomic structure & energy gap between valence band & conduction band. This shows that it depends on number of free electrons available for carrying the current.

* Formation of Energy Bands in Solids :→

In case of single isolated atom, an electron revolving in any orbit possesses ~~definite~~ definite energy.



ⓐ ⓑ ⓒ

Fig ⓐ shows atomic structure of an isolated atom while fig ⓑ shows energy levels of electrons in different orbits. Each orbit of atoms has definite energy. Therefore ~~energy~~ every electron can have only definite energy in certain orbit.

Fig (b) shows energy of electron in diff orbit in terms of energy level. When an atom is in solid, the electron in any orbit is influenced by closely packed neighbouring atoms so the energy levels of the electrons is differed by small amount. There are millions of first orbit electrons in ~~solids~~ solids, thier energy levels diff. slightly & form a group of energy levels called as first energy band shown in (c)

Similarly second orbit electrons of all atoms of solid, form second energy band so on. The energy bands are seperated by gap in which there is no energy levels available. In this way there are number of energy bands in solid

" The range of energies possessed by an electron in solids is called energy band."

* Definations of i) Conduction band.
  ii) Valence band.
  iii) Forbidden Energy Gap.

i) Conduction Band :->

" The range of energies possessed by conduction electrons" is called Conduction band."

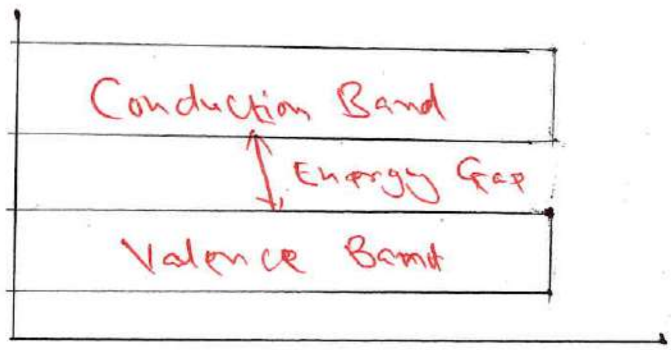
ii) Valence Band :→

"The range of energies possesed by valence electrons in solid called valence band"

iii) Forbidden Energy Gap :→

The seperation between conduction band and valence band an energy level diagram is known forbidden energy gap.

No electrons can stay in forbidden energy gap.

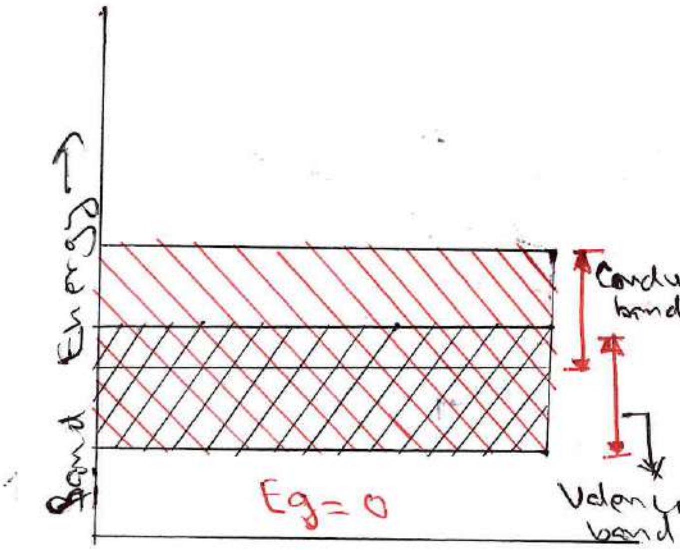


* Classification of Solids on the basis of band theory :→

Depending upon the energy gap betn the valence band & conduction band the solids are classified in conductors, insulators & semiconductors.

i) Conductors :→

Conductors are the materials, which easily allow the electric current through it. There are large number of free electrons available in conductor by which the current flows through it.



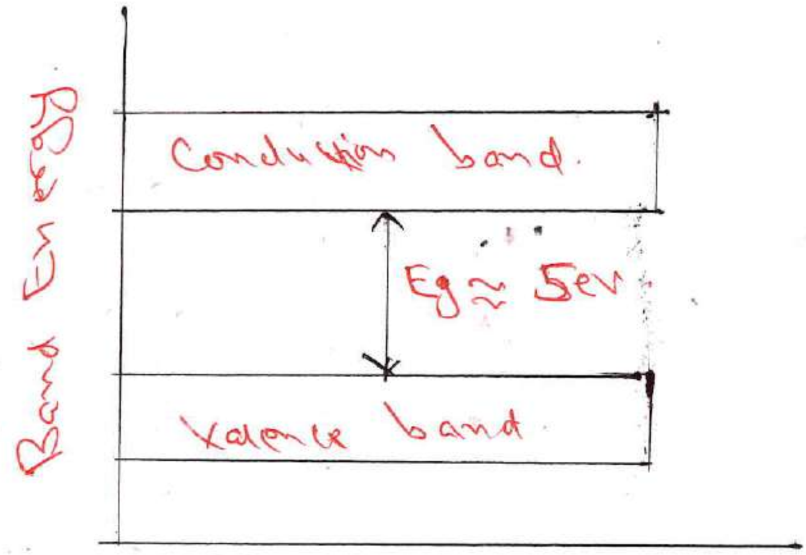
In Conductors the Valence band & Conduction band overlap each other as shown in fig. Due to overlaping, a small potential across the conductor causes the free electrons to establish the current.

Thus the electric property of conductor can be explained on the basis of band theory of Solids.

ii) Insulators :→

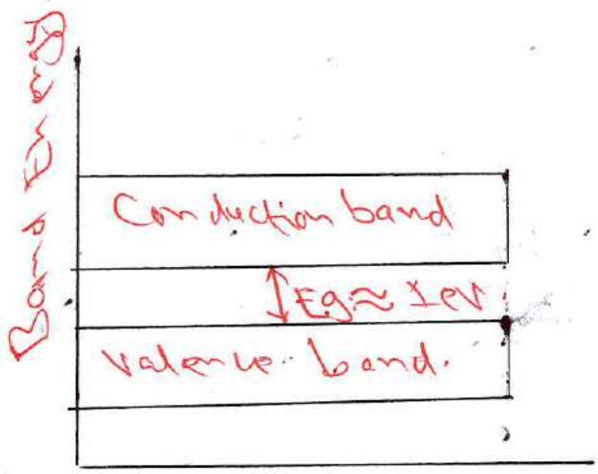
In insulators, the forbidden gap between the valence band & Conduction band is very large shown in fig.

When an electric field is applied across such solid, the electrons have difficult to acquire such sufficient amount of forbidden energy & so the electrons can not reach the Conduction band. Hence they remain in valence band and conduction band is almost empty. Therefore no electric current flows through such solids so they behaves as an insulators.



iii) Semiconductor :→

The energy band structure of Semiconductor is Similar to insulators, but in semiconductor, the size of forbidden energy gap is very much smaller (about 1 ev) than that of insulators as shown in figure.



When an electric field is applied across such semiconductor, then due to small width of forbidden gap, the electron in valence band can shift to conduction band. These electrons establish the current in semiconductor.

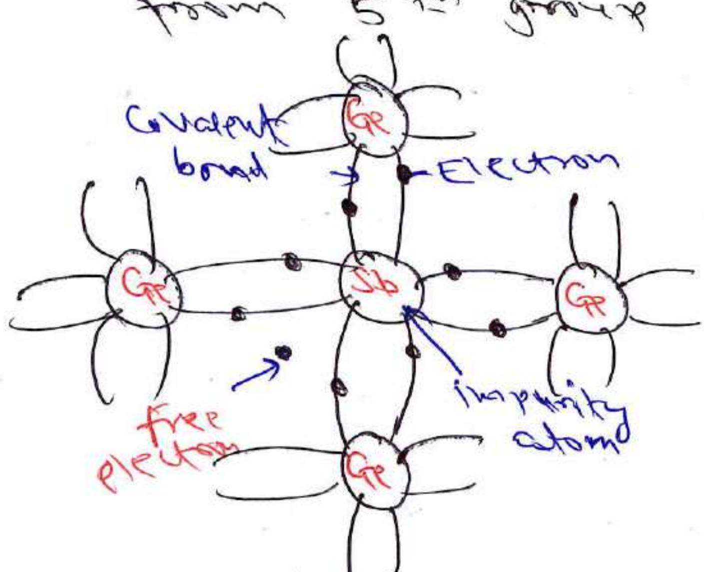
* The conductivity of semiconductor is between the conductivity of conductors and the insulators.

Semiconductors in doping process.
When an electric field is applied across the dopped crystal, an electron from neighbouring filled covalent bond jump into hole leaving a hole in its position. again this hole is jump & filled with its neighbouring bond & hole is produced at its position & so on. In this way electricity is conducted in semiconductor due to holes. The holes are positively charged. So such dopped semiconductor is called P type semiconductor.

In P-type semiconductor, majority carriers are hole. which carry electricity. The elements from IIIrd group like Al, Ga In, B etc accept electrons from pure semiconductor. So they are called acceptor impurities.

b) N-type Semiconductor :→

When a small amount of impurity from 5th group element is added to pure semiconductor is called N-type semiconductor.



As shown in fig. Antimony (Sb) atom is added to the atom of Germanium (Ge) crystal. It is a penta valent element, so it have five valence electrons four valence electron

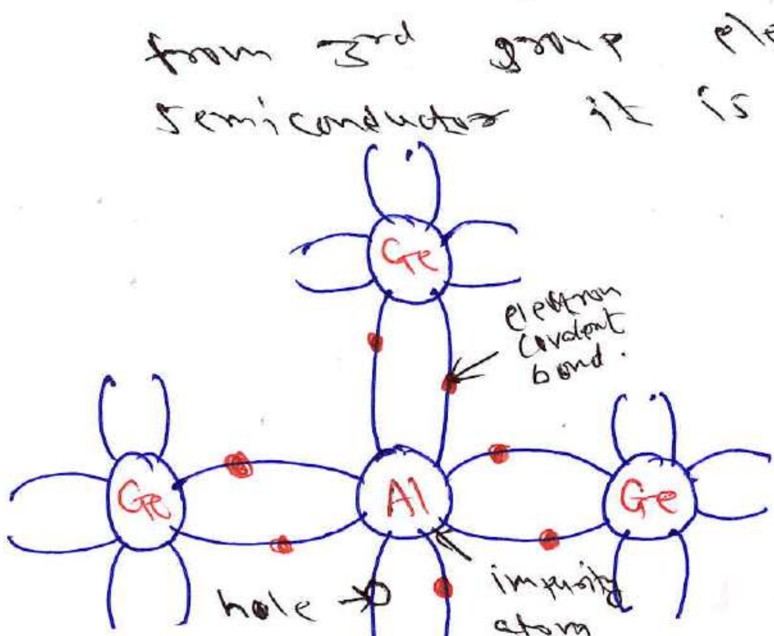
*Doping of Semiconductor :→

The process of addition of impurity to the pure semiconductor is called doping of semiconductor.

The added atoms to semiconductor are known as impurity. The impurity may be acceptor or donar.

a) P-type semiconductor :→

When a small amount of impurity from 3rd group element is added to pure semiconductor it is called 'p' type semiconductor.



As shown in fig. Aluminium (Al) atom is added to atoms of Ge crystal. It is trivalent elements. So it has three valence electrons. Which forms three covalent bond with surrounding Ge atom

There is one electron missing from one of the covalent bonds of Al atoms. The absence of electron leaves an empty space called as hole

Each of impurity atoms leaves a hole. thus small amount of impurity contains large number of atoms, which produce large number of holes in

Ge & Si atom has four valence electrons for stable structure, each atom shares one electron with each of its four neighbouring atom with each of its four neighbouring atoms in covalent bonds, so that all covalent bonds are filled with electrons.

At absolute zero temperature, covalent bonds so strong, that electrons are not available for conduction of electrons current through it. Hence at absolute zero temperature, semiconductor acts as insulator

* Effect of temperature on conductivity of semiconductor :→

When temperature of semiconductor increases the number of free electrons increases and hence current increases through the semiconductor, decreasing the resistance. So the conductivity of semiconductor increases as the temperature increases.

ii) Extrinsic Semiconductor :→

A semiconductor in impure form is called extrinsic semiconductor

Or

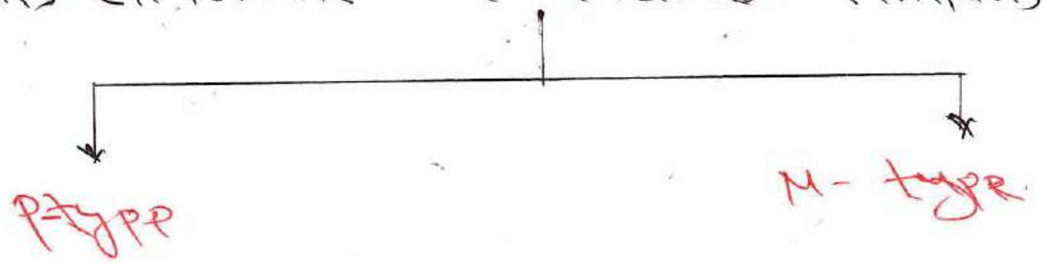
A semiconductor with impurity added is called extrinsic semiconductor.

* Classification of Semiconductors :-

There are two types of Semiconductor

i) Intrinsic Semiconductor (Pure) &

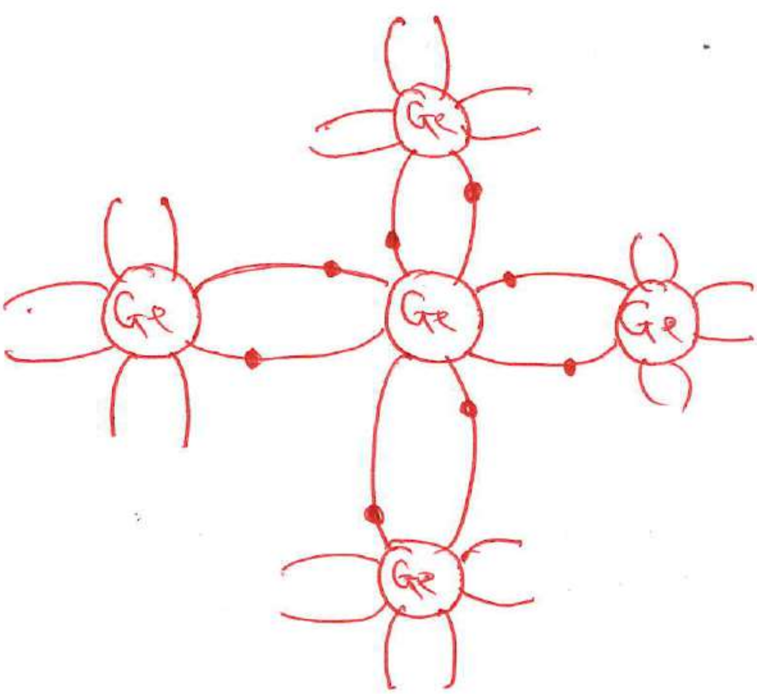
ii) Extrinsic Semiconductor (impure)



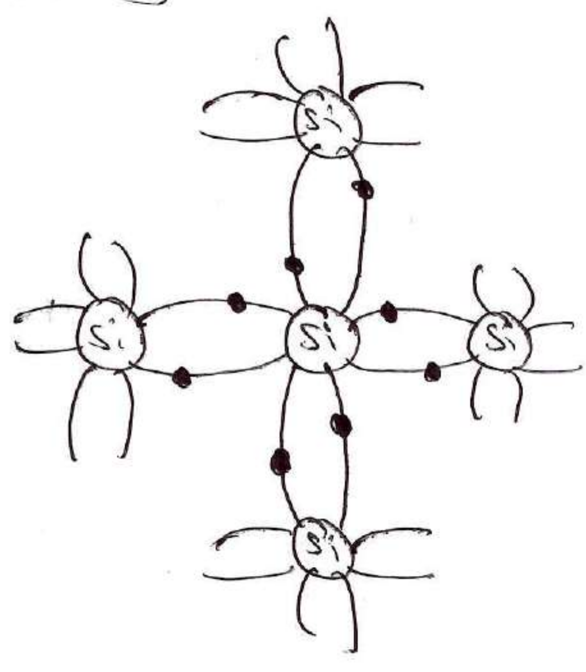
i) Intrinsic Semiconductor :-

A semiconductor in an extremely pure form is known as intrinsic semiconductor.

Germanium (Ge) & Silicon (Si) are two widely used semiconductors. They have same crystal structure and similar characts. They are fourth group element, so they have four valence electron. The crystal structure of 'Ge' & 'Si' is shown in fig.



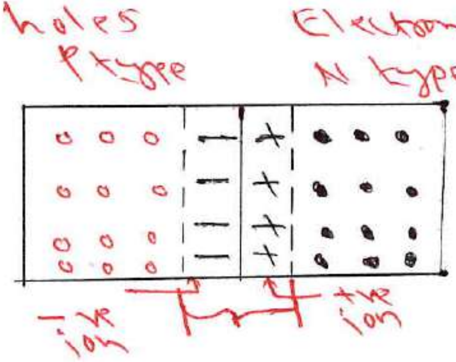
Ge crystal



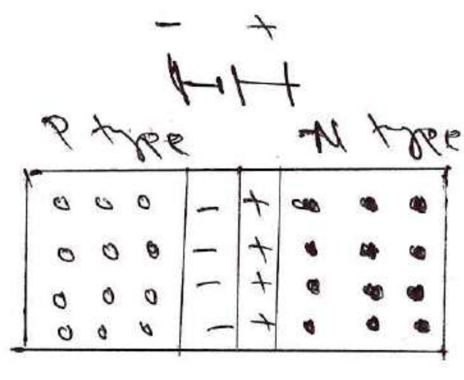
Si crystal.

holes in P-region, thus holes lost in P region. Thus near the junction, holes-elec pair lost, leaving empty space. Current is passed in this region it is called <u>depletion layer.</u>

Around the junction p-region accepts so it acquires -ve potential. At same time N-region accepts electron, so it acquires +ve potential. Thus potential difference is produced across the P-region & N-region the junction diode it is called potential barrier.



Depletion Zone



Potential barrier.

* <u>P-N Junction Diode - Forward biased:</u>→

When P-type region of P-N junction diode is connected to positive terminal of a battery and N type region to the negative terminal, the P-N junction diode is said to be in forward biased.

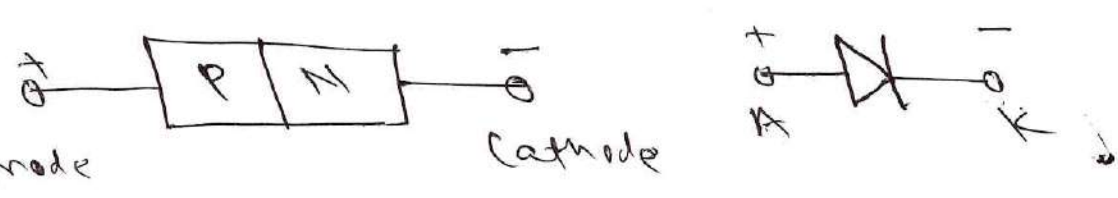
	P type Semiconductor	N type Semiconductor
(3)	Electrical Conduction is due to holes.	Electrical Conduction due to electrons.
(4)	Impurity atoms are trivalent.	Impurity atoms are pentavalent
(5)	Ex - Boron (B) Aluminium(Al) Gallium (Ga) Indium.	Ex :→ Arsenic (As) Antimony (Sb) phosphorous (P)

* P-N Junction :→

When P types, Semiconductor is joined to N-type Semiconductor, then boundary Joining two regions are called P-N junction.

P-N Junction Diode :→

When P type semiconductor is joined to N type Semiconductor, then the Structured formed is called P-N Junction diode.



* Barrier Potential & Depletion Layer :→

Due to difference in Concentration of holes in P-region & Concentration of electrons takes place from N-region. So the electrons cross the junction & fill from covalent bond with neighbouring germanium atoms and one valence electron remains free.

Each impurity atoms leaves one free electron. Thus small amount of impurity contains large amount of atoms which produces large amount of atoms which produces large number of free electrons in semiconductor in doping process.

When an electric field is applied across the crystal, free electrons in dopped semiconductor conduct electricity through it. The electrons are negatively charged. ~~So~~ So such dopped crystal is called n-type semiconductor.

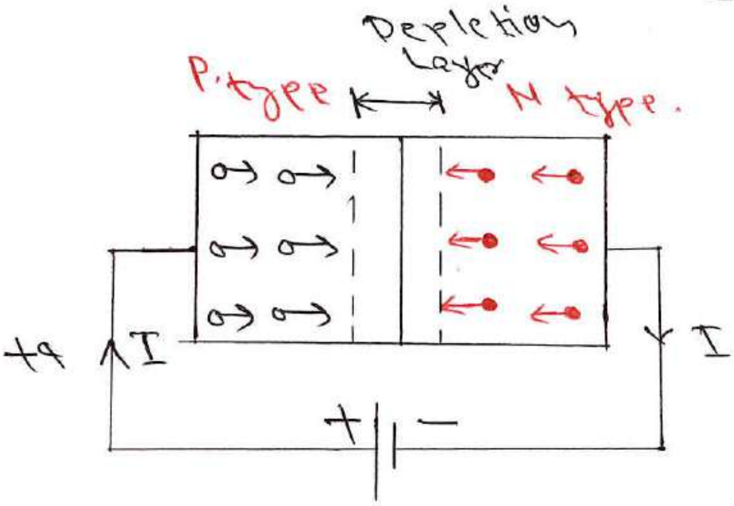
In n-type semiconductor majority carriers, which carry electricity. The elements from 5th group like Antimony (Sb), Arsenic (As) phosphorous (P) etc. Donate electrons to pure semiconductor. So they are called donar impurities.

* Distinguish betn intrinsic & Extrensic Semiconductor :-

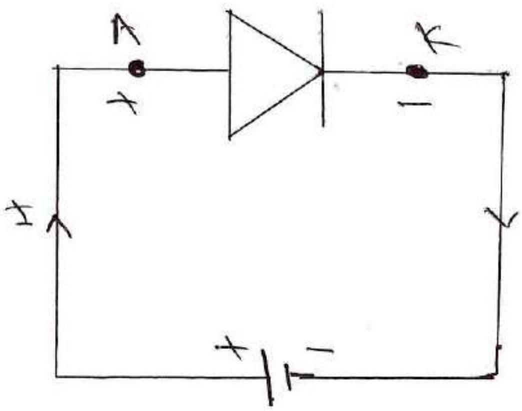
Intrinsic Semiconductor	Extrinsic Semiconductor
① Material is extremly in pure form.	Material is not in pure form. It contain impurity atoms.
② Material is not dopped with impurity atoms	Material is dopped with impurity atoms.
③ These semiconductors have no types.	These are of two types. ① P-type & ② N-type.
④ The conductivity of intrensic type semiconductor is poor.	The conductivity of extrensic semiconductor is high.
⑤ The current conduction takes place due to holes and electrons.	The current conduction take place due to holes & electrons depending on P or N-type.
⑥ Thier is no direct application	These are used in manufacturing of electronic components.

P type Semiconductor	N-type semiconductor
① When small amount of impurity from 3rd group element is added to pure semiconductor, called P-type semiconductor	When small amount of impurity from 5th group element is added to pure semiconductor called N-type semiconductor.
② Majority carriers are holes	Majority carriers are electrons.

The P-N junction diode is Connected in forward ~~and~~ biased shown in fig ⓐ with blocked diagram in fig ⓑ with symbol.



ⓐ Block diagram for P-N Junction diode in forward biased.



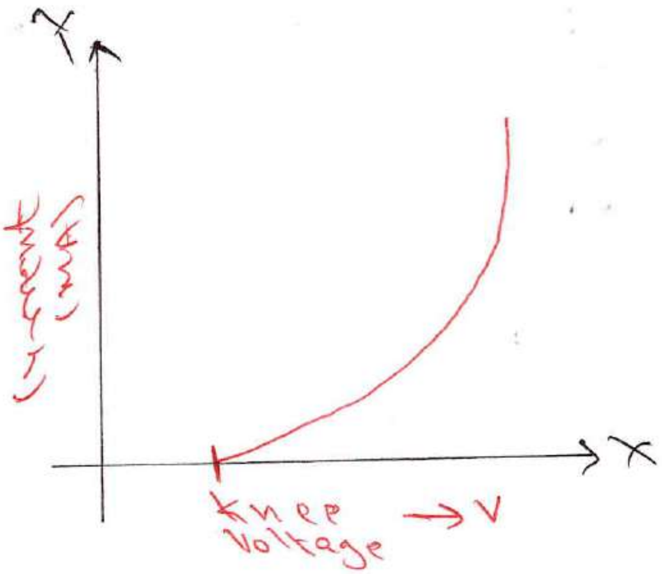
ⓑ Symbolic diagram for P-N junction in forward biased.

In forward baised, the positive terminal of battery repels the majority current Carriers (hole) in P type region & forces them towards the junction. Similarly negative terminals repels majority current Carriers in N-type region & forces them towards the junction. So holes in N-type & electrons in P-type neutralise in depletion layer. Hence depletion layer dissappears removing the barrier potential and P-N junction diode Supports a continuoes flow of current.

In this way P-N junction

diode worked is forward biased.

* Forward bias Characteristics of P-N Junction Diode:→



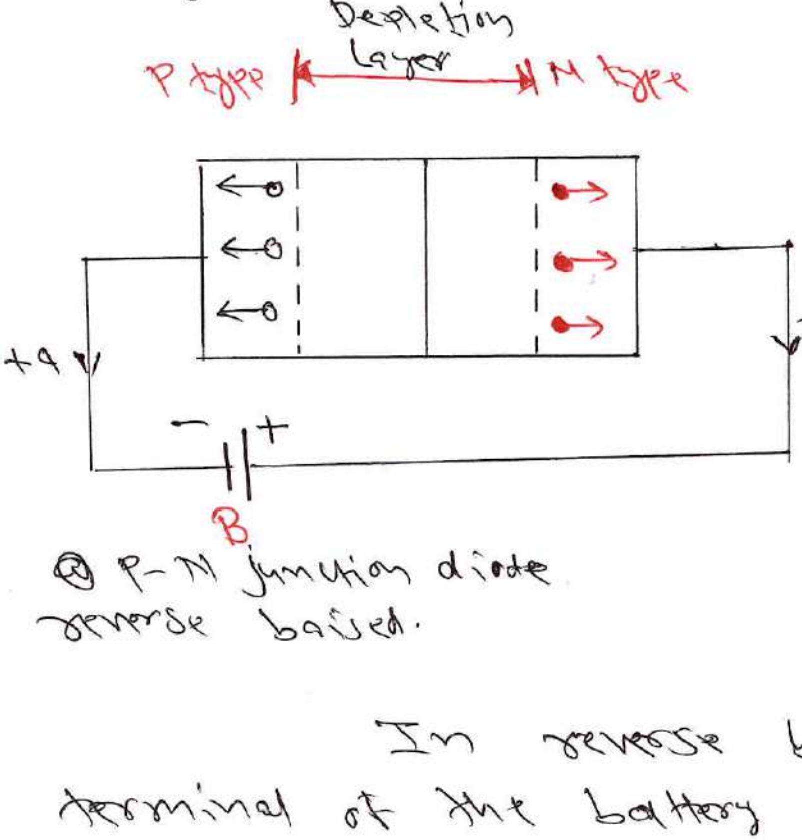
The graph shows I-V Characteristics of P-N Junction diode in forward biased. The graph represents the following information.

- Upto certain voltage, the current remains zero. The voltage is called Knee Voltage or Cut in Voltage.
- After knee voltage, barrier potential almost reduces to zero and current increases rapidly.
- As current is large, forward resistance of diode is small (reduces).
- Forward current is in 'mA' for most of the diodes. But it is in 'A' for power diode.

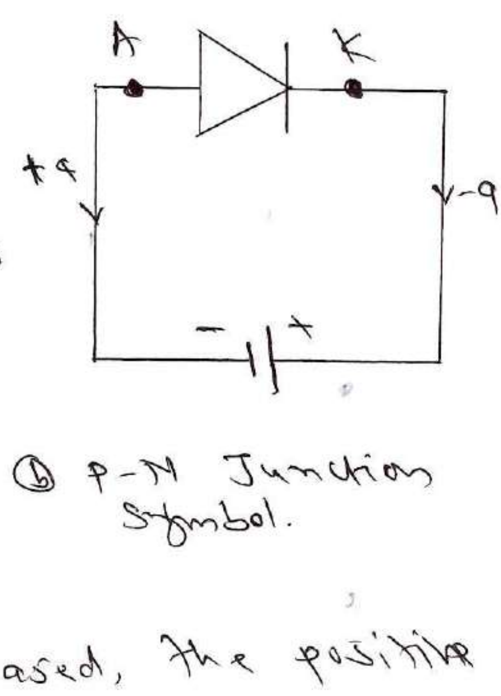
* P-N Junction diode in Reverse biased :→

When P region of junction diode is Connected to negative terminal of battery & N type region of junction diode is Connected to positive terminal of battery. the P-N junction diode is said to be in reverse biased.

the P-N Junction diode is connected in reverse biased, shown in fig ⓐ with block diagram & in fig ⓑ with Symbol.



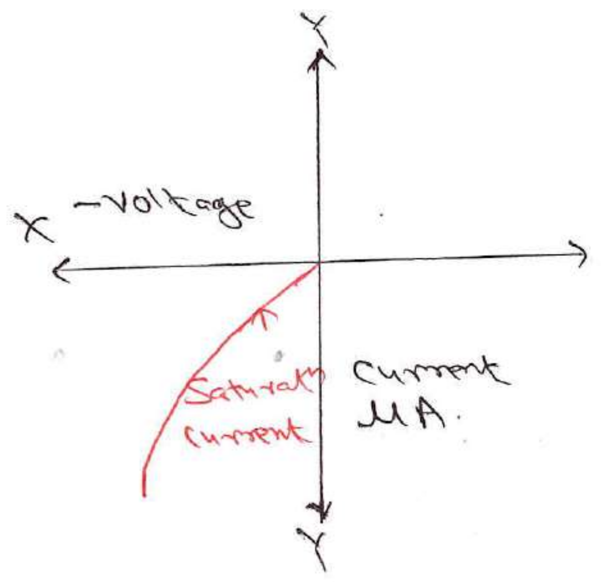
ⓐ P-N junction diode reverse baised.



ⓑ P-N Junction Symbol.

In reverse biased, the positive terminal of the battery attracts the majority Current Carriers in N type region & force them away from the junction. Similarly the negative terminal attracts the majority current Carriers in P-region & force them away from the junction. So the size of depletion layer increases and lastly no any type of charge carriers remains in diode. So current flow stops. In this way, p-n junction diode works in reverse biased.

* Reversed bias characteristics of P-N junction diode :->



- When P-N junction diode is in reverse bias, then the current-voltage characteristics is shown in figure. The graph gives following information.
- The flow of current is very small in few μA.
- Current is increases with voltage & afterward it becomes almost constant. It is called reverse saturation current.
- Reverse resistance of diode is very high.
- For very large reverse voltage, current suddenly increases. This is called as reverse breakdown or avalanche breakdown.

* Definitions :→

1) Depletion Region :→

The region near junction is depleted of free charges called the depletion region or depletion layer.

The width of depletion layer ranges from 0.5 μm to 1 μm.

2) Barrier Potential :→

It is the potential difference across the depletion region. It stops the flows of the diffusion current.

Barrier potential is 0.7 volt for Silicon & 0.3 volt for Germanium diode.

3) Reverse break down Voltage :→

The reverse biaus, reverse voltage at which the diode breakdown occurs is called reversed break down voltage.

4) Reverse Saturation Current :→

When the diode is reversed biaus, a very small current flows through it because of thermally produced minority carriers in depletion region. This is called reverse saturation current.

It does not changes with reverse bias.

5) Knee voltage :→

It is the value of forward voltage above which forward current increases rapidly.

It is 0.7 volt for Silicon & 0.3 volt for Germanium.

* Static and dynamic Resistance :→

i) Static or D.C. resistance :→

The resistance offered by P-N junction diode when, it is connected to D.C. Circuit is called static resistance or D.C. resistance.

Static resistance is also defined the ratio of D.C. voltage applied across the diode to the D.C. flowing the diode.

$$\boxed{R_S = \frac{\text{D.C. voltage applied across the diode.}}{\text{Direct current flowing through diode.}}}$$

$$\boxed{R_{dc} = R_S = \frac{V}{I}}$$

ii) Dynamic or A.C. resistance :→

The resistance offered by a P-N junction diode when it is connected to a A.C. circuit.

Dynamic resistance is also defined as the ratio of small change in voltage to corresponding small change in current in the diode.

$$\boxed{\text{Dynamic resistance} = \frac{\text{Change in voltage}}{\text{Change in current}}}$$

$$\boxed{R_{ac} = R_d = \frac{\Delta V}{\Delta I}}$$

The dynamic resistance of a diode is depends of the operating voltage.

Note :→ An ideal diode offers zero resistance in forward biased mode and infinite (∞) resistance in reverse biased mode.

* Applications of P-N junction Diode :→

i) As a switches in digital logic design.
ii) As a solar cell and LED.
iii) As a sensors in various applications.
iv) As radio demodulator.
v) As rectifier in D.C power supply.
vi) Clipping and clamping circuits.
vii) Voltage multipliers
viii) ~~Feedback~~ Feedback diode in power electronics
ix) Precision rectifiers using OP-Amp.

* Rectifiers :→

It is defined as an electronic device which is used for converting the a.c. into unidirectional (d.c) voltage or current

A.C. Signal = D.C. Signal.

* Rectification :→

It is the process of converting the alternating voltage or current into the corresponding direct quantity of voltage or current

The input to a rectifier is an a.c. voltage, whereas its output is unidirectional or D.C. voltage.

* Half wave Rectifiers :→

- P-N junction diode conducts only when it is in forward bias condition. Half wave rectifiers is based on this principle and converts A.C into D.C.

- Consider a single phase half wave rectifiers in this arrangement a single diode is connected in series with a load resistor. as shown in figure (1)

• A.C. input from secondary coil terminals of a step down transformer is applied to the diode.

• In A.C. during half cycle, current flows in one direction and in the next half cycle direction of flow of current is reversed. as shown in fig ② I/p & O/p form.

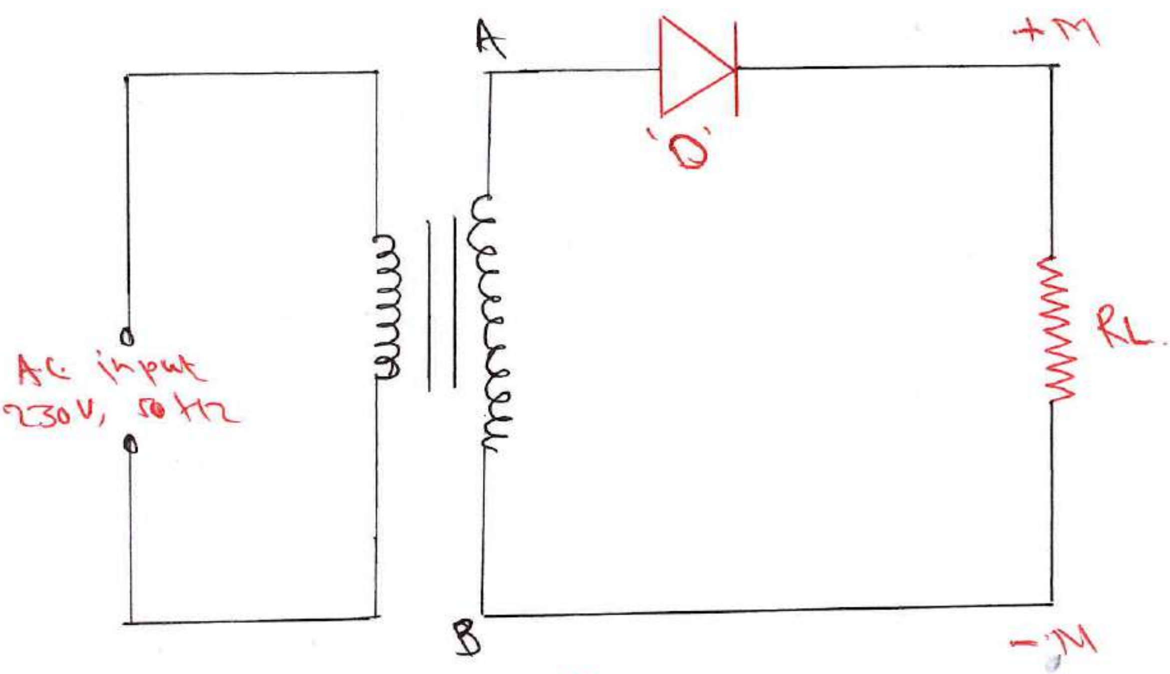


fig ①.

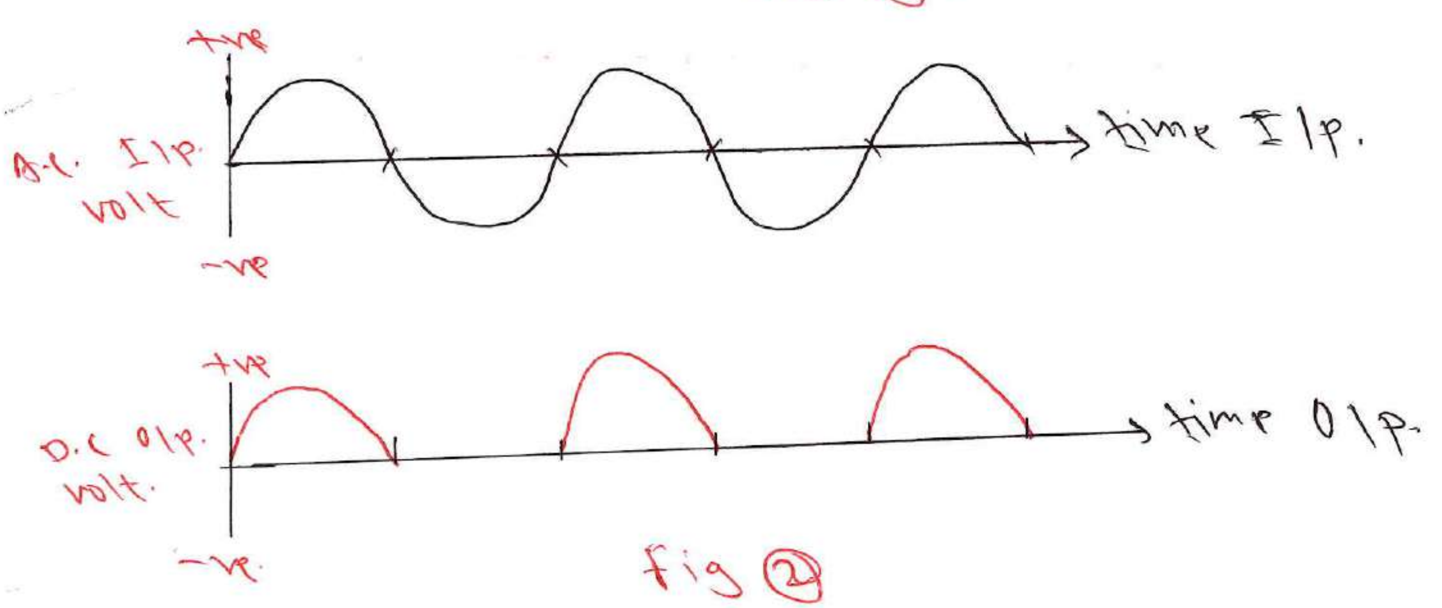


fig ②

• During positive half of the cycle, the upper end of the secondary coil of the transformer is positive with respect to its lower end and diode is in forward bias condition & gives output voltage across the load resistor.

• In the next half cycle which is termed negative cycle, the lower end of the secondary coil of transformer positive with respect to upper end which input is negative, the diode becomes reverse biased such there is no o/p. ~~form~~ from it. i.e. the diode does not conduct any current. There is some negative current however it is very small hence neglected.

• The D.C. is obtained during half the cycle as such this arrangment is called half wave ~~rectifier~~ ~~re~~ rectification.

Assigment No-02.

Electricity, Magnetism & Semiconductor.

1) Define ~~f~~ charge. State types of charge, with S.I unit of charge.

2) State Coulomb's Inverse square law. with its mathematical equations

3) State the properties of electric lines of forces.

4) Define (a) magnetic field (b) magnetism.
(c) Magnetic lines of forces.
(d) magnetic field intensity
(e) magnetic flux with its units.

5) State properties of magnets.

6) State the relations between magnetic flux Density and magnetic field intensity.

7) State the law of resistances parallel combinations. in details.

8) State the law of resistances in series combinations in details.

9) (a) State the joule's law. with its mathematical equation.
(b) State the applications of joule's law.

(10) Define Conductor, insulator & semiconductor on theory of energy bands.

(11) Define intrinsic & Extrinsic Semiconductor

(12) Distinguish between p type & N type semiconductor.

(13) Explain half wave rectifier in details.

(14) (a) Two likes charges each of $10\mu C$ are placed 10 cm apart in a medium of dielectric Const 2.5. Find the force between them ($\epsilon_0 = 8.85 \times 10^{-12}\ C^2/Nm^2$)

(b) Two charges at $9\mu C$ & $10\mu C$ when placed in dielectrix medium at a distance of 3m. will exert the force of 9×10^{-3} N. Calculate the dielectric Const of the medium.

(15) (a) A battery of emf 12 volt is connected across a resistances of 10Ω. Calculate the current flowing through the resistance.

(b) An electric heater draws a current 4A. when connected across 220 volt supply. What current it draws when connected across 180 volt supply.

(c) Calculate the length of wire of radius 0.2mm & resistivity $5 \times 10^{-7}\ \Omega m$ should be taken to form a coil of resistance $20\ \Omega$.

29/5/2026 29/5/26 29.5.26