SCIENCE ACADEMY P U COLLEGE

(A UNIQUE CENTRE FOR PU CLASSES)

3 MARK IMPORTANT QUESTIONS WITH ANSWERS

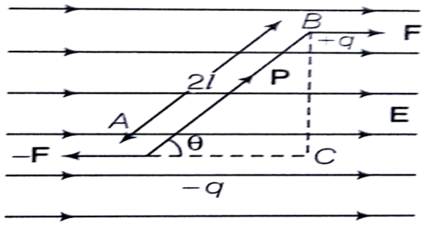
1. Write three Properties of electric charges

1) Charges possessed additive property.
2) Charges are quantized.
3) Charges are conserved

2. Write any three Properties of electric lines of force or field lines.

1. Lines of force are always starts from +ve charge and ends at –ve charge.
2. Lines of force never intersects each other.
3. Lines of force will not form a closed path.
4. Lines of force do not pass through a conductor.

3. Derive an expression for torque acting on a dipole placed in a uniform Electric – field.



Force acting on the + ve charge $F_1 = E\,q$

Force acting on the -ve charge $F_2 = E\,q$

But,

$$|F_1| = |F_2|$$

The moment of the couple or torque acting on the dipole is given by

τ = F x ⊥r distance between forces.

$\tau = Eq \times BC$.

$\tau = E \times q \times 2\,l \sin\theta$

$$\boxed{\tau = E \times p \sin\theta}$$

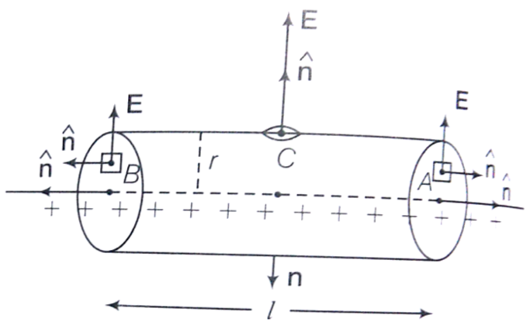
$\because$ In the ABN, $\sin\theta = \frac{BC}{AB}$

$BC = AB\sin\theta$

$BC = 2a\sin\theta$

($\because q \times 2l = p$)

4. Expression for electric fields at a point due to infinitely long straight charged wire.



This flux is given by

$$\Phi = \oint E\cos\theta \times ds$$

$\theta = 0,\ \cos 0 = 1$

$$\Phi = E \times \oint ds$$

but $\oint ds = 2\pi r \times \ell$

$$\Phi = E \times 2\pi r \times \ell \qquad \text{-------- (1)}$$

By Gauss theorem

$\Phi = \frac{1}{\varepsilon_0}(Q)$ But, $Q = \lambda\,\ell$

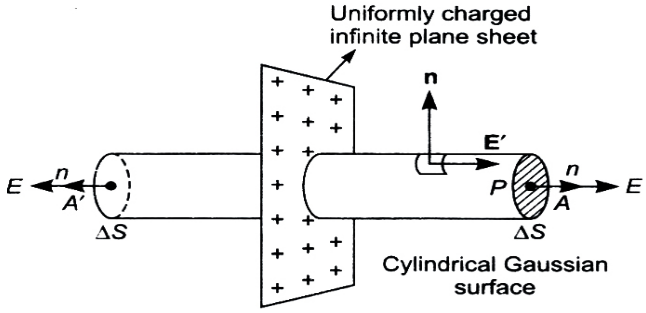
$$\Phi = \frac{1}{\varepsilon_0} \times \lambda\,\ell \qquad \text{---------------- (2)}$$

From the equations (1) and (2)we get

$$E \times 2\pi r\,\ell = \frac{1}{\varepsilon_0} \times \lambda\,\ell$$

$$\mathbf{E} = \frac{\lambda}{2\pi\varepsilon_0 r}.$$

5. Obtain an Expression for electric field due to an uniformly charged plane sheet.



Electric -flux through the cylinder is $\Phi = \oint E \cdot \Delta s + \oint E \cdot \Delta s$

$\Phi = (E \times \Delta s) + (E \times \Delta s)$ $\theta = 0$, $\cos\theta = 1$

$\Phi = 2E\Delta s$ .... (1)

By gauss theorem,

$\Phi = \frac{1}{\varepsilon_0} \times q$ $\sigma = \frac{q}{\Delta s}$

$\Phi = \frac{1}{\varepsilon_0} \times \sigma \times \Delta s$ .... (2) $(q = \sigma \times \Delta s)$

From equations (1) and (2)

$2E \times \Delta s = \frac{\sigma \times \Delta s}{\varepsilon_0}$

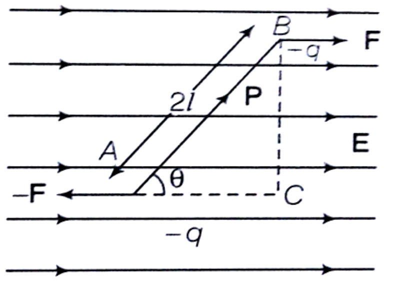
$$\mathbf{E} = \frac{\sigma}{2\varepsilon_0}$$

E is independent of the distance of the point from the sheet.

6. Write any three Properties of equipotential surfaces.

1. No work is done in moving a test charge over an equipotential surface.
2. The electric field is always at right angles to the equipotential surface.
3. The equipotential surfaces gives the direction of the electric – field.
4. No two equipotential surfaces can intersect each other.

7. Derive an Expression for electric potential energy of an electric dipole placed in a uniform electric field.



The torque acting on the dipole is given by

$\tau = PE\sin\theta$

The wonedone is given by

$dw = \tau \times d\theta = PE\sin\theta \times d\theta$

On Integrating, $\int dw = \int_{\theta_1}^{\theta_2} PE\sin\theta \, . d\theta = PE \; -[\cos\theta]_{\theta_1}^{\theta_2}$

$W = PE\,[-\cos\theta_2 + \cos\theta_1] = PE\,[\cos\theta_1 - \cos\theta_2]$

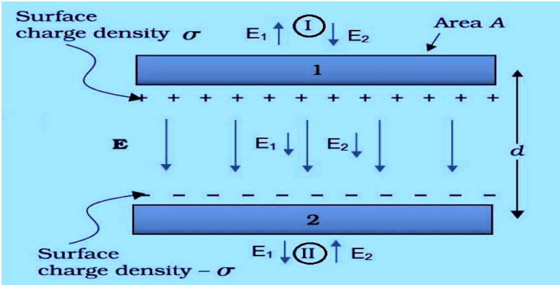
By definition, $\therefore W = U$

$U = PE\,[\cos\theta_1 - \cos\theta_2]$

When $\theta_1 = 90$ and $\theta_2 = \theta$ then

$$U = -PE\cos\theta$$

8. Derive an Expression for capacitance of parallel plate capacitor.



The electric intensity between the plates is given by

$E = \frac{\sigma}{\varepsilon_0}$ Where σ is surface charge density $\sigma = \frac{Q}{A}$

$E = \frac{Q}{A\varepsilon_0}$ ------ (1)

The relation between electric intensity and potential between the plates is given by

$E = \frac{v}{d}$---- (2) where 'v' is the P.D between plates

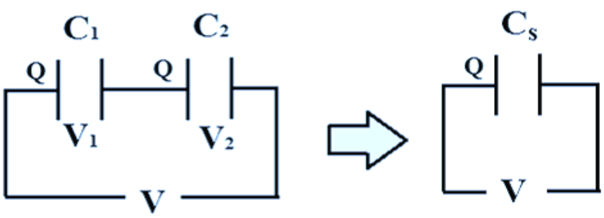
From eqn. (1)and (2) we get

$\frac{Q}{A\varepsilon_0} = \frac{V}{d}$.

$\frac{Q}{V} = \frac{\varepsilon_0 A}{d}$ By definition, $\frac{Q}{V} = C$ capacitance

∴ $C = \frac{\varepsilon_0 A}{d}$

9. Derive an Expression for equivalent capacitance of two capacitors in series.



From the figure, $V = V_1 + V_2$, ---- (1)

Charge on each capacitor is $Q = C_1V_1$ and $Q = C_2V_2$

∴ $V_1 = \frac{Q}{C_1}$ + $V_2 = \frac{Q}{C_2}$

Eqn., (1) becomes

$V = \frac{Q}{C_1} + \frac{Q}{C_2}$

$V = Q\left(\frac{1}{C_1} + \frac{1}{C_2}\right)$ ... ... (2)

If C_s is the equivalent capacitance of the combination

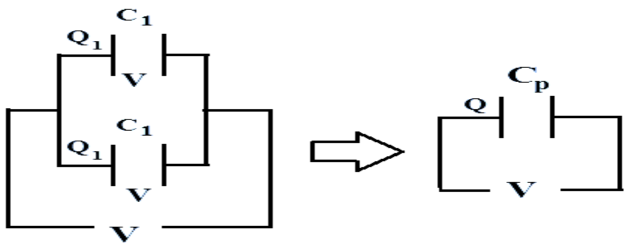
Then $V = \frac{Q}{C_s}$ ----- (3)

From eqn., (2) and(3)we get

$\frac{Q}{C_s} = Q\left(\frac{1}{C_1} + \frac{1}{C_2}\right)$

∴ $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$

10. Derive an Expression for equivalent capacitance of two capacitors connected in parallel



From the figure, $Q = Q_1 + Q_2$ ……… (1)

The charge on the first capacitor is given by $Q_1 = C_1V$, $Q_2 = C_2 V$

Equation (1) becomes

$Q = C_1 V + C_2 V$

$Q = V [C_1 + C_2]$ -----------(2)

If Cp is the effective capacitance of the combination then for the combination, we have

$Q = C_p V$ ---- (3)

From equation (2) and (3) we get,

$C_p V = V [C_1 + C_2]$

$$\boxed{C_p = C_1 + C_2}$$

11. Derive an Expression for energy stored in a capacitor ($U = ½ CV^2$)

Work done in transferring small amount of charge 'dq' is given by

$dw = V \times dq$

$dw = (q / C) \times dq$ $\quad (q = CV)$

Total work done in charging the capacitor to its full capacity of holding charge Q is given by ,

$$\int dw = \int_0^Q \frac{q}{C}\, dq$$

$$W = \frac{1}{C} \int_0^Q q\,.dq \qquad [\int q.dq = [q^{1+1}/(1+1)] = [q^2 / 2]$$

$$W = \frac{1}{C} \left[\frac{q^2}{2}\right]$$

By definition , W = U (energy)

$U = Q^2/2C = ½ C V^2$ $\quad [Q = CV]$

$$\boxed{U = ½ C V^2}$$

12. Derive the vector form of ohm's law [$\vec{J} = \sigma \vec{E}$]

Consider , $V = IR$ …………(i)

The electric field E produced in the conductor is given by

$$E = \frac{V}{L}$$

$$\therefore V = EL \quad \text{…………(ii)}$$

From (i) and (ii) we get

$$EL = IR$$

$$EL = I \times \rho \frac{L}{A} \qquad (R = \rho \frac{L}{A})$$

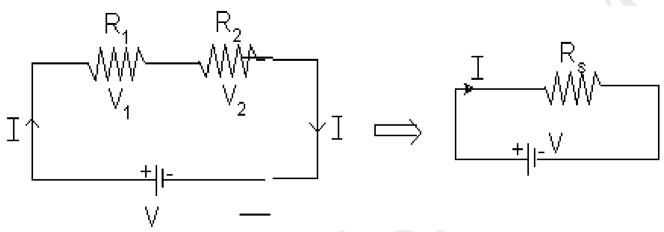
$$EL = \rho J L \qquad (\frac{I}{A} = J)$$

$$E = \rho J$$

$$J = \frac{E}{\rho} \qquad (\frac{1}{\rho} = \sigma)$$

$\vec{J} = \sigma \vec{E}$ → **This is the vector form of ohm's law.**

13. Obtain an Expression for Equivalent or effective resistance of two resistors connected in series (Rs = R₁ + R₂)



From the figure, $V = V_1 + V_2$ -------------- (1)

Apply ohm's law resistor we get

$V_1 = IR_1$ and $V_2 = IR_2$

$V = I [R_1 + R_2]$ ------------- -(2)

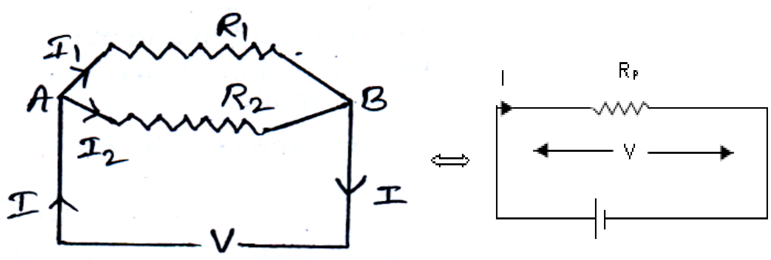
If R_s is the effective resistance of the combination then $V = I R_s$----(3)

∴ From eqns., (2) and (3) we get

$I R_s = I [R_1 + R_2]$

$$\boxed{R_s = R_1 + R_2}$$

14. Obtain an Expression for Effective resistance of two resistors connected in parallel.



From the figure, $I = I_1 + I_2$ ----- (1)

Applying ohm's law, $V = I_1R_1$ and $V = I_1R$

∴ from eqns., (2) and (3) we get

$$\frac{V}{R_p} = V\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$$

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

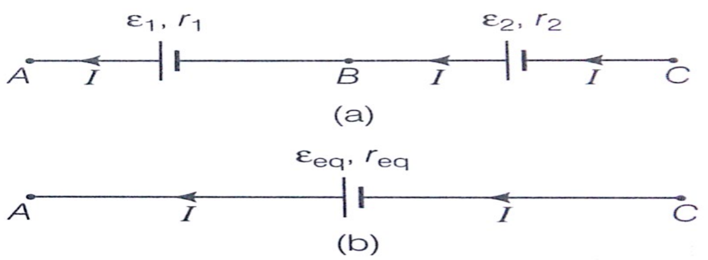
$$R_P = \frac{R_1 R_2}{R_1+R_2}$$

If the resistors are more than two in the combination

Then

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

15. Obtain an expression for equivalent emf and internal resistance of two Cells in series:



The terminal potential of cell E_1 is $V_1 = E_1 - I r_1$

The terminal potential of cell E_2 is $V_2 = E_2 - I r_2$

The terminal potential of the combination

$$V_{eff} = V_1 + V_2 = E_1 - I r_1 + E_2 - I r_2$$

$$= E_1 + E_2 - I\,(r_1 + r_2)$$

$$V_{eff} = E_1 + E_2 - I\,[r_1 + r_2] \quad \text{----- (1)}$$

For the combination we have

$$V_{eff} = E_{eff} - I\,r_{eff} \quad \text{------- (2)}$$

Comparing equations (1) and (2), we get.

$$E_{eff} = E_1 + E_2 \text{ and } r_{eff} = r_1 + r_2$$

16. Derive an Expression for Force on a current carrying conductor in a uniform Magnetic field.

The force acting on each electron in the conductor is given by

$$F^1 = e\,V_d\,B\sin\theta$$

Number of electrons contained in the conductor = N = n A l

Total force acting on all the electrons in the conductor is $F = F^1 N$

$$F = l \times n\,A\,e\,V_d \times B\sin\theta$$

$$F = l \times I \times B\sin\theta$$

$$F = B\,I\,l\sin\theta$$ (Current I is given by $I = nAeV_d$)

$$F_{max} = B\,I\,l$$

Force is zero when θ = 0 or 180, sin 0 = 0, F = 0

Force is maximum when $\theta = 90^0$, sin 90 = 1

17. Give the theory of suspended coil Galvanometer.

Torque due to current is given by

$\tau_i = n\,A\,I\,B \sin\theta$ --------- (1) , $\theta = 90^0$, $\sin 90^0 = 1$

$\tau_i \ \alpha \ \theta$

$\tau_i = C\,\theta$ ------- (2)

From (1) and (2), $n\,A\,I\,B = C\,\theta$, where C = spring constant

$\therefore \ I = \left(\frac{C}{n\,A\,B}\right).\ \Theta$

$\mathbf{I = K\,\theta}$ where $K = \left(\frac{C}{n\,A\,B}\right)$ called galvanometer constant

$\boxed{\mathbf{I \ \alpha \ \theta}}$

18. Explain the Conversion of Galvanometer into Ammeter

A galvanometer can be converted into ammeter by connecting suitable low resistance in parallel with the galvanometer.

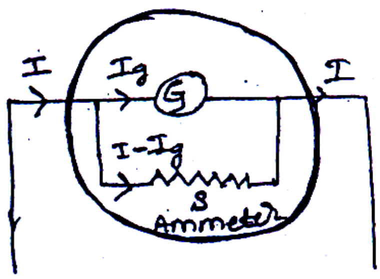
Applying Ohm's law to each resistance, we get

$V = I_g\,G$

$V = (I - I_g)\,S$

$(I - I_g)\,S = I_g G$

$\boxed{\mathbf{S = \frac{I_g\,.\,G}{I - I_g}}}$



19. Explain the Conversion of galvanometer into voltmeter

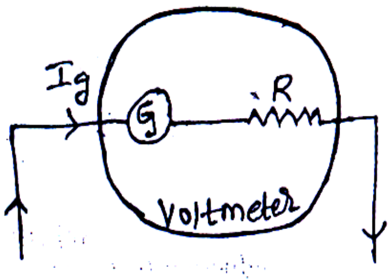
A galvanometer can be converted into voltmeter by connecting suitable high resistance in series with the galvanometer.

Applying Ohm's law, we get

$V = I_g\,(G + R)$

$V\,/\,I_g = (G + R)$

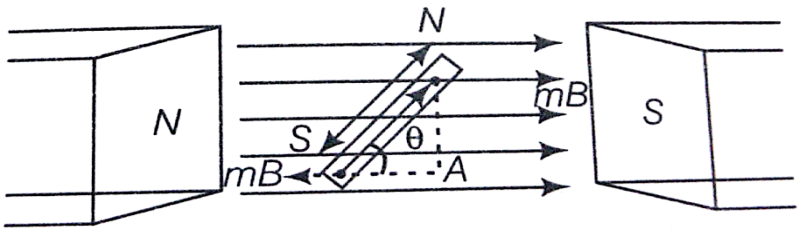
$\boxed{\mathbf{R = \frac{V}{Ig} - G}}$



20. Distinguish between Ammeter and Voltmeter

AMMETER	VOLTMETER
1.Ammeter is used to measure current 2. It is always connected in series. 3. Its effective resistance is very low. 4. Resistance of ideal ammeter is zero.	1. Voltmeter is used to measure p.d. b/w two points. 2. It is always connected in parallel. 3. Its effective resistance is very high. 4. Resistance of ideal voltmeter is infinity..

21. Magnetic dipole in a uniform Magnetic field. [Torque acting on dipole]



Force acting on North - pole = F_N = mB in direction of $\vec{B}$

Force acting on South- pole = F_S = mB in the opp. direction of $\vec{B}$

$|F_N| = |F_S| = F$

Torque acting on the dipole (magnet) is given by

τ = F x ⊥r distance between the forces

τ = mB x NA

τ = mB x 2ℓ sin θ

τ = (m x 2l) B sin θ

$$\tau = MB \sin\theta$$

22. Write any three Properties of Diamagnetic, Paramagnetic & Ferromagnetic materials.

Diamagnetic Materials	**Paramagnetic Materials**	**Ferromagnetic materials**
They are feebly repelled by a magnet. Ex: Antimony, Bismuth	1. They are feebly attracted by a magnet. Eg. Aluminium,Chromium	1. They are strongly attracted by a magnet. Eg. Iron, Cobalt,
2. Magnetic susceptibility has a small – ve value	2. Magnetic susceptibility has a small + ve value.	2. Magnetic susceptibility has a large + ve value.
3. Magnetic permeability is always less than unity.	3. Magnetic permeability is more than unity.	3. Magnetic permeability is large i.e. much more than unity.
4. Intensity of Magnetisation (M) has a small – ve value.	4. Intensity of Magnetisation (M) has a small + ve value.	4. Intensity of Magnetisation (M) has a large + ve value.
5. Induced Dipole Moment (M) is a small – ve value.	5. Induced Dipole Moment (M) is a small + ve value.	5. Induced Dipole Moment (M) is a large + ve value.

23. Expression for motional e.m.f induced in a conductor (rod) moving in a magnetic field:

The magnetic flux linking the conductor in time dt is given by

$$d\Phi = B \times l \times dx$$

Rate of change of magnetic flux is given by

$$\frac{d\Phi}{dt} = B\ l \,.\, \frac{dx}{dt}$$

$$\frac{d\Phi}{dt} = B\, l\, v \qquad \because \frac{dx}{dt} = v \text{ (velocity)}$$

By Faraday's second law, $\frac{d\Phi}{dt} = -e$

$$\mathbf{e = - B\, l\, v}$$

24. Obtain an expression for Energy stored in an Inductor.

Then dw = - e I dt

$$dw = + L \times \frac{dI}{dt} \times I \times dt \qquad (\text{since } e = - L\frac{dI}{dt})$$

$$dw = + L \times I\, dI$$

Total work done in establishing the current I is given by

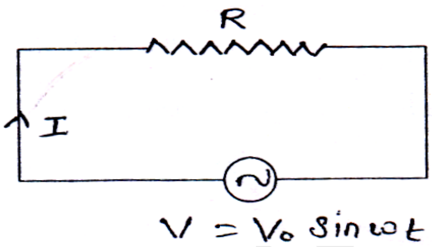
$$\int dw = \int_o^I I\, dI = L\int_o^I I dI = \frac{1}{2} L I^2$$

$$W = \frac{1}{2} L I^2$$

By definition, W = U

$$U = \frac{1}{2} LI^2$$

25. Obtain an expression for current in the AC circuit containing pure resistance only :



Let $V = V_0 \sin \omega t$ ----------(1) is the applied AC voltage

From Ohm's law : $I = V / R = \frac{V_0}{R} (\sin \omega t)$ ---------(2)

Current is maximum when sin wt = ± 1,

$\therefore I_0 = V_0 / R$

(2) becomes , $\mathbf{I = I_0 \sin \omega t}$ ------------(3)

26. Explain the Classification of Solids on the basis of energy bands into conductors, semiconductors and insulators:

Sl. No	Conductors	Semiconductors	Insulators
1	conduction band and valence band overlap. ($E_g = 0$)	Conduction band and valence band are separated by small energy gap (0.7 to 1.1 eV)	Conduction band and valence band are separated by a large energy gap (6 to 10 eV)
2	Resistivity of is very low (10^{-2} to 10^{-8} Ωm)	The resistivity of is of the order 10^{-5} Ωm to 10^{6} Ωm.	Resistivity is very high (about 10^{11} to 10^{19} Ωm).
3	Conductivity is very high between 10^{2} to 10^{8} S/m	Conductivity is between 10^{5} to 10^{-6} S/m	Conductivity is negligible between 10^{-11} to 10^{-19} S/m
4	Temperature co-efficient of resistance is positive	Temperature co-efficient of resistance is negative and large.	Temperature coefficient of resistance is slightly negative.
5	Type of bonding present is metallic bonding	Type of bonding present is Covalent	Type of bonding present is ionic.

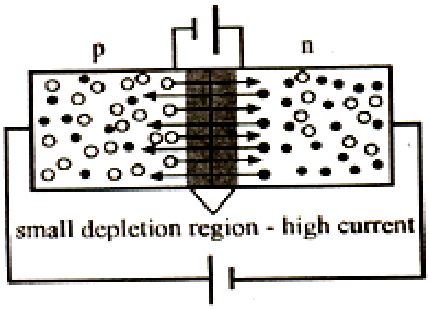
27. Write any three Differences between Intrinsic and extrinsic semiconductors:

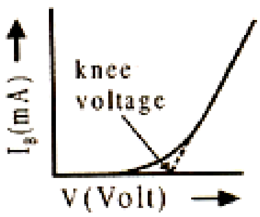
Intrinsic semiconductors	**Extrinsic semiconductors**
1. It is a pure semiconductor 2. Number of holes and electrons are equal 3. Conductivity depends only on temperature 4. Conductivity is due to both electrons and holes Ex: Ge in its purest state	1. It is a semiconductor doped with impurities. 2. Number of holes and electrons are unequal 3. Conductivity depends on temperature and impurities added. 4. Conductivity is mainly due to majority charge carriers. Ex: Ge doped with As

28. Write any three Differences between n-type and p-type semiconductors.

n-type	**p-type**
1) They are extrinsic semiconductor in which majority charge carriers are electrons. 2) Minority charge carriers are holes. 3) Produced by adding pentavalent impurities pure semiconductors. 4) Donor impurity level is closer to the conduction band Ex: Ge doped with Arsenic	1) They are extrinsic semiconductor in which majority charge carriers are holes. 2) Minority charge carriers are electrons. 3) They are produced by adding trivalent impurities to pure semiconductors. 4) Acceptor impurity level is closer to the valence band Ex: Ge doped with Indium

29. Explain the Action of diode during forward biasing.

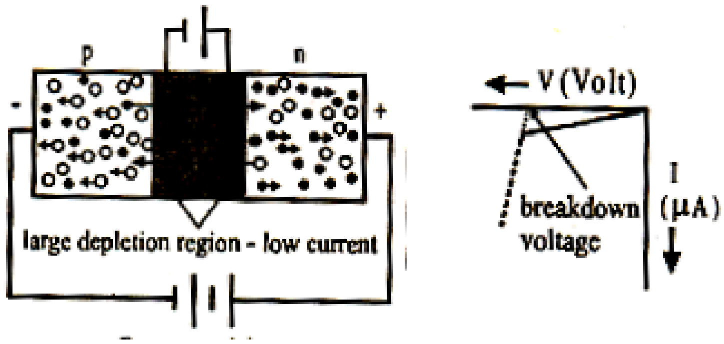




The P-N junction is said to be forward biased when the P-side of the junction is connected to the positive terminal and the N-side is connected to the negative terminal of the external source of emf.

In the forward bias position the holes in the P-region are repelled by the positive potential of the battery and move towards the junction. Similarly the electrons in the N-region are repelled by the negative potential of the battery and are driven towards the junction. As a result majority charge carriers diffuse across the junction. During Forward bias diode offers low resistance.

30. Explain the Action of diode during forward biasing.



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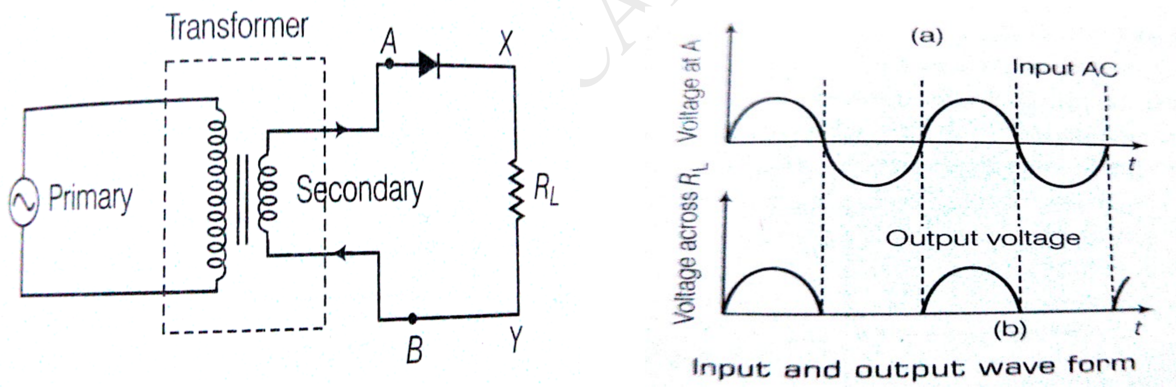
The P-N junction is said to be reverse biased when the P-side of the junction is connected to the negative terminal and the N-side is connected to the positive terminal of the external source of emf.

In the reverse bias position the holes in the P-region are attracted towards the negative potential of the battery and electrons in the N-region are attracted towards the +ve potential of the battery. As a result of this the depletion region widens and offers a very high resistance. Hence the majority charge carriers can not cross the junction. However a small current due to minority charges flows in the P and N-regions. During reverse bias diode offers high resistance.

31. Explain the working of a diode as a Half-wave Rectifier:



A half wave rectifier is one in which rectification is done for only one half cycle of input AC.

Working :

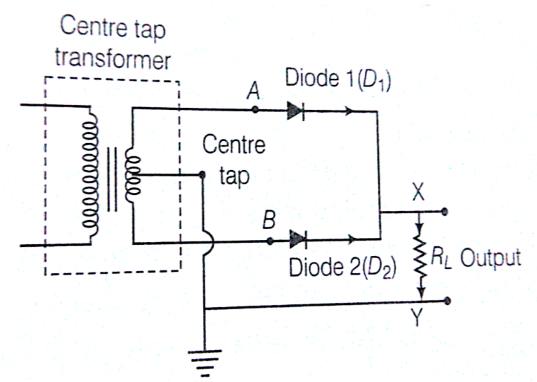
During the positive half cycle of input AC, A is +ve and B is –ve hence ***diode is forward biased, it conducts current*** therefore a current flows through the load resistance, there will be voltage across the load resistance.

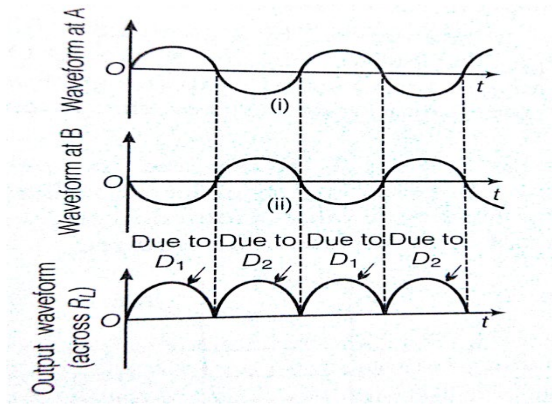
During negative half cycle, A is –ve and B is +ve hence ***diode becomes reverse biased, it will not conduct current***, no current flows through the load resistance and there is no voltage across the load resistance.

Thus half cycle of input AC is blocked by the diode.

Output is DC but not steady.

32. Explain the action of a diode as a Full-wave Rectifier:





A full wave rectifier is one in which rectification is done for the complete (both) cycle of input Ac.

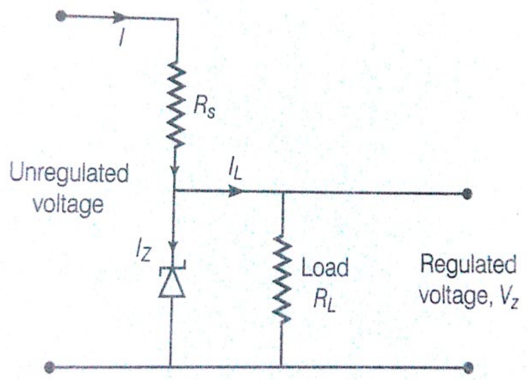
Working:

During positive half cycle of input AC , A is +ve and B is –ve hence diode ***D_1 is forward biased*** and ***D_2 is reverse biased***, ***D_1 only conducts current***. Current flows through the load resistance in the direction D_1 R_L T there will be output voltage across the load résistance.

During negative half cycle of input AC, A is –ve and B is +ve hence diode ***D_2 is forward biased*** and ***D_1 is reverse biased***. Diode ***D_2 only conducts current***. A current flows through the load resistance in the direction D_2 R_L T. There will be voltage across the load resistance.

In both the cases current flows in the same direction through the load resistance. Therefore *output is DC and steady*.

33. Explain the action of Zener diode as a voltage Regulator:



Working:

Case (i) : If the input DC voltage increases, the current through R_S and zener diode also increases. This increases the voltage drop across R_S without change in the voltage across zener diode. This is because in the breakdown region, zener voltage remains constant even though the current through the diode changes.

Case (ii) : Similarly **if the input DC voltage decreases**, the current through R_S and zener diode also decreases. This decreases the voltage drop across R_S without change in the voltage across zener diode. This is because in the breakdown region, zener voltage remains constant even though the current through the diode changes.

Thus in both the cases voltage across the zener diode remains constant and also the output voltage across R_L remains constant at V_Z.

Hence Zener diode acts as a voltage regulator.

34. Write any three experimental observations of photoelectric effect.

1) Photoelectric effect is an instantaneous effect. The time lag between the incidence of radiations and emission of photoelectron is very small, less than even 10^{-9} second.
2) For a photometal there is a minimum frequency of incident radiation below which there is no photoelectric effect, this minimum frequency is called '***threshold frequency*** (υ_0)'.
3) Above threshold frequency, kinetic energy of photoelectrons is directly proportional to the frequency of incident radiation. (**K.E α υ**)
4) Above threshold frequency, number of photoelectrons (and hence photoelectric current) is directly proportional to the intensity of incident radiation.

35. Write any three Properties of photon.

1. Photons travel at the speed of light in vacuum. i.e. 3 x 10^8 m/s.
2. Photons travel in straight lines. (Only in a homogeneous).
3. A photon has zero rest mass. i.e. $m_0 = 0$.
4. Photons do not have any charge. They are electrically neutral.
5. Photons are not deviated by magnetic as well as electric fields.

36. Explain the postulates of Bohr's Atom Model.

(i) Stationary Circular Orbits: A*n electron in an atom could revolve in certain stable orbits without the emission of radiant energy called Stationary orbits.*

ii) Quantum Condition : E*lectron* revolves around the nucleus *only in those orbits for which the angular momentum is some integral multiple of* $\frac{h}{2\pi}$

$$L = \frac{n\,h}{2\,\pi} \quad (L = mvr)$$

ii) Electron Transitions: Electrons emits energy only when they jump from stationary orbit of higher energy level to stationary orbit of lower energy level.

i.e $\mathbf{h\,\nu = E_2 - E_1}$

37. Obtain an expression for the radius of an electron in the n^{th} orbit of hydrogen atom

The electrostatic force of attraction between the electron and the nucleus is

$$F_E = \left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{Ze.e}{r^2}\right)$$

$$F_E = \left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{Ze^2}{r^2}\right)$$

But, the centripetal force is $F_c = \frac{mv^2}{r}$

For stability of the atom $F_E = F_c$

$$\left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{Ze^2}{r^2}\right) = \frac{mv^2}{r}$$

$$mv^2 = \left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{Ze^2}{r}\right) \quad \text{--------- (1)}$$

But, from Bohr's Quantization rule,

$$mvr = \frac{nh}{2\pi}, \; n = 1, 2, 3, \text{--------}$$

squaring , $m^2v^2r^2 = \frac{n^2h^2}{4\pi^2}$ ----------------- (2)

(2) ÷ (1) ⇒

$$\frac{m^2v^2r^2}{mv^2} = \left(\frac{n^2h^2}{4\pi^2}\right)\left(\frac{4\pi\varepsilon_0 r}{Ze^2}\right)$$

(For hydrogen z = 1)

$$r = \frac{\varepsilon_0 n^2 h^2}{\pi m\, e^2}$$

$$\therefore\ \mathbf{r_n = \frac{\varepsilon_0 n^2 h^2}{\pi m e^2}}$$

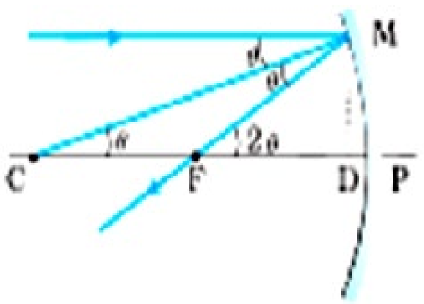
38. Write any three Characteristics of nuclear force:

1) Nuclear forces are strongest force in nature.
2) They are very short range force (Range 10^{-15} m or 1fermi).
3) They are charge independent.
4) They are spin dependent forces.
5) They are saturated forces.
6) They are non central forces.

39. Distinguish between nuclear fission and fusion.

Nuclear fission	Nuclear fusion
1) It is a process in which heavier nucleus breaks up into two or more lighter nuclei of comparable masses. 2) Reaction is controllable. 3) Energy released can be controlled. 4) It forms the principle of atom bomb. 5) Energy released per reaction is more. 6) Energy releases per nucleon is less. 7) This reaction takes place at ordinary temperature.	1) Nuclear fusion is a process in which two lighter nuclei are fussed together to form a heavier nucleus. 2) Reaction is uncontrollable. 3) Energy released cannot be controlled. 4) It forms the principle of hydrogen bomb. 5) Energy released per reaction is less. 6) Energy released per nucleon is more. 7) This reaction requires very very high temperature.

40. Obtain the Relation between focal length and Radius of curvature for concave mirror (f = R / 2) :



From the figure

In Δ PMC , $\tan\theta = \frac{PM}{PC}$ -------- (1)

In Δ PMF, $\tan 2\theta = \frac{PM}{PF}$ --------- (2)

As angles are very small,
$\tan\theta \approx \theta$ and $\tan 2\theta \approx 2\theta$

Equation (2) becomes, $2\theta = \frac{PM}{PF}$, By equation (1) $\theta = \frac{PM}{PC}$

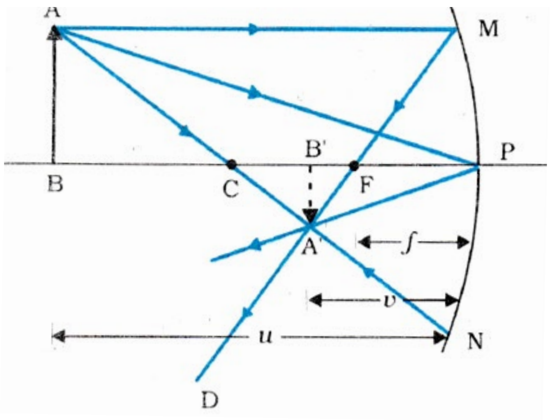
$$\therefore 2\frac{PM}{PC} = \frac{PM}{PF}$$

$$\frac{2}{PC} = \frac{1}{PF}$$

$$\frac{2}{R} = \frac{1}{f}$$ (From the figure, PC = R, PF = f)

$$\therefore \mathbf{f = \frac{R}{2}}$$

41. Obtain the Mirror Formula for concave mirror.



Triangles $A'B'P$ and ABP are similar

$\therefore \frac{B'A'}{BA} = \frac{PB'}{PB}$ .....(i)

Triangles $A'B'F$ and PMF are similar

$\therefore \frac{B'A'}{PM} = \frac{B'F}{PF}$ .....(ii) (PM = BA)

From (i) and (ii)

$$\frac{PB'}{PB} = \frac{B'F}{PF},$$

$$\frac{PB'}{PB} = \frac{PB' - PF}{PF}$$

$$\frac{v}{u} = \frac{v-f}{f}$$

f v = uv – uf

dividing throughout by u, v, f

$$\therefore \frac{1}{u} = \frac{1}{f} - \frac{1}{v}$$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

By sign conversion , u, v and f are –ve , above equation becomes

$$\boldsymbol{\frac{1}{f} = \frac{1}{u} + \frac{1}{v}}$$

42. Obtain an Expression for equivalent focal length of two thin convex lenses in contact.

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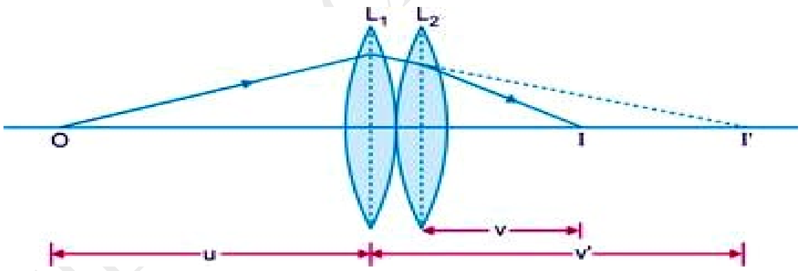


For Lens L_1 , $\frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1}$ ...(1)

For Lens L_2 $\frac{1}{v} - \frac{1}{v'} = \frac{1}{f_2}$ ...(2) ,

Adding equations (1) and (2), we get

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2} \quad ...(3)$$

If we replace the system of two lenses by a thin lens of focal length F, such that it forms the image of object O at I, then we have

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{F} \quad \text{------------------ (4)}$$

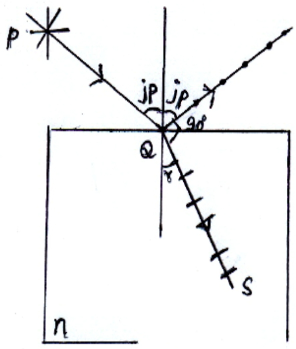
Comparing equations (3) and (4)

We get, $$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

43. State and prove Brewster's law:

Statement: " ***This law states that tangent of the polarising angle is equal to refractive index of the material of the reflector***".

Tan (i_p) = n



From the figure we have

$i_p + r = 90^0$

$\mathbf{r = 90^0 - i_p}$

Applying Snell's law, we get

$n = \sin i_p / \sin r$

$= \sin i_p / \sin (90^0 - i_p)$

$n = \sin i_p / \cos i_p = \tan i_p$

$$\mathbf{n = \tan i_p}$$

Hence, the Brewster's law.

44. Distinguish between Interference and diffraction

INTERFERENCE	DIFFRACTION
1. The modification in the intensity when two similar light waves traveling in same direction super impose on each other is called interference. 2. It is produced due to superposition of two waves from two coherent sources. 3. Interference pattern consists of alternate bright and dark band. 4. Interference bright bands are of equal thickness and intensity. 5. Interference dark bands are perfectly dark and of equal thickness.	1. The phenomenon of light waves bending round the corners or obstacles, is called diffraction. 2. It is produced due to the superposition of no. of secondary waves of same sources. 3. Diffraction pattern consists of central bright band bordered by alternate dark and bright band of decreasing intensity. 4. Diffraction bright bands are of unequal thickness and intensity. 5. Diffraction dark bands are of unequal thickness and intensity.