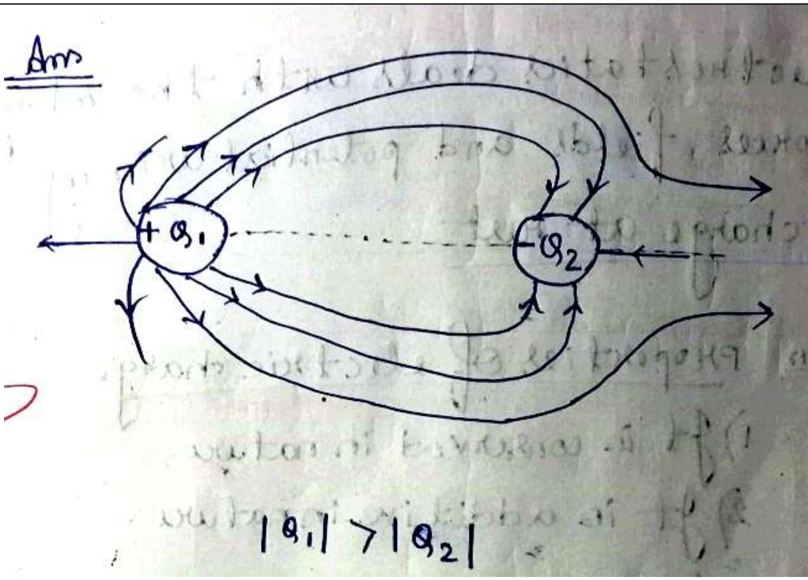
Class : XII || Pre Board Examination , 2024-25
Subject :Physics ||Full marks : 70||Time : 3 hours|| Set -01

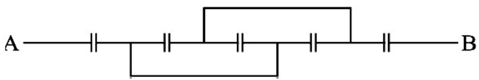
(The figures in the margin indicate full marks for the questions)

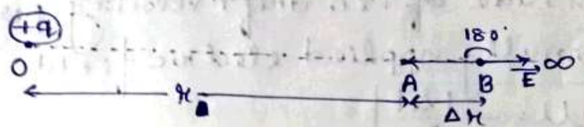
1:Answer any eight questions from the following : 1x8=8	
a	Electrostatics deals with the study of forces, fields and potentials arising from ____________ . (Fill in the blank)
	Electric charge
b	(a) Sketch the electric field lines due to two unequal electric charges $+Q_1$ and $-Q_2$, $\lvert Q_1\rvert > \lvert Q_2\rvert$.
	
c	What is the SI unit and the dimensional formula of

	the permitivity (ε) of a medium.
	$[\epsilon] = [M^{-1} L^{-3} T^{4} A^{2}]$ S.I unit of ϵ is $C^2 N^{-1} m^{-2}$
d	(b) Identify the set in which all the three materials are good conductors of electricity: (i) Cu, Ag and Au (ii) Cu, Si and diamond (iii) Cu, Hg and NaCl (iv) Cu, Ge and Hg
	Cu, Ag, Au
e	(c) If the magnetic monopole exists, then which of the Maxwell's equation to be modified? **(i)** $\oint \vec{\mathbf{E}}.d\vec{S} = q/\epsilon_o$ **(iii)** $\oint \vec{E}.\vec{\mathbf{dl}} = -\, d\phi_B/dt$ **(ii)** $\oint \vec{B}.d\vec{S} = 0$ **(iv)** $\oint \vec{B}.d\vec{\mathbf{l}} = \mu_o(I_c + I_d)$
	(ii) $\oint \vec{B} \cdot d\vec{s} = 0$
f	(d) A convex lens of power 4D and a concave lens of power 3D are placed in contact. What is the equivalent power of the combination? (i) 7 D (ii) 4 D (iii) 1 D (iv) 0.75 D

j	Given, Power of a convex lens = 4 D " " concave lens = -3 D Equivalent power, = 4 − 3 = 1 D Ans (iii) 1 D
g	What is the de Broglie's wavelength of an electron accelerated through a potential difference of 100V.
h	The maximum kinetic energy with which an electron is emitted from a metal surface is _______ of the intensity of the light and ______ upon its frequency . (Fill up the blank)
	Independent , dependent
i	**(i)** The total energy of an electron in 1st excited state of hydrogen atom is about -3.4eV.What is the kinetic energy of electron in this state? (I) -3.4 eV (ii) 3.4 eV (iii) 0.34 eV (iv) -0.34 eV
	0.34 eC
j	Binding energy per nucleon of a stable nucleus is about

	(i) 8 eV (ii) 8 KeV (iii) 8 MeV (iv) 8 meV
	8 MeV
Answer the following questions : 2x10 =20	
a	Write down the properties of electric charge. What is quantisation of electric charge ? 2 Or Two point charges + 0.01 μC and −0.01 μC are placed 20 cm apart in vacuum. Calculated the magnitude of electric field intensity at the middle point of the line joining the charges and mention its Direction . What will be the electric potential at that point ? 2
	Ans Properties of electric charge 1) It is conserved in nature. 2) It is additive in nature. 3) It is quantized in nature. Quantisation of electric charge: The electric charge of a body can takes only some definite values

<table>
<tr><td></td><td>which is integral multiple of the magnitude of the charge of an $e^{\ominus}$.
i.e $q = \pm n|e|$
where $n = 1, 2, 3, \ldots$
$|e| = 1.6 \times 10^{-19}$ C</td></tr>
<tr><td>b</td><td>Show that the electric field intensity at a point can be given as negative of potential gradient. 2
Or
Find equivalent capacitance between A and B , if capacitance of each capacitor is C


2</td></tr>
<tr><td></td><td>b) To prove $\boxed{E = \frac{-dV}{dr}}$


Let a point charge +q be placed at 'O'.
Let, $OA = r$, $OB = r + \Delta r$
$V_A = V$ and $V_B = V - \Delta V$
Now, by def. of pot. difference b/w ② two points
$V_A - V_B = \frac{W}{q_0}$</td></tr>
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$$\Rightarrow V-(V-\Delta V)=\frac{F\cdot\Delta r}{q_0}$$

$$\Rightarrow V - V + \Delta V = E\cdot\Delta r$$

$$\Rightarrow \Delta V = E\Delta r \cos 180^\circ$$

$$\Rightarrow \Delta V = -E\Delta r$$

$$\Rightarrow E = -\frac{\Delta V}{\Delta r} \longrightarrow (i)$$

taking limit of (i) as $\Delta r \longrightarrow 0$

$$(i) \Rightarrow E = -\lim_{\Delta r \to 0} \frac{\Delta V}{\Delta r}$$

$$\Rightarrow \boxed{E = -\frac{dV}{dr}}$$

c Define mobility . How does mobility of electron changes with temperature ?

1+1=2 Or

The resistance of a platinum wire at 0^0 C is 5.0 Ω and its resistance at steam point is 5.4 Ω .When the wire is immersed in a hot oil bath, the resistance is 5.8 Ω . Calculate the temperature of the oil bath. 2

Mobility of the free electrons the magnitude of its drift velocity per unit externally applied electric field.

$$\mu = \frac{|v_d|}{E}$$

Reln of μ with tempr

$$\mu = \frac{|v_d|}{E} = \frac{\frac{eE}{m_e}\tau_{av}}{E}$$

$$\mu = \frac{e\tau_{av}}{m_e}$$

Since, with rise in tempr, collision b/w the free electrons become more frequent, reducing the time interval b/w two successive collision & hence reducing τ_{av}.

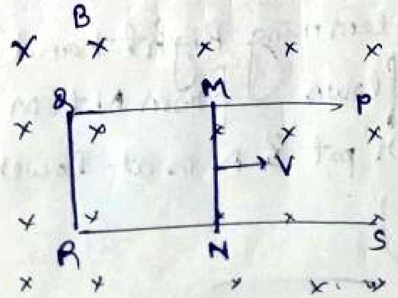
Therefore with rise in temperation mobility of ~~free~~ free electrons decreases.

d	Write any two important points of similarities and differences each between Coulomb's law for the electrostatic field and Biot-Savart's law for the

	magnetic field . 2 Or Define 1 tesla . Obtain the relation between testa & gauss . 2
	Similarities 1) Both obeys inverse squre law. 2) Both obeys ppl of superposition. Dissimilarites 1) In Biot-Savart's law, source is a vector source ($I\vec{dl}$), while in ~~colou~~ Coulomb's law source is a scalar source (Q) 2) Biot-Savart's law is angle dependent & Coulomb's law is angle independent.
e	Find the expression for the emf induced in a rod moving perpendicularly in a uniform magnetic field acting perpendicularly inward to the plane of paper . 2 Or A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in

	0.1 s, what is the induced emf in the loop while the current is changing? 2

c)



Let, PQRS be a u-shaped frame in which arm MN (length l) is movable placed in ~~let, the arm MN be moves~~ a uniform magnetic field $\vec{B}$, acting ⊥rly inside to the plane of paper.

Let the arm MN be moves with velocity v such that at a given instant of time, RN = QM = x (let)

Now,

$\phi_B = B \times$ Area of QMNR

$= B \times RN \times MN$

$\phi_B = Bxl$

Now, emf $= \frac{d\phi_B}{dt}$

	$= \frac{d(Bxl)}{dt}$ $= Bl\frac{dx}{dt}$ $emf = Blv \longrightarrow (i)$ In vector form, $emf = (\vec{v} \times \vec{B}) \cdot \vec{l}$ Hence, Accn to Flemming Right hand rule, current flows from N to M M is at haigher pot & N is at lower pot. $V_M - V_N = Bvl$
f	The electric field of an e.m. wave is given by , $E_y = 30 \cos(2\pi \times 10^8 t — 4\pi z)$, where E is in volts/meter, t in second and z in meter , Determine (i) the wavelength and frequency (ii) the magnetic field component . ½ + ½ +1 = 2 Or How are infrared waves produced ? Write their uses . 1+1=2

	i) Given, $E_y = 30\cos(2\pi \times 10^8 t - 4\pi z)$ (i) Here $k = 4\pi$ $\frac{2\pi}{\lambda} = 4\pi$ $\frac{1}{\lambda} = 2$ $\lambda = \frac{1}{2}$ $\lambda = 0.5$ m • $\omega = 2\pi \times 10^8$ $\frac{2\pi}{T} = 2\pi \times 10^8$ $2\pi f = 2\pi \times 10^8$ $f = 10^8$ Hz (ii) $B_0 = \frac{E_0}{C}$ $= \frac{30}{3 \times 10^8}$ 10 $= 10^{-7}$ T $B_x = 10^{-7}\cos(2\pi \times 10^8 t - 4\pi z$
g	A plane electromagnetic wave of frequency 25 MHz travels in free space along the *x*-direction. At

	a point in space , E = 6.3 V/m , along Y direction .What is B at this point ? Find its wavelength . 2 Or Show that the average energy density of the electric field equals the average energy density of the magnetic field. 2
h	Give the properties of the electromagnetic waves . 2 Or Write down the Einstein’s photo electric equation. Draw the graph between stopping potential and frequency of the incident photon . From it obtain threshold frequency . 2
	h) <u>Ans</u> The $E = h\nu$ can used in the following (2) ways— 1) The first part is used release the electrons from the atom, which is known as work function (w_0) 2) The second part part is used as KE of the photo electron.

$\therefore$ $\boxed{E = W_0 + K}$ → (i)

Einstein photo electric equation.

When $\nu = \nu_0$

$h\nu_0 = W_0$

(i) ⇒ $h\nu = h\nu_0 + K$

⇒ $K = h\nu - h\nu_0$ → (ii)

Let, V_0 be the stopping pot.

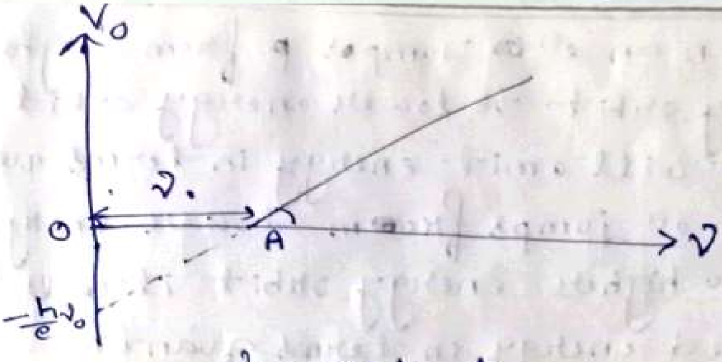
Work-energy theorem,

$W = K$

$eV_0 = K$ → (iii)

(ii) ⇒ $eV_0 = h\nu - h\nu_0$

⇒ $\boxed{V_0 = \frac{h}{e}\nu - \frac{h}{e}\nu_0}$ → (iv)



ν - coordinate

In OA = ν_0 is the threshold frequency.

i	State Huygen's principle . 2 Or Give the advantages of the reflective type telescope over refracting telescope . 2
	1) No chromatic abberation is present in a mirror. 2) Mechanical support is less problematic as weight of a mirror is much than that of a lens with equivalent optical property.
j	State Bohr's postulates . 2 Or Explain how the nuclear fusion can be explained with the help of the binding energy curve. 2
	1) An Bohr's Postulates 1) The electrons are revolving in a definite circular orbit around the nucleus called stationary orbit in which no energy emitted by the $e^{\ominus}$ & ~~agar~~ angular momentum is $m_e v r = \frac{nh}{2\pi}$, n = principle QN, h = planck's const

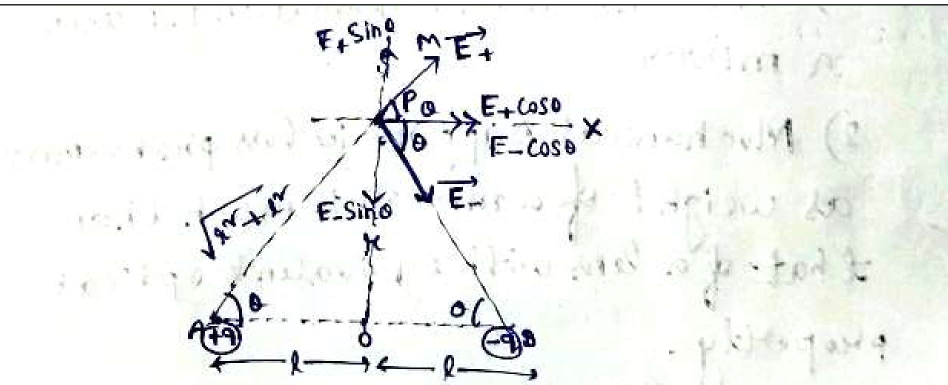
2) When an $e^{\ominus}$ jumps from higher energy orbit to lower energy orbit then it will emit energy in terms quanta & when $e^{\ominus}$ jumps from lower energy orbit to higher energy orbit it will absorbed energy in terms quanta.

$$E_2 - E_1 = h\nu$$

Where, E_1, E_2 are the energy of lower & higher energy orbit respectively.

Answer the following questions as directed : 3x9 =27

a Find an expression for electric field due to an electric dipole at a point in its equitorial line .
3 Or
Find an expression for capacitance of a parallel plate capacitor with vacuum in between its plates.3



Let AB be an electric dipole with electric dipole moment,

$$\vec{P} = |\pm q| \times \vec{2l}, \quad \vec{2l} = \vec{BA} \quad \text{(1)}$$

Let P be a point on the equitorial line of the dipole at a dist of r pro from the mid point 'o' of AB.

Electric intensity at P due to +q, $\vec{E_+} = \frac{1}{4\pi\epsilon_0}\frac{q}{(r^2+l^2)}$, towards $\vec{PM}$

Electric intensity at P due to −q,

$$\vec{E_-} = \frac{1}{4\pi\epsilon_0}\frac{q}{(r^2+l^2)},$$

towards $\vec{PB}$

$\because |\vec{E_+}| = |\vec{E_-}|$ & acting along diff dirn.

Let, $\angle PAB = \angle PBA = \angle MPX = \angle BPX = \theta$ (say)

Resolving $\vec{E_+}$	Resolving $\vec{E_-}$
1) $E_+\cos\theta$, along +x axis	1) $E_-\cos\theta$, along +x axis
2) $E_+\sin\theta$, along $\vec{PY}$	2) $E_-\sin\theta$, along $\vec{PO}$

Net electric intensity at, P,

$$E_P = E_+ \cos\theta + E_- \cos\theta$$

$$= 2\times\frac{1}{4\pi\epsilon_0}\frac{q}{(r^2+l^2)}\frac{l}{\sqrt{r^2+l^2}}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{(2ql)}{(r^2+l^2)^{3/2}}$$

$$E = \frac{1}{4\pi\epsilon_0}\frac{p}{(r^2+l^2)^{3/2}} \longrightarrow (ii)$$

when, $l <<< r$

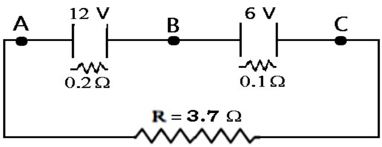
$$E = \frac{1}{4\pi\epsilon_0}\frac{p}{r^3} \longrightarrow (iii)$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{-\vec{p}}{r^3} \longrightarrow (iv)$$

b State the limitations of Ohm's law with proper graphs . 3

Or

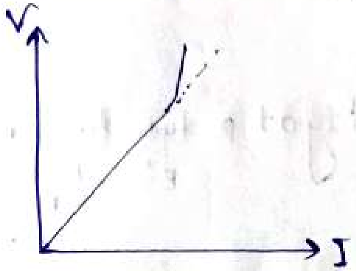
In the circuit given below , find the potential difference between A and B and between A and C .



. 1+2=3

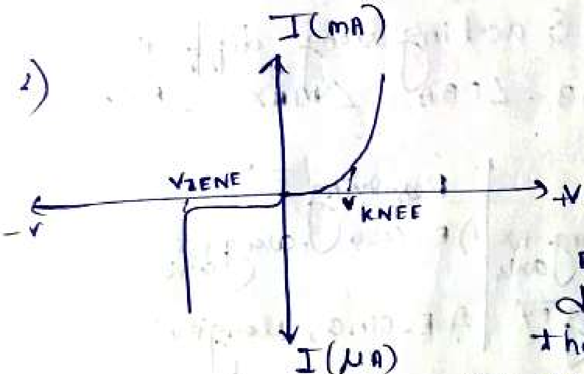
b) Limitation of ohm's law

1)



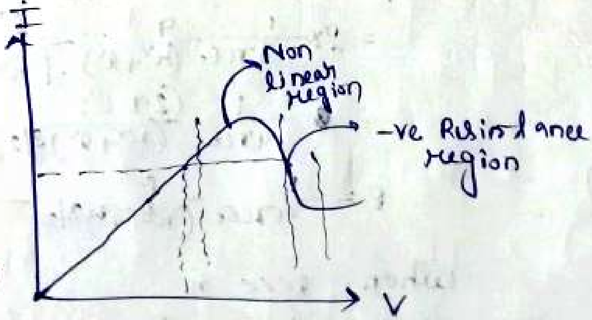
Linearity V-I graph disappears with higher value of ρ.

2)

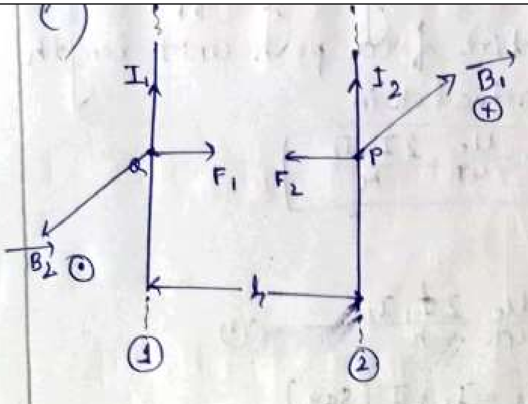


For PN Junction diode, on reversing the dirn of current we are not going to get same values of V.

3)



For GaAs, we are going to get more than one values of V for same I.

c	find an expression force acting between two straight conductors of infinite length carrying current I_1 and I_2 in the same direction , seperated by a distance r in vacuum . What is 1 ampere ? 2+1=3 Or A long straight wire of a circular cross-sectional radius 'R', carrying steady current I , which is uniformly distributed across this cross-section. Using Ampere's circuital law calculate the magnetic field at a distance (r) (i) region $r < R$
	(c)  Let, I_1 & I_2 be the two current flowing through the conductor of infinite extent sepn by a dist of r in vacuum. Let, P be point on conductor (2) at which mag. field due to I_1 $\vec{B_1} = \frac{\mu_0}{4\pi}\frac{2I_1}{r}(-\hat{k})$ ——— (i)

Similarly, a be the point on (1) at which mag field due to I_2

$$\vec{B_2} = \frac{\mu_0}{4\pi}\frac{2I_2}{r}(\hat{k}) \longrightarrow (ii)$$

Force on conductor (1) due to I_2 per unit length

$$\vec{F_1} = \vec{B_2} \times I_1 \times 1\ \hat{i}$$

$$= \frac{\mu_0}{4\pi}\frac{2I_2I_1}{r}\hat{i}$$

$$\vec{F_1} = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r}\hat{i}$$

Force on (2) per unit length

$$F_2 = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r}(-\hat{i})$$

Since $\vec{F_1} = -\vec{F_2}$ & acting along diff. dirn.

So the attractive force per unit length for the two conductor is

$$\boxed{F = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r}}$$

We know,

$$F = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r} \longrightarrow (1)$$

Let, $I_1 = I_2 = I$ (say)

$r = 1m$

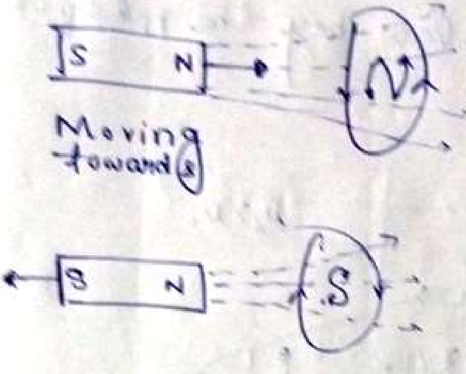
$F = 2\times10^{-7}$ N/m

$$(1) \Rightarrow 2\times10^{-7} = 10^{-7}\frac{2I^2}{1}$$

$$\Rightarrow \boxed{I = \pm 1 \text{ Ampere}}$$

2

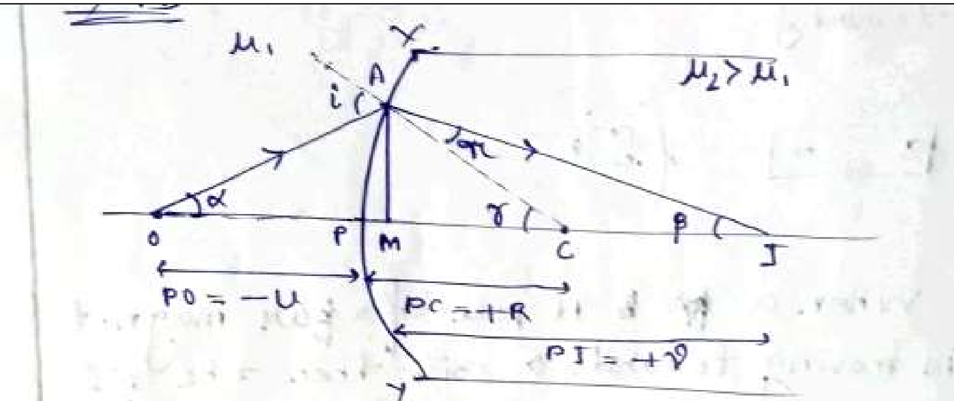
	Stright of a current flowing through two conductor of ∞ extent in the same dirn is said to be 1amp if they are placed at a dist 1m apart in vacuum & experiences an attractive force 2×10^{-7} N/m.
d	A short bar magnet placed with its axis at 30^0 with an external magnet field of 0.1 T experiences a torque of 0.02 Nm. (i) What is the magnetic moment of the magnet. (ii) Find work done in turning it from its most stable equilibrium to most unstable equilibrium position . (iii) What is the magnetic field at a point , at a distance of 1 m from its mid point on its axial line ? 3 Or State Lenz's law . Prove that it obeys the principle of conservation of mechanical energy . 1+2=3
	Ans Lenz's Law The dirn of current is such that it will try to oppose the cause creating it



When a N-pole of a bar magnet is moving towards a coil then the coil creates an acw current to oppose the moving N-pole. Work is done by the bar magnet at the cost of mechanical energy given to it which will be converted into electrical energy of the coil.

again, when N-pole of a bar magnet moving away from a coil then it induces a clock wise current to attract the moving away N-pole. In this case, work is done by the electrical energy given to the coil which will be converted into ~~mechani~~ mechanical energy of the bar magnet & restored in it.

Thus, the conversion of electrical energy into mechanical energy & vice-versa

	proves that Lenz's law obey the ppl of COME.
e	Establish the relation , $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$, where symbols are having usual meanings . 3 Or Draw the ray diagram showing the formation of image of a distant object at the infinity by an astronomical telescope . A small telescope has an objective lens of focal length 144cm and an eyepiece of focal length 6.0cm . What is the magnifying power of the telescope? 2+1=3
	 Let, O be the point object placed at the rarer medium of ri μ_1 on the ppl of a convex surface XPY of ri μ_2 whose image is formed at I as shown in the fig.

By Snell's law,

$$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$$

$$\Rightarrow \frac{i}{r} = \frac{\mu_2}{\mu_1}$$ [i & r are very very small]

$$\Rightarrow i\mu_1 = r\mu_2 \longrightarrow (i)$$

Let, $AM \perp^r PI$

$\angle AOM = \alpha$

$\angle AIM = \beta$

$\angle ACM = \gamma$

From ΔAOC

$$\alpha + \gamma = i \longrightarrow (ii)$$

From ΔACI

$$r + \beta = \gamma$$

$$r = \gamma - \beta \longrightarrow (iii)$$

Now,

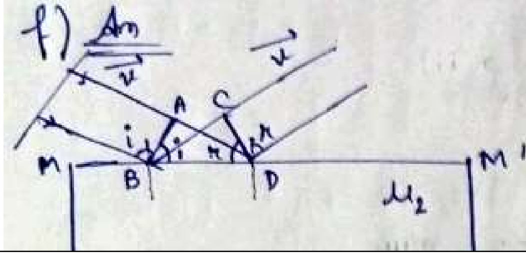
$$(i) \Rightarrow i\mu_1 = r\mu_2$$

$$\Rightarrow (\alpha + \gamma)\mu_1 = (\gamma - \beta)\mu_2$$

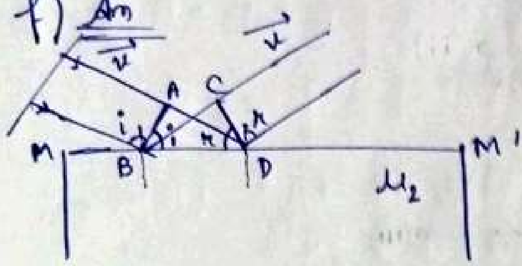
$$\Rightarrow (\tan\alpha + \tan\gamma)\mu_1 = (\tan\gamma - \tan\beta)\mu_2$$

$$\Rightarrow \left(\frac{AM}{OM} + \frac{AM}{CM}\right)\mu_1 = \left(\frac{AM}{CM} - \frac{AM}{IM}\right)\mu_2$$

$$\Rightarrow \left(\frac{1}{OM} + \frac{1}{CM}\right)\mu_1 = \left(\frac{1}{CM} - \frac{1}{IM}\right)\mu_2 \longrightarrow (iv)$$

	Since, A & P are very much closure. $\therefore$ OM $\approx$ PO = $-u$ CM = PC = $+R$ IM = PI = $+v$ (iv) $\Rightarrow \frac{\mu_1}{-u} + \frac{\mu_1}{R} = \frac{\mu_2}{R} - \frac{\mu_2}{v}$ $\Rightarrow \frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$
f	Establish the law of reflection on the basis of Huygen’s principle . 3 Or (i) Two slits are made 1 mm apart and is placed 0.8 m away in Young's double slit experiment. What is the fringe separation when blue-green light of wavelength 500 nm is used ? (ii) What is the distance of 8^{th} bright fringe from the central bright fringe . (iii) What is the distance of the 5^{th} dark fringe from the central bright fringe . 1+1+1= 3
	f) Ans 

f) Ans



let AB be a plane WF incident on a refracting surface MM' of ri μ_2 at an angle of incidence i.

Let light from A reaches D in the same time light from B reaches C.

$$\therefore t = \frac{AD}{v} = \frac{BC}{v}$$

$$\Rightarrow \boxed{AD = BC} \longrightarrow (1)$$

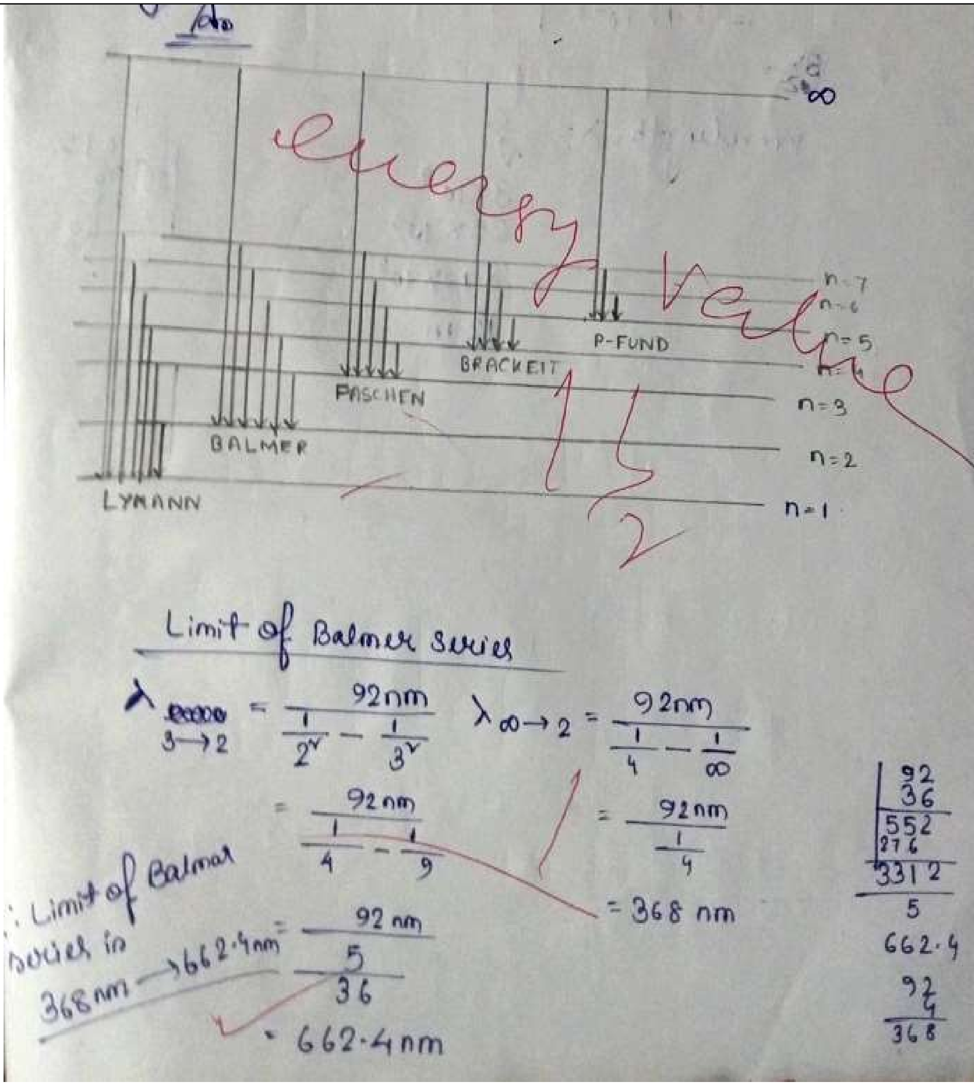
Considering A as centre or source & AD as radius & B as source & BC as radius, secondary wavelets are are drawn. Joing C to D we obtain the secondary WF w.r.t PWF AB.

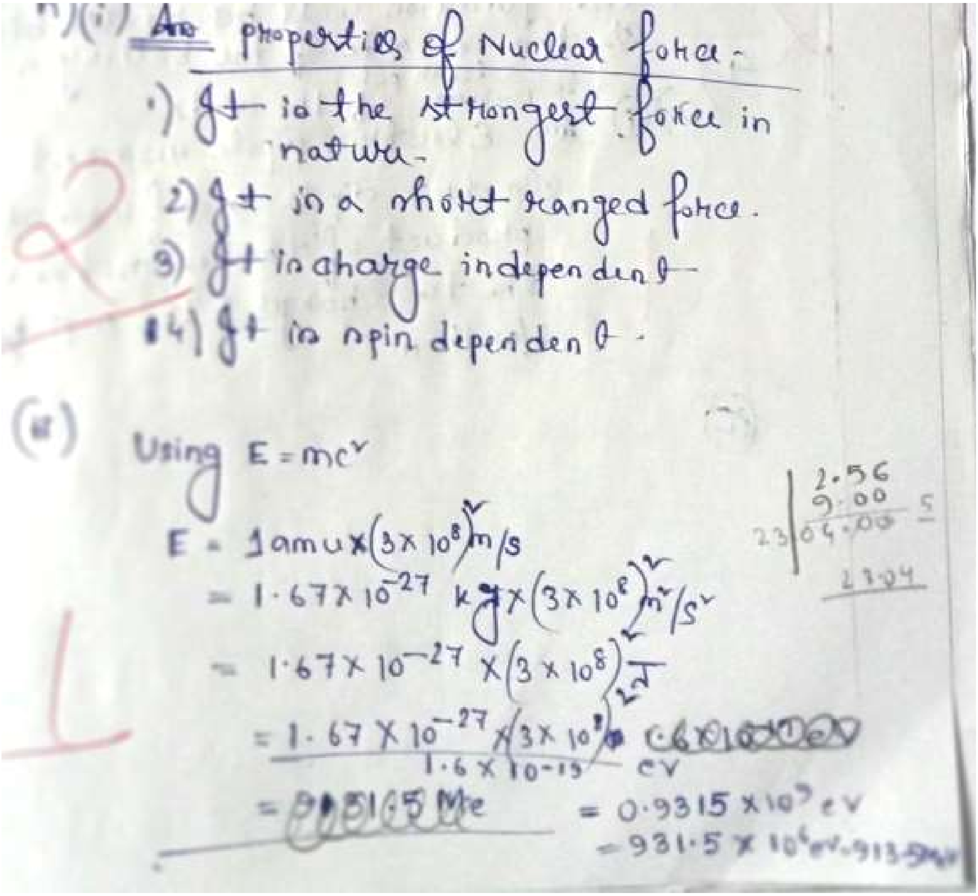
CD is the reflection plane WF.

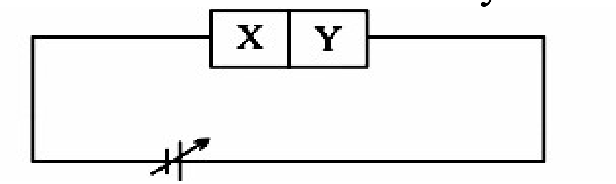
From fig, $\angle ABD = i$

$\angle CDB = r$

	from Δ ADB, $\sin i = \frac{AD}{BD}$ from Δ BCD, $\sin r = \frac{BC}{BD}$ Now, $\frac{\sin i}{\sin r} = \frac{AD}{BD} \times \frac{BD}{BC}$ $\Rightarrow \frac{i}{r} = \frac{AD}{BC}$ $\Rightarrow \frac{i}{r} = \frac{AD}{AD}$ $\Rightarrow \boxed{i = r}$ #
g	Monochromatic light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. (i) What is the energy of a photon in the light beam? (ii) How many photons per second, on an average, are emitted by the source? 1 +2 = 3 Or Draw the energy level diagram to show the different series of hydrogen spectra. Find the limit of Balmar series of Hydrogen spectrum . 1½+1½=3

	
h	(i) State the properties of the nuclear force . (ii) Calculate energy equivalent of 1 amu . 1½+1½=3 Or

	Determine from the given data the *Q*-value of the following reaction $_6C^{12} + {_6C^{12}} \rightarrow {_{10}Ne^{20}} + {_2He^4}$ Atomic masses are given to be $m\ ({_2He^4}) = 4.002603$ u $m\ ({_6C^{12}}) = 12.000000$ u $m\ ({_{10}Ne^{20}}) = 19.992439$ u  (i) An properties of Nuclear force:- 1) It is the strongest force in nature. 2) It is a short ranged force. 3) It is charge independent 4) It is spin dependent. (ii) Using $E = mc^2$ $E = 1 amu \times (3 \times 10^8)^2 m/s$ $= 1.67 \times 10^{-27} kg \times (3 \times 10^8)^2 m^2/s^2$ $= 1.67 \times 10^{-27} \times (3 \times 10^8)^2 J$ $= \frac{1.67 \times 10^{-27} \times (3 \times 10^8)^2}{1.6 \times 10^{-19}} eV$ $= 0.9315 \times 10^9 eV$ $= 931.5 \times 10^6 eV$
i	(i) An intrinsic semiconductor has equal

	electron and hole concentration of 6 x 10^{16} m^{-3}. On doping with certain impurity the electron concentration increases to 9 x 10^{22} m^{-3} . (i) Identify the extrinsic semiconductor. (ii) Calculate the new hole concentration. 2+1 = 3 Or (i) What is doping ? Write the name of the impurities used to fabricate P type & N type semiconductor. (ii) Two semiconductor materials X and Y shown in the given figure, are made by doping germanium crystal with indium and arsenic respectively. The two are joined at lattice level and connected to a battery as shown.  Will the junction be forward biased or reversed biased ? Explain . 1+!+1=3

Ans Dopping is the process of adding impurity to pure semiconductor
In P-type trivalent atoms are used like B, Al
In N-type pentavalent atoms are used for dopping like P, As, Sb

3

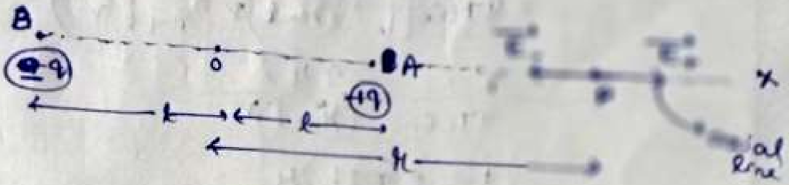
(ii) The junction will be reverse biased as the -ve side of the battery (lower pot) is connected to p-side of the diode.

4)

Answer any three of the following questions: 5 x 3 =15

a	(i) What is electric dipole moment of an electric dipole ? (ii) Derive the expression of intensity at a point on the axial line of an electric dipole . (iii) An electric dipole is placed at an angle of 30^0 with an electric field of intensity 2 x10^{5} N/C. It experiences a torque equal to 4 Nm .What is the electric dipole moment of the electric dipole ? 1+3+1=5

Ans Electric dipole moment of an electric dipole is defined as the product of the magnitude of the two charges & the sepr b/w them.



Let AB a electric dipole with electric dipole moment $\vec{P} = |\pm q| \times \vec{2l}$, $\vec{2l} = \vec{BA}$ ——→ (1)

Let us consider a point P on the axial line at a dist of r from the mid point 'O'.

Electric intensity at P due to +q,

$$\vec{E_+} = \frac{1}{4\pi\epsilon_0} \frac{q}{(r-l)^2}$$

toward $\vec{PX}$

Electric intensity at P due to -q.

$$\vec{E_-} = \frac{1}{4\pi\epsilon_0} \frac{q}{(r+l)^2}$$

along $\vec{PO}$

Since ...

Since, $|\vec{r}_+| > |\vec{r}_-|$ & acting along opp. dirn

∴ Net electric intensity at P,

$$E = |\vec{E}_+| - |\vec{E}_-|$$

$$= \frac{q}{4\pi\epsilon_0}\left[\frac{1}{(r-l)^2} - \frac{1}{(r+l)^2}\right]$$

$$= \frac{q}{4\pi\epsilon_0}\left[\frac{(r+l)^2 - (r-l)^2}{(r-l)^2(r+l)^2}\right]$$

$$= \frac{q}{4\pi\epsilon_0}\frac{4rl}{(r^2-l^2)^2}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{2(q\,2l)r}{(r^2-l^2)^2}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{2pr}{(r^2-l^2)^2} \longrightarrow (\text{ii})$$

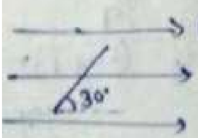
In vector form

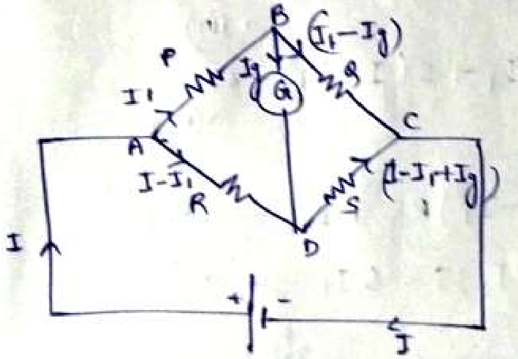
$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{2\vec{p}\,r}{(r^2-l^2)^2} \longrightarrow (\text{iii})$$

If $l <<< r$

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{2\vec{p}}{r^3} \longrightarrow (\text{iv})$$

(ii)

	(ii)  Given, $E = 2\times10^5$ N/C $\theta = 30°$ $\tau = 4$ Nm $\Rightarrow PE\sin\theta = 4$ $\Rightarrow P \times 2\times10^5 \sin 30° = 4$ $\Rightarrow P = \frac{4}{2\times10^5\times\frac{1}{2}} = 4\times10^{-5}$ Cm
b	(b) State Kirchoff's Laws of current electricity. Applying the same laws to establish the principle of a balanced Wheatstone's bridge. 2+3=5
	b) Kirchoff's Law ① Loop law The sum current meeting at a junction is equal to the sum of current leaving the juntion. (ii) Junction law The algebric sum of electric potential around any close loop involving resistors in the loop is zero.



The total I is distributed as follow—

1) along resistor P on arm AB: I_1
2) along " R " " AD: $I-I_1$
3) " " G " " BD: I_g
4) " " Q " " BC: I_1-I_g
5) " " S " " CD: $I-I_1+I_g$

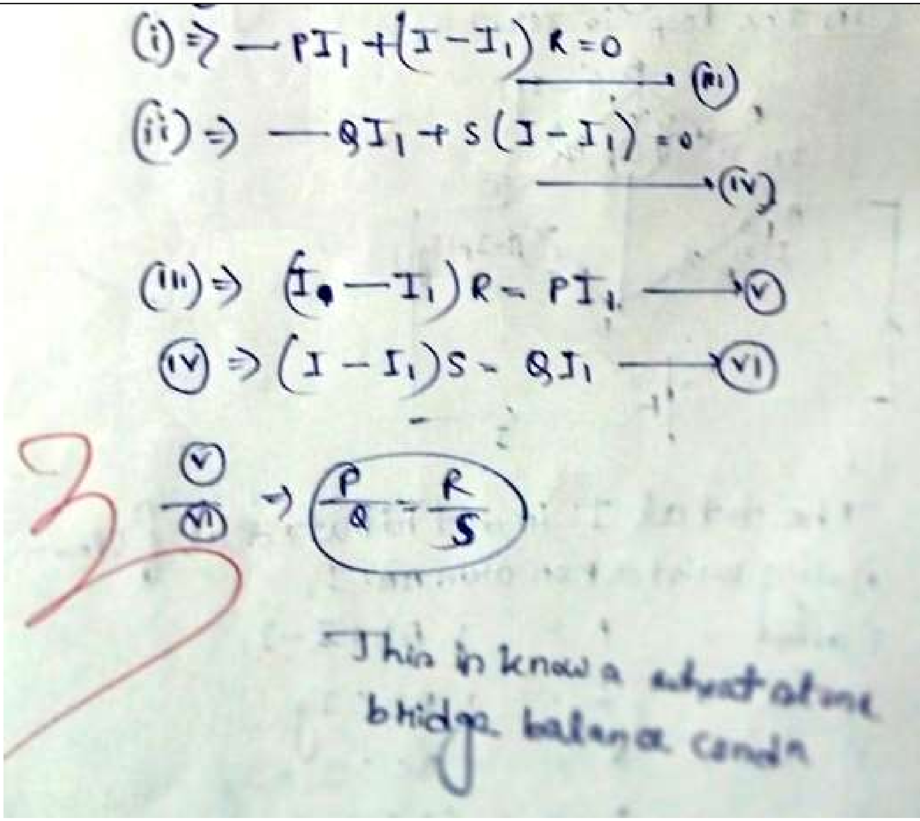
Using KVL for mesh ABDA

$$-PI_1-I_gG+(I-I_1)R=0 \quad \longrightarrow (i)$$

Using KVL for mesh BCDB

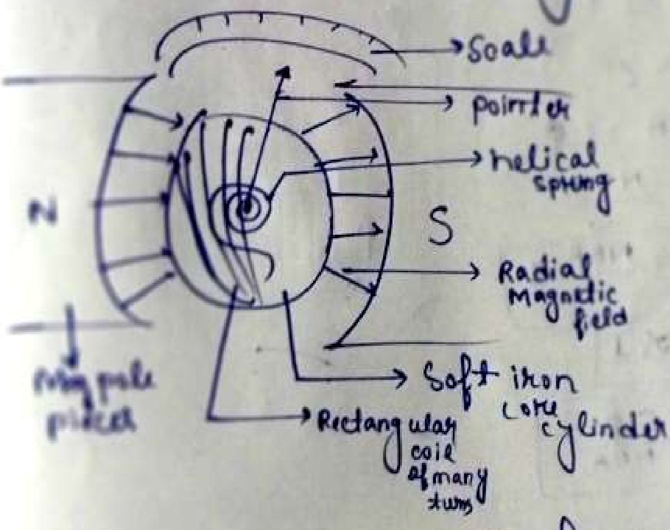
$$-Q(I_1-I_g)+S(I-I_1+I_g)+GI_g=0 \quad \longrightarrow (ii)$$

Putting $I_g=0$ in (i) & (ii)

	 (i) ⇒ $-PI_1 + (I - I_1)R = 0$ → (iii) (ii) ⇒ $-QI_1 + S(I - I_1) = 0$ → (iv) (iii) ⇒ $(I - I_1)R = PI_1$ → (v) (iv) ⇒ $(I - I_1)S = QI_1$ → (vi) $\frac{(v)}{(vi)} \Rightarrow \frac{P}{Q} = \frac{R}{S}$ This is known as wheatstone bridge balance condn 3
c	(c) What is the basic principle of a moving coil galvanometer? Derive an expression for current flowing through the galvanometer in terms of steady angular deflection of its coil. Define voltage sensitivity of the galvanometer. 1+3+1 =5

Moving coil galvanometer is used to detect very small amt of current flowing through it.

It is based on torque acting on the coil.



A galvanometer is consist of a rectangular coil of N no. of turns with a radial magnitic field $\vec{B}$ flowing I amt of through the galvanometer.

Torque acting on the the coil

$\tau = NBIA$ [$\theta = 90°$, as the field is Radial] → (i) let, C be the torsional const of the helical spring on the bottom of the galvanometer which will provide a counter torque balancing the existing torque & producing a steady deflection of ϕ.

$\therefore \tau' = C\phi$.

Now, $\tau = \tau'$

$NBIA = C\phi$

$\phi = \frac{NBIA}{C}$

$\boxed{\phi = \frac{NBA}{C} I}$

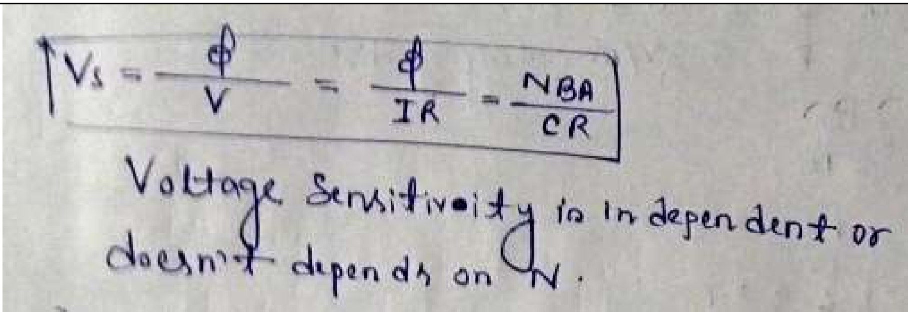
$\boxed{\phi \propto I}$

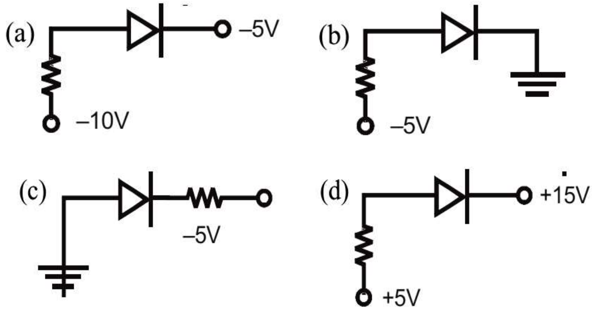
$\boxed{I = \frac{C\phi}{NBA}}$

Where, $\frac{NBA}{C}$ is know as galvanometer constant

Voltage Sensitive

It is the ~~rotaion~~ rotation produced in the coil of the galvanometer when a unit voltage is passing through it

	 $V_s = \frac{\phi}{V} = \frac{\phi}{IR} = \frac{NBA}{CR}$ Voltage Sensitivity is independent or doesn't depends on N.
d	(d) State the working principle of a transformer. What are the losses in transformer? Name them . 3+2=5
e	What is diffraction of light ? Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light.Obtain the conditions for the formation of central maxima , secondary maxima and secondary minima with the help of a neat diagram . 1+4=5
f	(i) Give the difference between forward and reverse biasing of a PN junction diode (ii)Identify the types of biasing done with the PN junction diode in the following diagram (a) , (b) , (c) and (d) 1½+1½+½+½+½+½=5


(a)
–5V
–10V
(b)
–5V
(c)
–5V
(d)
+15V
+5V