HIGHER SECONDARY EXAMINATION MARCH 2025

HSE II

PHYSICS

I Answer any 5 (1-7)

1) c) Electric field

2) Zero

3) ii) Lenz's law

4) (ii) $\nu_1 > \nu_3 > \nu_2$

5) $r = n^2 r_0 = 2^2 r_0 = \underline{4 r_0}$ | Hint $r \propto n^2$

6) 0.5 m | $P = P_1 + P_2 = 4 + {-2} = +2D$, $f = \frac{1}{P} = \frac{1}{2} = 0.5m$

7) Nuclear fusion

II Any 5 (8-14)

8) $I = neAV_d$ | $V_d = \frac{eE}{m}\tau$, $E = \frac{V}{l}$

$= neA \times \frac{eE}{m}\tau$

$= \frac{ne^2A\tau}{m} \times \frac{V}{l}$

$R = \frac{V}{I} = \frac{ml}{ne^2A\tau}$

9) diamagnetic

$\mu_r = 1 + \chi$

10) $i = 10 \sin 314t$

$V = 50 \sin(314t + \pi/2)$

a) $\pi/2$

b) 0

$\phi = 0$

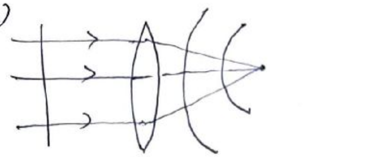
$\langle p \rangle = V_{rms} I_{rms} \cos\phi = 0$

11) a) Radiowaves

b) $I_D = \varepsilon_0 \frac{d\phi_E}{dt}$ (displacement current)

12) a) The locus of all points which are in phase when light is propagating.

b)



13) It is the minimum energy required to ionise an atom. (OR) minimum energy required to remove an electron from an atom.

$E = +13.6 eV$

OR

$E = 21.76 \times 10^{-19} J$

14) $M_N = 12 U$

$M = ZM_p + (A-Z)M_n$

$= 6 \times 1.007825 U + 6 \times 1.008665 U$

$= 12.09894 U$

$\Delta M = M - M_N$

$= (12.09894 - 12) U$

$= 0.09894 U$

$E_b = 0.09894 \times 931 MeV$

$= \underline{92.11314 MeV}$

III Any 6 (15-21)

15) a) product of magnitude of charge and distance between charges.

$P = q \times 2l$

b) $\tau = PE\sin\theta$ (or) $\vec{\tau} = \vec{p} \times \vec{E}$

τ is maximum when $\theta = 90°$

16) a) potential is same every-where on its surface

b)(i) Potential difference is zero

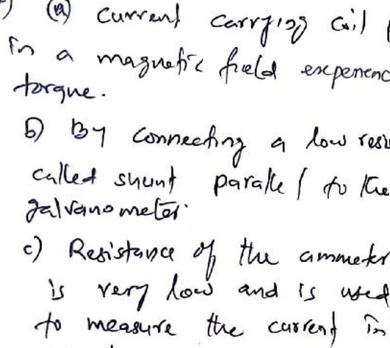
(ii) Work done in moving a charge from one point to another zero

17) (a) current carrying coil placed in a magnetic field experiences torque.

b) By connecting a low resistance called shunt parallel to the galvanometer.

c) Resistance of the ammeter is very low and is used to measure the current in the circuit.

18)



AB and CE are incident and refracted wave fronts in a time t

$$\sin i = \frac{BC}{AC} = \frac{V_1t}{AC}$$

$$\sin r = \frac{AE}{AC} = \frac{V_2t}{AC}$$

$$\frac{\sin i}{\sin r} = \frac{V_1t}{V_2t} = \frac{V_1}{V_2} \quad \text{—(1)}$$

$$n_1 = \frac{c}{V_1} \qquad n_2 = \frac{c}{V_2}$$

$$\therefore \frac{V_1}{V_2} = \frac{c/n_1}{c/n_2} = \frac{n_2}{n_1}$$

$$\therefore \frac{\sin i}{\sin r} = \frac{V_1}{V_2} = \frac{n_2}{n_1} = \text{Constant}$$

19) (iii) a)

b) $\phi_0 = 2\,eV = 2\times1.6\times10^{-19}\,J = 3.2\times10^{-19}\,J$

$$E = h\nu = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}$$

$$= 6.63\times10^{-19}\,J$$

$$= 4.14\,eV$$

$$KE_{max} = E - \phi_0$$

$$= (4.14 - 2)\,eV$$

$$= 2.14\,eV$$

(OR) $KE_{max} = (6.63 - 3.2)\times10^{-19}\,J$

$$= 3.43\times10^{-19}\,J$$

(20) a) Total magnetic flux through a closed surface is zero

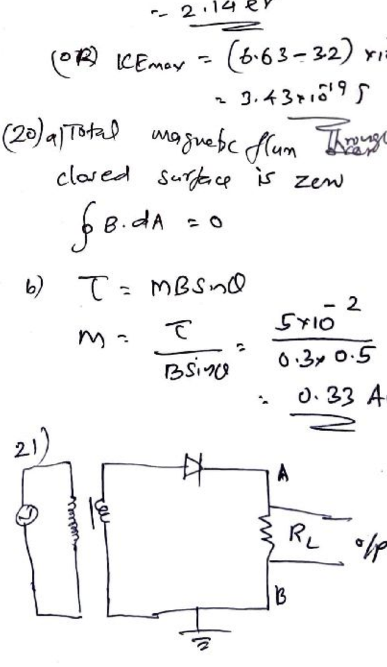
$$\oint B \cdot dA = 0$$

b) $\tau = MB\sin\theta$

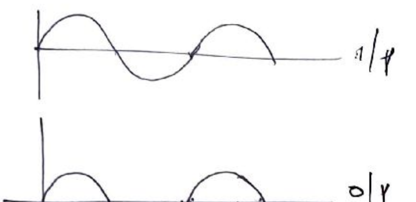
$$M = \frac{\tau}{B\sin\theta} = \frac{5\times10^{-2}}{0.3\times0.5}$$

$$= 0.33\,Am^2$$

21)

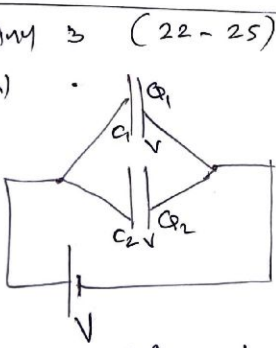


During positive half cycle of ac, the diode is forward biased, and it will conduct and the current flows from A to B. During -ve half cycle, the diode is reverse biased and act as insulator and will not conduct



(IV) Any 3 (22 - 25)

22) a)



potential diference is same charge is divided.

$Q = Q_1 + Q_2$ | $Q = CV$

$CV = C_1V + C_2V$

$\boxed{C = C_1 + C_2}$

b) $C = \frac{q}{V} = \text{slope} = \frac{\varepsilon_0 A}{d}$

slope $\propto A$

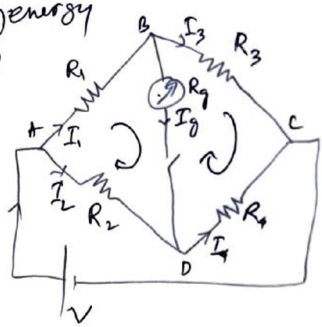
Since $A_2 > A_1$ (given)

slope of C_2 > slope of C_1

$\Rightarrow$ Y corresponds to C_1

23) a) energy

b)



Loop ABDA

$I_1R_1 + I_gR_g + -I_2R_2 = 0$ —(1)

Loop BCDB

$I_3R_3 + -I_4R_4 + -I_gR_g = 0$ —(2)

when bridge is balanced ($I_g = 0$)

$I_1 = I_3$ & $I_2 = I_4$

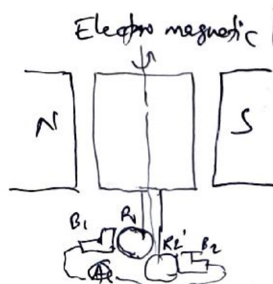
(1) $\Rightarrow$ $I_1R_1 = I_2R_2$ —(3)

(2) $\Rightarrow$ $IR_3 = I_2R_4$ —(4)

$\frac{(3)}{(4)} \Rightarrow \frac{R_1}{R_3} = \frac{R_2}{R_4} \Rightarrow \frac{R_1}{R_2} = \frac{R_3}{R_4}$

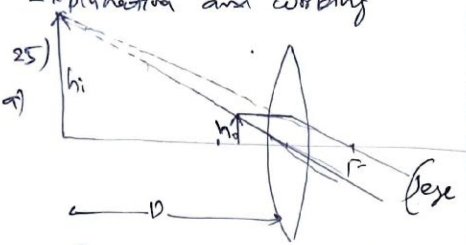
24) a) Electro magnetic Induction

b)



Explanation and working

25) a)



b) $f_e = 5$ cm, $M = 20$

near point adjustment

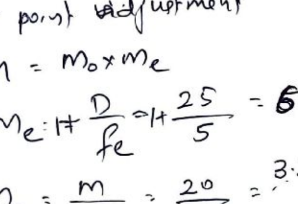
$$M = M_o \times M_e$$

$$M_e = 1 + \frac{D}{f_e} = 1 + \frac{25}{5} = 6$$

$$M_o = \frac{M}{M_e} = \frac{20}{6} = 3.33$$

(V) Any 3 (26-29)

26) a)



(i) gaussian surface is a sphere of radius r.

Electric flux,

$$\phi = \int_s E.ds = \int E\,ds$$

$$= E\int ds$$

$$= E \times 4\pi r^2 \quad \text{—(1)}$$

According to Gauss law

$$\phi = \frac{q}{\varepsilon_0} \quad \text{—(2)}$$

$$E \times 4\pi r^2 = \frac{q}{\varepsilon_0}$$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

(ii) On the surface $r = R$

$$E_s = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}$$

b) $\phi = -2 \times 10^{14}$

$\varepsilon_0 = 8.85 \times 10^{-12}$

(i) $\phi = \frac{q}{\varepsilon_0} \Rightarrow q = \phi\varepsilon_0$

$= -2 \times 10^{14} \times 8.85 \times 10^{-12}$

$= -17.7 \times 10^{2}$ C

(ii) Same (-2×10^{14} Nm²/C)

(ϕ depends on charge inside only)

27) a) It is the net force acting on a moving charge in a combined electric and magnetic field.

$$\vec{F}_L = q\vec{E} + q(\vec{v} \times \vec{B})$$

b) (i) $\vec{B}$ is ⊥r to $\vec{v}$

(ii) Centripetal force = magnetic Lorentz force

$$\frac{mv^2}{r} = qvB$$

$$r = \frac{mv}{qB}$$

$$v = \frac{2\pi r}{T} = 2\pi r\nu$$

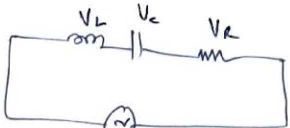
frequency, $\nu = \frac{v}{2\pi r} = \frac{v}{2\pi} \times \frac{qB}{mv}$

$$\nu = \frac{qB}{2\pi m},$$

independent of r.

iii) No, the motion of charged particle is uniform circular motion, speed v constant, KE is constant.

28)



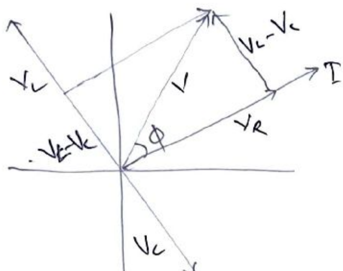
$E = E_0 \sin\omega t$

$I = I_0 \sin\omega t$

$V_L = V_m \sin(\omega t + \pi/2)$

$V_c = V_m \sin(\omega t - \pi/2)$

$V_R = V_m \sin\omega t$



$V = \sqrt{V_R^2 + (V_L - V_c)^2}$

$V_R = IR$

$V_L = I X_L = I L\omega$

$V_c = I X_c = I \times \frac{1}{C\omega}$

$V = \sqrt{I^2R^2 + (IX_L - IX_c)^2}$

$= I\sqrt{R^2 + (X_L - X_c)^2}$

Impedance, $Z = \frac{V}{I} = \sqrt{R^2 + (X_L - X_c)^2}$

$Z = \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

b) Impedance is minimum, when

$L\omega = \frac{1}{C\omega}$

$\omega = \frac{1}{\sqrt{LC}}$

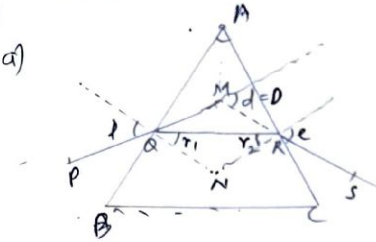
$\omega = \frac{1}{\sqrt{4.5 \times 72 \times 10^{-6}}} = 55\ Hz$

(OR)

$f = \frac{1}{2\pi\sqrt{LC}} = \frac{55}{2 \times 3.14} = 8.85\ Hz$

(29)

a)



b) $\square$ AQNR $\Rightarrow$

$A + \angle AQN + \angle NRA + N = 360$

$A + N = 180$ — ① $\because \angle AQN = 90$, $\angle NRA = 90$

$\triangle QNR \Rightarrow$

$r_1 + r_2 + N = 180$ — ②

① and ② $\Rightarrow$ $\boxed{A = r_1 + r_2}$ — ③

$\triangle QMR \Rightarrow d = \angle MQR + \angle MRQ$

$= (i - r_1) + (e - r_2)$

$= i + e - (r_1 + r_2)$

$= i + e - A$

$\boxed{d + A = i + e}$

c) When the angle of incidence increases from 0 to 90°, deviation first decreases, reaches a minimum value and then increases. This minimum value is called angle of minimum deviation

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