SECOND YEAR HIGHER SECONDARY EXAM - MARCH 2026

HSE II PHYSICS 5Y

I Any 5 (1 - 7) (5×1=5)

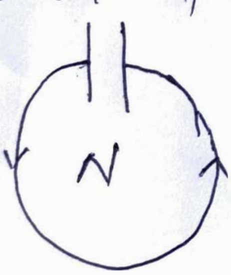
1. Increases
2. (a) Bismuth
3. (d) Gamma rays
4. (b) 2 ⟶ $(n_1 < n_2 \,;\, n_2 > n_3)$
5. Impact parameter
6. $A^{2/3}$ $(R \propto A^{1/3})$
   Area $\propto R^2 \Rightarrow$ Area $\propto A^{2/3}$
7. False

Any 5 (8 - 14) 5×2=10

8) Derivation of $\vec{\tau} = mB\sin\theta$
$\vec{\tau} = \vec{m} \times \vec{B}$

9) a) Statement of Lenz's law

b)



current in anticlockwise
es in clockwise
then A +ve
B +ve

10) Copper loss
Eddy current loss
Flux leakage loss
Hysterises loss
Humming loss

11) Current due to varying electric ~~flux~~ field

$$I_d = \varepsilon_0 \frac{d\phi_E}{dt}$$

b) $\oint \vec{B}\cdot\vec{dl} = \mu_0 I_c + \mu_0 I_d$

OR

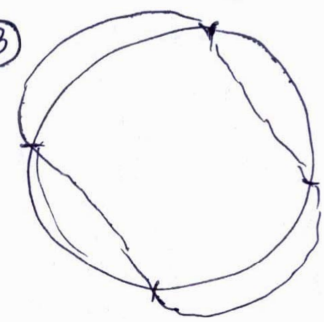
$$\oint \vec{B}\cdot\vec{dl} = \mu_0 I_c + \mu_0 \varepsilon_0 \frac{d\phi}{dt}$$

12) a) Sources having same frequency and zero or constant phase differences.

b) (i) P.d = $n\lambda$

(ii) P.d = $(2n-1)\lambda/2$
(OR) = $(2n+1)\lambda/2$

13)



$2\pi r = n\lambda$ — (1)

$\lambda = \frac{h}{p} = \frac{h}{mv}$ — (2)

Now, $2\pi r = n\frac{h}{mv}$

$mvr = n\frac{h}{2\pi}$

$$\boxed{L = \frac{nh}{2\pi}}$$

14) Isotope - [A different] - [N diff]
Isotone - [A different] N same

Any 6 (15-21) $6\times3=18$

15) $p = 4\times10^{-9}$ Cm

$\theta = 30^\circ$

$E = 5\times10^{4}$ N/C

$\tau = pE\sin\theta$

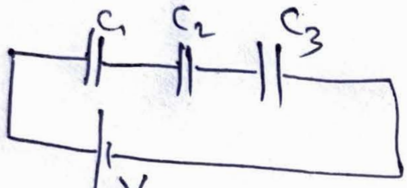
$= 4\times10^{-9}\times5\times10^{4}\times\sin30$

$= 20\times10^{-05}\times\frac{1}{2}$

$= 10^{-04}$ Nm

(b) $\theta = 90^\circ$

16 (a)



$V = V_1+V_2+V_3$ —(1)

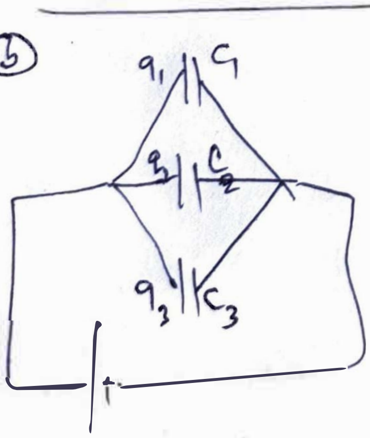
$V_1 = q/C_1 \quad V_2 = q/C_2 \quad V_3 = q/C_3$

$V = q/C$

(1) $\Rightarrow q/C = q/C_1 + q/C_2 + q/C_3$

$$\boxed{\frac{1}{C} = \frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}}$$

(b)



$q = q_1+q_2+q_3$

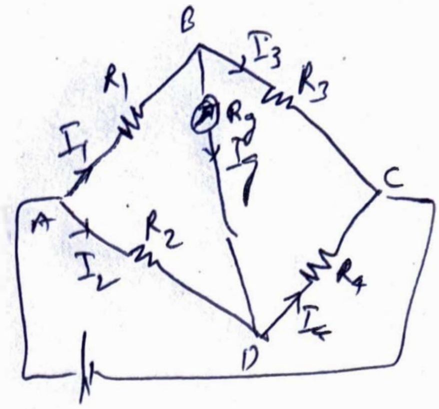
$q_1 = C_1V \quad q_2 = C_2V \quad q_3 = C_3V$

$q = CV$

$CV = C_1V + C_2V + C_3V$

$\boxed{C = C_1+C_2+C_3}$

(17)



Applying Kirchhoff loop rule.

For loop ABDA,

$I_1R_1 + I_gR_g + {}^-I_2R_2 = 0$ —(1)

For loop BCDB,

$I_3R_3 + {}^-I_4R_4 + {}^-I_gR_g = 0$ —(2)

when the Bridge is balanced,

$I_g = 0, \quad I_1 = I_3 \;;\; I_2 = I_4$

(1) $\Rightarrow I_3R_1 = I_4R_2$ —(3)

(2) $\rightarrow I_3R_3 = I_4R_4$ —(4)

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

is the balancing condition.

(18) a) It is the net magnetic dipole moment per unit volume

(b) $m_{net} = 2.5\,Am^2$

mass $= 6.6\times10^{-3}$ kg

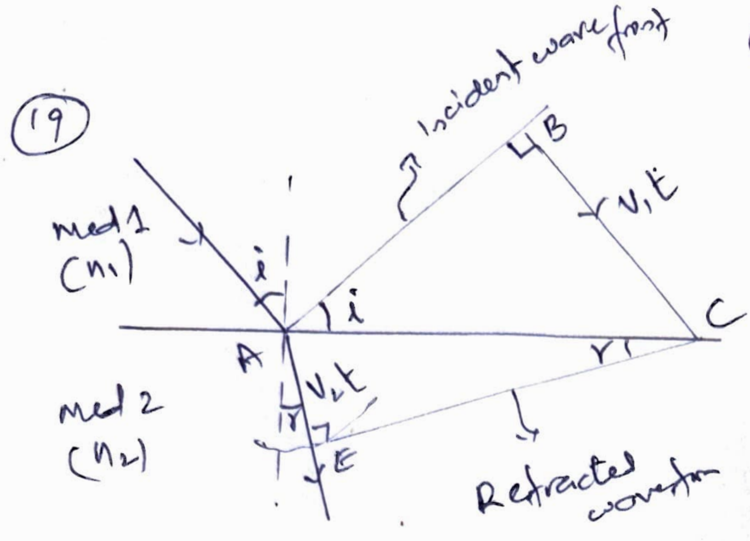
$d = 7.9\times10^{3}$ kg/m^3

Volume $= \frac{\text{Mass}}{\text{density}} = \frac{6.6\times10^{-3}}{7.9\times10^{3}}$

Magnetisation, $M = \frac{m_{net}}{V} = \frac{2.5}{\left[\frac{6.6\times10^{-3}}{7.9\times10^{3}}\right]}$

$= \frac{2.5\times7.9\times10^{3}}{6.6\times10^{-3}} = 2.99\times10^{6}$ A/m

19



AB is an incident wavefront moving from B to C in time t.

$BC = V_1 t$

$\sin i = \frac{BC}{AC} = \frac{V_1 t}{AC}$ —— (1)

CE is the refracted wave front moving from A to E, then in the same time, $AE = V_2 t$

$\sin r = \frac{AE}{AC} = \frac{V_2 t}{AC}$ —— (2)

$\frac{\sin i}{\sin r} = \frac{(V_1 t/AC)}{(V_2 t/AC)} = \frac{V_1}{V_2}$ —— (3)

we have, $n_1 = \frac{c}{V_1}$ and $n_2 = \frac{c}{V_2}$

$\frac{V_1}{V_2} = \frac{c/n_1}{c/n_2} = \frac{n_2}{n_1}$ —— (4)

$\therefore$ (3) $\Rightarrow \frac{\sin i}{\sin r} = \frac{n_2}{n_1} \rightarrow$ Snell's law

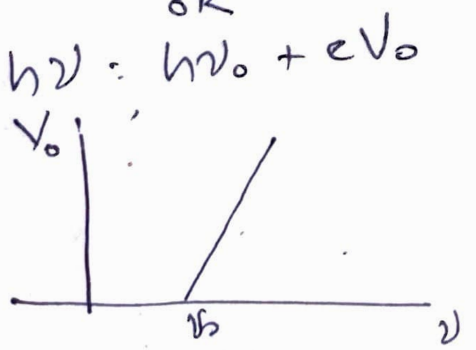
20) a) $E = \phi_0 + KE$

$h\nu = h\nu_0 + \frac{1}{2}mV^2$

OR

$h\nu = h\nu_0 + eV_0$

(b)



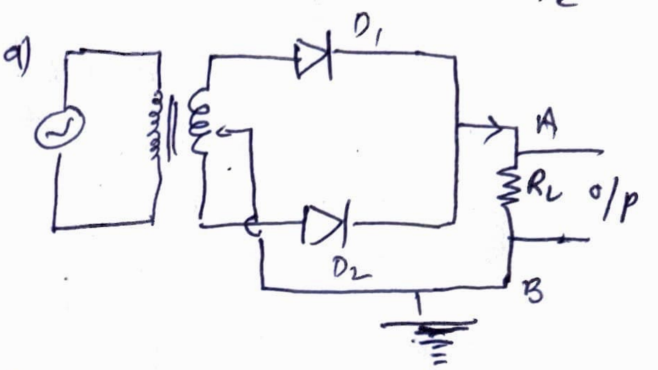
(c) h/e

$V_0 = \frac{h}{e}\nu - \frac{h}{e}\nu_0$

$y = mx + c$

$m = h/e$

21 a)



During +ve half cycle of input AC diode D_1 is forward biased and D_2 is reverse biased, and D_1 will conduct current from A to B.

During -ve half cycle, D_1 is reverse biased and D_2 is forward biased and D_2 will conduct from A to B.

b) By connecting a capacitor parallel to the Load Resistor

OR

By connecting a capacitive or inductive filter circuit.

(Filter circuit)

(Any 3 (22-25) $4\times3 = 12$

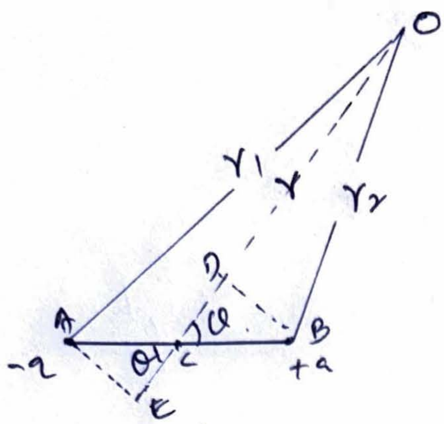
22 a) It is the work done to bring unit +ve charge from infinity to a point in the electric field

$V = W/q$

b) $V_1 = \frac{1}{4\pi\varepsilon}\frac{-q}{r_1}$ —— (1)

$V_2 = \frac{1}{4\pi\varepsilon}\frac{+q}{r_2}$ —— (2)

4



Total potential

$V = V_1 + V_2$

$= \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_2} - \frac{1}{r_1}\right]$ —③

From $\triangle$les BCD and ACE,

$CD = CE = l\cos\theta$

then, $r_1 = r + CE = r + l\cos\theta$
$r_2 = r - CD = r - l\cos\theta$ } ④

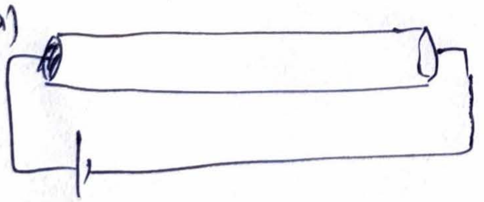
$= \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r - l\cos\theta} - \frac{1}{r + l\cos\theta}\right]$

$= \frac{q}{4\pi\varepsilon_0}\left[\frac{2l\cos\theta}{r^2 - l^2\cos^2\theta}\right]$ —⑤

$r^2 - l^2\cos^2\theta \approx r^2$, $q \times 2l = p$, dipole moment

∴ ⑤ ⇒ $\boxed{V = \frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2}}$

23 (a)



If n is the no. of $\bar{e}$s per unit volume, then

$q = Ne = nAl \times e$

$I = \frac{q}{t} = \frac{nAle}{t}$ —①

$V_d = \frac{l}{t} \rightarrow t = l/V_d$ —②

① ⇒ $I = \frac{nAle}{(l/V_d)} = nAeV_d$

(b) $A = 10^{-6}\,m^2$

$I = 2A$

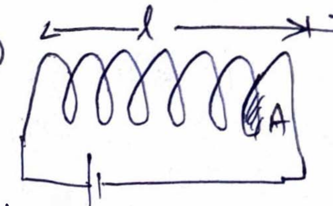
$n = 8 \times 10^{28}$

$V_d = \frac{I}{nAe} = \frac{2}{8\times10^{28}\times10^{-6}\times1.6\times10^{-19}}$

$= \frac{2}{12.8} \times 10^{-3}$

$= 0.156 \times 10^{-3}\,m/s$

24 (a)



magnetic flux

$\Phi_E = N\,\vec{B}\cdot\vec{A}$

$= nl \times BA$

$= nl \times \mu_0 n I \times A$

$= \mu_0 n^2 A l I$

self inductance, $L = \frac{\Phi}{I}$

$\boxed{L = \mu_0 n^2 A l}$

(b) $L_0 = 4.8\times10^{-3}\,H$

$L_m = 1.8\,H$

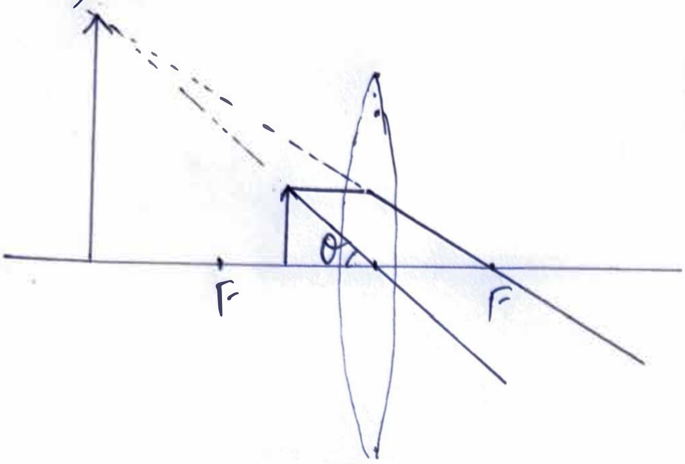
$L_m = \mu_0 \mu_r n^2 A l$

$L_m = \mu_r L_0$

$\mu_r = \frac{L_m}{L_0} = \frac{1.8}{4.8\times10^{-3}} = 375$

25) a) Converging

b) (i)



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

when image is at near point

$v = -D$

Now, $\frac{1}{f} = \frac{1}{-D} - \frac{1}{-u}$ (Sign convension)

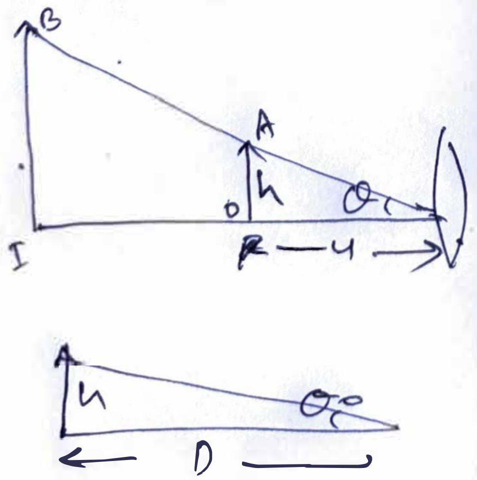
Now, $\frac{D}{f} = \frac{D}{-D} - \frac{D}{-u}$

$= -1 + \frac{D}{u}$

$= -1 + m$

Now, $\boxed{m = 1 + D/f}$

b (ii)



Angular magnification

$$m = \frac{\text{Angle subtended by final image at lens}}{\text{Angle subtended by object at naked eye}}$$

$= \theta / \theta_0$ —— ①

$\theta = h/u$

$\theta_0 = h/D$

$① \Rightarrow m = \frac{h/u}{h/D} = D/u$

when image at ∞, $u = f$

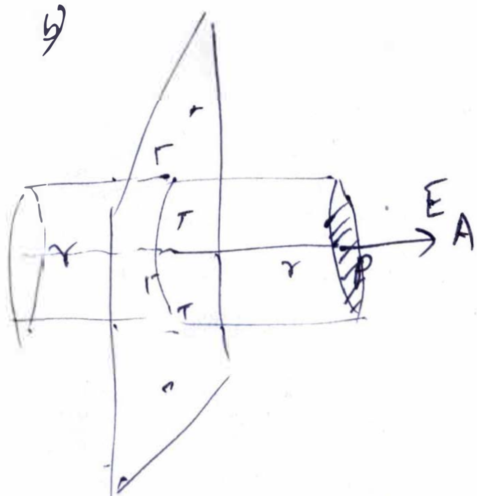
then $\boxed{m = D/f}$

Any 3 (26 - 29) (3×5 = 15)

26) a) Statement of Gauss law

(OR) $\phi_E = \frac{q}{\varepsilon_0}$

b)



The gaussian surface is a cylinder of length $2r$ and end Area A.
The curved surface does not contribute to electric flux as $\vec{E}$ and $\vec{ds}$ are ⊥r
For the two end planes,

$\phi_E = \vec{E}.\vec{A} + \vec{E}.\vec{A} = 2EA$ —— ①

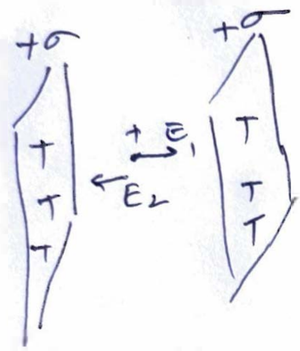
Gauss law,

$$\phi_E = \frac{q}{\epsilon_0} = \frac{\sigma A}{\epsilon_0} \quad \text{— (2)}$$

(1) and (2) → $2EA = \frac{\sigma A}{\epsilon_0}$

$$\boxed{E = \frac{\sigma}{2\epsilon_0}}$$

(c)



Btw the plates $E = E_1 - E_2$

$$= \frac{\sigma}{2\epsilon_0} - \frac{\sigma}{2\epsilon_0}$$

$$= 0$$

27 (a) Electrical torque,

$$\tau_{electric} = MB = NIAB \quad \text{— (1)}$$

Elastic torque, $\tau_{elastic} = C\phi$ — (2)

At equilibrium,

$$C\phi = NIAB$$

$$\phi = \frac{NAB}{C} I$$

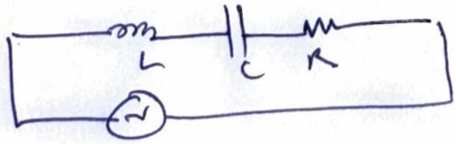
OR $\phi \propto I$

(b) $S_I = \frac{\phi}{I} = \frac{NAB}{C}$

$$S_V = \frac{\phi}{V} = \frac{\phi}{IR} = \frac{NAB}{CR}$$

(c) Increases

28

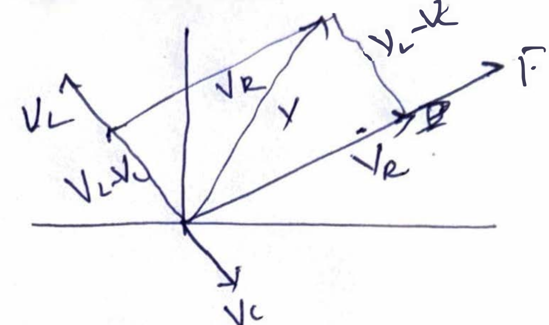


$I = I_0 \sin \omega t$

$V_R = V_m \sin \omega t$

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

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



Effective voltage,

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

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

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

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

OR

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

At resonance,

$$X_L = X_C$$

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

$$\omega^2 = \frac{1}{LC}$$

$$\omega = 2\pi f = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$

(b) $f = \frac{1}{2\pi\sqrt{LC}}$

$$= \frac{1}{2 \times 3.14 \sqrt{25.48 \times 10^{-3} \times 796 \times 10^{-6}}}$$

$$= \frac{1}{2 \times 3.14 \times \sqrt{20.28 \times 10^{-6}}}$$

$$= 35.4 \text{ Hz}$$

29 (a) Derivation of

$$\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(b) $R_1 = \cancel{+20\,cm}$ $R_1 = +R$

$R_2 = \cancel{-20\,cm}$ $R_2 = -R$

$n = 1.55$

$f = 20\,cm$

$$\frac{1}{f} = (n-1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$= (n-1) \times \frac{2}{R}$$

$$R = (n-1) \times 2f$$

$$= (1.55 - 1) \times 2 \times 20$$

$$= 0.55 \times 40$$

$$= 22\,cm$$

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