SECOND YEAR HSS MODEL EXAMINATION - 2023

HSE II

PHYSICS

(1) Electric Intensity $[E = F/q]$

(2) $C_1 = C/2$ $C_2 = 2C$ $\frac{C_1}{C_2} = \frac{1}{4}$

(3) Energy

(4) $\frac{E_0}{B_0} = C$, Velocity of light

(5) True

(6) Converging nature (Convex lens)

(7) Stability

(8) (a) doubled (Hint) $\left(V_d = \frac{eE}{m}\tau\right.$ $= \frac{e\tau}{m} \times \frac{V}{l}$.

(b) decreases

(9a) Am^2

(9b) Diamagnetic

(10) (a) No

Transformer works on the basis of mutual induction. A change in current in primary produces instantaneous emf in the secondary. Since there is no change in current in the case of DC, it cannot be varied using transformer

(b) Low hysterises loss (Area of hysterises curve is small)

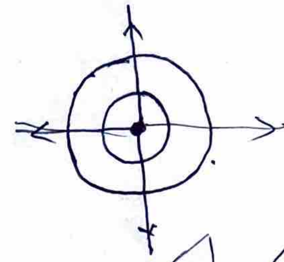
(11) a) Cellular phone

b) Water purifier

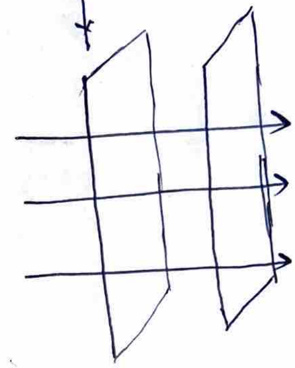
c) Radar

d) Night vision camera

(12) (i)



(ii)



(13) (a) Mass of the atom is concentrated in a small volume called nucleus and most of the portion are vacant space

(b) $180°$

(14) $E_b = [ZM_p + (A-Z)M_N - M]c^2$

$\Delta M = (20 \times 1.007825 + 20 \times 1.008665 - 39.962589)$ amu

$= (20.1565 + 20.1733 - 39.962589) \times 1.66 \times 10^{-27}$ kg

$= 0.367211 \times 1.66 \times 10^{-27}$

$= 0.60957 \times 10^{-27}$ kg

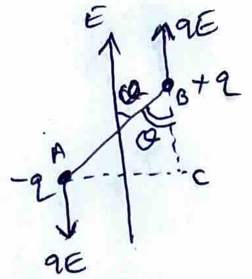
$E_b = \Delta M c^2 = 0.60957 \times 10^{-27} \times 9 \times 10^{16}$

$= 5.486 \times 10^{-11}$ J

(15) (a) It is the product of magnitude of charge and distance of separation

$\vec{p} = q \times 2\vec{l}$

15 (b)



Force acting on each charge are, $F = qE$, acting in opposite direction

Torque, τ = Force × ⊥r distance

$= qE \times AC$

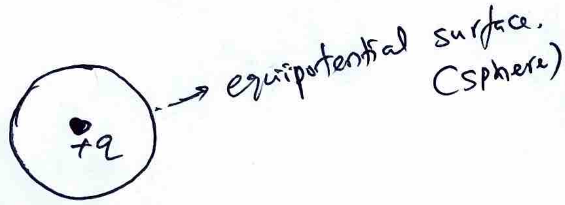
$= qE \times AB \sin\theta$

$= qE \times 2l \sin\theta$

$\boxed{\tau = pE \sin\theta}$

16

(a)



(b) No.

Inside a charged shell, electric field intensity is zero, but the electric potential is equal to the potential on the surface.

17 (a) By connecting a large resistor in series to a galvanometer.

(b) $R_G = 12\Omega$

$I_g = 3\times10^{-3}$ A

$V = 18$ V

$V = I_g(R + R_G)$

$R = \frac{V}{I_g} - R_G$

$= \frac{18}{3\times10^{-3}} - 12 = 5988\Omega$

By connecting $R = 5988\Omega$ in series to galvanometer, it can be converted to voltmeter

18 (a) Net magnetic flux through any closed surface is zero.

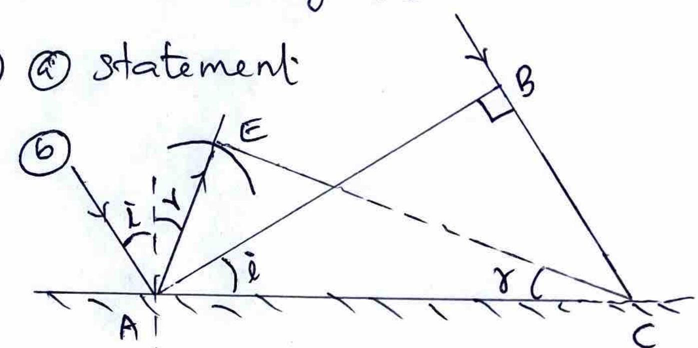
$\int_s \vec{B}\cdot\vec{ds} = 0$

(b) P — paramagnetic

Q → Diamagnetic

19 (a) statement

(b)



For incident ray with velocity V

$BC = Vt$ — (1)

For reflected wavefront, draw a sphere of radius Vt from A and CE is the tangent to the sphere.

∴ $AE = BC = Vt$

Now, ∆les EAC and BAC are congruent ⟹ $i = r$

20 (a) $\phi_0 = h\nu_0$ [frequency may be 4×10^{14} Hz]

$= 6.63\times10^{-34}\times4$

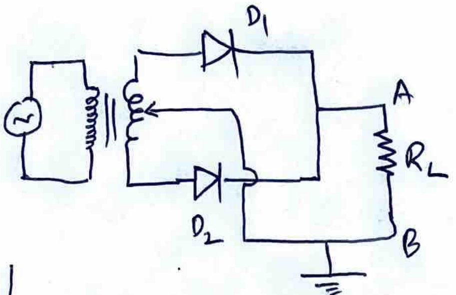
$= 26.52\times10^{-34}$ J

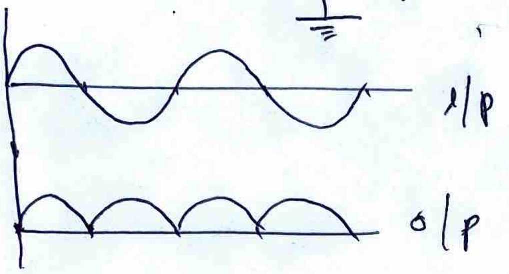
(b) $\frac{\phi_1}{\phi_2} = \frac{1}{2}$

$\phi = \frac{hc}{\lambda_0}$

$\frac{\lambda_1}{\lambda_2} = \frac{\phi_2}{\phi_1} = \frac{2}{1} \Rightarrow 2:1$

(21)





During +ve half cycle, D_1 is forward biased and D_2 is reverse biased. D_1 will conduct and a current flows from A to B.

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

In both half cycle, current flows from A to B, unidirectional.

(22) (a) $C = \frac{\varepsilon_0 A}{d}$

(i) Halved

(ii) Halved

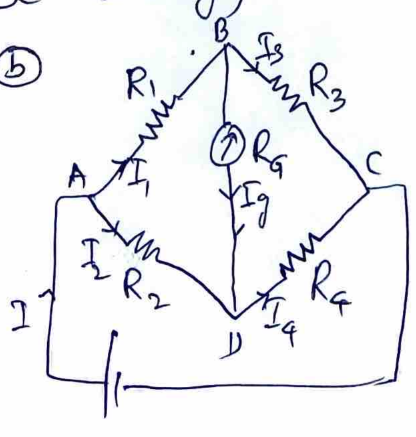
(b) $C = \frac{Q}{V} = \frac{1}{\text{slope}}$.

Slope of B > Slope of A

$\therefore C_A > C_B$.

(23) (a)(ii) Energy

(b)



For loop ABDA,

$$I_1 R_1 + I_g R_G + {}^{-}I_2 R_2 = 0 \quad \text{—(1)}$$

For loop BCDB,

$$I_3 R_3 + {}^{-}I_4 R_4 + {}^{-}I_g R_G = 0 \quad \text{—(2)}$$

When the bridge is balanced,

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

(1) ⇒ $I_1 R_1 = I_2 R_2$ —(3)

(2) ⇒ $I_1 R_3 = I_2 R_4$ —(4)

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

(24) (a) It is the magnetic flux linked with a coil if unit current passing through it.

$$\phi = LI$$

When I = 1 unit

$$\phi = L$$

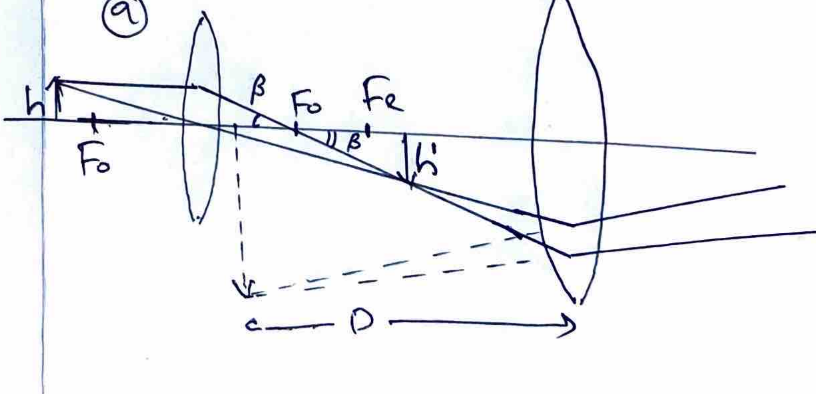
(b)

$$\phi = NBA$$
$$= N \times \frac{\mu_0 N I}{l} A$$
$$= \frac{\mu_0 N^2 A}{l} I$$

$$\boxed{L = \frac{\phi}{I} = \frac{\mu_0 N^2 A}{l}}$$

(25)

(a)



(b) Magnification,

$$M = M_o \times M_e$$

$$M = \frac{V_o}{U_o} \times \left(1 + \frac{D}{f_e}\right) \quad —①$$

(OR) $m_o = \frac{h'}{h} = \frac{L}{f_o}$

Since, $\tan\beta = \frac{h}{f_o} = \frac{h'}{L}$

Also, $M_e = 1 + D/f_e$

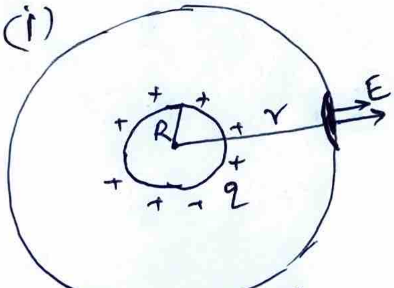
$$M = \frac{L}{f_o} \times \left(1 + D/f_e\right)$$

(26) (a) It is the number of electric field lines passing perpendicular through an area.

$$\phi = \int_s \vec{E} \cdot \vec{ds}$$

Unit → Nm^2/C (OR) Vm.

(b) (i)



—①

Let $\sigma = \frac{q}{4\pi R^2}$ be the surface charge density of spherical shell.

Electric flux through the small area ds of the spherical gaussian surface.

$$d\phi = E \cdot ds$$
$$= Eds$$

Total flux

$$\phi = \int Eds$$
$$= E \times 4\pi r^2 \quad —②$$

According to Gauss' law,

$$\phi = \frac{q}{\epsilon_0} = \frac{\sigma \times 4\pi R^2}{\epsilon_0} \quad —③$$

Now,

$$E \times 4\pi r^2 = \frac{q}{\epsilon_0}$$

$$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$$

(OR) $E \times 4\pi r^2 = \frac{\sigma \times 4\pi R^2}{\epsilon_0}$

$$E = \frac{\sigma}{\epsilon_0}\frac{R^2}{r^2}$$

(ii) Inside the spherical shell, the gaussian sphere does not enclose any charge, →

$$E \times 4\pi r^2 = \frac{q}{\epsilon_0} = 0$$

$$E = 0$$

(27) (a) circular.

(b) No.

Magnetic Lorentz force act as the centripetal force and the charge describes a circular path with uniform speed.

$\therefore KE = \frac{1}{2}mv^2 = $ Constant

(c) $\frac{mv^2}{r} = qvB$

$$\frac{v}{r} = \frac{qB}{m}$$

Time period $T = \frac{\text{Distance}}{\text{speed}}$

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

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

$= \frac{1}{2\pi} \times \frac{qB}{m}$ is independent of v

(28) (a) $V = 200\sqrt{2}\,\sin(100\pi t)$

$V = V_0 \sin \omega t$

$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{200\sqrt{2}}{\sqrt{2}} = 200\,V$

$\omega = 2\pi\nu = 100\pi$

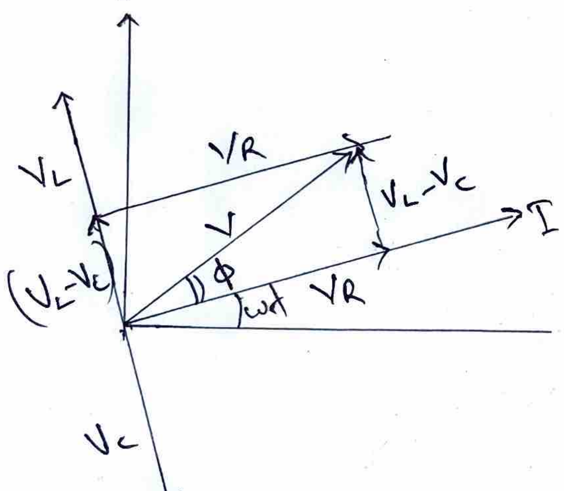
$\nu = \frac{100\pi}{2\pi} = 50\,Hz$

(b) Let current, $I = I_0 \sin \omega t$

$V_R = V_0 \sin \omega t$

$V_L = V_0 \sin(\omega t + \pi/2)$

$V_C = V_0 \sin(\omega t - \pi/2)$



Net voltage,

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

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

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

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

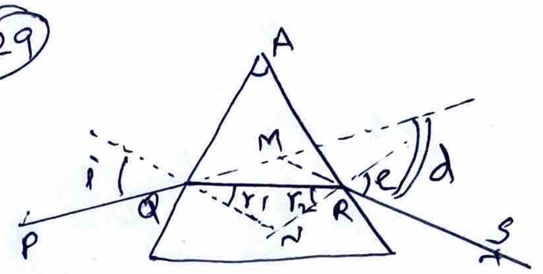
$= \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

(c) At resonance, $V = V_R$

then V and I are in phase

thus, $\phi = 0$.

(29)



From, ▱AQNR,

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

i.e., $\angle A + \angle N = 180^\circ$ —(1)

From △QNR, $r_1 + r_2 + \angle N = 180$ —(2)

$A = r_1 + r_2$ —(3)

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

$d = i + e - A$

At minimum deviation, $d = D$,

$r_1 = r_2 = r$

$i = e$

(3) ⇒ $A = 2r$

$r = A/2$

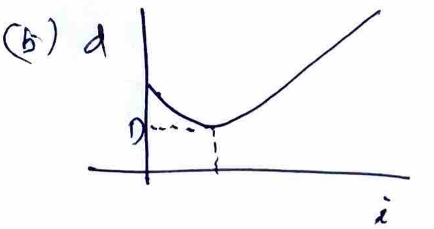
$D = 2i - A$

$i = \left(\frac{A+D}{2}\right)$

Then, Snell's law, $n = \frac{\sin i}{\sin r}$

$n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin(A/2)}$

(b)



(c) $n = 1.49$

$n = \frac{1}{\sin i_c}$

$\sin i_c = \frac{1}{n} = \frac{1}{1.49} = 0.6711$

$i_c = 42.18^\circ$

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