SECOND YEAR MODEL EXAMINATION MARCH 2022
PHYSICS

Part I - A

1) Coulomb

2) 90°

3) $\frac{h}{\lambda}$

4) $\frac{h}{2\pi}$

5) Neutrons - (A - Z)
protons - Z

6) False

7) $B_0 = \frac{\mu_0 n I}{2a}$ a → radius, I → current

8) Eddy current

9) Interference

part I B

10) b) Increases

11) d) Manganin.

12) Negative

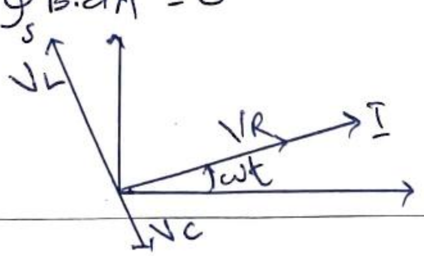
13) Scattering

part II - A

14) Surface integral magnetic field over a closed surface is always zero

$$\oint_S B.dA = 0$$

15)



16) a) NAND and NOR gates
b) We can create any logic gate circuit using these gates

17) Sources of light that emit light wave having same frequency, wavelength and zero or constant phase difference.

Part II - B

18) a) Circle
b) spiral $r = \frac{mv}{qB} \Rightarrow B\downarrow r\uparrow$

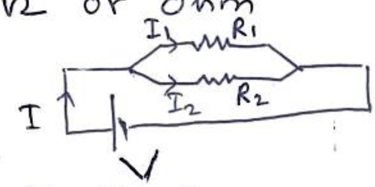
19) 1) Diagnose bone fracture
2) Treatment of cancer

20) $\vec{\tau} = \vec{p} \times \vec{E}$ or $\tau = pE\sin\theta$

Part III - A

21) a) Ω or ohm

b)



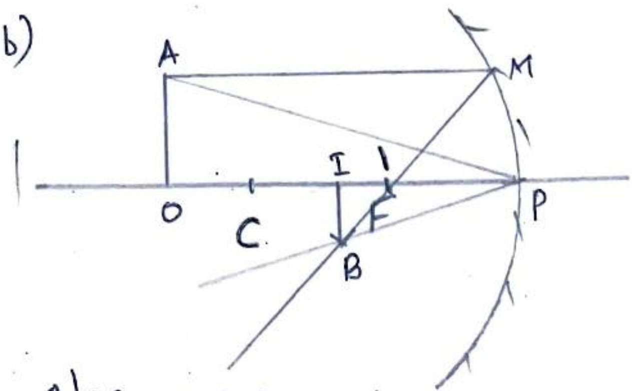
$I = I_1 + I_2$

$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2}$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ or $R = \frac{R_1 R_2}{R_1 + R_2}$

22) a) $R = 2f$

22) b)



Δles OAP and IBP are similar.

$$\frac{OA}{IB} = \frac{OP}{IP} \quad \text{——— (1)}$$

Δles IBF and PMF are similar.

$$\frac{PM}{IB} = \frac{FP}{IF} \qquad PM \equiv OA$$

$$\frac{OA}{IB} = \frac{FP}{IF}$$

$$= \frac{FP}{IP - FP} \quad \text{——— (2)}$$

(1) & (2) $\Rightarrow$

$$\frac{OP}{IP} = \frac{FP}{IP - FP}$$

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

$$uv - uf = vf$$

$\div$ing by $uvf \Rightarrow$

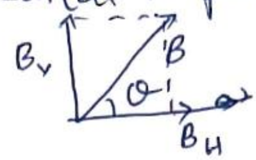
$$\frac{1}{f} - \frac{1}{v} = \frac{1}{u}$$

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

Applying signs, u, v, f are -ve

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

23) a) It is the angle between magnetic field of earth and its horizontal component



b) $$\tan\theta = \frac{B_V}{B_H}$$

$$B_V = B_H \tan 60$$

$$= 0.2 \times 10^{-4} \times \sqrt{3}$$

$$= 0.346 \times 10^{-4}\ Wb/m^2$$

24) a) 1) Potential is same everywhere

2) Workdone in moving a charge from one point to another in an equipotential surface is zero.

b) Spherical

Part. III - B

25) a) (1) photoelectric current is directly proportional to the intensity of incident light.

2) Kinetic energy of photo-electron is independant of the intensity of incident lingt, but depends of the fresnency of incident light

b) It is the retarding potential supplied to stop photoelectric emission.

26) It is the difference between Total mass of the nucleons and the mass of the nucleus

$$\Delta M = ZM_p + (A-Z)M_N - M$$

26) (b) Nuclear fission

27) a) It is the minimum amount of energy required to remove an electron from the outermost shell or to ionise an atom.

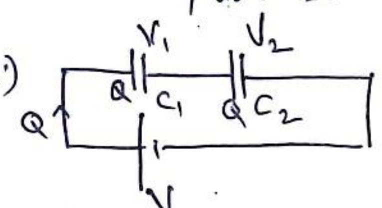
b) 1) The model is unable to explain the stability of an atom.

2) It could not explain the spectrum of H-atom.

3) The model could not explain the distribution of ē s in an atom.

Part IV - A

28) a)



Capacitors acquire same charge by induction.

$V = V_1 + V_2$

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

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

(OR) $C = \frac{C_1 C_2}{C_1 + C_2}$

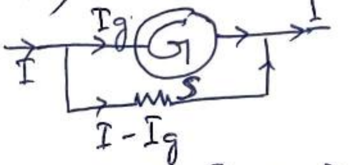
b) $U = \frac{1}{2} CV^2$

$= \frac{1}{2} \times 900 \times 10^{-6} \times 100^2$

$= 4.5$ J

29) a) A current carrying coil in a magnetic field experience a torque, and the coil rotates.

b) (i) To convert a MCG into ammeter, connect a low resistance parallel to it (shunt)



$I_g R_G = (I - I_g) S$

$S = \frac{I_g R_G}{I - I_g}$, is to be connected parallel to the galvanometer.

(b) (ii) To convert a MCG into voltmeter, connect a high resistance in series to it.

$V = I_g (R_G + R)$

$R = \frac{V}{I_g} - R_G$, to be connected in series to the galvanometer.

30) a) Self induction

b) Workdone against the back emf is stored as potential energy in inductor

Rate of workdone,

$$\frac{dW}{dt} = \text{induced emf} \times \text{current}$$

$$= e \times I$$

$$= L\frac{dI}{dt} \times I$$

$$dW = L I dI$$

$$W = \int dW = \int_0^I L I dI$$

$$= L\left(\frac{I^2}{2}\right)_0^I$$

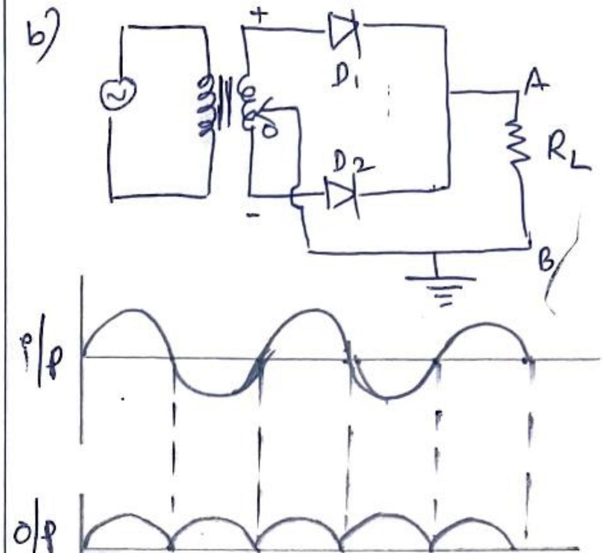
$$= \frac{1}{2} L I^2$$

This is the mag: potential energy stored in the inductor

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

31) a) Current flows through the diode in forward bias only and no current in reverse bias, when an alternating voltage is applied.

b)



When an ac voltage is applied, during +ve half cycle, D_1 is forward biased and D_2 is reversed biased. Now D_1 conduct and D_2 do not conduct and a current flows from A to B.

During -ve half cycle, D_1 is reverse biased and D_2 is forward biased. Now, D_2 conducts, and D_1 do not conduct and a current flows from A to B again. So, we get a unidirectional pulsating output across R_L

Part IV - B

32) a) Mutual induction

b) $V_p = 2300\,V$

$N_p = 4000$

$V_s = 230\,V$

$N_s = ?$

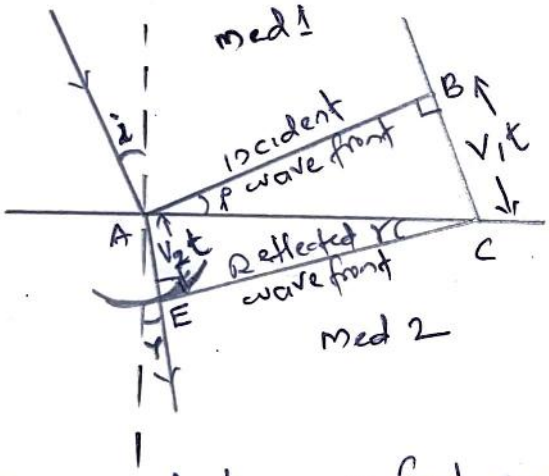
Transformer ratio,

$$\frac{N_s}{N_p} = \frac{V_s}{V_p}$$

$$N_s = \frac{V_s}{V_p} \times N_p = \frac{230}{2300} \times 4000$$

$$= \underline{\underline{400}}$$

33)



For incident wave front AB, moving with velocity v_1 in medium 1,

$$BC = V_1 t \quad \text{— (1)}$$

For getting the shape of reflected wave, draw a sphere of radius $V_2 t$ from point A in medium 2

Let CE be the tangent from C onto the sphere.

Then, $AE = V_2 t$ — (2) and CE is the reflected wavefront.

Now Δles ABC and AEC gives,

$$\sin i = \frac{BC}{AC} = \frac{V_1 t}{AC}$$

$$\sin r = \frac{AE}{AC} = \frac{V_2 t}{AC}$$

$$\frac{\sin i}{\sin r} = \frac{V_1 t}{V_2 t} = \frac{V_1}{V_2}$$

But $n_1 = \frac{c}{V_1}$; $n_2 = \frac{c}{V_2}$

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

(33) b) Defraction

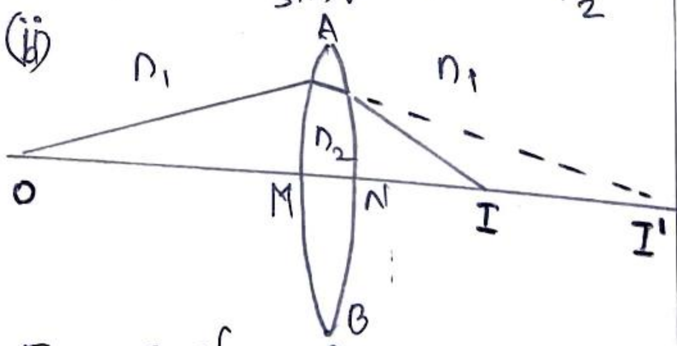
part V

34) i) statement OR

$$\frac{\sin i}{\sin r} = \text{Constant}$$

OR $\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{V_1}{V_2}$

(ii)



For surface AMB, image is formed at I', with image distance, say V'

Now, $\frac{n_2}{V'} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1}$ — (1)

where $R_1 \rightarrow$ radius of curvature of surface 1

Now, Second surface produce final image at I, with image distance V. For the second surface, image of the first surface act as the virtual object.

∴ For surface ANB

$$\frac{n_1}{v} - \frac{n_2}{v'} = \frac{n_1 - n_2}{R_2} \quad \text{—(2)}$$

(1)+(2) ⟹

$$\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{v} - \frac{1}{u} = \frac{n_2 - n_1}{n_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{—(3)}$$

If object is at infinity, image is formed at focus,

ie, if $u = \infty$, $v = f$

$$\therefore \frac{1}{f} - \frac{1}{\infty} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(iii) Virtual

35) a) flux (electric/magnetic)

b) statement

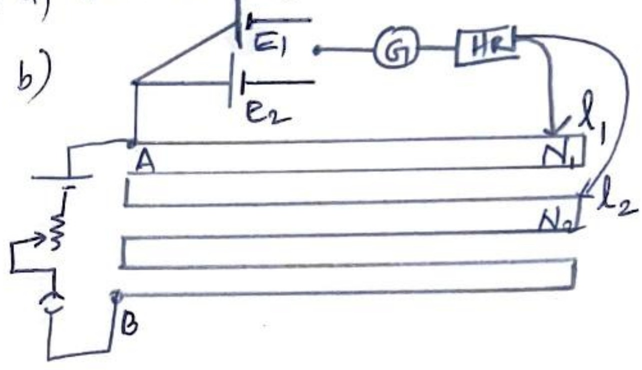
OR

$$\phi_E = \int_S \vec{E} \cdot \vec{ds} = \frac{q}{\varepsilon_0}$$

c) Derivation of $E = \frac{1}{2\pi\varepsilon_0}\frac{\lambda}{r}$

36) a) $V \propto l$ (OR) $E \propto l$.

b)



When the galvanometer is connected to E_1, we can apply Kirchhoff's rule for the loop AE_1GN_1A for the balancing length l_1 as,

$$\phi l_1 - E_1 = 0$$

$\phi \rightarrow$ potential drop / length.

$$E_1 = \phi l_1 \quad \text{—(1)}$$

For loop AE_2GN_1A with balancing length l_2

$$\phi l_2 - E_2 = 0$$

$$E_2 = \phi l_2 \quad \text{—(2)}$$

$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

c) $E_1 = 1.25\,V$ $l_1 = 35\,cm$, $l_2 = 70\,cm$

$$E_2 = \frac{l_2}{l_1} \times E_1 = \frac{70}{35} \times 1.25$$

$$= 2.5\,V$$

LALAN.V.M
HSST PHYSICS
GMBHSS Haripad
9496520070