

HSE II

PHYSICS

I Any 5 (1-7)

$5 \times 1 = 5$

- 1) Electric Flux density ( $\Phi_E = E$ )
- 2) Polarization
- 3) Paramagnetic
- 4) Visible light
- 5) Hertz
- 6)  $\frac{h}{2\pi}$

(OR)  
Electric intensity

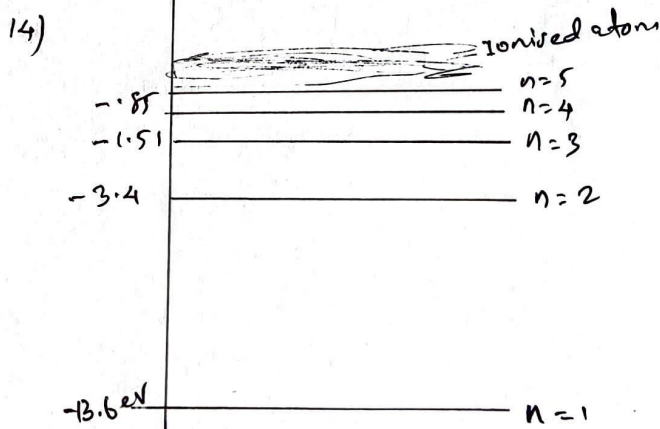
7) Insulator

(12) Sources which emits light with same frequency, wavelength and zero or constant phase difference. When light waves from coherent sources superimposed, sustained interference patterns produces.

(13)  $h\nu = \phi_0 + KE_{max}$

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

When light having particular frequency incident on a photo-sensitive substance, one part is used for emission of electron ( $\phi_0$ ) and remaining is used as kinetic energy. If frequency is less than threshold frequency ( $\nu_0$ ) no photo electric emission takes place.



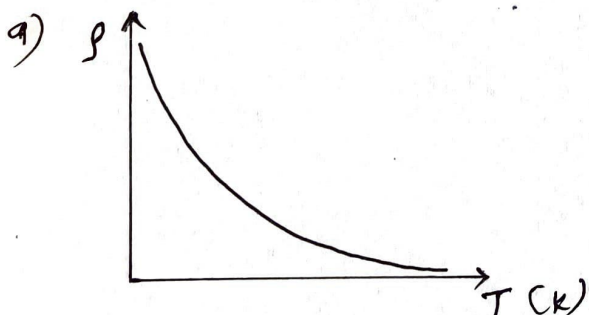
II Any 5 (8-14)

$5 \times 2 = 10$

8) Linear charge density  $\rightarrow$  charge distribution per unit length of a wire.  
 $\lambda = \frac{q}{l}$

Surface charge density. - charge distribution per unit area.

$\sigma = \frac{q}{A}$



10) (i) whenever magnetic flux linked with a conductor changes, an emf is induced in the coil. This induced emf lasts so long as the change in magnetic flux lasts.

(ii) Induced emf,  $\mathcal{E} = \frac{d\Phi_E}{dt}$

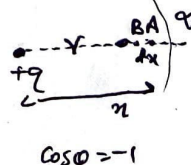
(OR) statement

11)  $P = \frac{V^2}{R}$       $R = \frac{V^2}{P} = \frac{220^2}{100} = 484 \Omega$

III Any 6 (15-21)

$6 \times 3 = 18$

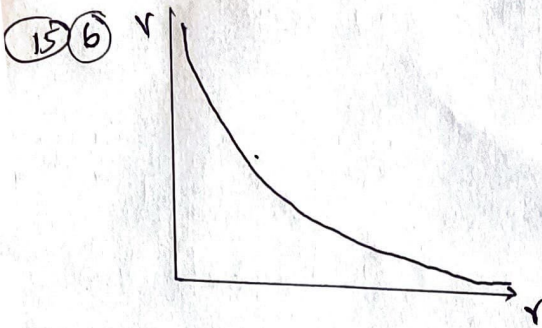
15) (a)  $E = \frac{1}{4\pi\epsilon_0} \frac{q}{x^2}$   
 $dW = \int_{x_1}^{x_2} \vec{E} \cdot d\vec{x}$   
 $= \int_{x_1}^{x_2} \frac{1}{4\pi\epsilon_0} \frac{q}{x^2} dx \cos\theta$   
 $= \frac{-q}{4\pi\epsilon_0} \left( \frac{-2+1}{-2+1} \right)^r$



$\cos\theta = -1$

$V = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$





(15) b) Statement (OR)

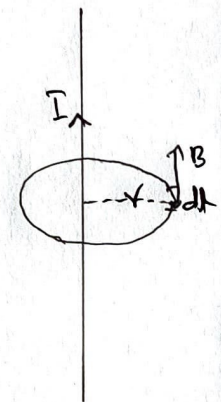
$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{enclosed}}$$

b)  $\int \vec{B} \cdot d\vec{l} = \mu_0 I$

$$B \int dl = \mu_0 I$$

$$B \times 2\pi r = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}$$



(17) Rate of work done

$$\frac{dw}{dt} = eI$$

$$= LI \frac{dI}{dt}$$

$$dw = LI dI$$

$$U = W = \int_0^I LI dI = L \left( \frac{I^2}{2} \right)_0^I = \frac{1}{2} LI^2$$

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

$$B = \mu_0 n I$$

$$= \frac{\mu_0 N I}{l}$$

$$I = \frac{Bl}{\mu_0 N}$$

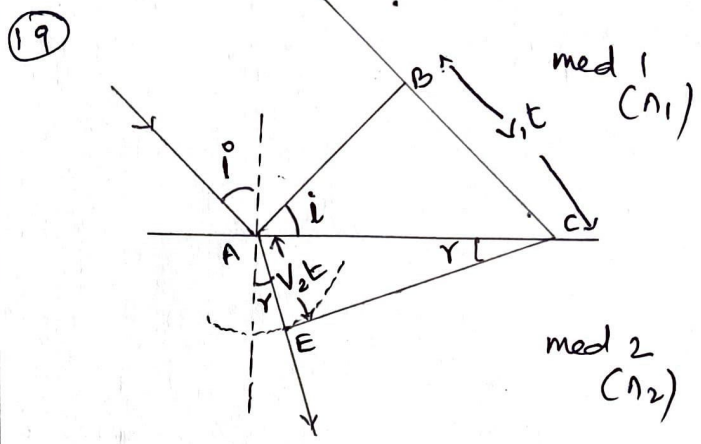
$$U = \frac{1}{2} \times \frac{\mu_0 N^2 A}{l} \times \frac{B^2 l^2}{\mu_0^2 N^2}$$

$$U = \frac{1}{2} \frac{B^2 l A}{\mu_0}$$

(18) An oscillating charged particle like electrons or ions produce oscillating electric field and magnetic field in space, which results in em waves.

(b) When infrared waves pass through water molecules, CO<sub>2</sub>, NH<sub>3</sub> etc, they readily absorb it and

(2) their thermal motion increases. They heat up and heat the surroundings. So IR are called heat waves.



AB is incident wavefront CE is refracted wavefront.

$$\Delta ABC \rightarrow \sin i = \frac{BC}{AC} = \frac{v_1 t}{AC}$$

$$\Delta AEC \rightarrow \sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$$

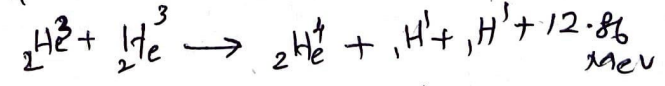
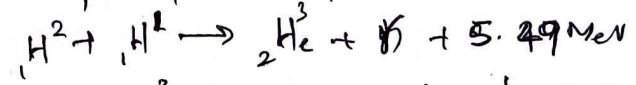
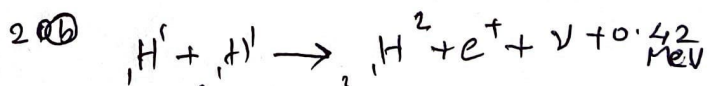
$$\frac{\sin i}{\sin r} = \frac{BC}{AE} = \frac{v_1 t}{v_2 t} = \frac{v_1}{v_2}$$

We have  $n_1 = \frac{c}{v_1}$  and  $n_2 = \frac{c}{v_2}$

$$\frac{v_1}{v_2} = \frac{n_2}{n_1}$$

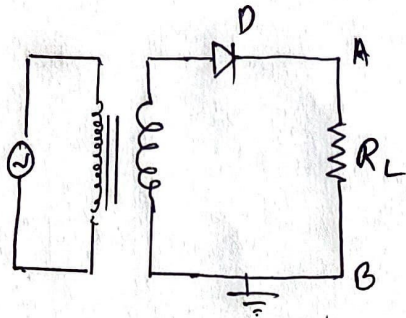
$$\therefore \frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \frac{n_2}{n_1} \rightarrow \text{Snell's Law.}$$

(20) It is the spontaneous disintegration of heavier unstable nucleus with the emission of particles or radiation and release of energy.

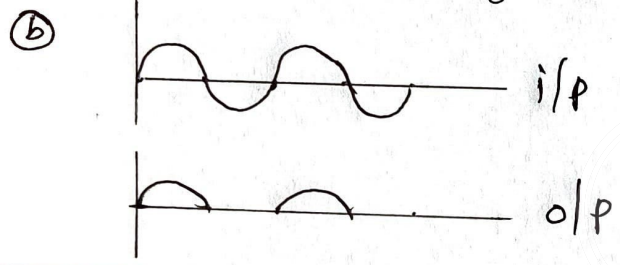


This is the proton-proton cycle occurs in stars.

21) a)

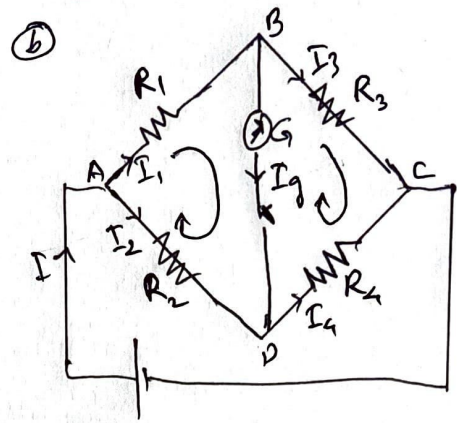


During positive half cycle of ac, Diode D is forward biased and it conducts current from A to B. During negative half cycle, D is reverse biased and it act as insulator, does not conduct. So, we get a unidirectional pulsating output



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23) a) Statement  
OR  
 $\sum IR + \sum E = 0$



For loop ABDA,  
 $I_1 R_1 + I_g R_g + I_2 R_2 = 0$  — (1)

For loop BCPB  
 $I_3 R_3 + I_g R_g + I_4 R_4 = 0$  — (2)

When bridge is balanced,  $I_g = 0$

$I_1 = I_3$   
 $I_2 = I_4$

$\therefore (1) \Rightarrow I_1 R_1 = I_2 R_2$  — (3)

$I_1 R_3 = I_2 R_4$  — (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) Statement

OR  
 $\int \vec{B} \cdot d\vec{s} = 0$

b) If monopoles exist, the law becomes,  
 $\int \vec{B} \cdot d\vec{s} = \mu_0 q_m$   
 $q_m \rightarrow$  monopole (magnetic charge)

(25) (i) Incident ray, normal, refracted ray in the same plane

(ii)  $\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \text{constant} \rightarrow$  Snell's law

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

(22) (a)  $U = \frac{1}{2} CV^2$  (derivation not required)

(b) When 2 capacitors are connected together, they attain same potential.

$V_1 = V_2$

$\frac{Q_1}{C} = \frac{Q_2}{C} \Rightarrow Q_1 = Q_2$

Also,  $Q_1 + Q_2 = Q \Rightarrow Q_1 = Q_2 = \frac{Q}{2}$

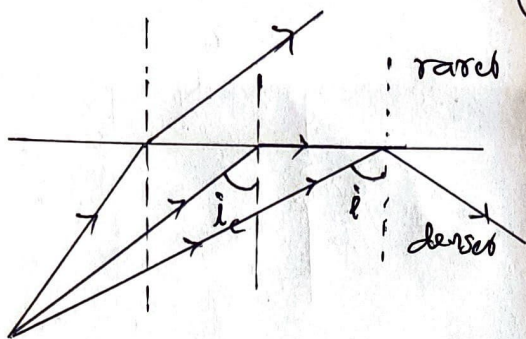
$\therefore V_1 = \frac{Q_1}{C} = \frac{Q}{2C} = \frac{V}{2} = \frac{100}{2} = 50V$

Also,  $V_2 = 50V$

$\therefore U = \frac{1}{2} C_1 V_1^2 + \frac{1}{2} C_2 V_2^2$   
 $= \frac{1}{2} \times 900 \times 10^{-12} (50^2 + 50^2)$   
 $= \frac{1}{2} \times 900 \times 10^{-12} \times 5000$   
 $= 2.25 \times 10^{-6} J$



25B

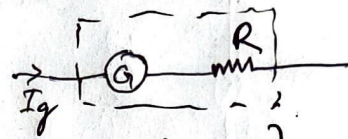


When light ray travels from denser to rarer and if the angle of incidence is greater than critical angle ( $i > i_c$ ), light ray totally reflected back to the same medium. This is Total internal reflection.

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(27) a)  $S_I = \frac{\Phi}{I}$  - deflection per unit current

(b) A galvanometer can be converted into voltmeter by connecting a high resistance in series with it.



$$V = I_g (G + R)$$

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

(c)  $R_A = 60 \Omega$

$R_1 = 3 \Omega$

$R = R_1 + R_A = 63 \Omega$

$V = 3V$

$I = \frac{V}{R} = \frac{3}{63} = 0.048A$

(28) a) Mutual induction

(b) step up

(i)  $N_p < N_s$

(ii)  $V_s > V_p$

(iii) Thickness of primary is more

(iv)  $I_s < I_p$

step down

(i)  $N_p > N_s$

(ii)  $V_s < V_p$

(iii) Thickness in secondary is more

(iv)  $I_s > I_p$

(c) copper loss, flux leakage loss, Eddy current loss, hysteresis loss.

29) (a) Diagram

Derivation of  $n = \frac{\sin A + D}{2 \sin A/2}$

(OR)

$A = r_1 + r_2$

$d = i + e - A$

$n = \frac{\sin i}{\sin r}$

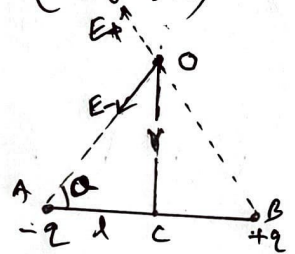
(b) For small angle,  $n \approx \frac{A + D}{2 \cdot A/2} = 1 + \frac{D}{A}$

$D = (n - 1) A$

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IV Any 3 (26-29) 3x5 = 15

26) a)



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

$E_{+q} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2 + l^2}$  along BO — (2)

$E = 2 E_{+q} \cos \alpha$   
 $= 2 \times \frac{1}{4\pi\epsilon_0} \frac{q}{r^2 + l^2} \times \frac{l}{(r^2 + l^2)^{1/2}}$

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

Since  $l^2 \ll r^2$   
 $E = \frac{1}{4\pi\epsilon_0} \frac{P}{r^3}$

(b)  $|q_A| = |q_B| = 2.5 \times 10^{-7} C$

$2l = z_2 - z_1 = 15 - 75$   
 $= 30 \text{ cm}$   
 $= 30 \times 10^{-2} \text{ m}$

Total charge,  $q = q_A + q_B = 0$   
 dipole moment  
 $p = q \times 2l = 2.5 \times 10^{-7} \times 30 \times 10^{-2}$   
 $= 7.5 \times 10^{-8} \text{ Cm}$