

PHYSICS
JEE-MAIN (April-Attempt) 9
April (Shift-1) Paper

SECTION - A

Q.1 The total number of turns and across-section area in a solenoid is fixed. However, its length L is varied by adjusting the separatoin between windings. The inductance of solenoid will be proportional to :

- (1) $\frac{1}{L^2}$ (2) L^2 (3) L (4) $\frac{1}{L}$

Sol. 4

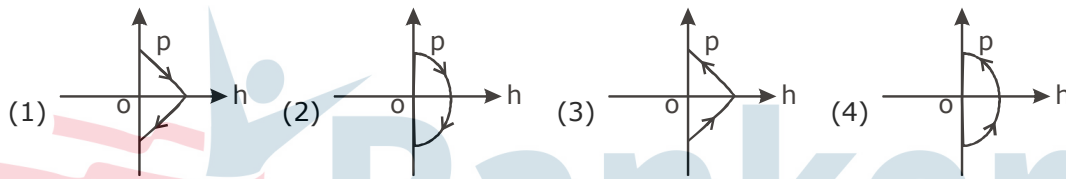
Self Inductance of solenoid = $\mu_0 n^2 A l$

$$\therefore \frac{L}{l} = \mu_0 n^2 \pi r^2 = \mu_0 \frac{N^2}{l^2} \pi r^2$$

$$\Rightarrow \boxed{L = \frac{\mu_0 N^2 \pi r^2}{l}}$$

$$\therefore \boxed{L \propto \frac{1}{l}}$$

Q.2 A ball is know id thrown vertically up (taken as + z - axis) from the ground. The correct momentum -height (p-h) diagram is :



Sol. 2

Velocity of particle at some height :

$$v^2 - u^2 = 2as$$

$$\Rightarrow v = \sqrt{u^2 + 2gh}$$

$$\text{Hence momentum} = m\sqrt{u^2 + 2gh}$$

$$p^2 = m^2 u^2 + 2m^2 gh$$

\therefore Option (2)

P first decreases and then increases.

Q.3 The Following bodies are made to roll up (without slipping) the same inclined plane from a horizontal plane : (i) a ring of radius R , (ii) a solid cylinder of radius $\frac{R}{2}$ and (iii) a solid sphere of

radius $\frac{R}{4}$. If in each case, the speed of the centre of mass at the bottom of the incline is same, the ratio of the maximum heights they climb is :

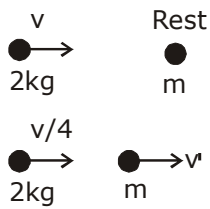
- (1) 2: 3: 4 (2) 14: 15: 20 (3) 4: 3: 2 (4) 10: 15: 7

Sol. 4

Q.4 A body of mass 2 kg makes an elastic collision with a second body at rest and continues to move in the original direction but with one fourth of its original speed. What is the mass of the second body ?

- (1) 1.2 kg (2) 1.8 kg (3) 1.0 kg (4) 1.5 kg

Sol. 1



from linear momentum conservation

$$2v = \frac{2v}{4} + mv'$$

$$\Rightarrow 2v - \frac{v}{2} = mv'$$

$$\Rightarrow mv' = \frac{4v - v}{2}$$

$$\Rightarrow mv' = \frac{3v}{2} \dots\dots(i)$$

$$e = 1 = \frac{v_2 - v_1}{u_1 - u_2}$$

$$\Rightarrow u_1 - u_2 = v_2 - v_1$$

$$\Rightarrow v = v' - \frac{v}{4}$$

$$\Rightarrow \boxed{v' = \frac{5v}{4}} \dots\dots(ii)$$

$$\therefore m \frac{5v}{4} = \frac{3v}{2}$$

$$\Rightarrow m = \frac{6}{5} \text{ kg} = 1.2 \text{ kg}$$

Q.5. A signal $A \cos \omega t$ is transmitted using $v_0 \sin \omega_0 t$ as carrier wave. The correct amplitude modulated (AM) signal is :

(1) $v_0 \sin[\omega_0(1 + 0.01A \sin \omega t)t]$

(2) $(v_0 + A) \cos \omega t \sin \omega_0 t$.

(3) $v_0 \sin \omega_0 t + A \cos \omega t$

(4) $v_0 \sin \omega_0 t + \frac{A}{2} \sin(\omega_0 - \omega)t + \frac{A}{2} \sin(\omega_0 + \omega)t$

Sol. 4

By NCERT

$$v_0 \sin \omega_0 t + \frac{A}{2} \sin(\omega_0 - \omega)t + \frac{A}{2} \sin(\omega_0 + \omega)t$$

All the Frequencies are present.

Q.6 The electric field of light wave is given as $\vec{E} = 10^{-3} \cos\left(\frac{2\pi x}{5 \times 10^{-7}} - 2\pi \times 6 \times 10^{14} t\right) \hat{x} \frac{N}{C}$ This light falls on a metal plate of work function 2eV. the stopping potential of the photo electrons is :

given, $E \text{ (in eV)} = \frac{12375}{\lambda \text{ (in \AA)}}$

- (1) 2.48 V (2) 2.0 V (3) 0.72 V (4) 0.48 V

Sol. 4

$$[E = E_0 \cos(kx - \omega t)]$$

$$K = \frac{2\pi}{5 \times 10^{-7}}$$

$$\therefore \lambda = 5 \times 10^{-7} \text{m}$$

$$\text{or } \boxed{\lambda = 5000 \text{\AA}}$$

$$\text{Now } E_{\text{phot}} = \frac{12375}{5000} = 2.475 \text{eV}$$

$$\text{Thus : } E = \phi + eV_0$$

$$\Rightarrow V_0 = \frac{E - \phi}{e}$$

$$= \frac{2.475 - 2}{1.6 \times 10^{-19}}$$

$$= 0.475 \text{V}$$



Q.7 In the density measurement of a cube, the mass and edge length are measured as (10.00 ± 0.10) kg and (0.10 ± 0.01) m, respectively. The error in the measurement of density is :

- (1) 0.31 kg/m³ (2) 0.01 kg/m³ (3) 0.10kg/m³ (4) 0.07 kg/m³

Sol. 1

$$m = (10.00 \pm 0.10) \text{kg}$$

$$l = (0.10 \pm 0.01) \text{m}$$

$$\text{Cube} \Rightarrow V = l^3$$

$$\rho = \frac{m}{V}$$

$$\pm \frac{d\rho}{\rho} = \pm \frac{dm}{m} \pm \frac{3dl}{l}$$

$$\Rightarrow \frac{d\rho}{\rho} = \frac{0.10}{10.00} + \frac{3(0.01)}{(0.10)}$$

$$\Rightarrow \frac{d\rho}{\rho} = 0.01 + 0.3$$

$$= 0.31$$

Q.8 A simple pendulum oscillating in air has period T . The bob of the pendulum is completely immersed in a non-viscous liquid. The density of the liquid is $\frac{1}{16}$ th of the material of the bob. If the bob is inside liquid all the time, its period of oscillation in this liquid is :

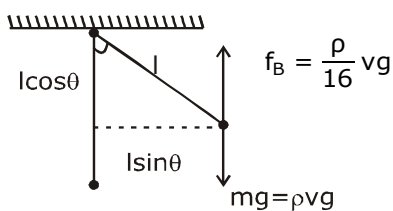
- (1) $4T\sqrt{\frac{1}{15}}$ (2) $2T\sqrt{\frac{1}{10}}$ (3) $2T\sqrt{\frac{1}{14}}$ (4) $4T\sqrt{\frac{1}{14}}$

Sol. 1

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\rho_l = \frac{\rho_B}{16}$$

$$\tau_{\text{net}} = I\alpha$$



$$\Rightarrow (\rho vg - \frac{\rho}{16} vg) \times l \sin \theta = (\rho v) l^2 \alpha$$

$$\Rightarrow \frac{15}{16} \rho v g l \sin \theta = \rho v l^2 \alpha$$

$$\Rightarrow \alpha = \frac{15g}{16l} \sin \theta$$

θ is small

$$\therefore \alpha = \frac{15g}{16l} \theta$$

Compare ; $\alpha = -\omega^2 \theta$

$$\therefore \omega = \sqrt{\frac{15g}{16l}}$$

$$\text{Hence : } T_{\text{new}} = 2\pi\sqrt{\frac{16l}{15g}} = 4 \times 2\pi\sqrt{\frac{l}{15g}}$$

$$\therefore T_{\text{new}} = 4T\sqrt{\frac{1}{15}}$$

Q.9 Taking the wavelength of first Balmer line in hydrogen spectrum ($n = 3$ to $n = 2$) as 660 nm, the wavelength of the 2nd Balmer line ($n = 4$ to $n = 2$) will be :

- (1) 889.2 nm (2) 488.9 nm (3) 388.9 nm (4) 642.7 nm

Sol. 2

By Rydberg formula :

$$\frac{1}{\lambda_1} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5}{36}R$$

$$\frac{1}{\lambda_2} = R\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \frac{3}{16}R$$

$$\therefore \frac{\lambda_2}{\lambda_1} = \frac{5R/36}{3R/16} = \frac{20}{27}$$

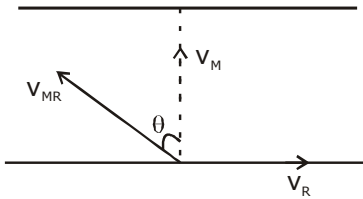
$$\lambda_2 = \frac{20}{27} \times 660$$

$$= 488.88 \text{ nm}$$

Q.10 The stream of a river is flowing with a speed of 2 km/h. A swimmer can swim at a speed of 4km/h. What should be the direction of the swimmer with respect to the flow of the river to across the river straight ?

- (1) 90° (2) 60° (3) 150° (4) 120°

Sol. 4



$$v_R = 2\text{ km / hr}$$

$$v_{MR} = 4\text{ km / hr}$$

$$\therefore \sin \theta = \frac{v_R}{v_{MR}} = \frac{2}{4} = \frac{1}{2}$$

$$\theta = 30^\circ \text{ with vertical}$$

$$\therefore \theta \text{ with river flow} = 30^\circ + 90^\circ = 120^\circ$$

Q.11 A concave mirror for face viewing has focal length of 0.4 m. The distance at which you hold the mirror from your face in order to see your image upright with a magnification of 5 is :

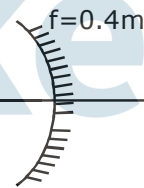
- (1) 0.16 m (2) 0.32 m (3) 1.60 m (4) 0.24 m

Sol. 2

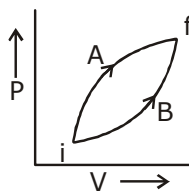
$$m = 5 = \frac{f}{f - u}$$

$$\Rightarrow 5 = \frac{-0.4}{-0.4 - u}$$

$$\Rightarrow u = -0.32\text{ m}$$



Q.12 Following figure shows two processes A and B for a gas. If ΔQ_A and ΔQ_B are the amount of heat absorbed by the system in two cases, and ΔU_A and ΔU_B are changes in internal energies, respectively, then :



(1) $\Delta Q_A > \Delta Q_B, \Delta U_A = \Delta U_B$

(2) $\Delta Q_A < \Delta Q_B, \Delta U_A < \Delta U_B$

(3) $\Delta Q_A > \Delta Q_B, \Delta U_A > \Delta U_B$

(4) $\Delta Q_A = \Delta Q_B; \Delta U_A = \Delta U_B$

Sol. 2

By FLOT :

$$dQ = du + dw$$

$$dw_A > dw_B$$

$$\therefore \Delta Q_A > \Delta Q_B$$

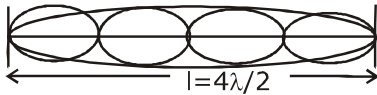
$$\Delta U_A = \Delta U_B \text{ (Initial and final conditions are same)}$$

Q.13 A string is clamped at both the ends and it is vibrating in its 4th harmonic. The equation of the stationary wave is $Y=0.3 \sin(0.157x) \cos(200\pi t)$. The length of the string is : (All quantities are in SI units.)

- (1) 60 m (2) 40 m (3) 20 m (4) 80m

Sol. 4

$$Y=0.3 \sin(0.157x) \cos(200\pi t)$$



$$f_1 = \frac{v}{2l}$$

$$f_4 = \frac{4v}{2l}$$

4th Harmonic

$$k = 0.157 = \frac{2\pi}{\lambda}$$

$$\Rightarrow \lambda = \frac{2\pi}{0.157}$$

$$\frac{4\lambda}{2} = l \Rightarrow 2\lambda = l$$

$$\Rightarrow \frac{2 \times 2\pi}{0.157} = l$$

$$\Rightarrow l = 80\text{m}$$

14. A moving coil galvanometer has resistance 50Ω and it indicates full deflection at 4 mA current. A voltmeter is made using this galvanometer and a $5 \text{ k}\Omega$ resistance. The maximum voltage, that can be measured using this voltmeter, will be close to :

- (1) 20 V (2) 40 V (3) 15 V (4) 10 V

Sol. 1

$$V = i_g(R + R_g)$$

$$= 4 \times 10^{-3}(5000 + 50)$$

$$\approx 20\text{V}$$

15. If 'M' is the mass of water that rises in a capillary tube of radius 'r', then mass of water which will rise in a capillary tube of radius '2r' is :

- (1) 2 M (2) M (3) 4 M (4) $\frac{M}{2}$

Sol. 1

$$m = \rho Ah$$

$$\Rightarrow m = \rho \times \pi r^2 \times \frac{2T \cos \theta}{r\rho g}$$

$$\Rightarrow m = \frac{2T r \pi \cos \theta}{g}$$

$$\Rightarrow m \propto r$$

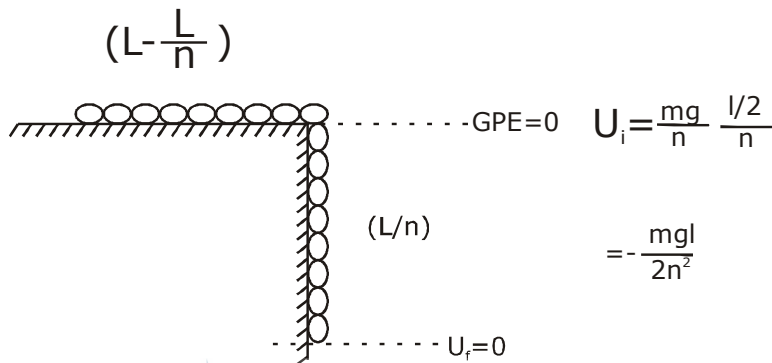
for 2r tube

$$\text{mass} = 2M$$

Q.16 A uniform cable of mass 'M' and length 'L' is placed on a horizontal surface such that its $(\frac{1}{n})^{\text{th}}$ part is hanging below the edge of the surface. To lift the hanging part of the cable upto the surface, the work done should be :

- (1) $\frac{Mgl}{n^2}$ (2) $\frac{2Mgl}{n^2}$ (3) $\frac{Mgl}{2n^2}$ (4) $nMgL$

Sol. 3



$$W_c = -\Delta U$$

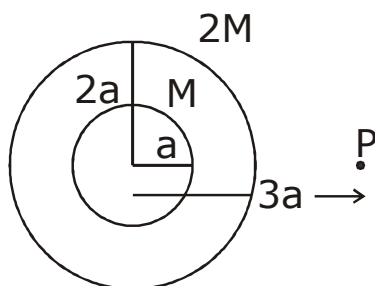
$$= -(U_f - U_i)$$

$$\Rightarrow W_c = \frac{mgl}{2n^2}$$

Q.17 A solid sphere of mass 'M' and radius 'a' is surrounded by a uniform concentric spherical shell of thickness 2a and mass 2M. The gravitational field at distance '3a' from the centre will be :

- (1) $\frac{2GM}{9a^2}$ (2) $\frac{GM}{9a^2}$ (3) $\frac{GM}{3a^2}$ (4) $\frac{2GM}{3a^2}$

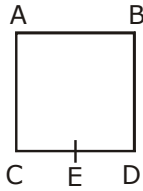
Sol. 3



$$g_p = \frac{Gm}{(3a)^2} + \frac{G2M}{(3a)^2}$$

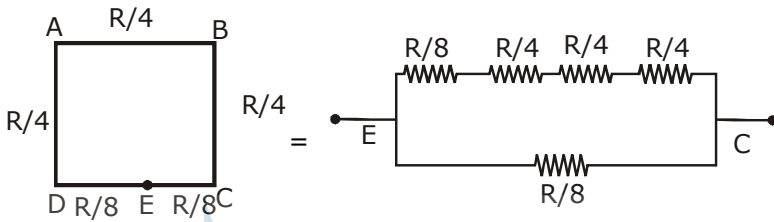
$$= \frac{3GM}{9a^2} = \frac{GM}{3a^2}$$

Q.18 A wire of resistance R is bent to form a square $ABCD$ as shown in the figure. The effective resistance between E and C is :
(E is mid-point of arm CD)



- (1) $\frac{3}{4}R$ (2) R (3) $\frac{1}{16}R$ (4) $\frac{7}{64}R$

Sol. 4



$$\therefore R_{eq} = \frac{7R}{64}$$

Q.19 A stationary horizontal disc is free to rotate about its axis. When a torque is applied on it, its kinetic energy as a function of θ , where θ is the angle by which it has rotated, is given as $k\theta^2$. If its moment of inertia is I then the angular acceleration of the disc is :

- (1) $\frac{k}{4I}\theta$ (2) $\frac{2k}{I}\theta$ (3) $\frac{k}{2I}\theta$ (4) $\frac{k}{I}\theta$

Sol. 2

Given :

$$\frac{1}{2}I\omega^2 = K\theta^2$$

$$\Rightarrow \omega^2 = \frac{2k\theta^2}{I}$$

Diff. wrt θ :

$$2\omega \frac{d\omega}{d\theta} = \frac{4k\theta}{I}$$

$$\Rightarrow 2\alpha = \frac{4k\theta}{I}$$

$$\Rightarrow \alpha = \frac{2k\theta}{I}$$

Q.20 An NPN transistor is used in common emitter configuration as an amplifier with $1\text{ k}\Omega$ load resistance. Signal voltage of 10 mV is applied across the base-emitter. This produces a 3 mA change in the collector current and $15\text{ }\mu\text{A}$ change in the base current of the amplifier. The input resistance and voltage gain are :

- (1) $0.33\text{ k}\Omega, 1.5$ (2) $0.33\text{ k}\Omega, 300$ (3) $0.67\text{ k}\Omega, 200$ (4) $0.67\text{ k}\Omega, 300$

Sol. 4

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B} = \frac{10 \times 10^{-3}}{15 \times 10^{-6}} = 0.67\text{ k}\Omega$$

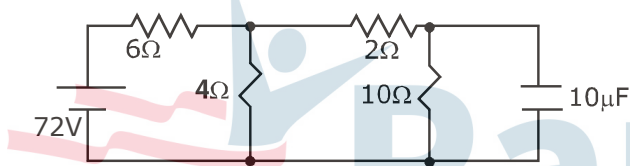
$$A_V = \beta \frac{R_L}{R_i}$$

$$\beta = \frac{I_C}{I_B}$$

$$\Rightarrow A_V = \frac{3 \times 10^{-3}}{15 \times 10^{-6}} \times \frac{1000}{0.67 \times 1000}$$

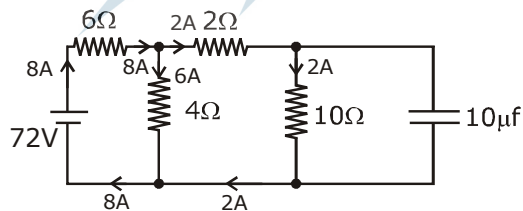
$$= 300$$

Q.21 Determine the charge on the capacitor in the following circuit :



- (1) $2\text{ }\mu\text{C}$ (2) $200\text{ }\mu\text{C}$ (3) $10\text{ }\mu\text{C}$ (4) $60\text{ }\mu\text{C}$

Sol. 2



$$R = \frac{12 \times 4}{12 + 4} = 3$$

$$R_{eq} = 9\Omega$$

$$V = iR_{eq}$$

$$\Rightarrow i = \frac{72}{9} = 8\text{ A}$$

$$V \text{ across } C = iR = 2 \times 10 = 20\text{ V}$$

$$\therefore Q = CV = 10 \times 10^{-6} \times 20 = 200\text{ }\mu\text{C}$$

Q.22 An HCl molecule has rotational, translational and vibrational motions. If the rms velocity of HCl molecules in its gaseous phase is \bar{v} , m is its mass and k_B is Boltzmann constant, then its temperature will be :

- (1) $\frac{mv^{-2}}{7k_B}$ (2) $\frac{mv^{-2}}{5k_B}$ (3) $\frac{mv^{-2}}{3k_B}$ (4) $\frac{mv^{-2}}{6k_B}$

Sol. 4

$$\frac{6}{2}KT = \frac{1}{2}mv^2$$

$$= T = \frac{mv^2}{6k}$$

Q.23 A rectangular coil (Dimension $5\text{cm} \times 2.5\text{cm}$) with 100 turns, carrying a current of 3 A in the clockwise direction, is kept centered at the origin and in the X-Z plane. A magnetic field of 1 T is applied along X-axis, If the coil is tilted through 45° about Z-axis, then the torque on the coil is :

- (1) 0.38 Nm (2) 0.42 Nm (3) 0.27 Nm (4) 0.55 Nm

Sol. 3

$$\tau = MB \sin 45^\circ$$

$$= \frac{NiAB}{\sqrt{2}} = \frac{1000 \times 3 \times 12.5 \times 10^{-4} \times 1}{1.414}$$

$$= 0.27\text{Nm}$$

Q.24 for a given gas at 1 atm pressure, rms speed of the molecules is 200 m/s at 127°C . At 2 atm pressure and at 227°C , the rms speed of the molecules will be :

- (1) $100\sqrt{5}$ m/s (2) 80 m/s (3) $80\sqrt{5}$ m/s (4) 100 m/s

Sol. 1

$$V_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$T_1 = 127^\circ\text{C} = 400\text{K}$$

$$T_2 = 227^\circ\text{C} = 500\text{K}$$

$$\therefore \frac{V_{\text{rms1}}}{V_{\text{rms2}}} = \sqrt{\frac{T_1}{T_2}}$$

$$\Rightarrow \frac{200}{V_2} = \sqrt{\frac{400}{500}}$$

$$V_2 = 100\sqrt{5}\text{m/s}$$

Q.25 The pressure wave, $P = 0.01 \sin[1000t - 3x]\text{Nm}^{-2}$, corresponds to the sound produced by a vibrating blade on a day when atmospheric temperature is 0°C . On some other day when temperature is T , the speed of sound produced by the same blade and at the same frequency is found to be 336ms^{-1} . Approximate value of T is :

- (1) 4°C (2) 15°C (3) 11°C (4) 12°C

Sol. 1

$$P = 0.01 \sin[1000t - 3x]\text{Nm}^{-2}$$

$$\omega = 1000 \Rightarrow V_1 = \frac{\omega}{k}$$

$$k = 3$$

$$V_1 = \frac{1000}{3} \text{ m/s}$$

At Temperature T :

$$V_2 = 336 \text{ m/s}$$

$$(v = \sqrt{\frac{\gamma RT}{M}})$$

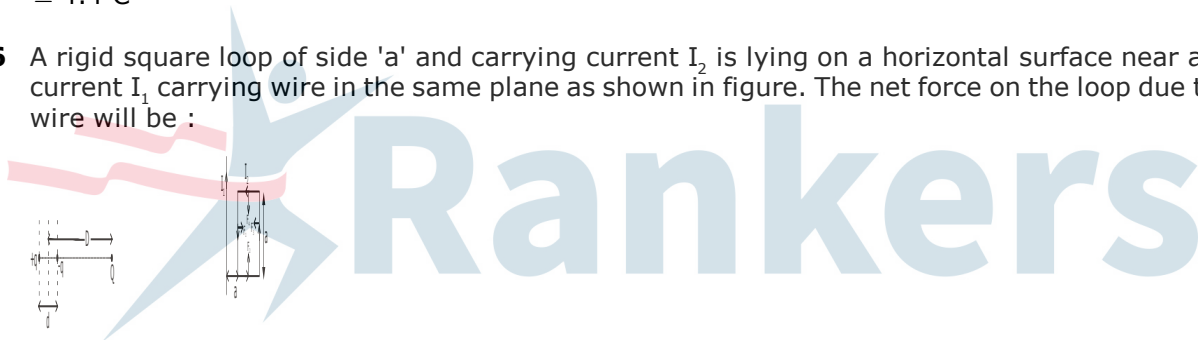
$$\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{1000/3}{336} = \sqrt{\frac{273}{T_2}}$$

$$T = 277.4 \text{ K}$$

$$\approx 4.4^\circ \text{C}$$

Q.26 A rigid square loop of side 'a' and carrying current I_2 is lying on a horizontal surface near a long current I_1 carrying wire in the same plane as shown in figure. The net force on the loop due to the wire will be :



(1) Zero

(2) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{4\pi}$

(3) Attractive and equal to $\frac{\mu_0 I_1 I_2}{3\pi}$

(4) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{2\pi}$

Sol. 2

Here F_2 and F_4 cancels.

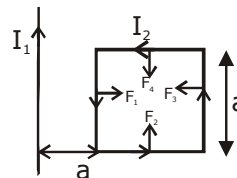
F_1 and F_3 are added

$$\therefore F_1 = \frac{\mu_0 i_1}{2\pi a} \times i_2 \times a$$

$$F_2 = \frac{\mu_0 i_1}{2\pi 2a} \times i_2 \times a$$

$$(F_1 > F_2)$$

$$\therefore F_{\text{net}} = F_1 - F_2 = \frac{\mu_0 i_1 i_2}{4\pi a} \text{ (Repulsive)}$$



Q.27 The magnetic field of a plane electromagnetic wave is given by :

$\vec{B} = B_0 \hat{i} [\cos(kz - \omega t)] + B_1 \hat{j} \cos(kz + \omega t)$ Where $B_0 = 3 \times 10^{-5} \text{ T}$ and $B_1 = 2 \times 10^{-6} \text{ T}$. The rms value of the force experienced by a stationary charge $Q = 10^{-4} \text{ C}$ at $z=0$ is closest to :

- (1) $3 \times 10^{-2} \text{ N}$ (2) 0.6 N (3) 0.9 N (4) 0.1 N

Sol. 2

$$\vec{B} = B_0 \hat{i} [\cos(kz - \omega t)] + B_1 \hat{j} \cos(kz + \omega t)$$

$$\therefore \vec{E} = -CB_0 \cos(kz - \omega t) \hat{j} - CB_1 \cos(kz + \omega t) \hat{i}$$

Thus rms value of force

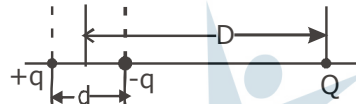
$$F_{\text{rms}} = qE$$

$$= 10^{-4} \left[\left(\frac{CB_0}{\sqrt{2}} \right)^2 + \left(\frac{CB_1}{\sqrt{2}} \right)^2 \right]^{\frac{1}{2}}$$

$$= \frac{10^{-4} \times 3 \times 10^8}{\sqrt{2}} \left[(3 \times 10^{-5})^2 + (2 \times 10^{-6})^2 \right]^{\frac{1}{2}}$$

$$\approx 0.63 \text{ N}$$

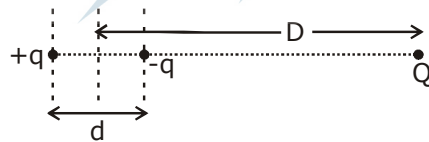
Q.28 A system of three charges are placed as shown in the figure :



If $D \gg d$, the potential energy of the system is best given by :

- (1) $\frac{1}{4\pi\epsilon_0} \left[+\frac{q^2}{d} + \frac{qQd}{D^2} \right]$ (2) $\frac{1}{4\pi\epsilon_0} \left[-\frac{q^2}{d} - \frac{qQd}{2D^2} \right]$ (3) $\frac{1}{4\pi\epsilon_0} \left[-\frac{q^2}{d} + \frac{2qQd}{D^2} \right]$ (4) $\frac{1}{4\pi\epsilon_0} \left[-\frac{q^2}{d} - \frac{qQd}{D^2} \right]$

Sol. 4



If $D \gg d$

$$U = \frac{-kq^2}{d} + \frac{kqQ}{D + \frac{d}{2}} - \frac{kqQ}{D - \frac{d}{2}}$$

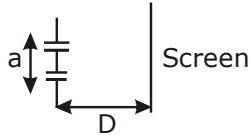
$$U = \frac{-kq^2}{d} - \frac{kqQd}{(D^2 - \frac{d^2}{4})}$$

Now

$D \gg d$

$$\therefore U = \frac{-kq^2}{d} - \frac{kqQd}{D^2}$$

Q.29 The figure shown a Young's double slit experimental setup. It is observed that when a thin transparent sheet of thickness t and refractive index μ is put in front of one of the slits, the central maximum gets shifted by a distance equal to n fringes widths. If the wavelength of light used is λ , t will be :



- (1) $\frac{nD\lambda}{a(\mu - 1)}$ (2) $\frac{2nD\lambda}{a(\mu - 1)}$ (3) $\frac{D\lambda}{a(\mu - 1)}$ (4) $\frac{2D\lambda}{a(\mu - 1)}$

Sol. 1
We know that :

$$\Delta x = \frac{dy}{D}$$

$$\Delta x = n\beta$$

$$(\mu - 1)t = \frac{nD\lambda}{a}$$

$$\Rightarrow t = \frac{nD\lambda}{a(\mu - 1)}$$

Q.30 A capacitor with capacitance $5 \mu\text{F}$ is charged to $5 \mu\text{C}$. If the plates are pulled apart to reduce the capacitance to $2 \mu\text{F}$, how much work is done ?

- (1) $2.55 \times 10^{-6}\text{J}$ (2) $6.25 \times 10^{-6}\text{J}$ (3) $2.16 \times 10^{-6}\text{J}$ (4) $3.75 \times 10^{-6}\text{J}$

Sol. 4
 $C_i = 5\mu\text{F}; Q = 5\mu\text{C}$
 $C_f = 2\mu\text{F}$

$$W = \frac{Q^2}{2C_f} - \frac{Q^2}{2C_i}$$

Put the values :

$$W = 3.75 \times 10^{-6}\text{J}$$