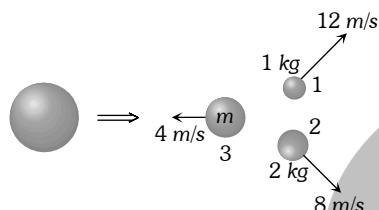


PHYSICS

151. An explosion blows a rock into three parts. Two parts go off at right angles to each other. These two are, 1 kg first part moving with a velocity of 12 ms^{-1} and 2 kg second part moving with a velocity of 8 ms^{-1} . If the third part flies off with a velocity of 4 ms^{-1} , its mass would be

- (1) 5 kg (2) 7 kg (3) 17 kg (4) 3 kg

Sol. (1)



According to conservation of linear momentum $p_3 = \sqrt{p_1^2 + P_2^2}$

$$\Rightarrow m \times 4 = \sqrt{(1 \times 12)^2 + (2 \times 8)^2} = 20 \Rightarrow m = 5 \text{ kg.}$$

152. A conducting circular loop is placed in a uniform magnetic field 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s . The induced *emf* in the loop when the radius is 2 cm is

- (1) $3.2 \pi \mu\text{V}$ (2) $4.8 \pi \mu\text{V}$ (3) $0.8 \pi \mu\text{V}$ (4) $1.6 \pi \mu\text{V}$

Sol. (1) $|e| = \frac{d\phi}{dt} = B \frac{d\Delta}{dt} = B \frac{d}{dt}(\pi r^2) = 2\pi Br \frac{dr}{dt}$

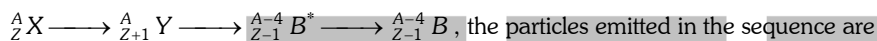
$$\Rightarrow |e| = 2\pi \times 0.04 \times 2 \times 10^{-2} \times 2 \times 10^{-3} = 3.2 \pi \mu\text{V}$$

153. If the dimensions of a physical quantity are given by $M^a L^b T^c$, then the physical quantity will be

- (1) Pressure if $a = 1, b = -1, c = -2$ (2) Velocity if $a = 1, b = 0, c = -1$
 (3) Acceleration if $a = 1, b = 1, c = -2$ (4) Force if $a = 0, b = -1, c = -2$

Sol. (1) $[P] = [ML^{-1}T^{-2}]$

154. In the nuclear decay given below



- (1) β, α, γ (2) γ, β, α (3) β, γ, α (4) α, β, γ

Sol. (1)

155. Three concentric spherical shells have radii a, b and c ($a < b < c$) and have surface charge densities $\sigma, -\sigma$ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then, for $c = a + b$, we have

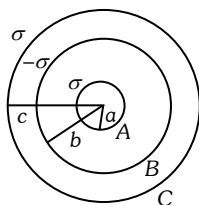
- (1) $V_C = V_A \neq V_B$ (2) $V_C = V_B \neq V_A$ (3) $V_C \neq V_B \neq V_A$ (4) $V_C = V_B = V_A$

Sol. (1) $V_A = \frac{\sigma}{\epsilon_0}(a - b + c)$

$$V_B = \frac{\sigma}{\epsilon_0} \left(\frac{a^2}{b} - b + c \right)$$

$$V_C = \frac{\sigma}{\epsilon_0} \left(\frac{a^2}{c} - \frac{b^2}{c} + c \right)$$

On putting $c = a + b \Rightarrow V_A = V_C \neq V_B$



156. A bus is moving with a speed of 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100 s. If the bus is at a distance of 1 km from the scooterist, with what speed should the scooterist chase the bus

- (1) 20 ms^{-1} (2) 40 ms^{-1} (3) 25 ms^{-1} (4) 10 ms^{-1}

Sol. (1) $S_{\text{scooter}} = S_{\text{Bus}} + 1000$
 $\Rightarrow u \times 100 = 10 \times 100 + 1000 \Rightarrow u = 20 \text{ m/s}$

157. Under the influence of a uniform magnetic field, a charged particle moves with constant speed V in a circle of radius R . The time period of rotation of the particle

- (1) depends on V and not on R (2) depends on R and not on V
 (3) is independent of both V and R (4) depends on both V and R

Sol. (3) $T = \frac{2\pi m}{qB} \Rightarrow T \propto V^0$ & $T \propto R^0$

158. A wave in a string has an amplitude of 2 cm. The wave travels in the +ve direction of x axis with a speed of 128 m/sec. and it is noted that 5 complete waves fit in 4 m length of the string. The equation describing the wave is

- (1) $y = (0.02) m \sin (7.85 x + 1005 t)$ (2) $y = (0.02) m \sin (15.7 x - 2010 t)$
 (3) $y = (0.02) m \sin (15.7 x + 2010 t)$ (4) $y = (0.02) m \sin (7.85 x - 1005 t)$

Sol. (4) According to given information $5\lambda = 4 \Rightarrow \lambda = 0.8 \text{ m}$

So, frequency $\nu = \frac{v}{\lambda} = \frac{128}{0.8} = 160 \text{ Hz}$

and Angular frequency $\omega = 2\pi\nu = 2 \times 3.14 \times 160 = 1005 \text{ rad/s}$

Also Propagation constant $k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.8} = 7.85 \text{ m}^{-1}$

on Putting these value in standard equation option (4) is correct.

159. A simple pendulum performs simple harmonic motion about $x=0$ with an amplitude a and time period T . The speed of the pendulum at $x = a/2$ will be

- (1) $\frac{\pi a\sqrt{3}}{2T}$ (2) $\frac{\pi a}{T}$ (3) $\frac{3\pi^2 a}{T}$ (4) $\frac{\pi a\sqrt{3}}{T}$

Sol. (4) $v = \omega\sqrt{a^2 - x^2} \Rightarrow v = \frac{2\pi}{T}\sqrt{a^2 - (a/2)^2} = \frac{\sqrt{3}\pi a}{T}$

160. A p-n photodiode is fabricated from a semiconductor with a band gap of 2.5 eV. It can detect a signal of wavelength

- (1) 6000 Å (2) 4000 nm (3) 6000 nm (4) 4000 Å

Sol. (4) $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{12400}{E(\text{eV})} = \frac{12400}{2.5} = 4960 \text{ Å}$

This is the maximum wavelength i.e., the signals having wavelength greater than this value are not detected by photodiode. Hence correct option is (4).

161. A body of mass 1 kg is thrown upwards with a velocity 20 m/s. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction ($g = 10 \text{ m/s}^2$)

- (1) 20 J (2) 30 J (3) 40 J (4) 10 J

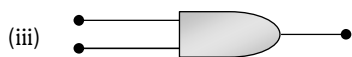
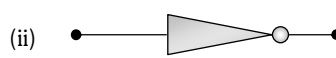
Sol. (1) Initial energy of body $= \frac{1}{2}mv^2 = \frac{1}{2} \times 1 \times (20)^2 = 200 \text{ J}$.

A part of this energy consumes in doing work against gravitational force and remaining part consumes in doing work against air friction.

i.e., $W_T = W_{\text{grav.}} + W_{\text{air friction}}$

$\Rightarrow 200 = 1 \times 10 \times 18 + W_{\text{air}} \Rightarrow W_{\text{air}} = 20 \text{ J}$

162. The symbolic representation of four logic gates are given below



The logic symbols for OR, NOT and NAND gates are respectively.

- (1) (iii), (iv), (ii) (2) (iv), (i), (iii) (3) (iv), (ii), (i) (4) (i), (iii), (iv)

Sol. (3)

163. If \vec{F} is the force acting on a particle having position vector \vec{r} and $\vec{\tau}$ be the torque of this force about the origin, then

- (1) $\vec{r} \cdot \vec{\tau} \neq 0$ and $\vec{F} \cdot \vec{\tau} = 0$ (2) $\vec{r} \cdot \vec{\tau} > 0$ and $\vec{F} \cdot \vec{\tau} < 0$ (3) $\vec{r} \cdot \vec{\tau} = 0$ and $\vec{F} \cdot \vec{\tau} = 0$ (4) $\vec{r} \cdot \vec{\tau} = 0$ and $\vec{F} \cdot \vec{\tau} \neq 0$

Sol. (3) $\vec{\tau} = \vec{r} \times \vec{F}$ hence $\vec{\tau} \perp \vec{r}$ and $\vec{\tau} \perp \vec{F}$.

164. If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is

- (1) repelled by both the poles
(2) repelled by the north pole and attracted by the south pole
(3) attracted by the north pole and repelled by the south pole
(4) attracted by both the poles

Sol. (1)

165. The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is

- (1) 30 ms^{-2} downwards (2) 4 ms^{-2} upwards (3) 4 ms^{-2} downwards (4) 14 ms^{-2} upwards

Sol. (2) $T = m(g + a) \Rightarrow 28000 = 2000(10 + a) \Rightarrow a = 4 \text{ m/s}^2$, upwards.

166. The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an

- (1) isobar of parent (2) isomer of parent (3) isotone of parent (4) isotope of parent

Sol. (4)

167. A rectangular, a square, a circular and an elliptical loop, all in the $(x-y)$ plane, are moving out of a uniform magnetic field with a constant velocity $\vec{V} = v \hat{i}$. The magnetic field is directed along the negative z -axis direction. The induced emf , during the passage of these loops, out of the field region, will not remain constant for

- (1) the rectangular, circular and elliptical loops (2) the circular and the elliptical loops
(3) only the elliptical loop (4) any of the four loops

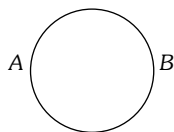
Sol. (2)

168. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 seconds is S_1 and that covered in the first 20 seconds is S_2 , then

- (1) $S_2 = 2S_1$ (2) $S_2 = 3S_1$ (3) $S_2 = 4S_1$ (4) $S_2 = S_1$

Sol. (3) $S \propto t^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{10}{20}\right)^2 \Rightarrow S_2 = 4S_1$

- 169.** A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10 cm. The resistance between its two diametrically opposite points A and B as shown in the figure, is



- (1) $0.6\pi\Omega$ (2) 3Ω (3) $6\pi\Omega$ (4) 6Ω

Sol. (1) Length of wire = $2\pi r = 2\pi(0.1) = 0.2\pi m$.

Resistance of complete wire = $12 \times 0.2\pi = 2.4\pi\Omega$

\therefore Resistance of each semicircle = $1.2\pi\Omega$

Hence equivalent resistance $R_{AB} = \frac{1.2\pi}{2} = 0.6\pi\Omega$

- 170.** The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$;

$$E_y = 2.5 \frac{N}{C} \cos \left[\left(2\pi \times 10^6 \frac{rad}{m} \right) t - \left(\pi \times 10^{-2} \frac{rad}{s} \right) x \right];$$

$E_z = 0$. The wave is

- (1) moving along y direction with frequency $2\pi \times 10^6$ Hz and wave length 200 m
 (2) moving along x direction with frequency 10^6 Hz and wave length 100 m
 (3) moving along x direction with frequency 10^6 Hz and wave length 200 m
 (4) moving along -x direction with frequency 10^6 Hz and wave length 200 m

Sol. (3) Comparing the given equation with standard equation $k = \frac{2\pi}{\lambda} = \pi \times 10^{-2} \Rightarrow \lambda = 200 m$.

and $\omega = 2\pi\nu = 2\pi \times 10^6 \Rightarrow \nu = 10^6$ Hz

Direction of wave propagation is towards +x axis.

- 171.** A thin circular ring of mass M and radius R is rotating in a horizontal plane about an axis vertical to its plane with a constant angular velocity ω . If two objects each of mass m be attached gently to the opposite ends of a diameter of the ring, the ring will then rotate with an angular velocity

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

Sol. (2) According to Conservation of angular momentum

$$L = L^1$$

$$MR^2\omega = (M+2m)R^2\omega^1 \Rightarrow \omega^1 = \frac{\omega M}{(M+2m)}$$

- 172.** A transistor is operated in common-emitter configuration at $V_c = 2V$ such that a change in the base current from $100\mu A$ to $200\mu A$ produces a change in the collector current from $5 mA$ to $10 mA$. The current gain is

- (1) 75 (2) 100 (3) 150 (4) 50

Sol. (4) $\beta = \frac{\Delta i_c}{\Delta i_b} = \frac{(10-5) \times 10^{-3}}{(200-100) \times 10^{-6}} = 50$

- 173.** A black body at $227^\circ C$ radiates heat at the rate of $7 Cal/cm^2s$. At a temperature of $727^\circ C$, the rate of heat radiated in the same units will be

- (1) 60 (2) 50 (3) 112 (4) 80

Sol. (3) $E \propto T^4 \Rightarrow \frac{E_1}{E_2} = \left(\frac{T_1}{T_2} \right)^4 \Rightarrow \frac{7}{E_2} = \left(\frac{273+227}{273+727} \right)^4 = \frac{1}{16}$

$$\Rightarrow E_2 = 112 \frac{cal}{cm^2 \times sec.}$$

174. A student measures the terminal potential difference (V) of a cell (of $emf \in$ and internal resistance r) as a function of the current (I) flowing through it. The slope, and intercept, of the graph between V and I , then, respectively, equal

- (1) \in and $-r$ (2) $-r$ and \in (3) r and $-\in$ (4) $-\in$ and r

Sol. (2) $E = V + ir \Rightarrow V = -ri + E$

Comparing it with $y = mx + c$; Slope (m) = $-r$ and intercept = E .

175. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$, respectively. The centre of mass of this system has a position vector

- (1) $-2\hat{i} + 2\hat{k}$ (2) $-2\hat{i} - \hat{j} + \hat{k}$ (3) $2\hat{i} - \hat{j} - \hat{k}$ (4) $-\hat{i} + \hat{j} + \hat{k}$

Sol. (2) $\vec{R}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2} = \frac{1(\hat{i} + 2\hat{j} + \hat{k}) + 3(-3\hat{i} - 2\hat{j} + \hat{k})}{1 + 3}$
 $\Rightarrow \vec{R}_{cm} = 2\hat{i} - \hat{j} + \hat{k}$

176. The internal energy change in a system that has absorbed 2 Kcals of heat and done 500 J of work is

- (1) 8900 J (2) 6400 J (3) 5400 J (4) 7900 J

Sol. (4) $\Delta Q = \Delta U + \Delta W \Rightarrow 2 \times 10^3 \times 4.2 = \Delta U + 500$
 $\Rightarrow \Delta U = 7900 \text{ J}$

177. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water

- (1) $\frac{1}{2}mv^3$ (2) mv^3 (3) $\frac{1}{2}mv^2$ (4) $\frac{1}{2}m^2v^2$

Sol. (1) $\frac{dk}{dt} = \frac{d}{dt} \left(\frac{1}{2} Mv^2 \right) = \frac{v^2}{2} \cdot \frac{dM}{dt} = \frac{v^2}{2} \left(\frac{dM}{dl} \times \frac{dl}{dt} \right)$
 $\Rightarrow \frac{dk}{dt} = \frac{1}{2}mv^2 \times \frac{dl}{dt} = \frac{1}{2}mv^3$

178. The driver of a car travelling with speed 30 m/sec towards a hill sounds a horn of frequency 600 Hz . If the velocity of sound in air is 330 m/s , the frequency of reflected sound as heard by driver is

- (1) 550 Hz (2) 555.5 Hz (3) 720 Hz (4) 500 Hz

Sol. (3) Apparent frequency $n' = n \left[\frac{V + V_{car}}{V - V_{car}} \right] = 600 \left[\frac{330 + 30}{330 - 30} \right]$
 $\Rightarrow n' = 720 \text{ Hz}$

179. In a Rutherford scattering experiment when a projectile of charge z_1 and mass M_1 approaches a target nucleus of charge z_2 and mass M_2 , the distance of closest approach is r_0 . The energy of the projectile is

- (1) directly proportional to $M_1 \times M_2$ (2) directly proportional to $z_1 z_2$
(3) inversely proportional to z_1 (4) directly proportional to mass M_1

Sol. (2)

180. Three capacitors each of capacitance C and of breakdown voltage V are joined in series. The capacitance and breakdown voltage of the combination will be

- (1) $\frac{C}{3}, \frac{V}{3}$ (2) $3C, \frac{V}{3}$ (3) $\frac{C}{3}, 3V$ (4) $3C, 3V$

Sol. (3)

181. The magnetic force acting on a charge particle of charge $-2\mu\text{C}$ in a magnetic field of 2T acting in y direction, when the particle velocity is $(2\hat{i} + 3\hat{j}) \times 10^6 \text{ ms}^{-1}$ is

- (1) 8 N in $-z$ direction (2) 4 N in z direction (3) 8 N in y direction (4) 8 N in z direction

Sol. (1) $\vec{F} = q(\vec{v} \times \vec{B}) = -2 \times 10^{-6} [(2\hat{i} + 3\hat{j}) \times 10^6] \times 2\hat{j}$
 $\vec{F} = -8\hat{k}$

182. Which one of the following equations of motion represents simple harmonic motion

- (1) acceleration $= -k_0x + k_1x^2$ (2) acceleration $= -k(x+a)$
(3) acceleration $= k(x+a)$ (4) acceleration $= kx$

Where k, k_0, k_1 and a are all positive

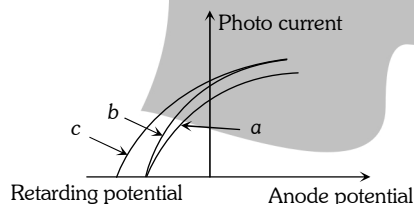
Sol. (2)

183. Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW . The number of photons arriving per sec. on the average at a target irradiated by this beam is

- (1) 9×10^{17} (2) 3×10^{16} (3) 9×10^{15} (4) 3×10^{19}

Sol. (2) $\frac{n}{t} = \frac{P\lambda}{hc} = \frac{(9 \times 10^{-3}) \times (667 \times 10^{-9})}{6.6 \times 10^{-34} \times 3 \times 10^8} = 3 \times 10^{16}$

184. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement



- (1) curves (a) and (b) represent incident radiations of different frequencies and different intensities
(2) curves (a) and (b) represent incident radiations of same frequency but of different intensities
(3) curves (b) and (c) represent incident radiations of different frequencies and different intensities
(4) curves (b) and (c) represent incident radiations of same frequency having same intensity

Sol. (2) Stopping potential is same for a & b, hence their frequencies are same. Also maximum current values are different for a & b so they will have different intensities

185. Power dissipated in an LCR series circuit connected to an a.c. source of $emf \ \varepsilon$ is

(1) $\varepsilon^2 R / \left[R^2 + \left(L\omega - \frac{1}{C\omega} \right)^2 \right]$ (2) $\frac{\varepsilon^2 \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega} \right)^2}}{R}$ (3) $\frac{\varepsilon^2 \left[R^2 + \left(L\omega - \frac{1}{C\omega} \right)^2 \right]}{R}$ (4) $\frac{\varepsilon^2 R}{\sqrt{R^2 + \left(L\omega - \frac{1}{C\omega} \right)^2}}$

Sol. (1) $P = E_{rms} i_{rms} \cos\phi = \frac{E^2 R}{Z^2} = \frac{E^2 R}{\left[R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2 \right]}$

186. The electric potential at a point (x, y, z) is given by

$$V = -x^2y - xz^3 + 4$$

The electric field \vec{E} at that point is

(1) $\vec{E} = \hat{i}(2xy + z^3) + \hat{j}x^2 + \hat{k}3xz^2$

(2) $\vec{E} = \hat{i}2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$

(3) $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$

(4) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}xy^2 + \hat{k}3z^2x$

Sol. (1) $E_x = -\frac{dv}{dx} = -[-2xy - z^3]$

$$E_y = -\frac{dv}{dy} = -[-x^2]$$

$$E_z = -\frac{dv}{dz} = -[-3xz^2]$$

$$\therefore \vec{E} = E_x\hat{i} + E_y\hat{j} + E_z\hat{k} = (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$$

187. A bar magnet having a magnetic moment of $2 \times 10^4 \text{ JT}^{-1}$ is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4} \text{ T}$ exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is

(1) 0.6 J

(2) 12 J

(3) 6 J

(4) 2 J

Sol. (3) $w = MB(1 - \cos\theta) = 2 \times 10^4 \times 6 \times 10^{-4}(1 - \cos 60) = 6 \text{ J}$

188. A galvanometer having a coil resistance of 60Ω shows full scale deflection when a current of 1.0 amp passes through it. It can be converted into an ammeter to read currents upto 5.0 amp by

(1) putting in parallel a resistance of 240Ω

(2) putting in series a resistance of 15Ω

(3) putting in series a resistance of 240Ω

(4) putting in parallel a resistance of 15Ω

Sol. (4) $\frac{i}{ig} = 1 + \frac{G}{S} \Rightarrow \frac{5}{1} = 1 + \frac{60}{S} \Rightarrow S = 15 \Omega$

189. The two ends of a rod of length L and a uniform cross-sectional area A are kept at two temperature T_1 and T_2 ($T_1 > T_2$). The rate of heat transfer, $\frac{dQ}{dt}$, through the rod in a steady state is given by

(1) $\frac{dQ}{dt} = \frac{kL(T_1 - T_2)}{A}$

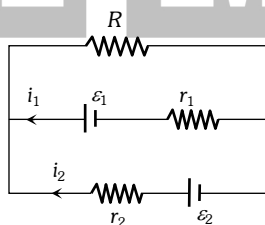
(2) $\frac{dQ}{dt} = \frac{k(T_1 - T_2)}{LA}$

(3) $\frac{dQ}{dt} = kLA(T_1 - T_2)$

(4) $\frac{dQ}{dt} = \frac{kA(T_1 - T_2)}{L}$

Sol. (4)

190. See the electrical circuit shown in this figure. Which of the following equations is a correct equation for it



(1) $\epsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

(2) $\epsilon_2 - i_2 r_2 - \epsilon_1 - i_1 r_1 = 0$

(3) $-\epsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

(4) $\epsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

Sol. (1) According to kirchhoff's voltage law only option (1) is correct.

191. The mean free path of electrons in a metal is $4 \times 10^{-8} \text{ m}$. The electric field which can give on an average 2 eV energy to an electron in the metal will be in units of V/m

- (1) 8×10^7 (2) 5×10^{-11} (3) 8×10^{-11} (4) 5×10^7

Sol. (4) $K = eV = eEl$

$$\Rightarrow 2(eV) = eEl \Rightarrow E = \frac{2}{l} = \frac{2}{4 \times 10^{-8}}$$

$$\Rightarrow E = 5 \times 10^7 \text{ V/m}$$

192. The number of photo electrons emitted for light of a frequency ν (higher than the threshold frequency ν_0) is proportional to

- (1) $\nu - \nu_0$ (2) Threshold frequency (ν_0)
(3) Intensity of light (4) Frequency of light (ν)

Sol. (3)

193. Each of the two strings of length 51.6 cm and 49.1 cm are tensioned separately by 20 N force. Mass per unit length of both the strings is same and equal to 1 g/m . When both the strings vibrate simultaneously the number of beats is

- (1) 5 (2) 7 (3) 8 (4) 3

Sol. (2) Using $n = \frac{1}{2l} \sqrt{\frac{T}{m}}$

$$\text{Number of beats} = \frac{1}{2} \sqrt{\frac{T}{m}} \left[\frac{1}{l_2} - \frac{1}{l_1} \right]$$

$$= \frac{1}{2} \sqrt{\frac{20}{1 \times 10^{-3}}} \left[\frac{1}{49.1 \times 10^{-2}} - \frac{1}{51.6 \times 10^{-2}} \right]$$

$$= 7$$

194. The ionization energy of the electron in the hydrogen atom in its ground state is 13.6 eV . The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between

- (1) $n = 3$ to $n = 2$ states (2) $n = 3$ to $n = 1$ states (3) $n = 2$ to $n = 1$ states (4) $n = 4$ to $n = 3$ states

Sol. (4) Number of wavelength = $\frac{n(n-1)}{2}$; where $n =$ No. of orbit from which transition takes place

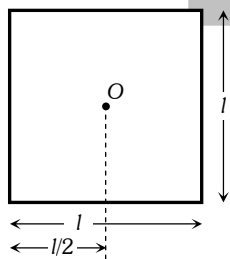
$$\therefore 6 = \frac{n(n-1)}{2} \Rightarrow n = 4$$

In all given options wavelength of emitted radiation's will be maximum for transition $n = 4$ to $n = 3$.

195. Four identical thin rods each of mass M and length l , form a square frame. Moment of inertia of this frame about an axis through the centre of the square and perpendicular to its plane is

- (1) $\frac{4}{3} M l^2$ (2) $\frac{2}{3} M l^2$ (3) $\frac{13}{3} M l^2$ (4) $\frac{1}{3} M l^2$

Sol. (1)



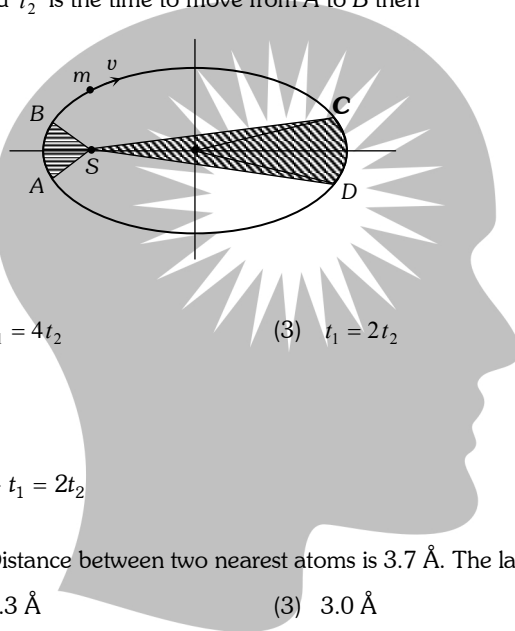
$$\text{M.I. of given frame about the axis passing through } O \text{ and perpendicular to the plane of the frame is } I = 4 \times \left[\frac{Ml^2}{12} + M \left(\frac{l}{2} \right)^2 \right] = \frac{4}{3} Ml^2$$

196. In thermodynamic processes which of the following statements is *not* true

- (1) In an adiabatic process the system is insulated from the surroundings
- (2) In an isochoric process remains constant
- (3) In an isothermal process the temperature remains constant
- (4) In an adiabatic process $PV^\gamma = \text{constant}$

Sol. (2) In isochoric process, volume remains constant.

197. The figure shows elliptical orbit of a planet m about the sun S . The shaded area SCD is twice the shaded area SAB . If t_1 is the time for the planet to move from C and D and t_2 is the time to move from A to B then



- (1) $t_1 > t_2$
- (2) $t_1 = 4t_2$
- (3) $t_1 = 2t_2$
- (4) $t_1 = t_2$

Sol. (3) $\frac{\Delta A}{\Delta t} = \frac{L}{2m} \Rightarrow \Delta A \propto \Delta t$

$$\Rightarrow \frac{\Delta A_{SCD}}{\Delta A_{SAB}} = \frac{t_1}{t_2} \Rightarrow \frac{2A}{A} = \frac{t_1}{t_2} \Rightarrow t_1 = 2t_2$$

198. Sodium has body centred packing. Distance between two nearest atoms is 3.7 \AA . The lattice parameter is

- (1) 6.8 \AA
- (2) 4.3 \AA
- (3) 3.0 \AA
- (4) 8.6 \AA

Sol. (2) For bcc packing, distance between two nearest atoms $d = 2r = 2 \left(\frac{\sqrt{3}}{4} a \right)$

$$\Rightarrow \text{Lattice constant } a = \frac{2d}{\sqrt{3}} = \frac{2 \times 3.7}{\sqrt{3}} = 4.3 \text{ \AA}$$

199. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k . The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be

- (1) Mg/k
- (2) $2Mg/k$
- (3) $4Mg/k$
- (4) $Mg/2k$

Sol. (2)

200. A body, under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$, acquires an acceleration of 1 m/s^2 . The mass of this body must be

- (1) $2\sqrt{10} \text{ kg}$
- (2) 10 kg
- (3) 20 kg
- (4) $10\sqrt{2} \text{ kg}$

Sol. (4) $|\vec{F}| = \sqrt{(6)^2 + (-8)^2 + (10)^2} = 10\sqrt{2}$

$$\therefore m = \frac{|\vec{F}|}{a} = \frac{10\sqrt{2}}{1} = 10\sqrt{2} \text{ kg.}$$