JEE (Main)-2025 (Online) Session-2

4 April 2025 Shift – 1

PART : PHYSICS

1. Mean free path for an ideal gas is to be observed 2×10^{-7} m while average speed of molecules of gas is observed to be 600 m/s. then frequency of collision is near by

(1) 4×10^{7} Hz (2) 1.2×10^{7} Hz (3) 3×10^{9} Hz (4) 3×10^{10} Hz

Ans. **(3)**

Sol. liver $\lambda = 2\times10^{-7}$

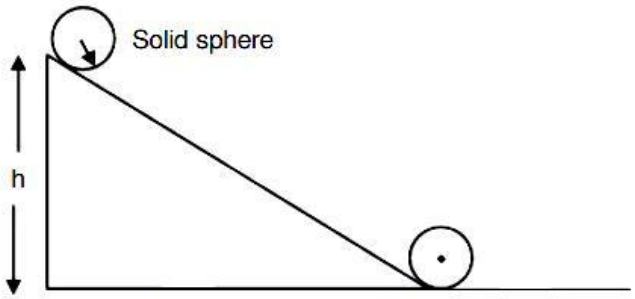
$v = 600$ mls

$$\tau = \frac{2\times10^{-7}}{600} = \frac{1}{3} \times 10^{-9}$$

$$f = \frac{1}{\tau}$$

$f = 3\times10^{9}$ Hz Ans.

2. A ring and a solid sphere released from rest from same height on enough rough inclined surface. Ratio of their speed when they reach at bottom is $\sqrt{\frac{7}{x}}$ m/s. Then x is :



(1) 5 (2) 10 (3) 15 (4) 20

Ans. **(2)**

Sol. For solid sphere total energy conservation

$E_c = E_f$

$$mgh = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$$

$$mgh = \frac{1}{2}\left(\frac{2}{5}mR^2\right)\omega^2 + \frac{1}{2}mv^2$$

$$gh = \frac{1}{5}R^2\omega^2 + \frac{1}{2}v^2$$

$$gh = \frac{1}{5}R^2\frac{v^2}{R^2} + \frac{1}{2}v^2$$

$$gh = \frac{7}{10}v^2$$

$$\sqrt{\frac{10}{7}gh} = v_s \qquad \ldots(1)$$

For ring

$$mgh = \frac{1}{2}mR^2\omega^2 + \frac{1}{2}mv^2$$

$$gh = \frac{1}{2}R^2\frac{v^2}{R^2} + \frac{1}{2}v^2$$

$v_{ring} = \sqrt{gh}$ ...(2)

$$\frac{v_{ring}}{v_{solid}} = \frac{\sqrt{gh}}{\sqrt{gh}\sqrt{\frac{10}{7}}} = \sqrt{\frac{7}{10}}$$

3. Which of the following is ratio of 5th bohr radius of He^{+} and Li^{+2} ?

(1) $\frac{2}{3}$ (2) $\frac{3}{2}$ (3) $\frac{9}{4}$ (4) $\frac{4}{9}$

Ans. **(2)**

Sol. $r_n = \frac{n^2 a_0}{z}$

$r_n \propto \frac{n^2}{z}$

$\frac{r_{He^+}}{r_{Li^{+2}}} = \frac{3}{2}$

4. If ratio of electric flux and magnetic flux dimension of is $M^P L^Q T^R A^S$ then (where, E represent electric field and B represent magnetic field)

(1) (Q,R) → [1,1] (2) (Q,R) → [1,2] (3) (Q,R) → [1,–1] (4) (Q,R) → [1,0]

Ans. **(3)**

Sol. $\frac{E}{B} = C$

[where, c = speed of light]

dimension of $-C \Rightarrow [m0L^1T^{-2}]$

dimension of $\left(\frac{E}{B}\right) \Rightarrow [M^0L^1T^{-1}]$

$Q \Rightarrow 1$

$R \Rightarrow -1$

5. Distance between object and image is 30 cm by using spherical mirror of found length $\frac{x}{4}$, $m = -\frac{1}{3}$ there find 'x'

(1) 15 (2) 30 (3) 45 (4) 75

Ans. **(3)**

Sol. $m = -\frac{1}{3} = -\frac{v}{u}$ $\quad |v - u| = 30$

$-\frac{u}{3} = v$ $\quad \left(\frac{4}{3} - u\right) = 30$

$u = 45$

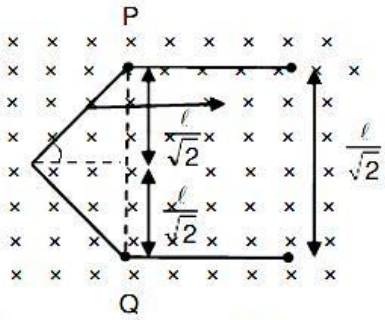
$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ $\quad \rightarrow v = \frac{4}{3}$

$\frac{1}{f} = \frac{1}{15} + \frac{1}{45}$ $\quad v = \frac{45}{3} \Rightarrow 15$

$= \frac{3+1}{45}$

$f = \frac{45}{4}$, $\frac{x}{4} = \frac{45}{4}$, $x = 45$ Ans.

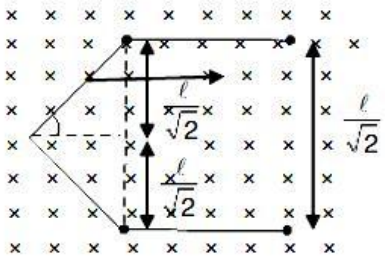
6. A rods of equal length are joined as shown in the figure. Combined system is moving with speed 10 cm/s in a perpendicular magnetic field of $\frac{1}{\sqrt{2}}$ tesla. Find emf induced between point P and Q in millivolts (given ℓ = 10 cm)



(1) 30 (2) 10 (3) 35 (4) 25

Ans. **(2)**

Sol.



$E = Bv\ell = Bv(\ell\sqrt{2})$

$\Rightarrow \frac{1}{\sqrt{2}} \times 10 \times 10^{-2} \times 10 \times 10^{-2} \times \sqrt{2} = 10$ mV

7. If slit width is increased to .02 to 0.4 then percentage change fringe width will be.

(1) 20% (2) 25% (3) 60% (4) 50%

Ans. **(4)**

Sol. $\frac{\Delta\beta}{\beta} = \frac{\Delta\frac{1}{d}}{\frac{1}{d}} \times 100$

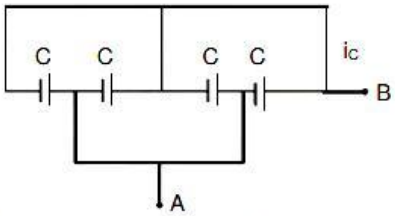
$= \frac{\frac{1}{.04} - \frac{1}{.02}}{\frac{1}{.02}} \times 100$

$= \frac{.02}{.04 \times .02} \times .02 \times 100$

$= \frac{100}{2}$

$= 50\%$

8. Find the equivalent capacitance between A & B. If C = 16 μF



(1) 48 m ϕ (2) 64m ϕ (3) 8 m ϕ (4) 16 m ϕ

Ans. **(2)**

Sol. $A - B = C + C + C + C$

$= 4C$

$= 4 \times 15\ \mu\phi$

$= 64\ \mu\phi$

9. Find ratio of Speed of sound in H_e , Me then , Co_2 If ratio of pressure and density are same for each gas

(1) $\sqrt{\frac{5}{3}}, \sqrt{\frac{4}{3}}, \sqrt{\frac{7}{5}}$ (2) $\sqrt{\frac{5}{3}}, \sqrt{\frac{3}{4}}, \sqrt{\frac{7}{5}}$ (3) $\sqrt{\frac{5}{3}}, \sqrt{\frac{4}{3}}, \sqrt{\frac{6}{5}}$ (4) $\sqrt{\frac{3}{5}}, \sqrt{\frac{4}{3}}, \sqrt{\frac{7}{5}}$

Ans. **(1)**

Sol. Speed of sound in a gas $= \sqrt{\frac{\gamma RT}{M}} = \sqrt{\frac{\gamma p}{\rho}}$

γ for $H_e \rightarrow \frac{5}{3}$, γ for $CO_2 = \frac{7}{5}$, γ for Me then $\frac{4}{3}$

M for He $\rightarrow 4\ \frac{gm}{mol}$, m for $co_2 = 44\ \frac{gm}{mol}$

Speed of sound in He $V_{He} = \sqrt{\frac{\frac{5}{3}RT}{4}}$

$V_{He} = \sqrt{\frac{5}{12}RT}$

Speed of sound in C_{o2} $V_{Co2} = \sqrt{\frac{\frac{4}{3}RT}{44}}$

$V_{Co2} = \sqrt{\frac{RT}{33}}$

Ratio $\frac{V_{He}}{VCo_2} = \frac{\sqrt{\frac{5}{12}RT}}{\sqrt{\frac{RT}{33}}}$

$\Rightarrow \sqrt{\frac{5 \times 33}{12}}$

$= \frac{\sqrt{55}}{2}$

10. It AC current i = $100\sqrt{2}\ \sin 100\pi t$ Find frequency & current

(1) 100 A, 50 Hz (2) $100\sqrt{2}$ A , 50 Hz (3) 100 A, 100 Hz (4) $100\sqrt{2}$ A , 100 Hz

Ans. **(1)**

Sol. i = 100 A

f = 50 Hz

11. In spherical mirror distance between RO and RI is 30cm and magnificent is $-\frac{1}{2}$, how much object shift so magnification become $-\frac{1}{3}$

(1) $\frac{40}{3}$ (2) $\frac{60}{3}$ (3) $\frac{90}{3}$ (4) $\frac{80}{3}$

Ans. **(4)**

Sol. Shift = $\left|\frac{80}{3}-20\right| = \frac{20}{3}$

Towards mirror

$m_1 = \frac{1}{2} = \frac{y}{x}$

$x = 2y$

$x + y = 30$

$y = 10$

$x = 20$

$\frac{1}{f} = \frac{1}{-10} + \frac{1}{-20}$

$= \frac{3}{-20}$

$m_2 = -\frac{1}{3} = \frac{-y}{x}$

$3y = x$

$-\frac{3}{-20} = \frac{1}{-x} - \frac{1}{y}$

$\frac{3}{20} = \frac{4}{3y}$

$t = \frac{80}{9}$

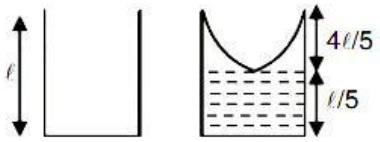
$x = \frac{80}{3}$

12. If $\frac{1}{5}$th of volume of closed organ pipe is filled in water. Then percentage change in frequency

(1) 25% (2) –25% (3) 20% (4) –20%

Ans. **(1)**

Sol.



$$f = \frac{v}{4\ell} \times \frac{4}{4} \quad \Rightarrow \quad \frac{4v}{16\ell}$$

$$f' = \frac{v}{4\left(\frac{4\ell}{5}\right)} \quad \Rightarrow \quad \frac{5v}{16\ell}$$

$$\% \text{ change in frequency} = \frac{f'-f}{f} \times 100$$

$$\Rightarrow \quad \frac{\frac{5v}{16\ell} - \frac{4v}{16\ell}}{\frac{4v}{16\ell}} \times 100$$

$$\Rightarrow \quad \frac{1}{4} \times 100$$

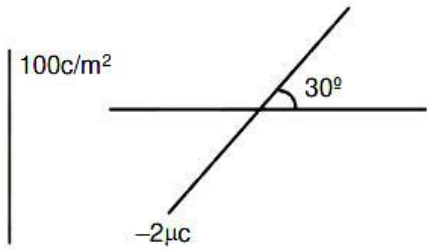
$$= \quad 25\% \quad \textbf{Ans.}$$

13. An electric dipole with charges $2\mu C$ and separation 20 cm is placed closed to an infinitely charge non-conducting sheet with surface charge density 100 cm^2 . Find the torque acting on the dipole if the dipole makes an angle $30^º$ with the formal to the sheet ?

(1) $\frac{12}{\varepsilon_0} \times 10^{-5}$ nm (2) $\frac{2}{\varepsilon_0} \times 10^{-5}$ nm (3) $\frac{4}{\varepsilon_0} \times 10^{-5}$ Nm (4) $\frac{1}{\varepsilon_0} \times 10^{-5}$ Nm

Ans. **(4)**

Sol.



$$\tau = = PE \sin 30^º$$

$$\Rightarrow (ad)\left(\frac{6}{2\varepsilon_0}\right)\frac{1}{2}$$

$$= \frac{2\times10^{-6}\times0.2}{\varepsilon_0} \times \frac{100}{y}$$

$$= \frac{1}{\varepsilon_0} \times 10^{-5}$$

14. **Assertion :** KE required to project body from surface of earth to infinity is $mg\frac{R}{2}$

Reason : Highest PE is zero between surface of earth and infinity

(1) (A) and (R) are correct and (R) is correct explanation of (A)

(2) (A) and (R) both are correct and ® is not correct explanation of (A)

(3) (A) is correct but (R) is incorrect

(4) (A) is incorrect but (R) is correct

Ans. **(4)**

15. **Assertion :** In photoelectric effect, if intensity of monochromatic light is increased then stopping potential increase

Reason : Increased intensity results in increment of photocurrent.

(1) Assertion is correct, Reason is correct and Reason is explanation of Assertion

(2) Assertion is correct, Reason is correct and Reason is not correct explanation of Assertion

(3) Assertion is incorrect and reason is correct

(4) Assertion is correct and reason is incorrect

Ans. **(3)**

16. In two different capillary tube $\frac{\cos\theta_1}{\cos\theta_2} = z$ which option is correct

(1) z is negative, if first meniscus is concave & second convex

(2) z is negative, if first meniscus is convex & second concave

(3) z is positive, if both are convex

(4) z is positive, if first meniscus is convex & second concave

Ans. **(2)**

Sol. (1) $\Rightarrow$ convex

(2) $\Rightarrow$ concave.

17. Two simple pendulums with angular amplitudes θ_1 and θ_2 have length of strings as l_1 and l_2 respectively. Choose the correct option's if the maximum angular acceleration are same

(1) $\theta_2 \times \ell_2 = \theta_1 \times \ell_1$ (2) $\theta_1 \times \ell_2 = \theta_2 \times \ell_1$

(3) $\theta_1 \times \ell_2^2 = \theta_2 \times \ell_1^2$ (4) $\theta_2 \times \ell_2^2 = \theta_1 \times \ell_1^2$

Ans. **(2)**

Sol. $\alpha_{1max} = \alpha_{2max}$

$\tau = mg\ell\sin\theta = I\alpha$

$mg\ell\theta = \frac{m\ell^2}{3}\alpha$

$\alpha \propto \frac{\theta}{\ell}$

$\theta_1 \times \ell_2 = \theta_2 \times \ell_1$

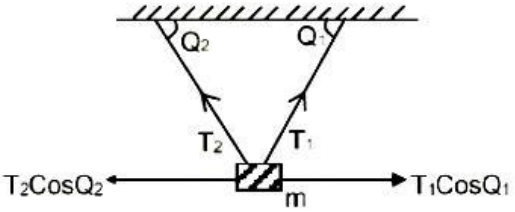
18. A block of mass m kg is connected to two strings as shown. If $T_1 = \sqrt{3}\,T_2$, then choose correct option

(1) $Q_1 = 60°$, $Q_2 = 30°$ $T_1 = \frac{mg}{2}$ (2) $Q_1 = 60°$, $Q_2 = 30°$ $T_2 = \frac{mg}{2}$

(3) $Q_1 = 30°$, $Q_2 = 60°$ $T_1 = \frac{3mg}{4}$ (4) $Q_1 = 30°$, $Q_2 = 60°$ $T_2 = \frac{3mg}{4}$

Ans. **(2)**

Sol.



$T_1 \cos Q_1 = T_2 \cos Q_2$

$\sqrt{3} \cos Q_1 = \cos Q_2$

$Q_1 = 60°, Q_2 = 30°$

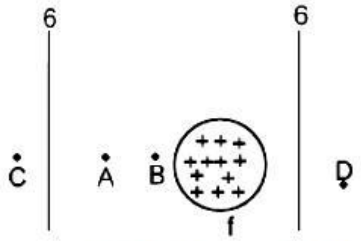
$T_2 \sin Q_2 = T_1 \sin Q_1 = mg$

$$\frac{T_2}{2} + \frac{T_1\sqrt{3}}{2} = mg$$

$$\frac{T_2}{2} + \frac{3T_2}{2} = mg$$

$$T_2 = \frac{mg}{2}$$

19. In arrangement shown. has two non-condu. Balne sheet with charge density, and a non conducting sphere with volume charge density ? choose the correct relation between the magnitude of electric field at A.B.C. and D.



(1) $E_A \neq E_B$ $E_D > E_C$ (2) $E_A = E_B$ $E_D > E_C$

(3) $E_A \neq E_B$ $E_C > E_D$ (4) $E_A = E_B$ $E_D > E_C$

Ans. **(1)**

20. If current (i) = 0.02 t + 0.01, flow of charge from t = 1 to t = 2

(1) 0.04 (2) 0.02 (3) 0.01 (4) 0.06

Ans. **(1)**

Sol. $q = \int i dt = \left(0.02\frac{t^2}{2} 0.01t\right)_1^2$

$= (0.01 \times 4 + 0.02) - (0.01 \times 2) = 0.04$ Ans

21. Light of energy E incident on bob of simple pendulum, Find its amplitude

Ans. $\sqrt{\frac{2Ea\ell}{mg}}$

Sol. $E \times a = \frac{1}{2}mv^2$

$Ea = \frac{1}{2}m(\omega A)^2$

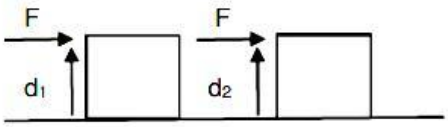
$\omega = \sqrt{\frac{\theta}{\ell}}$

$Ea = \frac{m}{2}A^2 \times \frac{g}{\ell}$

$A = \sqrt{\frac{2Ea\ell}{mg}}$ Ans.

a = absorption power

22.



$d_2 = 2d_1$

$\theta_2 = 2\theta_1$

$\eta_1 = 4 \times 10^9$

$\eta_2 = x \times 10^9$ then find value of x.

Ans. **0.5**

Sol. $\eta = \frac{F}{A \times Q} = \frac{F}{d_2 \times Q}$

$\frac{\eta_2}{\eta_1} = \left(\frac{d_1}{d_2}\right)^2 \times \frac{\theta_1}{\theta_2}$

$\eta_2 = 4 \times 10^9 \times \left(\frac{1}{2}\right)^2 \times \frac{1}{2}$

$\eta_2 = 0.5 \times 10^9$

$x = 0.5$