PART: PHYSICS

1. Find maximum wavelength in paschen series for hydrogen.
   (1) 1.54 $\mu$m  (2) 1.87 $\mu$m  (3) 1.23 $\mu$m  (4) 2.36 $\mu$m

   Ans. (2)

   Sol. \( \frac{h}{\lambda} = E_d - E_2 = 13.6 \left( \frac{1}{9} - \frac{1}{16} \right) \) eV

   \( \lambda \approx 0.3 \text{ m} \)
2. Find $B_{net}$ at point O

\[
\begin{align*}
B_{net} &= \frac{4\pi}{4\pi} \left[ \frac{1}{4} \right] \\
&= \frac{1}{4} \\
&= 0.25 \text{ T} \\
B_{net} &= \frac{4 \times 10^{-7} \times 4}{4\pi} \left[ \frac{3}{4} \right] \\
&= \frac{3 \times 10^{-7}}{4\pi} \text{ T} \\
B_{net} &= 3 \times 10^{-7} \text{ T} \\
\end{align*}
\]

3. **Assertion**: Angular velocity of moon revolving about earth is more than angular velocity of earth revolving around sun.

**Reason**: Time taken by moon to revolve around earth is less than time taken by earth to revolve around sun.

(1) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).
(2) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A).
(3) Assertion (A) is true and Reason (R) is false.
(4) Assertion (A) is false and Reason (R) is true.

**Ans.** (1)

**Sol.**

\[
T = \frac{2\pi}{\omega}
\]

4. If the work function of a metal is 6.63 eV. Find the threshold frequency of metal.

(1) $1.9 \times 10^{15}$ Hz
(2) $1.6 \times 10^{15}$ Hz
(3) $2 \times 10^{15}$ Hz
(4) $1.2 \times 10^{15}$ Hz

**Ans.** (2)

**Sol.**

\[
\begin{align*}
\phi &= 6.63 \text{ eV} \\
h &= 6.63 \times 10^{-34} \text{ J s} \\
u_m &= \frac{\phi}{h} \\
&= \frac{6.63 \times 1.6 \times 10^{-19}}{6.63 \times 10^{-34}} \\
&= \frac{1.6 \times 10^{15}}{6.63 \times 10^{-19}} \\
\end{align*}
\]

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5. Statement 1: Positive zero error is added in measured value.
Statement 2: Defect may occur during manufacturing of measuring instruments.

(1) Statement 1 is true while statement 2 is false
(2) Statement 1 is false while statement 2 is true
(3) Both statements are true
(4) Both statements are false

**Ans.** (2)

**Sol.** Theory Based

6. If \( P = \frac{a}{V^2} \) (V - b) = nRT where P, V, R & T are pressure, volume, universal gas constant and temperature, then \( \frac{a}{b^2} \) has same dimensional formula as that of

(1) R
(2) PV
(3) RT
(4) P

**Ans.** (4)

**Sol.**

\[
\begin{align*}
\left[ \frac{a}{b^2} \right] &= [P] \\
[\text{PV}] &= [V] \\
[\text{RT}] &= [T]
\end{align*}
\]
7. Find total kinetic energy of 1 mole of oxygen gas at 27°C (Take R = \frac{25}{3} \text{ J/mole-K})

(1) 6250 J  
(2) 3125 J  
(3) 12500 J  
(4) 625 J

Ans. (1)

Sol. K.E. = \frac{1}{2} nRT

K.E. = \frac{5}{2} \times \frac{25}{3} \times 300

K.E. = 6250 J

8. Kinetic friction and static friction depend.
(1) Only on surface area
(2) Only on material
(3) Both material and surface
(4) None of these

Ans. (2)

Sol. Theory Based

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9. A particle losses \frac{1}{3}^{th} of its velocity when it strikes a block and covers a distance of 4cm inside the fixed block. Then find D if D is the distance covered by the particle inside block before it stops.

(1) \frac{63}{5} \text{ cm}  
(2) \frac{36}{5} \text{ cm}  
(3) \frac{54}{5} \text{ cm}  
(4) \frac{21}{5} \text{ cm}

Ans. (2)

Sol. \frac{4v^2}{\theta} - v^2 = 2a \times 4

0 - v^2 = 2aD

\frac{5}{4} \theta = 9

D = \frac{36}{5} \text{ cm.}

10. In a series LCR circuit where coefficient of self induction L = \frac{100}{\pi} \text{ mH}, capacitance C = \frac{10^{-3}}{\pi} \text{ F} and resistance R = 10 \Omega. Find power factor for given circuit. (approximately)

(1) 1  
(2) 0.5  
(3) 0.4  
(4) 0.6

Ans. (1)

Sol. \chi_L = 2 \pi L = 2 \pi \times 50 \times \frac{100}{\pi} \times 10^{-3} = 10 \Omega

\chi_C = \frac{1}{2 \pi f C} = \frac{\pi}{100 \pi \times 10^{-3}} = 10 \Omega

Z = \sqrt{R^2 + (\chi_L - \chi_C)^2} = \sqrt{(10)^2 + (10 - 10)^2} = 10 \Omega

\cos \phi = \frac{R}{Z} = \frac{10}{10} = 1

11. There in a prism of apex angle of `A`. Its refractive index is equal to \cot A/2 then find minimum angle of deviation?

(1) \frac{\pi}{2} - A

(2) \pi - 2A

(3) \pi + A

(4) \frac{\pi}{2} + A

Ans. (2)

Sol. \mu = \frac{\sin \frac{A + \delta_{\text{min}}}{2}}{\sin \frac{A}{2}}, \quad \cot \frac{A}{2} = \frac{\sin \frac{A + \delta_{\text{min}}}{2}}{\sin \frac{A}{2}}

\cos \frac{A}{2} = \sin \frac{A + \delta_{\text{min}}}{2}
12. In an adiabatic process on a gas \( P \propto T^n \) find \( \gamma \) of the gas.
   (1) 3/2
   (2) 5/3
   (3) 7/5
   (4) 4/3

   Ans. (1)

   Sol.
   \[
   \frac{nRT}{V} \propto T^n
   \]
   \[\frac{1}{T} \frac{dV}{V} = \text{constant}\]
   \[\frac{1}{T} \frac{dV}{V} = \text{constant}\]
   
   compare with \( T^{-n-1} = \text{constant}\)
   \[\gamma - 1 = \frac{1}{2}\]
   \[\gamma = 3/2\]

13. A ring and a solid sphere of same mass and radius rolls down a same inclined plane. Find ratio of their kinetic energies on reaching bottom starting from rest from the top.
   (1) 1 : 2
   (2) 1 : 1
   (3) 2 : 1
   (4) 1 : 5

   Ans. (2)

   Sol. K.E. = mgh
   
   So ratio = 1 : 1

14. In a Galvanometer deflection is 60° when flowing electric current is 200 \( \mu \)A through Galvanometer then find electric current at \( \frac{\pi}{10} \) rad deflection.
   (1) 50 \( \mu \)A
   (2) 70 \( \mu \)A
   (3) 60 \( \mu \)A
   (4) 80 \( \mu \)A

   Ans. (3)

   Sol.
   \[
   I_1 \times \theta = I_2 \times \theta_2
   \]
   \[\Rightarrow \frac{I_1}{I_2} = \frac{\theta}{\theta_2}\]
   \[\Rightarrow \frac{I_1}{I_2} = \frac{200 \mu A \times \pi/3}{\pi/10} \]
   \[\Rightarrow I_2 = 60 \mu A\]
15. Find radiation pressure for perfectly absorbing surface if intensity of radiation = 6 \times 10^6 \text{ W/m}^2
\[ C = 3 \times 10^7 \text{ m/s}. \text{ refractive index of whole medium in which event occurring is } \mu = 3 \]

(1) 0.12 N/m²  
(2) 0.18 N/m²  
(3) 0.24 N/m²  
(4) 0.06 N/m²

Ans. (4)

Sol.
\[ P = \frac{\Delta P_{\text{pressure}}}{\Delta \lambda} = \text{pressure} \]
\[ P = \frac{E}{V} = \frac{1}{V} \quad \left[ E = \text{m}v^2 \right] \]
\[ P = \frac{6 \times 10^6}{c/\mu} \]
\[ P = \frac{6 \times 10^6}{3 \times 10^7} \times 3 \]
\[ P = 0.06 \text{ N/m}^2 \]

16. **Assertion**: A rod is stretched by two equal forces from both sides, when force is removed the rod regain its original configuration

**Reason**: This happens due to elastic property of the rod.

(1) Assertion is true while Reason is false
(2) Assertion is false while Reason is true
(3) Both Assertion and Reason are true
(4) Both Assertion and Reason are false

Ans. (3)

17. Two bodies having mass 4 Kg and mass 5 Kg having same Kinetic energy find the ratio of there linear momentum?

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

Ans. (2)

Sol.
\[ P_1 = \sqrt{2m_1\frac{K}{2m_1}} = \sqrt{\frac{m_1^2}{2}} \]
\[ P_2 = \sqrt{2m_2\frac{K}{2m_2}} = \sqrt{\frac{m_2^2}{2}} \]

18. A particle moves 80 m in last 2 sec in free fall condition then find distance covered 2 sec before striking the ground from initially point.

(1) 125 m  
(2) 115 m  
(3) 60 m  
(4) 45 m

Ans. (4)

Sol.
\[ h = h' = 80 \]

\[ \frac{1}{2} g t_1^2 - \frac{1}{2} g (t - 2)^2 = 80 \]
\[ \Rightarrow t = 5 \text{ sec} \]
\[ \Rightarrow h' = \frac{1}{2} g (t - 2)^2 = 45 \text{ m} \]

19. A simple pendulum have same acceleration at lower position (mean position) & at extreme position. Find its angular amplitude.
20. There exists a uniform electric field of 20 \text{i} \text{ N/C}. A dipole moment \( |\vec{P}| = 15 \) cm is placed at angle 30° with electric field. Torque on dipole is:

\begin{itemize}
  \item[(1)] 120 N·cm
  \item[(2)] 110 N·cm
  \item[(3)] 150 N·cm
  \item[(4)] 100 N·cm
\end{itemize}

\textbf{Ans.}

\textbf{Sol.}

\begin{align*}
  \tau &= \vec{P} \times \vec{E} \\
     &= 15 \left( \cos 30° \vec{i} - \sin 30° \vec{j} \right) \cdot 20 \vec{i} \\
     &= -15 \times 30° \vec{k} \\
     &= -150 \vec{k} \\
  |\tau| &= 150 \text{ N·cm}
\end{align*}

21. Find electric potential at the surface of a nucleus \((z = 50)\) of radius \(9 \times 10^{-13} \text{ m}\).

\begin{itemize}
  \item[(1)] \(6 \times 10^6\) volt
  \item[(2)] \(8 \times 10^6\) volt
  \item[(3)] \(10 \times 10^6\) volt
  \item[(4)] \(12 \times 10^6\) volt
\end{itemize}

\textbf{Ans.}

\textbf{Sol.}

\begin{align*}
  V &= \frac{kq}{r} \\
  V &= \frac{9 \times 10^9 \times 50 \times 1.6 \times 10^{-19}}{9 \times 10^{-13}} \\
  V &= 8 \times 10^4 \text{ volt}
\end{align*}
(c) Assertion is false while reason is true
(3) Both Assertion and Reason are true
(4) Both Assertion and Reason are false

Ans. (3)
Sol. Theory Based

24. A closed organ pipe has length 150 cm and another open organ pipe has length 350 cm. Both are vibrating in fundamental mode. If value of beat frequency is 7 Hz. Find the speed of sound.

(1) 300 m/s
(2) 204 m/s
(3) 280 m/s
(4) 310 m/s

Ans. (2)
Sol. \[ f_1 = \frac{v}{4/l_1} \quad \text{(closed pipe)} \]

\[ f_2 = \frac{v}{2/l_2} \quad \text{(open organ pipe)} \]

\[ f_1 - f_2 = \frac{v}{4/l_1} - \frac{v}{2/l_2} = \frac{v}{4/l_1} - \frac{v}{\sqrt{2} \cdot 2} \]

\[ \Rightarrow \frac{v}{4/l_1} - \frac{v}{\sqrt{2} \cdot 2} = \frac{v}{6/7} \]

\[ \Rightarrow v = 294 \text{ m/s} \]