PART 1 : PHYSICS

SECTION-I

1. **Ans (C)**

Max potential energy of deformation = max.

K.E. loss

$$= \frac{1}{2} \times 3 \times 2^2 + \frac{1}{2} \times 2 \times 3^2 = 15\text{ J}$$

2. **Ans (D)**

In the presence of non-zero external force for the system, we cannot conserver the mechanical energy.

3. **Ans (C)**

$$\frac{\lambda}{2} = 1 \Rightarrow \lambda = 2 \Rightarrow v = \frac{\omega}{k} \Rightarrow \frac{\lambda}{T} = \frac{2}{2} \Rightarrow 1\text{ cm/ sec}$$

$$v_p = \omega\sqrt{A^2 - x^2} = \frac{2\pi}{T}\sqrt{4^2 - \left(2\sqrt{3}\right)^2} = \frac{2\pi}{2}\sqrt{16-12}$$

$$\frac{2\pi}{2} \times 2 = 2\pi\text{ cm/ sec}$$

4. **Ans (A)**

Distance between two position of bridge is $\lambda/2$ (Distance between two nodes)

$$\frac{\lambda}{2} = 25\text{cm}$$

$$\lambda = 50\text{ cm}$$

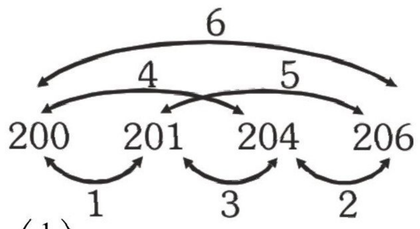
$$v = n\lambda \Rightarrow \sqrt{\frac{T}{\mu}} = n\lambda$$

$n = 400$; $T = 20$ N

$\mu = 0.5$ gm /m

5. **Ans (B)**

Now divide 1 second into number of beats between two frequencies



$\left(\frac{1}{1}\right)$

$\left(\left(\frac{1}{2}\right)\right), \left(\frac{2}{2}\right)$

$\left(\left(\left(\frac{1}{3}\right)\right)\right), \left[\frac{2}{3}\right], \left(\frac{3}{3}\right)$

$\frac{1}{4}, \left(\left(\frac{2}{4}\right)\right), \frac{3}{4}, \left(\frac{4}{4}\right)$

$\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}, \left(\frac{5}{5}\right)$

$\frac{1}{6}, \left(\left(\frac{2}{6}\right)\right), \left(\left(\frac{3}{6}\right)\right), \left[\frac{4}{6}\right], \frac{5}{6}, \left(\frac{6}{6}\right)$

6. **Ans (B)**

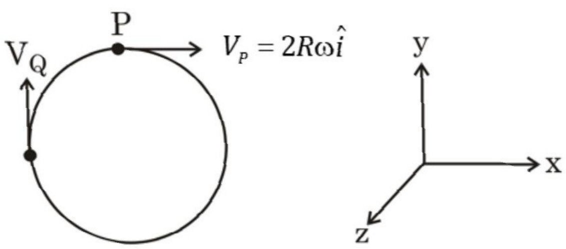
$$f = f_0\left(\frac{v}{v - v_s}\right) = 1000\left(\frac{330}{330 - 220}\right) = 3000\text{Hz}$$

7. **Ans (C)**

$$\frac{3\cancel{v}}{4\ell_1} = \frac{2\cancel{v}}{2\ell_2}$$

$$\frac{\ell_1}{\ell_2} = \frac{3}{4}$$

8. **Ans (A)**



$$V_Q = R\omega\hat{j} + R\omega\hat{i}$$

$$\therefore \frac{|V_P|}{|V_Q|} = \frac{2}{\sqrt{2}} = \frac{\sqrt{2}}{1}$$

9. **Ans (D)**

$T_1 + T_2 = mg$ (Force balance)

Torque about one end of rod

$$T_2\ell\cos 30^\circ - mg\frac{\ell}{2}\cos 30^\circ = 0$$

So $T_1 = T_2 = \frac{mg}{2}$

10. **Ans (A)**

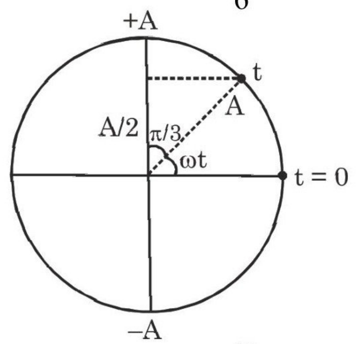
$$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}(MR^2)\left(\frac{v}{R}\right)^2 \Rightarrow v = \sqrt{gh}$$

Angular momentum $L = I\omega$

$$= MR^2\frac{\sqrt{gh}}{R} = MR\sqrt{gh}$$

11. **Ans (C)**

Corresponding to equilibrium positions to A/2, phase angle will be $\frac{\pi}{6}$.



$\therefore$ Time required $= \frac{T}{12}$

12. **Ans (A)**

Time period $\Rightarrow T = 2\pi\sqrt{\frac{m_{total}}{k_{eq}}}$

$$T = 2\pi\sqrt{\frac{3m}{3k}} = 2\pi\sqrt{\frac{m}{k}}$$

13. **Ans (B)**

$$I = \frac{1}{2}\epsilon_o c E_0^2$$

$$E_0 = \sqrt{\frac{2I}{\epsilon_0 c}} \text{ or } \sqrt{\frac{2 \times 500 \times 10^9 \times 36\pi}{\pi \times 3 \times 10^8}}$$

$$E_0 = 2\sqrt{3} \times 10^2 \text{N/C}$$

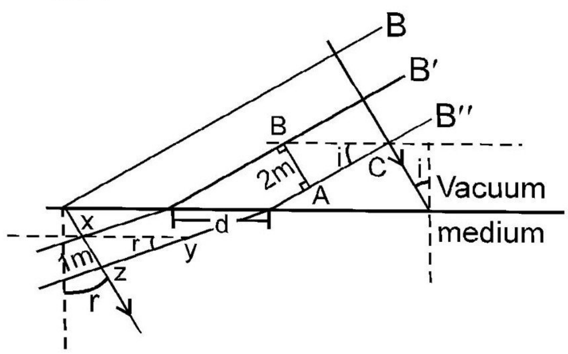
14. **Ans (D)**

$B_0 = \frac{E_0}{C}$ and $\vec{V}$ should be || to $\vec{E} \times \vec{B}$

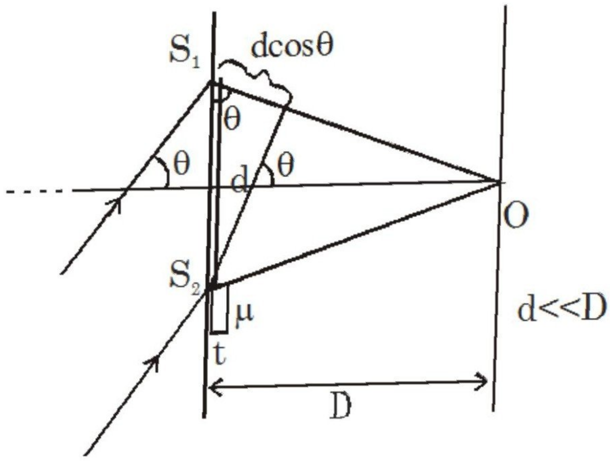
15. **Ans (A)**

In Δ ABC ; $\sin(i) = \frac{2}{d}$ In Δ xyz ; $\sin(r) = \frac{1}{d}$

$$\Rightarrow \frac{\sin i}{\sin r} = 2 = \mu$$



16. **Ans (A)**

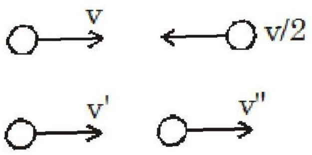


$d\sin\theta = (\mu - 1)t$

17. **Ans (C)**

β rays which are emitted from a radioactive material are electrons or positrons emitted by a nucleons.

18. **Ans (D)**



λ same ⇒ p same

$$mv - \frac{2mv}{2} = mv' + 2mv''$$

$$1 = \frac{v'' - v'}{v + \frac{v}{2}}$$

$$v' = -2v''$$

$$v'' - v' = \frac{3v}{2}$$

$$3v'' = \frac{3v}{2}$$

$$v'' = \frac{v}{2}$$

$v' = -v$ ⇒ 

19. **Ans (C)**

Find $\frac{B \cdot E}{A}$ of all and compair

20. **Ans (D)**

$$h(2n) = hn + \frac{1}{2}\, mv^2_{max} \;\Rightarrow\; v_{max} = \sqrt{\frac{2hn}{m}}$$

PART 1 : PHYSICS

SECTION-II

1. **Ans (5)**

Ionization energy of hydrogen atom = W_0

for H and He^+ :

$$\frac{1}{2}\mu V_{rel}^2 = W$$

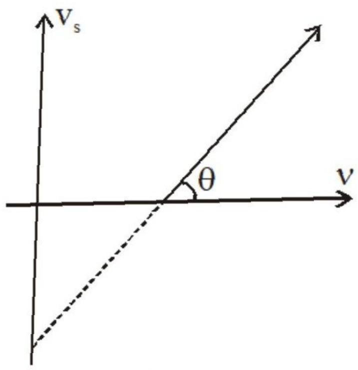
$$\mu = \frac{m_H m_{He^+}}{m_H + m_{He^+}} = \frac{4}{5}m_H \quad \because\ m_{He} \approx 4m_H$$

Ionization energy for hydrogen atom is same in both cases.

$$\frac{1}{2}\left(\frac{4}{5}m_H\right)V^2 = W_0$$

$$\Rightarrow \frac{E_{He^+}}{5} = W_0 \Rightarrow E_{He^+} = 5W_0 = \alpha W_0 \Rightarrow \alpha = 5$$

2. **Ans (1)**



$$ev_s = h\nu - \phi$$

$$v_s = \left(\frac{h}{e}\right)\nu - \frac{\phi}{e}$$

$$\Rightarrow \text{slope} = \frac{h}{e} = \text{constant}$$

$$\Rightarrow \text{ratio} = 1$$

3. **Ans (4)**

$(\mu_2 - \mu_1)t = 3\lambda$

4. **Ans (8)**

$$\beta = 10\log\left(\frac{P}{P_0}\right)$$

$$70 = 10\log\left(\frac{60}{P_0}\right)$$

$$x = 10\log\left(\frac{120}{P_0}\right)$$

Subtract

$$x - 70 = 10\log(2)$$

$$x - 70 = 3$$

$$x = 73$$

$$\frac{x+7}{10} = \frac{80}{10} = 8$$

5. **Ans (2)**

$$T = 2\pi\sqrt{\frac{I}{C}} \Rightarrow$$

$$\frac{T'}{T} = \sqrt{\frac{I'}{I}} = \sqrt{\frac{\left(\rho\pi\frac{4r^2}{2}\frac{t}{4}\right)4r^2}{\frac{(\rho\pi r^2 t)r^2}{2}}}$$

$$T' = 2T$$