1. $$f' = f_0\left[\frac{v}{v - v_s}\right]$$

$\because f' > f_0$

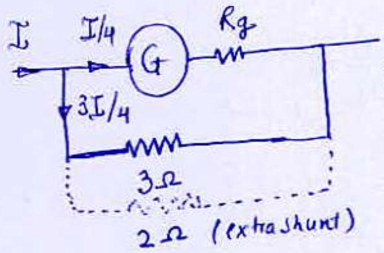
$\Rightarrow \lambda' < \lambda_0$ [$\because$ speed of sound is constant]

NOTE : No change in wavelength is observed if observer moves towards a stationary source.

(A)

2. shunt is added to reduce the amount of current only one option is less than 1/4 hence (D)

proof:-



$\frac{I}{4} R_g = \frac{3I}{4} \times 3\Omega$

$\Rightarrow R_g = 9\,\Omega$

New shunt resistance = $\frac{2\times 3}{2+3}\,\Omega$

$\therefore I_g \times 9 = (I - I_g) \times \frac{6}{5}$

$\Rightarrow I_g = \frac{I}{8.5}$

(D)

3. $$\frac{1}{2}mu^2 + \left(-\frac{GM_e m}{R_e}\right) = 0 + \left(-\frac{GM_e m}{(R_e + h)}\right)$$

substitute $\frac{GM_e}{R_e^2} = g$ and solve for 'h'

(where R_e is Radius of earth given as R)

we get $$h = \frac{u^2 R_e}{2gR_e - u^2}$$

(A)

4. $$\frac{1}{2} \times \frac{C_1}{N_1} \times (3V)^2 = \frac{1}{2} \times \frac{C_2}{N_2} \times (V)^2 \Rightarrow C_1 = \frac{C_2 N_1}{9N_2} \quad (C)$$

$\cancel{C_2 = \frac{9N_2 C_1}{N_1}}$

9. $V_{orbital} = \sqrt{\frac{GM}{(R+h)}}$, $V_{escape} = \sqrt{\frac{2GM}{R}}$ (at Surface)

$\Rightarrow \sqrt{\frac{GM}{(R+h)}} = \frac{1}{4}\sqrt{\frac{2GM}{R}}$ square and solve

we get $h = 7R$

(D)

10. $f_n = \frac{(2n+1)c}{4L}$ [substitute options to get quick results]

(detailed solution)

$\because f_n < 1000\text{ Hz}$ $\Rightarrow$ $1000 > \frac{(2n+1) \times 332}{4 \times 0.83}$

$10 > (2n+1)$

$4.5 > n$ {$\because$ n is integer minimum value can be 4}

(B)

11. $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$, $I_{min} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

$\Rightarrow I_{max} + I_{min} = 2(I_1 + I_2)$

(B)

12. $I_c = \frac{V_{rms}}{X_c} = \omega C \cdot V_{rms} = 100 \times 10^{-6} \times 200 = 20\text{ mA}$

(D)

18.

$$1^2 = (0.8)^2 + (b)^2 + (0.4)^2$$

$$\Rightarrow b = \sqrt{0.2}$$

(D)

19. Theory based.

(C)

20. $mg = Kx_0$ [for equilibrium position]

$x_0 = \frac{mg}{K}$, here x_0 can be treated as Amplitude

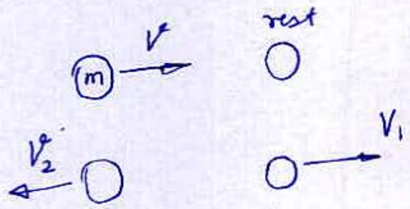
$$V_{max} = A\omega \qquad \left(\omega = \sqrt{\frac{K}{m}} \text{ also } \omega = 2\pi f\right)$$

$$V_{Max} = \frac{g}{\omega^2}\cdot\omega = \frac{10}{2\pi \times 5} = \frac{1}{\pi}\ m/s$$

(D)

21.

$$e = \frac{V_2 + V_1}{V - 0} \quad -(1)$$



also

$$mv = mV_1 - mV_2 \quad -(2)$$

from (1) & (2)

$V_1 = (e+1)\frac{V}{2}$ ~~and V_2 =~~

$$\therefore \frac{V_1}{V} = \frac{(e+1)}{2}$$

(C)

27.

$$\frac{\Delta X}{X} \times 100 = 2\left(\frac{\Delta a}{a} \times 100\right) + 2\left(\frac{\Delta b}{b} \times 100\right) + \left(\frac{\Delta c}{c} \times 100\right)$$

$$= 2 \times 2\% + 2 \times 3\% + 4 = 14\%.$$

(B)

28. Theory based or draw graph from equation, $eV_s = h\nu - \phi$

(A)

29. theory based

(D)

30. $\lambda = \dfrac{h}{p}$

$$E = \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2}$$

(B)

31. $h = \dfrac{2T\cos\theta}{\rho r g} \Rightarrow h \propto \dfrac{1}{\sqrt{\text{Area}}}$

$$\therefore \frac{h'}{h} = \frac{\sqrt{A}}{\sqrt{A/9}} = 3$$

$h' = 3h$

(B)

36. Angular momentum is conserved.

$$2I \cdot \omega_{combined} = I\omega$$

$$\omega_{combined} = \frac{\omega}{2}$$

$$\Delta K.E. = \left(\frac{1}{2}I\omega^2\right) - \left(\frac{1}{2}I(\omega/2)^2 + \frac{1}{2}I(\omega/2)^2\right)$$

$$= \frac{I\omega^2}{4}$$

(B)

37. $\vec{P_3} = 3p\hat{i} - 2p\hat{j}$ $[\vec{P_1} + \vec{P_2} + \vec{P_3} = \vec{P_i} = 0]$

$\therefore |\vec{P_3}| = \sqrt{13}\, p$

(D)

38. $V_s = \frac{h}{e}\nu - \frac{\phi}{e}$

(B)

39. $a_c = \frac{v^2}{l} = \frac{(\sqrt{3gl})^2}{l} = 3g$

(B)

40. $\vec{E}$ due to thin plate close to its surface is $\frac{\sigma}{2\epsilon_0}$

hence, (A)

[it can be derived easily using gauss's law]

45. $\frac{\mu_0 I}{2R} = B$ (given)

$$B_{axial} = \frac{\mu_0 I R^2}{2(R^2+x^2)^{3/2}} = \frac{1}{8} \times \frac{\mu_0 I}{2R}$$

solving for x we get $x = R\sqrt{3}$

(B)

46. Limit of resolution $= \frac{0.61\lambda}{N.A.}$

(C)

47. Theory based

(D)

48. M_z should be proportional to B and inversely proportional to T

$\therefore M_z \propto \frac{B}{T}$

$M_z = \frac{cB}{T}$

(B)

49. $$\frac{1}{\lambda} = R\left[1 - \frac{1}{(4)^2}\right]$$

$$\Rightarrow p = \frac{h}{\lambda} = \frac{15}{16}R\,h$$

$$\therefore \text{speed} = \frac{15Rh}{16m}$$

(D)

50. $$\rho \cdot \pi r^2 \cdot l g = 2Tl$$

$$r = \sqrt{\frac{2T}{\pi \rho g}}$$

$$\Rightarrow r \propto \sqrt{\frac{T}{\pi \rho g}}$$

(A)

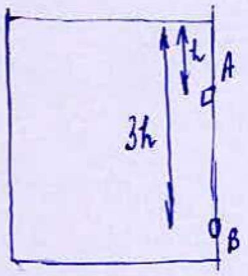
41. Time period $= 2\pi \times \sqrt{\dfrac{1}{\pi^2}} = 2\,s$

$\Rightarrow \omega = \pi$ rad/s

$V_{Max} = A\omega = 8\pi$ cm/s

(C)

42.



$\because$ flow rate is same

$V_A \cdot L^2 = V_B \cdot \pi r^2$

$\sqrt{2gh} \cdot L^2 = \sqrt{2g(3h)} \cdot \pi r^2$

$\therefore L = r \cdot (\pi)^{1/2} \cdot (3)^{1/4}$

(C)

43. $R_g = \dfrac{2000}{150}$, Current gain $= \dfrac{1.5 \times 10^{-3}}{20 \times 10^{-6}}$

$\therefore$ Votage gain $= \dfrac{2000}{150} \times \dfrac{1.5 \times 10^{-3}}{20 \times 10^{-6}} = 1000$

(B)

44. $\dfrac{\tau}{I} = \alpha = \dfrac{\omega}{t}$

$\therefore \dfrac{f \times R}{MR^2/2} = \dfrac{\omega}{t}$

$\Rightarrow f = \dfrac{MR\omega}{2t}$

(B)

32. current flows in forward biasing

$\therefore$ acts as closed switch

(C)

33. Time period $= \dfrac{2\pi m}{eB} = \dfrac{1}{\nu}$

$\Rightarrow B = \dfrac{2\pi m \nu}{e}$

$KE_{Max} = 2\pi^2 m \nu^2 R^2$ $\quad \left[v_{Max} = \dfrac{eBR}{m} \right]$

(A)

34. $\dfrac{x}{V_a} = \dfrac{5}{V_g}$

$\Rightarrow \dfrac{x}{5} = \dfrac{V_a}{V_g} = \dfrac{\mu_g}{\mu_a}$

$\Rightarrow x = 5 \times 1{\cdot}6 = 8$ cm

(B)

35. $\dfrac{2{\cdot}4}{6} = \dfrac{\lambda}{2} \Rightarrow \lambda = 0{\cdot}8$

Separation of successive node and antinode $= \dfrac{\lambda}{4} = 0{\cdot}2$

(B)

22.

$$< |\vec{v}| > = \frac{4a}{T} = \frac{4a}{1/n} = 4an$$

(B)

23. Power remains conserved

$$\therefore \quad 220 \times I_p = 3.3 \times 10^3 \times I_s = 4.4 \times 10^3 \text{ W}$$

$$\Rightarrow \quad I_s = \frac{4}{3} \text{ A}$$

(B)

24.

$$R_1 = \frac{4\rho L_1}{\pi d_1^2} \quad \text{and} \quad R_2 = \frac{4\rho L_2}{\pi d_2^2} \quad \text{also} \quad L_1 \times \frac{\pi d_1^2}{4} = L_2 \times \frac{\pi d_2^2}{4}$$

$$\therefore \quad \frac{R_1}{R_2} = \frac{d_2^4}{d_1^4} \quad (A)$$

25. formula based.

or solve, $C_V + C_P = R$ and $\frac{C_P}{C_V} = \gamma$

(D)

26.

$$\frac{\Delta l_P}{\Delta l_Q} = \frac{FL}{A_P Y} \times \frac{A_Q Y}{FL} = \frac{m_Q}{m_P} = \frac{m_2}{m_1}$$

(C)

13. given circuit is a balanced wheatstone bridge.

$\cancel{(18\Omega) \times I_{15} = (I_{15} - 2.1) \times 24\Omega}$

$\therefore \quad 18\Omega \times I_{15} = (2.1 - I_{15}) \times 24\Omega$

$\Rightarrow \quad I_{15} = 1.2\ A$

(C)

14. Theory based (A)

15. $\dfrac{a_t}{a_r} = \dfrac{\alpha r}{V^2/r} = \dfrac{\alpha r^2}{V^2}$

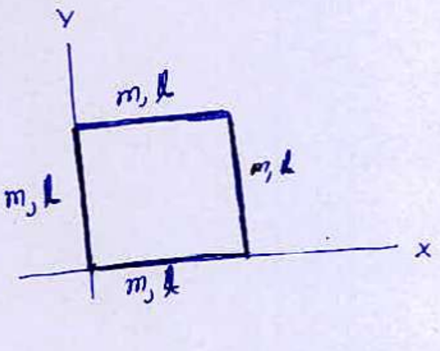
(C)

16. $\vec{A} = \vec{B} + \vec{C}$

Now, $|\vec{A}| = \sqrt{14}$, $|\vec{B}| = \sqrt{35}$, $|\vec{C}| = \sqrt{21}$

$\therefore \quad B^2 = A^2 + C^2$

(B)

17. 

$I = \dfrac{ml^2}{3} + \dfrac{ml^2}{3} + ml^2 = \dfrac{5}{3} ml^2$

(A)

5. $$a_a + a_r + a_t = 1$$

$$\Rightarrow a_t = 1 - 0.8 - 0.1 = 0.1$$

$\Rightarrow \frac{1}{10}$th of total energy is transmitted, which will be 500J

(B)

6. frequency $\propto \sqrt{\text{Tension}}$, [no. of waves produced in a second equals frequency]

$\therefore$ no. of waves $= \sqrt{2}\,n$

(B)

7. $$\frac{\text{Energy}}{\text{Volume}} = \frac{1}{2} \times \text{stress} \times \text{strain} = \frac{1}{2} \times \frac{(\text{stress})^2}{Y}$$

$$\frac{E}{AL} = \frac{1}{2} \times \frac{F^2}{A^2 Y}$$

$$\Rightarrow E = \frac{F^2 L}{2AY}$$ (B)

8. use $B = \dfrac{\mu_0 M d}{2\pi (d^2 - l^2)^2}$ [where d is distance of point from center and l is magnet's length]

$$\frac{25}{2} = \frac{10}{(10^2 - l^2)^2} \cdot \frac{(20^2 - l^2)}{20}$$

solving for 'l' we get $l = 5$ cm

(A)