

WEEKLY TEST TYM TEST - 34 BALLIWALA  
SOLUTION Date 05-01-2020

**[PHYSICS]**

1. (a) It is given that energy remains the same.

Hence,  $E_A = E_B$

$$\text{Energy} \propto a^2 n^2 \Rightarrow \frac{a_B}{a_A} = \frac{n_A}{n_B} \quad (\because \text{energy is same})$$

$$\therefore \left(\frac{a_A}{a_B}\right)^2 = \left(\frac{n_B}{n_A}\right)^2$$

Given,  $n_A = n, n_B = \frac{n}{8}$

$$\therefore \frac{a_A}{a_B} = \frac{n/8}{n} = \frac{1}{8} \Rightarrow a_B = 8a_A = 8a$$

2. (d) The frequency of note emitted by the wire,

$$n = \frac{1}{2l} \sqrt{\frac{T}{m}}$$

$m$  = mass  $m$  per unit length of wire and  $T$  = tension,  
and  $l$  = length of wire.

$$\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$$

Given,  $T_1 = 10 \text{ N}, n_1 = n,$  and  $n_2 = 2n$

$$\Rightarrow \frac{n}{2n} = \sqrt{\frac{10}{T_2}} \Rightarrow T_2 = 10 \times 4 = 40 \text{ N}$$

3. (c) Phase difference =  $\frac{2\pi}{\lambda} \times$  path difference

$$\text{Path difference } \Delta = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6}$$



4. (a) The apparent change in the frequency of the source due to relative motion between source and observer is known as Doppler's effect. The perceived frequency ( $n'$ ) when listener is static and source is moving away is given by

$$n' = n \left( \frac{v}{v + v_s} \right)$$

where  $n$  is frequency of source,  $v$  is velocity of sound and  $v_s$  is velocity of source.

Putting  $v = 330$  m/s,  $v_s = 30$  m/s,  $n = 800$  Hz.

$$n' = 800 \times \left( \frac{330}{330 + 30} \right)$$

$$n' = 733.3 \text{ Hz}$$

In the limit when speed of source and observer is much lesser than that of sound  $v_1$ , the change in frequency becomes independent of the fact whether the source is moved or the detector.

5. (b) The velocity of sound is given by  $v = \sqrt{\frac{\gamma P}{\rho}}$

where  $P$  is pressure,  $\rho$  is density and  $\gamma$  is adiabatic constant.

$$\Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{4}{1}} = 2:1$$

6. (b) Compare with  $y = a \sin(\omega t - kx)$

$$\text{We have } k = \frac{2\pi}{\lambda} = 62.4 \Rightarrow \lambda = \frac{2\pi}{62.4} = 0.1$$

7. (b) The frequency produced in a string of length  $l$ , mass per unit length  $m$ , and tension  $T$  is

$$n = \frac{1}{2l} \sqrt{\frac{T}{m}}$$

Given  $l_1 = 50$  cm,  $n_1 = 800$  Hz

and  $n_2 = 1000$  Hz

$$n_1 l_1 = n_2 l_2$$

$$\Rightarrow 800 \times 50 = 1000 \times l_2$$

$$\Rightarrow l_2 = 40 \text{ cm}$$

8. (d) Points  $B$  and  $F$  are in same phase as they are  $\lambda$  distance apart.
9. (c) Water waves are transverse as well as longitudinal in nature.

10. (d) Fundamental frequency of open organ pipe =  $\frac{v}{2l}$

Frequency of third harmonic of closed pipe =  $\frac{3v}{4l}$

$$\therefore \frac{3v}{4l} = 100 + \frac{v}{2l}$$

$$\Rightarrow \frac{3v}{4l} - \frac{2v}{4l} = \frac{v}{4l} = 100 \Rightarrow \frac{v}{2l} = 200 \text{ Hz}$$

11. (a)  $dB = 10 \log_{10} \left[ \frac{I}{I_0} \right]$ ,

where  $I_0 = 10^{-12} \text{ w m}^{-2}$

Since  $40 = 10 \log_{10} \left[ \frac{I_1}{I_0} \right] \Rightarrow \frac{I_1}{I_0} = 10^4$

Also,  $20 = 10 \log_{10} \left[ \frac{I_2}{I_0} \right] \Rightarrow \frac{I_2}{I_1} = 10^2$

$$\Rightarrow \frac{I_2}{I_1} = 10^{-2} = \frac{r_1^2}{r_2^2}$$

$$\Rightarrow r_2^2 = 100 r_1^2 \Rightarrow r_2 = 10 \text{ m}$$

12. (b) Given  $\frac{I_1}{I_2} = \frac{4}{1}$

We know  $I \propto a^2$

$$\therefore \frac{a_1^2}{a_2^2} = \frac{I_1}{I_2} = \frac{4}{1} \quad \text{or} \quad \frac{a_1}{a_2} = \frac{2}{1}$$

$$\begin{aligned} \therefore \frac{I_{\max}}{I_{\min}} &= \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \left( \frac{2+1}{2-1} \right)^2 \\ &= \left( \frac{3}{1} \right)^2 = \frac{9}{1} \end{aligned}$$

Therefore, difference of loudness is given by

$$\begin{aligned} L_1 - L_2 &= 10 \log \frac{I_{\max}}{I_{\min}} = 10 \log (9) \\ &= 10 \log 3^2 = 20 \log 3. \end{aligned}$$

13. (a) When the source is coming to the stationary observer,

$$n' = \left( \frac{v}{v - v_s} \right) n \quad \text{or} \quad 1000 = \left( \frac{350}{350 - 50} \right) n$$

or  $n = (1000 \times 300/350) \text{ Hz}$

When the source is moving away from the stationary observer.

$$\begin{aligned} n'' &= \left( \frac{v}{v + v_s} \right) n \\ &= \left( \frac{350}{350 + 50} \right) \left( \frac{1000 \times 300}{350} \right) \\ &= 750 \text{ Hz} \end{aligned}$$

14. (c) Fundamental frequency of closed pipe

$$n = \frac{v}{4l} = 220 \text{ Hz} \Rightarrow v = 220 \times 4l$$

If 1/4 of the pipe is filled with water then remaining

length of air column is  $\frac{3l}{4}$

$$\text{Now fundamental frequency} = \frac{v}{4 \left( \frac{3l}{4} \right)} = \frac{v}{3l} \text{ and}$$

First overtone = 3 × fundamental frequency

$$= \frac{3v}{3l} = \frac{v}{l} = \frac{220 \times 4l}{l} = 880 \text{ Hz}$$

15. (c)  $f \propto \sqrt{T}$

$$\begin{aligned} f &= \frac{1}{2l} \sqrt{\frac{T}{\mu}} \Rightarrow \frac{\Delta f}{f} = \frac{1}{2} \frac{\Delta T}{T} \\ \Rightarrow \Delta f &= \frac{202}{2} \times \frac{1}{101} = 1 \end{aligned}$$

16. (d)  $\frac{v_1}{v_2} = \frac{28}{27}$

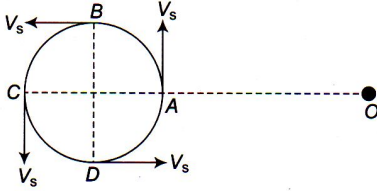
$$v_1 - v_2 = 3 \text{ or } \frac{28}{27} v_2 - v_2 = 3$$

$$v_2 = 27 \times 3 \text{ Hz} = 81 \text{ Hz}$$

or  $v_1 = v_2 + 3 = (81 + 3) \text{ Hz}$

or  $v_1 = 84 \text{ Hz}$

17. (d) Frequency heard by the observed will be maximum when the source is in the position  $D$ . In this case, source will be approaching towards the stationary observer, almost along the line of sight (as observer is stationed at a larger distance).



Similarly, frequency heard by the observer will be minimum when the source reaches at the position  $B$ . Now, the source will be moving away from the observer.

$$n_{\min.} = \frac{v}{v + v_s} \times n = \frac{330}{330 + 1.5 \times 20} \times 440$$

$$= \frac{330 \times 440}{360} = 403.3 \text{ Hz}$$

18. (d) When pulse is reflected from a rigid support, the pulse is inverted both lengthwise and sidewise

19. (c) Here  $A = 0.05\text{m}$ ,  $\frac{5\lambda}{2} = 0.025 \Rightarrow \lambda = 0.1\text{m}$

Now standard equation of wave

$$y = A \sin \frac{2\pi}{\lambda}(vt - x) \Rightarrow y = 0.05 \sin 2\pi(33t - 10x)$$

20. (d) Intensity  $\propto a^2 \omega^2$

$$\text{here } \frac{a_A}{a_B} = \frac{2}{1} \text{ and } \frac{\omega_A}{\omega_B} = \frac{1}{2} \Rightarrow \frac{I_A}{I_B} = \left(\frac{2}{1}\right)^2 \times \left(\frac{1}{2}\right)^2 = \frac{1}{1}$$