

WEEKLY TEST TYM -1 TEST - 34 Rajpur Road
SOLUTION Date 05-01-2020

[PHYSICS]

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

Hence, $E_A = E_B$

Energy $\propto a^2 n^2 \Rightarrow \frac{a_B}{a_A} = \frac{n_A}{n_B}$ (\because 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, $T_1 = 10$ N, $n_1 = n$, and $n_2 = 2n$

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

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

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, ρ is density and γ 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 λ 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,

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

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

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) $f \propto \sqrt{T}$

$$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}} \Rightarrow \frac{\Delta f}{f} = \frac{1}{2} \frac{\Delta T}{T}$$

$$\Rightarrow \Delta f = \frac{202}{2} \times \frac{1}{101} = 1$$

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

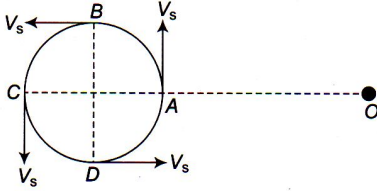
$$v_1 - v_2 = 3 \text{ or } \frac{28}{27} v_2 - v_2 = 3$$

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

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

$$\text{or} \quad v_1 = 84 \text{ Hz}$$

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 $\propto a^2 \omega^2$

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