QB365 Question Bank Software Study Materials

Waves Important 2 Marks Questions With Answers (Book Back and Creative)

11th Standard

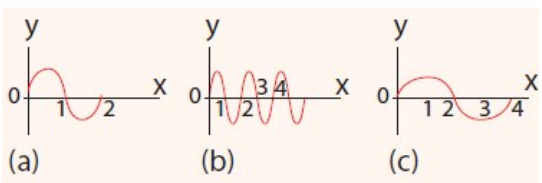
Physics

Total Marks : 60

2 Marks

30 x 2 = 60

1) Which of the following has longer wavelength?



Answer : **Answer** is (c)

2) Calculate the speed of sound in a steel rod whose Young's modulus Y = 2×10^{11} N m^{-2} and ρ = 7800 kg m^{-3}.

Answer : $v=\sqrt{\frac{y}{\rho}}=\sqrt{\frac{2\times10^{11}}{7800}}=\sqrt{0.2564\times10^{8}}$

$= 0.506\times10^{4} ms^{-1} = 5\times10^{3} ms^{-1}$

Therefore, longitudinal waves travel faster in a solid than in a liquid or a gas. Now you may understand why a shepherd checks before crossing railway track by keeping his ears on the rails to safeguard his cattle.

3) Suppose a man stands at a distance from a cliff and claps his hands. He receives an echo from the cliff after 4 second. Calculate the distance between the man and the cliff. Assume the speed of sound to be 343 m s^{-1}.

Answer : Th e time taken by the sound to come back as echo is $2t = 4 \Rightarrow t = 2$ s

$\therefore$ Th e distance is d = vt =(343 m s^{-1})(2 s) = 686 m.

4) A mobile phone tower transmits a wave signal of frequency 900MHz. Calculate the length of the waves transmitted from the mobile phone tower.

Answer : Frequency, f = 900 MHz = 900×10^{6} Hz

The speed of wave is c = 3×10^{8} m s^{-1}

$\lambda=\frac{v}{f}=\frac{3\times10^{8}}{900\times10^{6}}=0.33m$

5) Two vibrating tuning forks produce waves whose equation is given by y_1 = 5 sin(240πt) and y_2 = 4 sin(244πt). Compute the number of beats per second.

Answer : Given y_1 = 5 sin(240πt) and y_2 = 4 sin(244πt)

Comparing with y = A sin(2π f_1t), we get

$2\pi f_1 = 240\pi \Rightarrow f_1 = 120$Hz

$2\pi f_2 = 244\pi \Rightarrow f_2 = 122$Hz

The number of beats produced is $|f_1 - f_2| = |120 - 122| = |-2| = 2$ beats per sec

6) Compute the distance between anti-node and neighbouring node.

Answer : For n^{th} mode, the distance between antinode and neighbouring node is

$\Delta x_n=\left(\frac{2n+1}{2}\right)\frac{\lambda}{2}-n\frac{\lambda}{2}=\frac{\lambda}{4}$

7) A baby cries on seeing a dog and the cry is detected at a distance of 3.0 m such that the intensity of sound at this distance is 10^{-2} W m^{-2}. Calculate the intensity of the baby's cry at a distance 6.0 m.

Answer : I_1 is the intensity of sound detected at a distance 3.0 m and it is given as 10^{-2} W m^{-2}. Let I_2 be the intensity of sound detected at a distance 6.0 m. Then,

r_1 = 3.0 m, r_2 = 6.0 m

and since, $I \propto \frac{1}{r^2}$

the power output does not depend on the observer and depends on the baby. Therefore

$\frac{I_1}{} = \frac{r_2^2}{}$

$I_2 \quad r_1^2$

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

$I_2 = 0.25 \times 10^{-2}$ W m^{-2}

8) If a flute sounds a note with 450Hz, what are the frequencies of the second, third, and fourth harmonics of this pitch? If the clarinet sounds with a same note as 450Hz, then what are the frequencies of the lowest three harmonics produced?

Answer : For a flute which is an open pipe, we have

Second harmonics $f_2 = 2\ f_1 = 900$ Hz

Third harmonics $f_3 = 3\ f_1 = 1350$ Hz

Fourth harmonics $f_4 = 4\ f_1 = 1800$ Hz

For a clarinet which is a closed pipe, we have

Second harmonics $f_2 = 3f_1 = 1350$ Hz

Third harmonics $f_3 = 5\ f_1 = 2250$ Hz

Fourth harmonics $f_4 = 7f_1 = 3150$ Hz

9) What is meant by waves?.

Answer : The disturbance which carries energy and momentum from one point in space to another point in space without the transfer of the medium is known as a wave.

10) What are transverse waves? Give one example.

Answer : In transverse wave motion, the constituents of the medium oscillate or vibrate about their mean positions in a direction perpendicular to the direction of propagation (direction of energy transfer) of waves.

Example: light (electromagnetic waves)

11) What is meant by interference of waves?.

Answer : Interference is a phenomenon in which two waves superimpose to form a resultant wave of greater, lower or the same amplitude.

12) Define intensity of sound and loudness of sound.

Answer : "The sound power transmitted per unit area taken normal to the propagation of the sound wave". The loudness of sound is defined as "the degree of sensation of sound produced in the ear or the perception of sound by the listener".

13) Explain Doppler Effect.

Answer : When the source and the ob.server are in relative motion with respect to each other and to the medium in which sound propagates, the frequency of the sound wave observed is different from the frequency of the source. This phenomenon is called Doppler effect.

14) Explain red shift and blue shift in Doppler Effect.

Answer : The spectral lines of the star are found to shift towards red end of the spectrum (called as red shift) then the star is receding away from the Earth. Similarly, if the spectral lines of the star are found to shift towards the blue end of the spectrum (called as blue shift) then the star is approaching Earth.

15) What is meant by an echo? Explain.

Answer : An echo is a repetition of sound produced by the reflection of sound waves fiom a wall, mountain or other obstructing surfaces. The speed of sound in air at 20De is 344 ms^{-1}. If we shout at a wall which is at 344 m away, then the sound will take 1 second to reach the wall. After reflection, the sound will take one more second to reach us. Therefore, we hear the echo after two seconds. Scientists have estimated that we can hear two sounds properly if the time gap or time interval between each sound is $\left(\frac{1}{10}\right)^{th}$ of a second (persistence of hearing) i.e., 0.1 s. Then,

Velocity = $\frac{Distance\ travelled}{time\ taken} = \frac{2d}{r}$

$2d = 344 \times 0.1 = 34.4$ m

$d = 17.2$ m

The minimum distance from a sound reflecting wall to hear an echo at 2°Ce is 17.2 meter.

16) Consider a mixture of 2 mol of helium and 4 mol of oxygen. Compute the speed of sound in this gas mixture at 300 K.

Answer : Number of molecules of Helium -2

Number of molecules of Oxygen -4

When helium and oxygen are mixed, the molecular weight of the mixture of gases is

$\mathrm{M_{mix}} = \frac{n_1 M_1 n_2 M_2}{n_1+n_2} = \left(\frac{2\times4+4\times32}{2+4}\right) \times 10^{-3}\ \mathrm{kg/mol}$

$= \frac{8+128}{6} = \frac{136}{6} = 22.6 \times 10^{-3}\ \mathrm{kg/mol}$

In addition, Helium is mono atomic $C_{v_1} = \frac{3R}{2}$

Oxygen is diatomic $C_{v_2} = \frac{5R}{2}$

$\therefore$ For mixture, $(C_v)_{\mathrm{mix}} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1+n_2}$

$= \left[\frac{2\times\frac{3}{2}R+4\times\frac{5}{2}R}{2+4}\right] = \frac{13R}{6}$

$(C_p)_{\mathrm{mix}} = (C_v)_{\mathrm{mix}} + R = \frac{13R}{6} + R = \frac{19R}{6}$

$\therefore r_{\mathrm{mix}} = \frac{C_p}{C_v} = \frac{19R/6}{13R/6} = \frac{19}{13} = \frac{19}{3}$

According to laplace, the velocity of sound is

$v = \sqrt{\frac{rRT}{M}}$

$v = \sqrt{\frac{19\times8.31\times300\times6}{13\times136\times10^{-3}}}$

$v = \sqrt{\frac{28420}{1768}} \times 10^4$

$= 4.009 \times 10^2$

$= 400.9\ \mathrm{ms^{-1}}$

17) Let the source propagate a sound wave whose intensity at a point (initially) be I. Suppose we consider a case when the amplitude of the sound wave is doubled and the frequency is reduced to one-fourth. Calculate now the new intensity of sound at the same point?

Answer : Given

Amplitude of the sound waves is

a = $2a_o$

Frequency of the sound waves is

$\mathrm{f} = \frac{f_0}{4}$

Formula $I \propto a^2 4^2$

$I_{\mathrm{new}} \propto a^2 f^2$

$I_{\mathrm{old}} \propto a_0^2 f_o^2$

$I_{\mathrm{new}} \propto (2a_0)^2 \left(\frac{f_0}{4}\right)^2$

$I_{\mathrm{new}} \propto \frac{4a_o^2}{16} f_0^2$

$\propto \frac{a_o^2 f_0^2}{4}$

$\therefore I_{\mathrm{new}} \propto \frac{I_{\mathrm{old}}}{4}$

18) Is it possible to realize whether a vessel kept under the tap is about to fill with water?

Answer : (i) The frequency of a note generated by an air column is inversely proportional to its length. Consequently, as the length of air column decreases. The frequency increases i.e., the note becomes more shrill.

(ii) In our case, when a vessel kept under the tap is about to fill with water, as the water level rises, the length of air column in the vessel goes on decreasing and the emitted send becomes more and more shrill. Hence it is realized.

19) Consider a tuning fork which is used to produce resonance in an air column. A resonance air column is a glass tube whose length can be adjusted by a variable piston. At room temperature, the two successive resonances observed are at 20 cm and 85 cm of the column length. If the frequency of the length is 256 Hz, compute the velocity of the sound in air at room temperature.

Answer : Given two successive length (resonance) to be L_1 =20 cm and L_2 =85 cm

The frequency is f = 256 Hz

$v = f\lambda = 2f\Delta L = 2f\,(L_2 - L_1)$

$= 2 \times 256 \times (85-20) \times 10^{-2}\ \mathrm{m\ s^{-1}}$

$v = 332.8\ \mathrm{m\ s^{-1}}$

20) 1. What is mean by Endcorrection ?

Answer :

21) Define frequency and time period.

Answer : Frequency is defined as "the number of waves crossing a point per second" It is measured in hertz.

Frequency and time period are inversely related i.e.,

$T = \frac{1}{f}$

Time period is defined as the time taken by one wave to cross a point.

22) Define amplitude of the wave.

Answer : An amplitude of the wave is defined as the maximum displacement of the medium with respect to a reference axis (for example in this case x-axis). Here, it is denoted by A.

23) What is persistence of hearing?

Answer : Velocity = $\frac{Distance\ travelled}{time\ taken} = \frac{2d}{t}$

2d = 344×0.1 = 34.4 m

d = 17.2 m.

24) What is Reverberation?

Answer : In a closed room the sound is repeatedly reflected from the walls and it is even heard long after the sound source ceases to function. The residual sound remaining in an enclosure and the phenomenon of multiple reflections of sound is called reverberation.

25) Two astronauts on the surface of the moon cannot talk to each other why

Answer : Sound waves require material medium for their propagation. As there is no atmosphere on the moon, hence the sound wave cannot propagate on the moon

26) What do you mean by phase of a wave?

Answer : The phase of a harmonic is a quantity that gives complete information of the wave at any time and at any position.

27) Define reverberation time?

Answer : It is defined as the time which sound takes to fall in intensity to one millionth (10-6) part of its original intensity after it was stopped,

28) A steel wire 0.72 m long has a mass of 5.0×10^{-3} kg. If the wire is under a tension of 60 N.
What is the speed of transverse waves on the wire?

Answer : Here T = 60 N, Mass = 5.0×10^{-3} Kg, Length = 0.72 m

mass per unit length, $m = \frac{5.0 \times 10^{-3} kg}{0.72m} = 6.9 \times 10^{-3} kgm^{-1}$

The speed of the transverse wave-on the wire,

$v = \sqrt{\frac{T}{m}} = \sqrt{\frac{60N}{6.9 \times 10^{-3} kgm^{-1}}} \Rightarrow v = 93ms^{-1}$

29) If the radius of a wire is reduced to half, how is wave speed affected?

Answer : Speed of a wave v $= \sqrt{\frac{T}{\mu}}$

$= \sqrt{\frac{T}{m/\ell}}$

μ - mass/ length

Now $m \propto r^2$ where r is the radius of the wire.

$\therefore v \propto \frac{1}{\sqrt{m}} \propto \frac{1}{\sqrt{r^2}} \propto \frac{1}{r}$

When radius of the wire is reduced to half the speed of a wave becomes two times the initial speed.

30) How much velocity of sound in air changes when temperature is increased by 1°C?

Answer : The velocity of sound in air is increased by 0.61 ms^{-1} for every 1°C rise in temperature.