Sound: In-Text Questions

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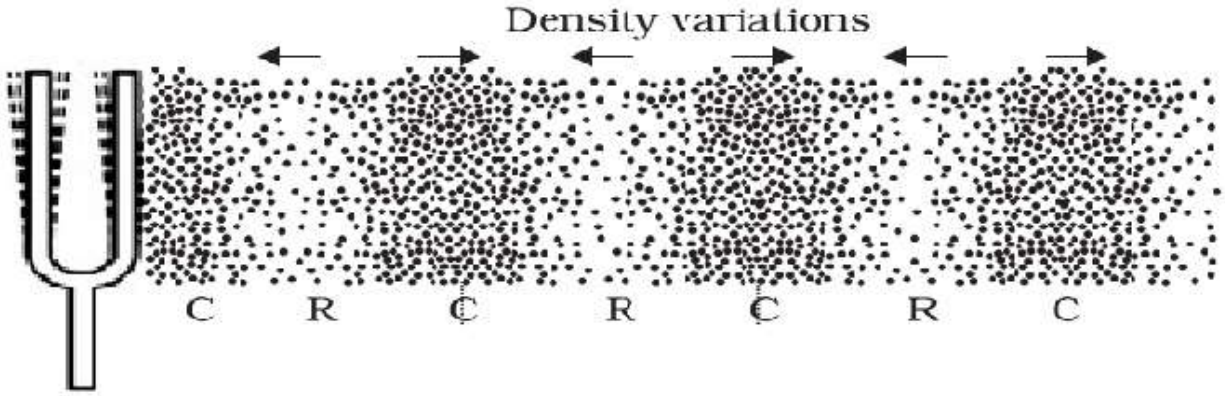
Q.1 How does the sound produced by a vibrating object in a medium reach your ear?

When an object vibrates, it alternately compresses and rarefies the neighborhood air. The compressed air has higher pressure and higher density than surrounding air. Therefore it pushes its near air particles and due to this compression moves forward. A rarefaction or low pressure is created at the original place. These compressions and rarefaction causes particles in the air to vibrate at their mean position. The energy is moved forward in these vibration. In this way, sound travels in a medium.



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Q.1 Explain how sound is produced by your school bell?

Sol. When the peon of school strikes the bell through a stick, vibrations are produced in the bell. These vibrations create compressions and rarefactions in particles of air. These compressions and rarefactions are transmitted to our ears and produce the sensation of sound.

Q.2 Why sound waves are called mechanical waves?

Sol. Sound waves need a material medium to travel that's why sound wave are called mechanical waves.

Q.3 Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Sol. As we know that sound needs a medium to propagate. But on the moon, there is no atmosphere and sound cannot travel. So, we will not be able to hear any sound.

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Q.1 Which waves property determines (a) loudness (b) pitch?

Sol. (i) Loudness is determined by the amplitude of the sound. If a sound wave has larger amplitude, the sound will be louder.

(ii) The frequency of sound wave determines the pitch. Higher the frequency of a sound wave more is its pitch. If a sound has higher frequency, then the sound will be high pitch.

Q.2 Guess which sound has a higher pitch: guitar or car horn?

Sol. Guitar has the higher pitch than car horn because the pitch of the sound is directly proportional to its frequency.

Q.3 What are wavelength, frequency, time period and amplitude of a sound wave?

Sol. **Wavelength**: It is defined as the distances between two consecutive compressions or rarefaction of a wave. Its S.I unit is meter. It is represented by 'λ' symbol.

Frequency: It can be defined as the number of vibration in a second is called frequency. Its unit is Hertz. It is represented by n or ν.

Amplitude: Sound waves are produced by vibration of the particles about their mean position. The maximum displacement of the particles from its mean position is called amplitude. It is measured in meters (m).

Time period: It is defined as the time taken by the sound wave to complete one oscillation is called time period. It is measured in second (s) and represented by T.

Q.4 How are the wavelength and frequency of a sound wave related to its speed?

Sol. The wavelength and frequency of a sound wave are related to its speed by the following relationship:

Speed = Wavelength x frequency

$V=\lambda \times \nu$

Q.5 Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Sol. ***Given: Frequency*** ν = 220Hz,

Speed V = 440 m/s

$\lambda = V / \nu = 440 / 220 = 2m$

So, the wavelength of the sound wave is 2 m.

Q.6 A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?

Sol. **Given: Frequency** ν= 500 Hz.

Distance d = 450 m

So, the time interval T = 1/ ν

Therefore T= 1/500 = 0.002 s

Q.7 Distinguish between loudness and intensity of sound?

Sol. Loudness and intensity both the physical quantities depend upon the amplitude of sound. But loudness is the physiological response of our ears. Our ears are more sensitive to different frequencies as compared to others. While intensity is the amount of sound energy passing in per unit area in per unit time.

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Q. 1 In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Sol. As we know that sound travels fastest in solids and slowest in gas medium. So, sound travels faster in iron and slowest in air.

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Q.1 An echo returned in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is $342 ms^{-1}$?

Sol. ***Given:*** Time of echo = 3 s
Speed of sound v = 342 m/s
V= 2d /t
Therefore d = (v x t)/2
d = (342 x 3) / 2513 m.
So, the distance of the reflecting surface from the source is 513 m.

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Q.1 Why are the ceilings of concert halls curved?

Sol. The ceilings of concert halls are curved so that after reflections from the curved surface, sound can distribute uniformly each and every part of the hall.

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Q.1 What is the audible range of the average human ear?

Sol. The audible range of the average human ear is 20Hz–20,000Hz.

Q.2 What is the range of frequencies associated with (a) Infra sound? (b) Ultrasound?

Sol. The range of frequencies associated with
(a) Infra-sound less than 20 Hz
(b) Ultra-sound greater than 20, 000 Hz.

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Q.1 A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Sol. ***Given: time of return of echo*** t = 1.02 s,
Speed of sound v = 1531 m/s
d = (v × t) /2 = (1531×1.02) / 2
=780.81m