Hints & Solutions

1. **(B)**
Frequency

2. **(A)**
Decibel

3. **(A)**
Longitudinal waves

4. **(A)**
Amplitude

5. **(C)**
Steel

6. Sound is a form of mechanical wave that is produced by a vibrating source. It travels through a medium, usually air, and consists of compressions and rarefactions. When an object vibrates, it creates a disturbance in the surrounding air molecules, causing them to compress and expand, resulting in the transmission of sound waves.

7. Audible sounds are those that can be perceived by the human ear, typically within the frequency range of 20 Hz to 20,000 Hz. Inaudible sounds, on the other hand, fall outside this range and cannot be heard by humans. Examples of inaudible sounds include ultrasonic waves (frequency greater than 20,000 Hz) and infrasonic waves (frequency less than 20 Hz).

8. The pitch of a sound is directly proportional to its frequency. As the frequency of a sound wave increases, the pitch also increases, making the sound higher. Conversely, a decrease in frequency results in a lower pitch. This relationship is crucial for understanding how musical instruments produce different notes based on the varying frequencies of their vibrations.

9. An echo is a reflected sound wave that arrives at the listener's ears after bouncing off a surface. For an echo to occur, the distance between the source of sound and the reflecting surface must be sufficient to allow the sound wave to travel and return after reflection. The phenomenon of hearing an echo is used to estimate the distance between an observer and a reflecting surface by measuring the time interval between the production of sound and the reception of its echo.

10. The eardrum, also known as the tympanic membrane, is a thin, sensitive membrane located at the end of the ear canal. Its primary role is to vibrate in response to the incoming sound waves. When sound waves strike the eardrum, it vibrates at the same frequency as the sound wave and transmits these vibrations to the three small bones (ossicles) in the middle ear, initiating the process of auditory signal transmission.

11 Sound is produced by the vibration of an object. When an object vibrates, it sets air particles around it into motion, creating a series of compressions and rarefactions. These compressions and rarefactions form a longitudinal wave known as a sound wave. The vibrating object is the source of the sound, and the medium through which sound travels is usually air.

The process begins with the disturbance or vibration of particles in the object. This vibration causes the adjacent air particles to vibrate as well, transferring the disturbance from one particle to another. As a result, a series of compressions and rarefactions are formed, propagating through the air. In simpler terms, the air particles get compressed together during the high-pressure regions (compressions) and spread apart during the low-pressure regions (rarefactions).

The transmission of sound requires a medium like air, water, or solids because the particles in these mediums can easily transfer the vibrational energy. In a vacuum, where there is no medium, sound cannot travel because there are no particles to carry the disturbance.

12. Sound waves exhibit several characteristics, including frequency, wavelength, amplitude, and speed. The frequency of a sound wave determines its pitch, while the amplitude is related to its loudness.

Frequency is the number of oscillations or cycles of a sound wave per unit of time and is measured in Hertz (Hz). High-frequency sound waves produce a high-pitched sound, while low-frequency waves produce a low-pitched sound. For example, a whistle produces a high-pitched sound due to its high-frequency vibrations.

Amplitude, on the other hand, is the maximum displacement of particles in a sound wave from their rest position. It is directly related to the loudness of the sound. A larger amplitude results in a louder sound, while a smaller amplitude produces a softer sound. For instance, a loudspeaker generates a high-amplitude sound, producing a louder volume.

In summary, pitch is determined by frequency, with higher frequencies corresponding to higher pitches, while loudness is influenced by amplitude, with greater amplitudes leading to louder sounds.

13 The speed of sound in a medium is influenced by various factors, namely temperature, density, and elasticity. These factors are interconnected and play crucial roles in determining how fast sound waves travel through a medium.

Temperature: The speed of sound generally increases with an increase in temperature. In warmer conditions, the air molecules have higher kinetic energy, leading to faster vibrations and, consequently, a higher speed of sound. Conversely, in colder temperatures, the speed of sound decreases. An example is the faster speed of sound on a hot summer day compared to a cold winter day.

Density: The density of a medium affects the speed of sound inversely. In a less dense medium, such as hot air, sound waves can travel more quickly. In a denser medium, like cold air, sound waves move more slowly. For instance, sound travels faster in humid air (less dense) compared to dry air (more dense).

Elasticity: Elasticity refers to the ability of a medium to regain its original shape after being distorted. The more elastic a medium is, the faster sound waves can travel through it. Solids, for example, are more elastic than gases, resulting in higher speeds of sound in solids. This is why sound travels faster through a metal rod than through air.

In summary, temperature, density, and elasticity collectively determine the speed of sound in a given medium, with each factor playing a distinct role in influencing the propagation of sound waves.

14. The students' observation that sound traveled faster through the metal rod than the wooden rod can be explained by the difference in the materials of the rods and their physical properties. The speed of sound in a material is influenced by factors like elasticity, density, and stiffness.

In solids, sound travels through the vibration of particles. Metals generally have higher elasticity and stiffness compared to wood. When the rods were struck simultaneously, the disturbance caused by the striking force propagated as a wave through the rods. In the metal rod, the high elasticity allowed the particles to vibrate quickly, transmitting the sound wave faster. In contrast, the wooden rod, having lower elasticity, resulted in a slower transmission of the sound wave.

Therefore, the key factors influencing the speed of sound in solids are the elasticity and stiffness of the material. Higher values of these properties lead to faster sound transmission.

15. **(A)**

Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.