Chapter 10

SOUND WAVES

REVIEW EXERCISES

Q.1 ***Circle the most appropriate option:***

a) Light and sound waves travel through longitudinal waves.
(i) transverse waves
(ii) longitudinal waves
(iii) Both the transverse and longitudinal waves

b) Wavelength is symbolised as λ.
(i) ν (ii) λ (iii) δ

c) A normal human ear can hear sounds of the frequency ranges ***20 - 20,000 Hz***.
(i) *6 - 20,000 Hz* (ii) *20 - 20,000 Hz*
(iii) *20 - 3,000 Hz*

d) Sound travels fastest in the ***wood***.
(i) air (ii) water (iii) wood

e) Decibel is the unit of measurementn of ***wavelength***.
(i) pitch (ii) amplitude (iii) wavelength

Q.2 ***Explain the factors that impact the quality and intensity of sound.***

Ans: The following factors are impact quality and intensity of sound.
(i) Pitch (ii) Loudness

(i) Pitch:

Pitch is the highness and lowness of sound that is determined by the rate of the vibrations of frequency of sound waves. As pitch is the perceptual property of sound, high frequency of sound waves results into high-pitched, (thin sound) while a low frequency of sound waves results in low pitched, heavy sound.

Females and children have a thin and delicate voice as compared to the adult males.

(ii) Loudness

Loudness is "the degree of the sensation of sound produced in the human ear". Loudness basically depends on the amplitude of the sound waves. However, the surface area of the source of sound and its distance from the listener also impact the loudness of the sound.

In other words, a greater amount of energy results into the higher amplitude of the sound waves which in turn increases the loudness and the intensity of the sound.

Q.3 Describe five ways in which sound is important for humans.

Ans: Sound as a form of energy has multiple applications in our daily life following five ways in which sound is important for humans.

1) The sound of home security alarm attracts the attention of its residents to the danger.
2) The sound of doorbell indicates the presence of someone on the other side of the door.
3) The sound of mobile phone attract our attention to the distance call.
4) Siren is used at multiple occasions to attract people for different reasons for instance, it is used to warn us about incoming danger.
5) Radio is used for the transmission of sound (voice and music).

Q.4 Given to the sound frequency ranges, identify the audible frequency ranges to a young woman, an old man, bats, cars, whale, dogs, dolphins and elephants.

Sound Frequency Ranges	Audible Frequency Ranges to
20 – 15,000 Hz	Human
2,000 – 110,000 Hz	Bat
20 – 120,000 Hz	Dolphin
45 – 64000 Hz	Cat

Q.5 *Explain the characteristics of sound waves.*

Ans: In order to explain the characteristics of sound waves, we need to learn different terms such as:

(i) wavelength,
(ii) frequency,
(iii) amplitude and,
(iv) speed of these waves.

(i) Wavelength:

In a transverse wave, the wavelength is the distance between its two adjacent crests or troughs as shown in figure 10.4. Similarly, the wavelength is the distance between two adjacent compressions or refractions of a longitudinal wave. Wavelength is symbolised by the Greek letter, lamba (λ) while it is measured in metres (m).

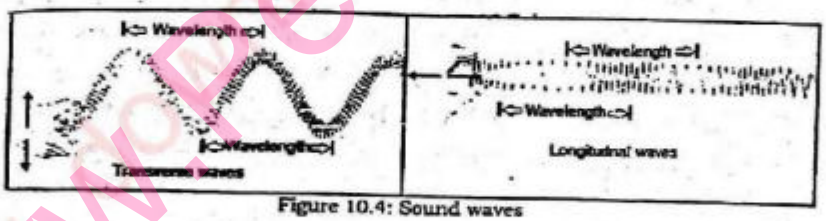

Figure 10.4: Sound waves

(ii) Amplitude:

As waves travel, the distance between the rest position of the moving particles to the top of a crest or the bottom of a trough is termed as amplitude (a). Amplitude is measured in metre (m) as well as decibel (dB) of the sound pressure. Here it is important to understand that amplitude is not the distance between

the crest (top) and the trough (bottom) of a wave. The difference between amplitude (a) and wavelength (λ) is evident in figure 10.5.

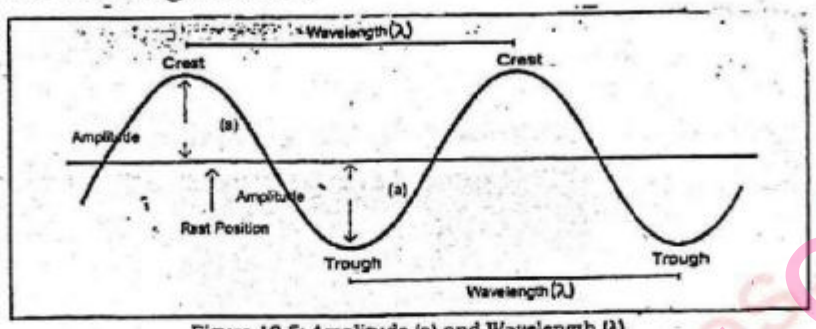

Figure 10.5: Amplitude (a) and Wavelength (λ)

(iii) Frequency:

The number of vibrations produced by a vibrating body in a second is called Frequency (*f*). Frequency is measured in Hertz (*Hz*). Frequency of the sound waves can be calculated by the following formula.

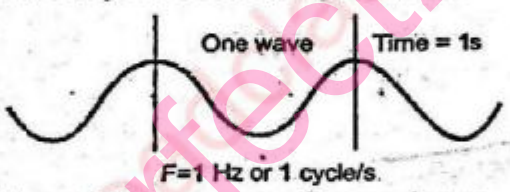

Figure 10.6: Frequency of a sound wave

$$\text{Frequency (f)} = \frac{\text{Number of waves}}{\text{Time (in seconds)}}$$

For instance, when one wave passes through a point in one second, the frequency will be 1Hz(figure 10.6). It will be mentioned as *1* cycle/s. Here 's' denotes time in seconds.

(iv) Speed:

The distance a sound wave covers in a unit of time is called its Speed. Speed is measured in metre per second (m/s). Both light and sound are forms of energy that have different speed. Light waves travel faster as compared to the sound waves. The speed of sound also

depends on the properties of its medium, hence sound travels at a different speed in different mediums. For instance, sound travels fastest in diamond and slowest in air. The stiffer the medium, the faster is the speed of sound.

Figure Lightning and thunder

Q.5 *Describe Longitudinal Waves & Transverse Waves.*

Figure 10.3(d): Longitudinal waves

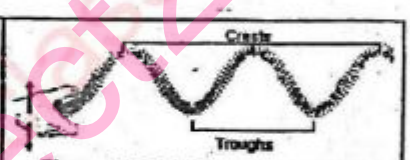

Figure 10.3 (e): Transverse waves

Waves having compressions and refractions (as shown in figure 10.3 d) with oscillation (movements) of particles parallel to the direction of wave propagation are named as longitudinal waves. Examples are seismic and sound waves. In contrast, waves having crests and troughs (as shown in figure 10.3 e) with oscillatin (movements) of particles perpendicular to the direction of wave propagation are called transverse waves. Examples are sound waves (in solids) and light. Moreover, transverse light waves can also travel in space while longitudinal waves need a medium to travel from one place to another.