Chapter – 13

Sound

Sound is Produced by a Vibrating Body

Production of sound: Sound is produced due to the vibrations in a body. When a body vibrates it produces sound in the form of waves.

Example: Write the parts of a drum that vibrates when a drum player strikes the membrane of it.

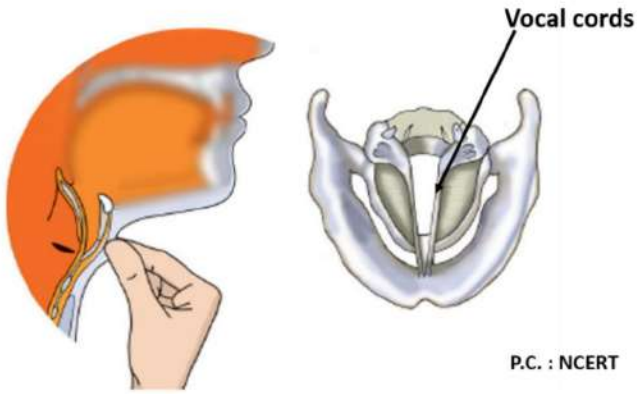
Solution: When a person strikes the membrane of the drum. The sound that we hear is not only that of the membrane but of the whole body of the instrument.

When any part of a body is vibrating, the whole body is forced to vibrate and it is the sound of the vibration of the whole body that we heard.

Tip: Remember one vibration is complete when the vibrating object goes from one extreme position to another extreme position and comes back to its initial extreme position.

Sound Produced by Humans

Sound produced by humans: The larynx is the voice box of a human. It is located at the upper end of a windpipe. The larynx has two vocal cords, which are stretched across the voice box such that it leaves a narrow slit between them for the passage of air. When we speak, the air passes through the slit and cords start vibrating to produce sound.



Tip: Remember the voices of men, women and children are different due to variations in their vocal length.

Sound Needs a Medium for Propagation

Propagation of sound: Sound needs a medium for propagation. It cannot travel through a vacuum because in the empty space there are no atoms or particles to vibrate.

Example: Astronauts on the moon are not able to communicate with each other without using any special device. Why?

Solution: The moon is in space and most of the space is a vacuum. On the moon, there is no air exists, only a very thin layer of gases is present in the atmosphere. The particles of these gases are very far apart from each other and don't interact with each other.

Therefore, the sound does not propagate as sound needs a medium having particles to vibrate and the moon does not have that.

Tip: When a body vibrates in a medium. The particles around the vibrating body start to vibrate and travel in all directions.

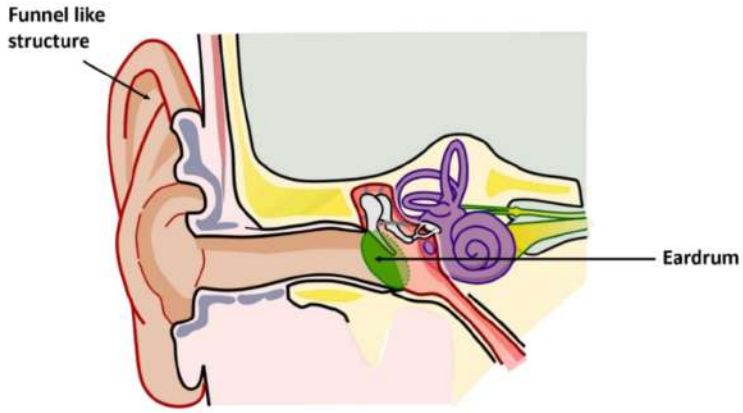
We Hear Sound through Our Ears

How do humans hear a sound: The eardrum in a human ear is in the outer part of the ear. The eardrum is a stretched membrane that produces vibration in the human ear.

Working: The sound vibrations enter the human ear by the outer part of the ear which is shaped like a funnel.

The sound entered travels down the canal at which a thin membrane is present. The sound vibration makes the eardrum vibrate and then the eardrum sends a vibration to the inner ear.

The inner ear transfers the vibration signals to the brain and the human sense the sound.



Human Ear

Amplitude, Time Period and Frequency of a Vibration

Time Period: Time taken by a vibrating object for one complete oscillation is called the time period of the sound wave.

The time period is represented by the symbol T. The SI unit to measure the time period is second (s).

Frequency: The number of oscillations made per second is called the frequency of oscillation. Frequency is expressed in hertz (Hz).

$$Frequency = \frac{Number\ of\ Oscillations}{Total\ time\ taken}$$

Example: If an object oscillates 40 times in two seconds, what would be its frequency?

Solution: Frequency of the sound wave (f) using the relation

$$Frequency = \frac{Number\ of\ Oscillations}{Total\ time\ taken}$$

$$f = \frac{40}{2}$$

$$f = 20\ Hz$$

Amplitude: The maximum displacement of the vibrating object from the central position is known as the amplitude of the oscillation.

Loudness: The volume of a sound is the loudness or softness of sound. The loudness is expressed in a unit called decibel (dB).

The loudness of sound is directly proportional to the square of the amplitude of the vibration producing the sound.

$\text{Loudness} = (\text{Amplitude})^2$

Pitch: It is a characteristic of sound which help to distinguish between different sounds of the same loudness.

The pitch of a sound is directly proportional to its frequency.

Tip: Remember the sound having a lower pitch is called a flat sound.

And, when the sound having a higher pitch, we say the sound is shrill.

Example: If a drum and a whistle are vibrating. The sound produced by the whistle has a higher frequency as compared to the drum that means the whistle has a higher pitch and the drum has a lower pitch.

Audible and Inaudible Sounds

Audible Sound: For the human ear, the range of audible frequencies is roughly from 20 Hz to 20,000 Hz.

Inaudible Sound:

1) Sounds of frequencies less than 20 Hz are called infrasonic sound or infrasound.

2) Sounds of frequencies greater than about 20 kHz are called ultrasound.

Human ears do not detect either infrasonic sound or ultrasonic sound. Hence, the sounds of these frequencies are inaudible sounds.

Applications of infrasound: Whales, elephants and rhinoceroses communicate using infrasound over long distances.

Applications of ultrasound:

- The police use high-frequency whistles which dogs can hear but a human ear cannot.
- Bats also communicate using ultrasonic sounds over long distances.
- Ultrasonic sounds are also used in the investigation of medical conditions.

Noise and Noise Pollution

Noise: The unpleasant sounds are called Noise.

Musical sound: Musical sounds are that sounds which are pleasant to hear.

Tip: Remember a musical sound is no longer pleasant if it becomes too loud. It becomes noise.

Major sources of noise pollution:

- Sound of vehicles and machines in industries.
- Explosive loudspeakers including television and transistor radio at higher volumes.
- Home appliances like a desert cooler.
- Aircraft engines.

Harmful effect of noise pollution on humans:

- Lack of sleep
- Irritation
- Loss of concentration
- Hypertension
- Headache
- Impairment of hearing

Some Measures to control noise pollution:

- Noisy operations and industries must be set up away from any residential areas.
- The horns of vehicles should not be blown unnecessarily.
- Radio, TV and loudspeakers should be played at low volumes.
- Trees should be planted along the roads and around the buildings to reduce the noise reaching the residential area.
- Good quality silencers should be used in the engine of vehicles and aircraft.