

Lesson at a Glance

- Sound is produced by the vibration of materials.
- **Vibration or oscillation:** If a body *moves to and fro* repeatedly about a mean position, its motion is said to be **oscillatory motion**.

One complete back and forth motion of oscillating body about its mean (central) position is called a *vibration* or an *oscillation*.

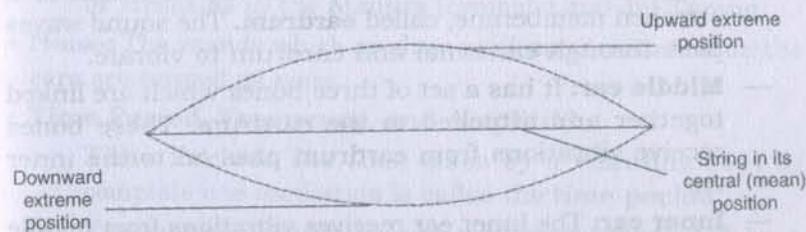


Fig. 13.1 Vibration in stretched metal string.

For example, when we vibrate a tightly stretched metal string (Fig. 13.1), it makes a to and fro motion about its central position. During to and fro motions, string goes from upward extreme position to downward extreme position. When the string goes from upward extreme position to downward extreme position and then back to upward extreme position, we say that string has completed one vibration or one oscillation.

- The whole musical instrument is forced to vibrate, by plucking string, striking membrane etc., and it is the sound of the vibration of the instrument that we hear.
- In humans, the sound is produced by **vocal cords** present in **voice box (larynx)**, when the lungs force air through the slit present between cord. Air passing through the slit causes vibration in stretched vocal cords producing sound.
- Sound travels through a *medium*. It may be gas, liquid or solid. It cannot travel in a *vacuum*.

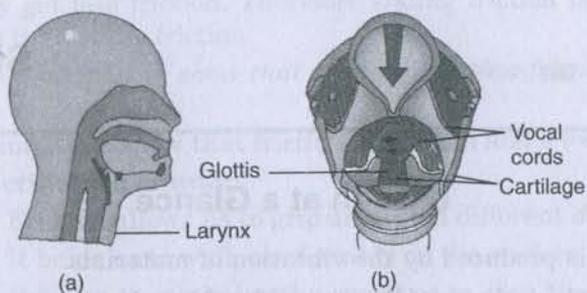


Fig. 13.2 (a) Voice box in humans (b) Inner view of larynx.

- We hear sound through our ear. The human ear has three main parts:

- **Outer ear:** It has a canal at the end of which is a stretched membrane, called **eardrum**. The sound waves pass through ear canal and eardrum to vibrate.
- **Middle ear:** It has a set of three bones which are linked together and attached to the eardrum. These bones receive vibrations from eardrum pass on to the inner ear.
- **Inner ear:** The inner ear receives vibrations from middle ear and changes them into *nerve impulses*. These nerve impulses are carried by nerve (auditory nerve) to the brain. The brain interpretes impulses. That is how we hear.

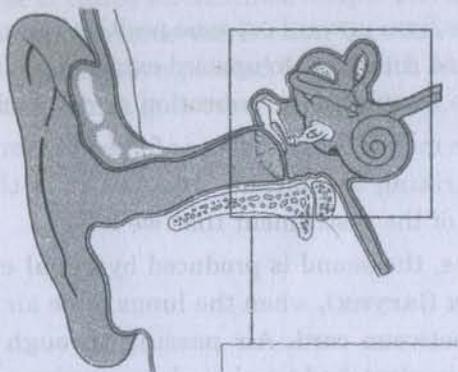


Fig. 13.3 Human ear.

- **Musical Sounds:** The sounds which produce pleasant sensation on the ear are termed as *musical sound*.
- **Musical instruments:** Musical instruments are generally of following type:
 - **String instruments:** The vibration of string produces musical sound as in sitar.
 - **Wind instruments or reed instruments:** The column of air is vibrated by blowing air directly through tubes is known as reeds as in Shehnai or Flute.
 - **Membrane instruments:** The musical sound is produced due to the vibration of skin or membrane mounted on the instruments such as Tabla.
 - **Ghana vadya:** The instruments which are simply beaten or struck as in the Manjira (cymbals) and Jal Tarang.
- **Noise:** The sounds which produce *unpleasant sensation* on the ears are termed as *noise*.
- **Time Period, Frequency, and Amplitude:**
 - **Time Period:** The time taken by a vibrating body to complete one oscillation is called the **time period**.
 - **Frequency:** The number of oscillations completed by a vibrating body in one second is called the **frequency**.
Frequency is equal to number of oscillations divided by time taken.
 - **The unit of frequency is hertz.** It is denoted by **Hz**. If a vibrating body makes 20 oscillations in a second we say that its frequency is 20 Hz.
The human voice can produce sounds with a frequency between 60 Hz and 13,000 Hz. It is interesting to note that a normal human ear can hear sound of frequency between 20 Hz to 20,000 Hz. The sounds of frequency higher than 20,000 Hz and less than 20 Hz cannot be heard by a human ear. The ears of some animals like bat, dog respond to sounds of frequency higher than 20,000 Hz. The sound of frequency greater than 20,000 Hz is called **ultrasonic**.
 - **Amplitude:** During to and fro motion, a vibrating string goes a certain distance in the upward or downward direction from its central position, i.e. position of rest. The maximum distance to which the string goes upward or downward from its central position is called the **amplitude**.

The maximum displacement of an oscillating body from its central position is called **amplitude**.

- **Loudness:** Loudness of sound depends on the amplitude of vibration. It is *proportional to the square of the amplitude of the vibration producing the sound*. It is, if the amplitude becomes twice, the loudness increases by a factor of 4.

The loudness is expressed in a unit called **decibel (dB)**.

- **Shrillness or Pitch:** Frequency determines the pitch of a sound. If the *frequency of vibration is higher, higher is the pitch, and shriller is the sound*.

- **Causes of Noise and Harms of Noise Pollution:**

- **Causes of noise:** Sounds of vehicles, machines, crackers, explosions, loudspeakers including television and transistor radio at high volumes, aeroplanes etc. contribute to noise pollution.

- **Harm of noise pollution:** Presence of excessive noise in the surroundings may cause:

- Lack of sleep
- Hypertension (high blood pressure)
- Anxiety and other health disorders
- Temporary or even permanent impairment of hearing.

- **Measures to limit noise pollution:**

- Loud sound
- Noise producing industries should be set up away from residential areas.
- Airports should be made away from residential areas. Silencing devices must be installed in aircraft engines.
- Use of automobile horns should be minimised.
- TV, music systems, loud speakers should be run at low volumes.
- Trees must be planted along the roads and around building.
- Use of high noise creating crackers should be avoided.

■ TEXTBOOK QUESTIONS SOLVED ■

Q. 1. Choose the correct answer. Sound can travel through:

- (a) gases only (b) solids only
(c) liquids only (d) solids, liquids and gases.

Ans. (d) solids, liquids and gases.

Q. 2. Voice of which of following is likely to have minimum frequency?

- (a) Baby girl (b) Baby boy
(c) A man (d) A woman.

Ans. (a) Baby girl.

Q. 3. In the following statements, tick 'T' against those which are true, and 'F' against those which are false:

- (a) Sound cannot travel in vacuum.
(b) The number of oscillations per second of a vibrating object is called its time period.
(c) If the amplitude of vibration is large, sound is feeble.
(d) For human ears, the audible range is 20 Hz to 20,000 Hz.
(e) The lower the frequency of vibration, the higher is the pitch.
(f) Unwanted or unpleasant sound is termed as music.
(g) Noise pollution may cause partial hearing impairment.

Ans. (a) True (b) False (c) False
(d) True (e) False (f) False
(g) True.

Q. 4. Fill in the blanks with suitable words:

- (a) Time taken by an object to complete one oscillation is called _____.
(b) Loudness is determined by the _____ of vibration.
(c) The unit of frequency is _____.
(d) Unwanted sound is called _____.
(e) Shrillness of a sound is determined by the _____ of vibration.

Ans. (a) time period (b) amplitude (c) hertz
(d) noise (e) frequency

Q. 5. A pendulum oscillates 40 times in 4 seconds. Find its time period and frequency.

Ans. Number of oscillations = 40
Total time = 4 seconds

Time taken to complete one oscillation

$$= \frac{4}{40} = \frac{1}{10} = 0.1 \text{ second}$$

So time period = 0.1 second.

$$\text{Frequency} = \frac{1}{\text{Time period}} = \frac{1}{0.1} = 10 \text{ Hz.}$$

Q. 6. The sound from a mosquito is produced when it vibrates its wings at an average rate of 500 vibrations per seconds, what is the time period of the vibrations?

Ans. Total vibrations = 500

Time taken = 1 second

Time taken to complete one vibration

$$= \frac{1}{500} = 0.002 \text{ seconds.}$$

So time period = 0.002 seconds.

Q. 7. Identify the part which vibrates to produce sound in following instruments.

(a) Dholak

(b) Sitar

(c) Flute.

Ans. (a) Stretched membrane

(b) Strings

(c) Air column.

Q. 8. What is the difference between noise and music? Can music become noise sometimes?

Ans. The sound which is unpleasant for our ears is called noise while music is the sound which is pleasant for our ears. Music becomes noise sometimes when it crosses the bearable range of sound for our ears.

Q. 9. List sources of noise pollution in your surroundings.

Ans. Sources of noise pollution: Honking of horns, loud speakers, loud sounds of machines in factories, loud sounds of T.V., radio, domestic appliances etc.

Q. 10. Explain in what way noise pollution is harmful to humans?

Ans. Harmful effects of noise pollution:

(i) It causes deafness.

(ii) It causes mental illness.

(iii) It causes headache and high blood pressure.

Q. 11. Your parents are going to buy a house. They have been offered one on the road side and another three lanes away from the road side. Which house would you suggest your parents to buy? Explain your answer.

Ans. I would suggest my parents to buy house three lanes away from the roadside. This house would safeguard our health and peace of mind.

Q. 12. Sketch larynx and explain its function in your own words.

Ans. Larynx is also known as voice box. It has vocal cords which have air column vibrating in them, which cause sound in humans.

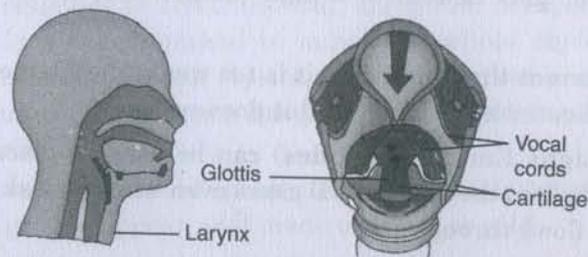


Fig. 13.4 Voice box in humans.

Q. 13. Lightening and thunder take place in the sky at the same time and at the same distance from us. Lightening is seen earlier and thunder is heard later. Can you explain?

Ans. The speed of light is more than that of sound. Due to more speed the light reaches us before the sound does. So lightening is seen earlier and thunder is heard later.