

Sound

1. What is Sound?

Ans. Sound is a form of energy that produces the sensation of hearing in our ear.

2. What causes sound?

Ans. Sound is caused due to vibrations of a body.

3. How is Sound produced?

Ans. Sound is produced by a vibrating body.

4. What is the source of Sound?

Ans. The source of sound is any vibrating body.

5. State three characteristics of the medium required for propagation of sound?

Ans. Requisites of the medium for propagation of sound:

- (i) The medium must be elastic.
- (ii) The medium must have inertia.
- (iii) The medium should be frictionless.

6. Name the two kinds of waves in form of which sound travels in a medium.

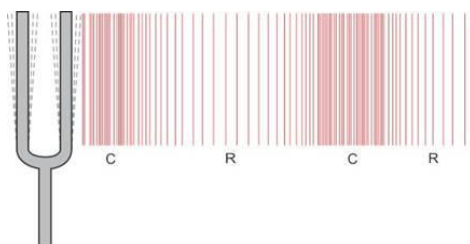
Ans. Sound travels in a medium in form of longitudinal and transverse waves.

7. What is a longitudinal wave? In which medium: solid, liquid or gas, can it be produced?

Ans. A type of wave motion in which the particle displacement is parallel to the direction of wave propagation is called a longitudinal wave. It can be produced in solids, liquids as well as gases.

8. Explain meaning of the terms compression and rarefaction in relation to a longitudinal wave.

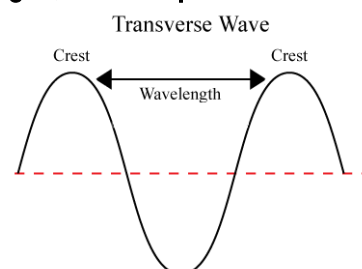
Ans. A longitudinal wave propagates by means of compressions and rarefactions. When a vibrating object moves forward, it pushes and compresses the air in front of it creating a region of high pressure. This region is called a compression (C), as shown in Fig. This compression starts to move away from the vibrating object. When the vibrating object moves backwards, it creates a region of low pressure called rarefaction (R), as shown in Fig. Compressions are the regions of high density where the particles of the medium come very close to each other and rarefactions are the regions of low density where the particles of the medium move away from each other.



9. Define Transverse Wave. In which medium: solid, liquid or gas, can it be produced?

Ans. The wave in which the particle of the medium vibrates above their mean position in the direction perpendicular to the direction of propagation of the wave is called Transverse wave.

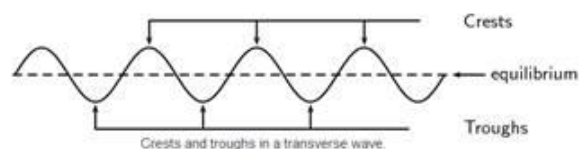
Transverse wave can only be produced in solids and on surface of liquids. They cannot propagate inside the liquids and gases.



10. Explain the terms crest and trough in relation to a transverse wave.

A crest is a point on the transverse wave where the displacement of the medium is at a maximum.

A point on the transverse wave is a trough if the displacement of the medium at that point is at a minimum.



11. What are the Characteristics of Wave Motion?

Ans. The characteristics of wave motion are–

- A wave is produced by the periodic disturbance at a point in the medium.
- Due to propagation of wave in a medium the particles of medium vibrate about their mean position and energy is transferred with a constant speed from one place of medium to the other place.

12. Define the term amplitude of a wave. Write its S.I. unit.

Ans. The maximum displacement of the particle of medium on either side of its mean position is called the amplitude of wave.

Its SI unit is **metre**.

13. What do you mean by the term frequency of a wave? State its S.I. unit.

Ans. The number of vibrations made by the particle of the medium in one second is called the frequency of the wave. It can also be defined as the number of waves passing through a point in one second.

Its SI unit is **hertz (Hz)**.

14. How is the frequency of a wave related to its time period?

Ans. Frequency of a wave is the reciprocal of the time period.

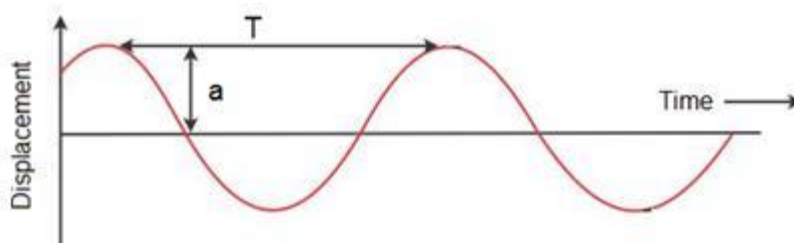
$$\nu = \frac{1}{T}$$

15. Define the term wave velocity. Write its S.I. unit.

Ans. The distance travelled by a wave in one second is called its wave velocity.

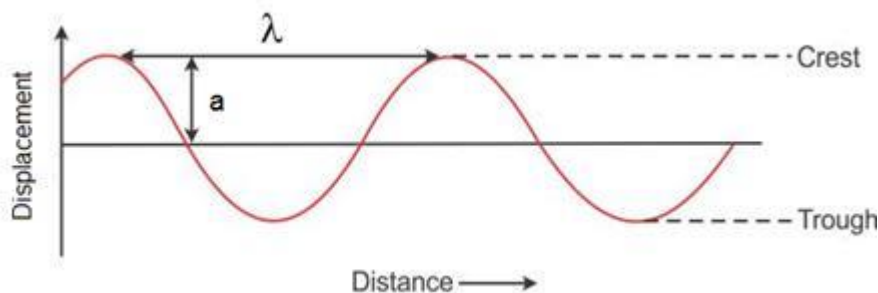
Its SI unit is **metre per second (ms^{-1})**.

16. Draw displacement-time graph of a wave and show on it the amplitude and time period of wave.



17. Draw a displacement-distance graph of a wave and mark on it, the amplitude of wave by the letter 'a' and wavelength of wave by the letter λ .

Ans.



18. How are the wave velocity V , frequency ν and wavelength λ of a wave related? Derive the relationship.

Ans. Let the velocity of a wave be V , time period T , frequency ν and wavelength λ . By the definition of wavelength,

Wavelength = Distance travelled by the wave in one time period i.e., in T second

Or, wavelength = Wave velocity \times Time period

$$\text{Or, } \lambda = V \times T$$

$$\text{Or, } \lambda = V \times 1/\nu \quad [\text{As, } T = 1/\nu]$$

$$\text{Therefore, } V = \lambda \nu$$

Therefore, **Wave velocity = Frequency \times wavelength**

19. State two properties of medium on which the speed of sound in it depends.

Ans. The speed of sound in a medium depends upon its elasticity and density.

20. Arrange the speed of sound in gases V_g , solids V_s and liquids V_l in an ascending order.

$$\text{Ans. } V_g < V_l < V_s$$

V_g	330 ms^{-1}
V_l	1450 ms^{-1}
V_s	5100 ms^{-1}

21. Answer the following questions:

(i) Can sound travel in vacuum?

(ii) How does the speed of sound differ in different media?

Ans. (i) No, sound cannot travel in vacuum as it requires a material medium for its propagation.

(ii) Speed of sound is maximum in solids, less in liquids and least in gases.

22. Flash of lightning reaches earlier than the sound of thunder. Explain the reason.

Ans. This happens because the speed of light is greater than speed of Sound. So, the light can travel more distance than sound at same time.

23. The speed of Sound depends on which factors?

Ans. The Speed of Sound depends on

- i. Density
- ii. Temperature
- iii. Humidity
- iv. Direction of Wind

24. How does the speed of sound change with change in (i) amplitude and (ii) wavelength, of sound wave?

Ans. (i) Speed of sound does not change with a change in amplitude.

(ii) Speed of sound does not change with a change in wavelength.

25. In which medium the speed of sound is more: humid air or dry air? Give a reason to your answer.

Ans. Speed of sound is more in humid air because in presence of moisture, the density of air decreases and sound travels with greater speed.

$$V \propto \frac{1}{\sqrt{\rho}}$$

26. How do the following factors affect, if at all, the speed of sound in air?

(i) Frequency of sound, (ii) Temperature of air,

(iii) Pressure of air and (iv) Moisture in air?

Ans. (i) Frequency of sound has no effect on the speed of sound.

(ii) Speed of sound increases with the increase in the temperature of sound.

(iii) Pressure of sound has no effect on the speed of sound.

(iv) Speed of sound increases with the increase in presence of moisture in air.

27. Describe how speed of sound depends on the density of Gas?

Ans. We know the Velocity of Sound

$$V = \sqrt{\frac{E}{\rho}} \quad \text{[Where } E = \text{Modulus of Elasticity and} \\ \rho = \text{Density of the gas]}$$

It is clear that $V \propto \sqrt{\frac{1}{\rho}}$

i.e. The speed of the sound is inversely proportional to the square root of the Density of gas.

So, the speed of Sound increases with the decrease of density of gas and vice versa.

28. How speed of Sound depends on the Temperature?

Ans. The Speed of the sound is directly proportional to the square root of temperature.

$$V \propto \sqrt{T} \quad \text{[Where } T = \text{Temperature of gas in Kelvin scale]}$$

The speed of the sound in the gas is increased with the increase in temperature of gas.

Because with the increase in temperature the density of gas decreases and consequently the speed of the sound increases,

29. How the speed of sound is changing with the Humidity of Air?

Ans. The speed of sound in air increases with the increase in humidity in air. The density of water vapor is about $5/8^{\text{th}}$ times the density of dry air at ordinary temperature. Therefore, the increase of moisture in air tends to decrease the density of air. Hence the speed of sound in the humid air is greater than the speed of sound in dry air. In other words, the sound travels faster in humid air than the dry air.

30. How the speed of Sound is changed with the direction of Wind?

Ans. The speed of sound increases or decreases according to the direction of travel of wind. If the wind is blowing in the direction of propagation of sound the speed increases, while if it is blowing in the direction opposite to that of sound, the speed of sound decreases.

31. Write the difference between Speed of Light and Speed of Sound?

Speed of Light	Speed of Sound
The light wave can travel in vacuum.	Sound wave cannot travel in vacuum. Any medium is required to travel Sound wave.
The speed of Light is greater than the speed of Sound.	The speed of Sound is less than the Speed of Light.
The speed of light wave decreases in an optically denser medium.	The speed of the sound wave is more in solid, less in liquid and still less in gas.
The light waves are transverse electromagnetic wave.	The sound waves are transverse longitudinal Wave.

32. Describe a simple experiment to determine the speed of sound in air. What approximation is made in the method described by you?

Ans. The simple experiment that a person can do to calculate the speed of sound in air is that a person stands at a known distance (d meter) from the cliff and fires a pistol and simultaneously start the stopwatch. He stops the stopwatch as soon as he hears an echo. The distance travelled by the sound during the time (t) seconds is $2d$.

So, speed of sound = distance travelled / time taken = $2d/t$

The approximation made is that speed of sound remains same for the time when the experiment is taking place.

33. Divide the sound waves with frequency level?

Ans.

Sound Waves	Frequency level
Sonic or Audible Sound	20 Hz to 20 kHz
Infrasonic Sound	< 20 Hz
Ultra Sound	> 20 kHz

34. What do you mean by the audible range of frequency?

Ans. The range of frequency within which the sound can be heard by a human being is called the audible range of frequency.

35. What is the audible range of frequency for human?

The audible range of frequency for humans is 20 Hz to 20 kHz.

36. For which range of frequencies, human ears are most sensitive?

Ans. Human ears are most sensitive for the range 2000 Hz to 3000 Hz.

37. Which has the higher frequency - ultrasonic sound or infrasonic sound?

Ans. Ultrasonic has higher frequency.

38. State the properties of ultrasound that make it useful to us.

Ans. The properties of ultrasound which make it useful to us are:

- a. High energy contents
- b. High directivity

39. Explain how do bats locate the obstacles and prey in their way.

Ans. Bats locate the obstacles and prey in their path by producing and hearing the ultrasound. They emit an ultrasound which returns after striking an obstacle in their way. By hearing the reflected sound and from the time interval (when they produce ultrasound and they receive them back), they can judge the direction and the distance of the obstacle in their way.

40. State two applications of ultrasound.

Ans. Two applications of ultrasound:

- a. Ultrasound is used for drilling holes or making cuts of desired shape in materials like glass.
- b. Ultrasound is used in surgery to remove cataract and in kidneys to break the small stones into fine grains.