Study of sound

EXTRA QUESTIONS

Q.1 For a fix temperature the velocity of the sound does not depend on the _____.
Ans.- Pressure of the gas.

Q.2 Children under the age of _____ can hear up to 25000 Hz.
Ans.- Five.

Q.3 What did Italian scientist Spallanzani discover?
Ans.- The Italian scientist Spallanzani discovered that the ability of bats to fly in the dark depends on their ears and not eyes.

Q.4 How much frequency do ultrasonic sounds have?
Ans.- Ultrasonic sounds have frequency above 20,000Hz.

Q.5 What type of sounds can bats produce?
Ans.- Ultrasonic sounds can be produced by bats.

Q.6 Why is SONAR technology used to discover a sunken ship or objects inside the sea?
Ans.- SONAR, Sound Navigation and Ranging is used to determine the distance and speed of an underwater object with the help of ultrasonic sound waves. Sound transmitted by transmitter is reflected by the objects inside the sea. This reflected sound is received by the receiver after some time interval. The distance of the object is measured using this time interval.

Q.7 In which state of matter is the velocity of sound highest?
Ans.- Solids.

Q.8 Longitudinal wave : parallel :: transverse wave ____.
Ans.- Perpendicular.

Q.9 Value of frequency : pitch of the sound : : value of amplitude _____.
Ans.- Strength or loudness.

Q.10 Match the pairs.

(A)	(B)
1) Density	$v \propto \frac{1}{\sqrt{T}}$
2) Molecular weight	$v \propto \frac{1}{\sqrt{P}}$
	$v \propto \frac{1}{\sqrt{M}}$

Ans.-

(A)	(B)
1) Density	$v \propto \frac{1}{\sqrt{P}}$
2) Molecular weight	$v \propto \frac{1}{\sqrt{M}}$

Q.11 Define time period (T) of a sound wave.

Ans.- The time taken for one oscillation of pressure or density at a point in the medium is called the time period (T) of a sound wave.

Q.12 What is the relation between frequency and time period of a sound wave?

Ans.- For a sound wave, frequency and time period are inversely related to each other i.e. $v = \frac{1}{T}$

Q.13 Name the following. The maximum value of pressure of density.

Ans.- Amplitude.

Q.14 Name the following - Technology that uses ultrasonic sound waves to generate images of internal organs of the human body.

Ans.- Sonography.

Q.15 Give an example of Infra sound.

Ans.- Sound produced by a pendulum.

Q.16 Explain the reasons behind the precautions to be taken in the experiment of reflection of sound.

Ans.- 1) In the reflection of sound experiment, the sound of stopwatch should not reach the listener directly so that the listener can distinguish between the reflected sound and direct sound.
2) The angle of reflection should be measured where the reflected sound is the loudest to get almost accuracy.
3) The centre most part of the tubes should match perfectly with the line of incidence and line of reflection to measure the angle of incidence and angle of reflection accurately.

Q.17 What should be the dimensions and the shape of classrooms so that no echo can be produced there?
Ans.- At 220c, the minimum distance required for hearing a distinct echo is 17.2m. Classrooms should be designed in such a way that distance between two walls of the classroom should be less than 17.2m. Classrooms are mostly designed in rectangular shape to avoid echo production.

Q.18 Bad reflectors absorb sound instead of reflecting it is the following statement true or false.
Ans.- True.

Q.19 Sound waves give rise to a chain of compression and rarefaction in the medium. Is the following statement true or false?
Ans.- True.

Q.20 What is reverberation?
Ans.- repeated reflections of sound waves from the walls causing a single sound to be heard continuously is called Reverberation.

Q.21 What is pitch?
Ans.- The way our brain interprets the frequency of an emitted sound is called the pitch.

Q.22 What is the minimum distance required to hear distinct echo?

Ans.- The minimum distance of the obstacle from the source of sound should be 17.2m.

Q.23 Sound on the moon cannot be heard.

Ans.- a) A material medium is necessary for the propagation of sound waves.

b) As there is no atmosphere on the moon sound cannot travel on the moon.

Hence, sound on the moon cannot be heard.

Q.24 Distinguish in between Infrasound and Ultrasound.

Ans.-

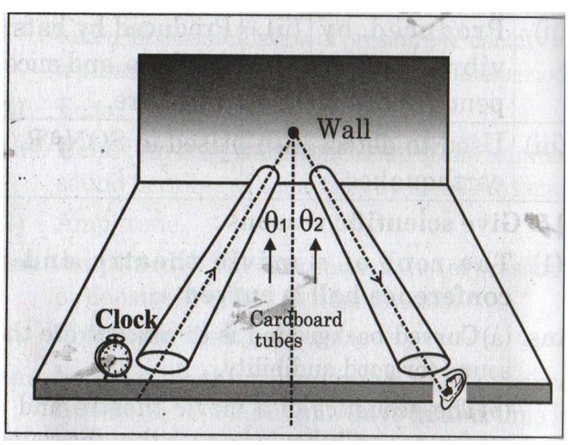
Infrasound	Ultrasound
1) Infrasound has the frequency less than 20 Hz.	1) The frequency is more than 20000 Hertz.
2) Produced by vibrations of pendulum.	2) Produced by bats, dolphins and mice.
3) Used to detect an earthquake.	Used in SONAR technology.

Q.25 Does the sound follow the same laws of reflection as light does. Explain.

Ans.- Yes, sound follows the same laws of reflection as light does, because,

1) Angle of incidence of sound is always equal to that of angle of reflection of sound waves.

2) The direction in which sound is incident, the direction in which it is reflected, and normal all lie in the same plane.



Q.26 Prove that velocity of sound is the product of frequency and wavelength.

Ans.- The distance which a point on a wave, such as compression of rarefaction travels per unit time is the velocity of sound.

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

If we consider the distance travelled by the sound wave in one time period, then

$$\text{Velocity} = \frac{\text{Wavelength}}{\text{Time}}$$

$$\therefore v = \frac{\lambda}{T}$$

$$\therefore \ v = u\lambda = \left(\text{as}\ \frac{1}{T} = v\right)$$

i.e Velocity = Frequency × Wavelength.

Q.27 The frequency of a sound wave is 50Hz. Find the time period that is, T.

Ans.- Frequency of a sound wave (F) = 50 Hz.

$$\text{Time period (T)} = \frac{1}{\text{Frequency of the wave}}$$

$$= \frac{1}{\text{Frequency}}$$

$$= 0.02s$$

∴ Time period of a wave = 0.02s.

Q.28 Shruti hears a thunder 2 seconds after a flash of lightning is seen. At what distance is the lightning struck neglecting speed of light?

Ans.- Speed of sound = 340 m/s.

$$\text{Speed} = \frac{\text{Distance}}{T}$$

∴ Distance = Speed × Time

= 340 × 2

∴ Distance = 680 m.

The lightning has struck at a distance of 680 m.

Q.29 The speed of sound in air at 0^0c is 332 m/s. If it increases at the rate of 0.6 m/s per degree, what will be the temperature when the velocity has increased to 344 m/s.

Ans.- Given - Speed in air at 0^0c - 332 m/s.
Increase in velocity of sound per degree = 0.6 m/s per degree.
Temperature = ?
Difference in velocity = (344 − 332) m/s = 12 m/s.
∴ For 1^0c rise in temperature velocity increases by 0.6 m/s.
∴ For x^0c rise in temperature velocity increases by 12 m/s.

$$\frac{1}{x} = \frac{0.6}{12}$$

$$\therefore 12 = x \times 0.6$$

$$\therefore x = \frac{12}{0.6}$$

$$\therefore x = \frac{120}{6}$$

$$\therefore x = 20^0 c.$$

∴ Temperature will be $20^0 c$ when velocity of sound is 344 m/s.

Q.30 Prashant is listening to a sound of 50 Hz sitting at a distance of 500m from the source sound. What is the time interval between the successive compressions from the source?
Ans.- Frequency $(v) = 500\ Hz.$
Distance $(\wedge) = 450\ m.$
Time period (T)

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

$$\therefore T = \frac{1}{v}$$

$$= \frac{1}{50}$$

∴ Time = 0.02 Second.
Time interval between successive compression is 0.02 second.

Q.31 At a hill station Jane heard as echo at a echo point after 0.1 second when he shouted loudly. If speed of sound was 200 m/s calculate the distance of reflecting surface from the person.
Ans.- Time (T) = 0.1s
Speed of sound = 240 m/s.
Distance of reflecting surface = ?
The distance travelled by sound
= Time × Speed

= 0.1 × 240

= 24 m.

Distance of reflecting surface is half the distance travelled = $\frac{24}{2} = 12m$

∴ Distance of reflecting surface from the person = 12m.

Q.32 How does the velocity of sound depend on its frequency?

Ans.- The velocity of sound is given by

v = vh

v = Velocity

u = Frequency.

∧ = Wavelength.

Thus as the frequency of sound increases its velocity also increases. Hence, velocity of sound is directly proportional to its frequency.

Q.33 What is the main difference between the frequencies of the voice of a man and woman?

Ans.- Pitch is the frequency of vibrations of sound source. For faster vibrations frequency is higher and echne pitcher is higher. The value of frequency of a women's voice is high resulting into a high pitch's voice. The value of frequency of a man's voice is low resulting into a low pitch voice.

Q.34 When is the reflection of a sound harmful?

Ans.- Reflection of sound is harmful when multiple sounds get mixed together due to reflection and produce a continuous sound of increased loudness which cannot be deciphered clearly.

Q.35 How is Ultrasound used in medical science?

Ans.- Ultrsound is used in medical science for various purposes.

a) Sonography technology uses ultrasonic sound waves to generate images of internal organs of the human body. It is useful in finding out the cause of swelling, infection, pain etc.

b) The condition of the heart, the state of the heart after heart attack can be studied using the ultrasonic waves, Echocardiography

c) Ultrasound can help to follow the growth and well being of an unborn baby.

Q.36 Define. 1) Supersonic speed and 2) Shock wave.

Ans.- 1) Supersonic speed - When a body moves in air with a speed greater than the speed of sound, it is said to have supersonic speed.

2) Shock wave - When a supersonic aircraft moves through air, it leaves behind itself a conical region of disturbance which spreads continuously. Such a disturbance is called a shock wave. Shock wave travel at supersonic speeds and carry a huge amount of energy.

Q.37 State the important characteristics of wave motion.

Ans.- Characteristics of wave motion -

1) It is the disturbance which travels forward through the medium and not the particles of the medium, the particles of the medium merely vibrate about their mean positions.

2) Each particle receives vibrations a little later than its preceding particle.

3) The velocity with which wave travels is different from the velocity of the particles with which they vibrate about their mean positions.

4) The wave velocity remains constant in a given medium.

Q. 38 What are mechanical or elastic waves? Give examples.

Ans.- Mechanical waves - The waves which require a material medium for their propagation are called mechanical waves. They are also called elastic wastes, because their propagation depends on the elastic properties of the medium.

Examples of mechanical waves.

a) Sound waves in air.

b) Waves over water surface.

c) Waves produced during earthquake. These are known as seismic waves.

Q.39 Define the terms time period and frequency of an oscillating body. Write the relation between them.

Ans.- a) Time period - The time taken by an oscillating body to complete one oscillation is called its time period. It is denoted by T. Its SI unit is second (s).

b) Frequency - The number of oscillations or vibrations completed by an oscillating body in one second is called its frequency. It is denoted by v. (Greek letter nu)

SI unit of frequency = per second (s^{-1})

= Cycles per second (cps)

= Hertz (Hz).

Relation between time period and frequency : Let T = Time period of an oscillating body. Then, number of oscillations completed in T second = 1

Number of oscillations completed in 1 second = $\frac{1}{T}$

But number of oscillations completed in

1 second = Frequency (v)

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

Hence, frequency is equal to the reciprocal of time period.

Q.40 Mention the important properties which a medium must possess for the propagation of mechanical waves through it.

Ans.- 1) Elasticity- The medium must possess elasticity so that the particles can return to their mean positions after being disturbed.

2) Inertia - The medium must possess inertia or mass so that particles can store kinetic energy.

3) Minimum friction - The medium should have minimum frictional force between its particles so that they can continue oscillating for a sufficiently long time.

Q.41 Define the term 'crests'.

Ans.- In transverse waves, the particles of the medium which have maximum displacement in the positive y-direction are called 'crests'.

Q.42 Define the term 'troughs'.

Ans.- In transverse waves, the particles of the medium which have maximum displacement in the negative y-direction are called 'troughs'.

Q.43 Differentiate between transverse and longitudinal waves.

Ans.-

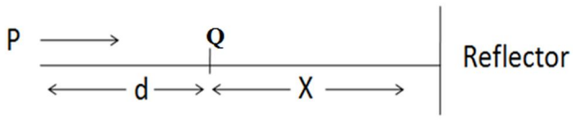
Transverse waves	Longitudinal waves
1) In transverse waves the particles of the medium vibrate perpendicular to the direction of waves motion.	1) In longitudinal waves, the particles of the medium vibrate along the direction of wave motion.
2) These waves travel in the form of alternate crests and troughs.	2) These waves travel in the form of alternate compressions and rarefactions.
3) These waves can be transmitted through solids or over liquid surfaces.	3) These waves can be transmitted through all the three types of media, viz, solids, liquids and gases.
4) They do not cause pressure changes in the medium through which they pass. Example - Waves in stretched strings.	4) They cause changes in the pressure of the different parts of the medium through which they pass. Example - Sound waves in air.

Q.44 What is a hearing aid?

Ans.- The hearing aid used by the persons who are hard of hearing is also called ear trumpet. The sound enter hearing aid or the trumpet through a narrow opening and undergoes multiple reflections and comes out from the wide end with a large amplitude.

Q.45 How will you determine velocity of sound using echo?

Ans.- Suppose, a person is standing at P in front of a wall, producing a sound. Let 't_1' be the time taken to hear an echo. Now, the person moves towards the reflector by a distance 'd' to a position Q and again produces a sound. Now, the echo is heard after 't_2' time.



$v = \frac{2(d+x)}{t_1}$ and $v = \frac{2x}{t_2}$

$\therefore 2(d + x) = vt_1$ and $2x = vt_2$

$\therefore 2d + 2x = vt_1$

Eliminating x, we have $2d + vt_2 = vt_1$

$\therefore vt_1 - vt_2 = 2d$

$\therefore v = \frac{2d}{t_2 - t_1}$

If the initial and final position of the person are 'Q' and 'P' and 't_1' and 't_2' are the time intervals to hear the echo at these positions, then $v = \frac{2d}{t_2 - t_1}$

Q.46 Which type of waves are sound waves? State their characteristics.

Ans.- 1) Sound waves are longitudinal waves that propogate through a medium, like solid, liquid or gas.

2) The sound waves have characteristics as wavelength, frequency, time period, pitch, amplitude, intensity, loudness, quality or timber.

3) The frequency of the sound depends on the pitch, hence the higher frequency of sound, higher is the pitch. It depends upon how the brain interprets the frequency of sound.

4) Loudness of sound depends on the physiological perception of sound and increases with intensity.

5) The quality or timber of sound is the characteristic of sound that enables us to distinguish one sound from another having the same pitch and loudness.

Q.47 State how the velocity (or speed) of sound in a gas, depends upon various factors.

Ans.- The velocity (or speed) of sound in a gas is directly proportional to the square root of the absolute temperature of the gas ($v \propto \sqrt{T}$) and inversely proportional to the square root of the molecular mass of the gas $\left(v \propto \frac{1}{\sqrt{M}}\right)$.

Q.48 The molecular weight of oxygen gas (O_2) is 32, while that of hydrogen gas (H_2) is 2. Prove that under the same physical conditions, the velocity of sound in hydrogen is four times that in oxygen.

Ans.- Here, $v \propto \frac{1}{\sqrt{M}}$

$\therefore \frac{v(H_2)}{v(O_2)} = \sqrt{\frac{32}{2}} = \sqrt{16} = 4$

Q.49 Write a short note on ultrasound.

Ans.- Sound with frequency greater than 20,000Hz, is called Ultrasound. We cannot hear ultrasound. Ultrasound is produced by bats, rats, dolphins etc.

Ultrasounds are used 1) to establish ship to ship communication. 2) For welding plastic surfaces. 3) To kill bacteria in liquids like milk to preserve them. 4) In echocardiography. 5) For imaging them. 6) In industry to clean parts of a machine. 7) to detect cracks and flaws in metal blocks.

Q.50 What is a rapid to and fro motion of an object about its mean position called?

Ans.- A rapid to and fro motion of an object about its mean position is called vibration.