SOUND

Sound.

- Sound is a form of energy which usually produces the sensation of hearing in our ear.
- Sound is produced by vibrating objects. A vibrating tunning fork produces sound. The sound of human voice is also produced due to vibration in the vocal chords.
- A disturbance is a rapid back and forth motion of a rapid particle. about its mean position vibration is also called oscillation.
- Different sources of sound in our environment are human beings, birds, animals, bells, machines, musical intruments like guitar, sitars, mridangam etc.
- The matter through which the sound trasmitted from the point generator to the listerner is called medium. The medium can be solid liquid and gas.
- The Disturbance set by sound in the medium travels through the vibrating of the particles of the medium hence the particle of the medium is not

- When the same vibrating object suddenly moves backward it causes a temporary low pressure region which is called rarefaction
- The compression is a region of high pressure & rarefraction is a region of low pressure pressure is related to the no of particles of a medium in a given volume.
- More density of the particles in the medium gives more pressure & vice versa. Therefore, the propagation of sound can be visualized as propagation of alternatively fluctuating levels of density or pressure
- The density and pressure variations respectively are given in the fig, as a sound wave propagation in the medium.

(i) Time period
- Time taken by a vibrating body or a vibrating particle to complete one oscillation is time period.
- It is denoted by T. Its SI unit is seconds (s)

(ii) Relation between frequency & time period
Frequency & time period are reciprocal to each other

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

or, $\nu = 1/T$.

④ Pitch or shrillness.
- Pitch is the characteristics of a sound that depends on the frequency received by a human ear
- A sound wave of high frequency has high pitch and a a sound wave of low frequency has a low pitch.

5. Loudness
- Loudness of a sound depends on the amplitude of the vibrating body producing the sound.
- Loudness

6. Intensity
- Intensity of a sound is defined as the sound energy transfer per unit time through a unit area placed ⊥ to the direction of

=> Particle application of the multiple reflection of sound.

Megaphones, loudspeakers, horns musical instruments such as trumpets, shehnai, etc. are all designed to send sound in a particular direction without spreading in all directions one end of megaphone tube is narrow and its other end is wide.
When a person speaks into the narrow end, the sound waves produced are prevented from spreading by successes reflection. So sound is heard over a longer distances.
The ceiling of concert halls, cinema halls are curved so that sound after reflection reaches all the corners of the hall. sometimes a curved soundboard may be placed behind the stage. sound after reflecting from the soundboard spreads evenly across the width of the hall. Stethoscope used by doctors also works on the principle of multiple reflection of sound.

technique is called 'echocardiography.

- Ultrasound scanner is an instrument which uses ultrasonic waves for getting images of internal organs of the human body. In this technique the ultrasonic waves travel through the tissues of the body and get reflected from a region where there is a change of tissue density. These waves are then converted into electrical signals that are used to generate image of the organ. These images are then displayed on a monitor or printed on a film. This technique is called 'ultrasonography' ultrasonography is also used for examination of the foetus during pregnancy to detect congenial defects and groun abnormalities.
- Ultrasound may be employed to break small 'stones' formed in the kidneys into fine grains. These grains later get flushed out with urine.

Range of Hearing

- The audible range of sound for humans extends from about 20Hz to 20,000 Hz
- sounds of frequencies below 20Hz are called infrasonic sounds or ultrasound
- Ultrasonic sounds are produced by dolphins, bats and porpoises.

Application of Ultrasound

- ultrasound is reflected just like ordinary sound waves it produces echoes Due to their high frequencies, the ultrasonic of waves have a high penetrating power.
- ultrasound is used to clean parts located in hard to reach places eg, spiral tube, odd shaped parts etc. Objects to be cleaned are placed in a cleaning solution and ultrasonic waves are sent into the solution. Due to the high frequency, the particles of dust, grease and dirt get detached and drop out.
- Ultrasound can be used to detect cracks and flaws in metal blocks. ultrasonic waves are allowed to pass through the metal block and detectors are used to detect the transmitted waves. if there is even a small defect
- Ultrasonic waves are made to reflect from various parts of the heart and form the image of the heart. This

Echo

- It is the second distinct sound that is heard by the observer after it is reflected from a rigid surface
- This is a common phenomenon in mountains & valleys where the sound emitted from the source strikes the mountain and returns to the source after a certain interval of time. This similar sound which is heard is called an echo
- To hearn distinct echos the mindistances of the obstacles from the source of sound must be 11.2m so the reflected sound reaches thear after 0.1 second.
- The sensation of sound persists in our brain for 0.1 second Echos may be heard more than once due to successive or multiple reffections. The rolling & thunder is due to the successive reflections of the sound frams of reflecting surfaces

⇒ Reverberation

- The repeated reflection of sound that results in the persistence of sound is called xwerberation
- A sound created in a big hall will persist by reapeated reflection from the walls until it is reduced to a value where it is no longer audible

propagation of sound.

- Thus,

$$\text{Intensity of sound} = \frac{\text{Sound energy}}{\text{Time} \times \text{Area}}$$

- Its SI unit is Joule $s^{-1} m^{-2}$ or watt m^{-2}.

(i) Relation between wave length speed frequency & wavelength.

$$\text{Speed of wave} = \text{wavelength} \times \text{frequency}$$

$$v = \lambda v$$

- Speed of a sound wave differs only when the sound goes from one medium to other.

Reflection of Sound.

- Sound bounces off a solid or liquid like a rubberball bounces of a wall. This is called reflection of sound. Sound is reflected like light & the same laws of reflecton are applicable

- The directions in which the sound is incident & reflected make equal angles with the normal to the reflecting surface. The incident ray, the normal & the reflected ray, all these lie on the same place.
- For reflection of sound waves a polished rough of large size is needed.

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Characteristics of Sound Wave.

A sound wave can be characterised by
* Amplitude
* wavelength
* frequency
* pitch or shrillness.
* loudness.
* Intensity

1. Amplitude ⇒
   - The maximum displacement of a vibrating body or particle from its mean position is called amplitude.
   - It's SI unit is metre (m)
   - It is denoted by the letter A.
   - The loudness or softness of a sound is determined basically by its amplitude. The amplitude of the sound wave depends upon the force with which an object is made to vibrate.

2. Wavelength ⇒
   - The distance between 2 consecutive compression are rarefraction is the wavelength of the wave.
   - It is represented by lambda (λ) SI unit (m)
   - The distance between a compression & a adjacent rarefraction is equal to half the wavelength.

3. frequency ⇒
   - The number of oscillation made by a vibrating body or particles of a medium in 1 second is known as frequency of a wave.
   - It is represented by V, SI unit is Hertz (Hz)

Difference between longitudnal & transverse waves.

Longitudnal waves	Transverse waves
i) In longitudnal waves the particles of the medium vibrate parallel to the wave propagation.	In transverse waves, the particles of the medium vibrate at the right angle to the midirection of the wave propagation.
ii) Longitudnal waves can travel only through a material medium, no through vacuum.	Transverse waves can travel through vacuum as well as through medium. Eg:- light wave which is not a mechanical waves.

Propagation of sound through air:-

- Sound propagation through medium at a finate speed. It's speed is much less than that of a object light that is why the sound of the thunder is heard only a little latter than a flash of light seen during thunderstrom.
- A vibrating object when moves forward, first pushes the air in front of it & compression the air creating a region high pressure. This region is called compression.

Longitudinal waves in a Slinky.

(ii) Transverse waves.

In transverse waves: the individual particles of the medium move about their mean position in a direction ⊥ to the direction of wave propagation. Transverse waves are produced on water surfaces and in the strings of musical instruments.

Characteristics of transverse waves:-

When a transverse wave travels through a medium elevations depressions are formed as shown in fig

- The point on the elevation of the medium whose distance from the mean position is maximum is known as 'Crest [C]
- The point of the depression of the medium of the medium of whose distance from the mean position is maximum is known as Trough [T]

(i) Longitudnal waves

- Sound waves are longitudnal waves. In this waves the individual particles of the medium move in a direction parallel to the direction of motion of the disturbance.

- The particles of the medium do not move from one place to another, but they simply oscillate back and forth about their position, This is how sound waves propagates.

Characteristics of longitudnal waves.

- when a longitudnal waves passes through a medium, the medium is divided into the regions - compression & rarefraction.
- The part of a medium, where, the particles of the medium are way close to eachother is known as compression, denoted by C.
- The part of a medium where the particles of the medium are far apart from each other is known as rarefraction, denoted by R.

moving from one place to another

Wave.

- The movement of the disturbance through a medium due to repeated periodic motion of the particles of the medium about their mean position known as wave.

- Sound wave are characterised by vibration of particles in medelum are called mechanical waves. Sound being a mechanical wave needs materials medium like air, water, steel etc. for its propagation. It cannot travel through vaccum.

Examples of mechanical waves :-

- Sound waves in air
- water waves
- waves produced due to earthquake (seismic waves)
- waves produced by supersonic jet planes (shock waves)
- waves produces in a streched string
- waves produces in a slinky or long spring