CHAPTER 11

WAVES AND SOUNDS

NOTES

Production of sound

- Sound is produce by the vibrational motion of a body.
- Vibration means a kind of rapid to and fro periodic motion of an object.
- A wave is a periodic disturbance that moves through the medium when the particles of the medium induce the neighbouring particles into motion.
- Mechanical wave is a periodic disturbance which requires material medium for its propagation.

Propagation of sound

- When a vibrating object moves forward, it pushes and compresses the air adjacent to it creating a region of high pressure called compression.
- When the vibrating objects moves backward in course of its motion, it creates a region of low pressure called rarefaction.

Types of waves

Longitudinal waves

- When the compression and rarefaction move parallel to the direction of propagation, the waves are called longitudinal waves. Example: Sound waves

Transverse waves

- These are the waves in which the particle of the medium vibrates in a direction perpendicular to the direction of wave motion. Example: light.

Characteristics of a sound wave:

A sound wave can be described by its three characteristics. They are

- Frequency
- Amplitude
- Speed

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Reflection of sound:

- Sound is reflected at the surface of solid or liquid and follows the laws of reflection.
- The direction of incident sound and reflected sound make equal angles with the normal at the point of incidence and the three are in the same plane.

Echo:

- It is the phenomenon of repetition of sound due to its reflection from the surface of a large obstacle.
- To hear an echo, the time interval between the original sound and the echo must be at least 0.1s.
- Since the speed of sound in air is 344m/s, the distance travelled by sound in 0.1s= 344m/s ×0.1s= 34.4m.
- So to hear an echo clearly, the minimum distance of the reflecting surface should be half the distance i,e 17.2m.

Reverberation:

The persistence of sound in an auditorium is the result of repeated reflections of sound and is called reverberation. The reverberation can be reduced by covering the roofs and walls of the auditorium with sound-absorbent materials like compresses, fibreboard, rough plaster or draperies.

Uses of echo or multiple reflection of sound:

1. Stethoscope – instrument used by doctor's for listening sound produced by human body. The sound of heartbeat reaches the doctor's ear by multiple reflections.
2. Megaphones or loudhailer, horns. Here the sound will travel in a particular direction without spreading in all directions.
3. The ceiling of cinema halls and auditoriums are curved so that sound after multiple reflections reaches all parts of the hall.

Range of hearing:

- Audible range of sound for human beings is between 20Hz to 20,000 Hz.
- Children under the age of five and animals such as dogs can hear upto 25 KHz

Infrasonic:

Sound having frequencies less than 20Hz is called infrasonic sound. Human cannot perceive infrasonic.

Ultrasonic:

Sound whose frequencies higher than 20 KHz are called ultrasonic or ultrasound.

Application of Ultrasound:

- Ultrasounds are used in industries (cleaning, detection of flows or cracks)
- For medical purposes (echocardiography, ultrasound scanner, breaking of small stones formed in kidneys, sterilization.) and navigation purposes.

SONAR:

It is a device which uses ultrasonic waves to measure the depth of seabed, direction and speed of underwater objects. It stands for Sound Navigation and Ranging.

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