PHYSICS OF S6

**UNIT 1: SOUND WAVES**

1. **INTRODUCTION**

A sound can be produced by any vibrating object and propagates in medium in form of wave.

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A **wave** is any disturbance that transfers energy from one point to another in a medium without transport of matter.

**Sound wave** is a vibration that propagates as an acoustic wave, through a transmission medium such as a gas, liquid or solid.

**Noise** is an unwanted sound or a sound pollution.

***1.1 CHARACTERISTICS AND PROPERTIES OF SOUND WAVES***

* + 1. **Properties of sound waves**

**Sound waves can undergo:**

* Refrection,
* Refraction,
* Diffraction and
* Interference.
  + 1. **Characteristics of sound waves**
* Frequency, 
* Wavelength, λ
* Period, T
* Wave speed , 
* Amplitude, A.

**Wavelength** is the distance covered by a wave in a period and is measured in meters.

The **amplitude** of a wave is the maximum displacement of the medium from its rest position when the wave passes through it. The amplitude is measured in meters.

**NATURE OF SOUND WAVES**

Sound wave is **mechanical** and **longitudinal.** Sound wave cannot travel in vacuum.

**Factors which affect the velocity of sound in air**

1. The speed of a sound wave through a medium does not depend on the frequency of the wave.
2. The speed of sound waves in a medium depends on the compressibility and density of the medium. If the medium is a liquid or a gas and has a bulk modulus *B* and density *ρ* , the speed of sound waves in that medium is given by:
3. 

For longitudinal sound waves in a solid rod of material, for example, the speed of sound depends on Young’s modulus *Y* and the density *ρ:*



For sound traveling through air, the relationship between wave speed  and medium temperature T is



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Where *v*0 = 330 *m* / *s* is the speed of sound in air at 00C.

T0 = 273K

The speed of sound increases with the increase of temperature. 

The **speed of sound** in air at standard temperature and pressure (25 oC, 760 mm of mercury) is 343 m/s.

Sound travels faster in liquids and solids than in gases, since the particles in liquids and solids are closer together and can respond more quickly to the motion of their neighbors. As examples, the speed of sound in water is 1500 m/s and it is 5000 m/s in iron. Sound does not travel in vacuum.

**Sound waves are classified into three categories that cover different frequency ranges:**

1. ***Audible sound*** lies within the range of sensitivity of the human ear. They can be generated ina variety of ways, such as musical instruments, human voices, or loudspeakers. It is almost impossible to hear sounds outside the range of **20 Hz** to **20 kHz**. These are the limits of audibility for human beings but the range decreases with age.
2. ***Infrasonic waves*** have frequencies below the audible range. They are sound waves withfrequencies that are below 20 Hz limit. Some animals such as elephants can use infrasonic waves to communicate with each other, even when they are separated by many kilometers. Rhinoceros also use infrasonic as low as 5 Hz to call one another.
3. ***Ultrasonic waves*** have frequencies above the audible range. They are sound waves whosefrequencies are higher than 20 KHz. You may have used a “silent” whistle to retrieve your dog. The ultrasonic sound emitted by that device is easily heard by dogs, although humans cannot detect it at all. Ultrasonic waves are also used in medical imaging.