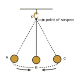
Sound

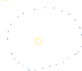
- Translational motion x → x
- Rotational motion → earth revolves around sun.
- Vibrational motion. Moon revolves around the earth.

oscillatory motion

wave motion

To and fro motion





A ↔ B

→ No particle of the medium actually displaces

→ All particles of medium vibrate and transfer their energy to adjacent particle.

Based on vibration of particles: → (Slinky)

- longitudinal
- Transverse. (Mexican wave)

Based on medium on propagation

Mechanical wave (Material medium is required)

→ solid, liquid, gas etc.

water waves, sound waves, slinky.

Non mechanical wave (Material medium is not required).

→ They can even travel through vacuum.

→ Radiation, radio EM wave waves

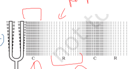
Sound waves - longitudinal wave + mechanical wave (Material med)

Collision b/w two particles (vibration) ⇒ wave Energy

high density high pressure

Rarefaction

Tuning fork

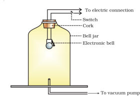


Human ear

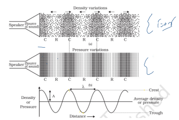
Compression

low density, low pressure.

12.2.1 Sound needs a medium to travel



12.2.3 Characteristics of a sound wave

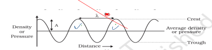


hill type structure - compression (Air particles crowded)

valley type structure - Rarefaction (Not crowded)

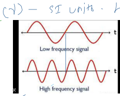
Peak of compression - Crest.

Peak of Rarefaction - trough.



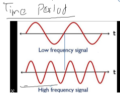
wavelength - (λ) m

Frequency - (ν) - SI unit. hertz



$\nu_2 > \nu_1$

Time Period



T_1 T_2

$T_1 > T_2$

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

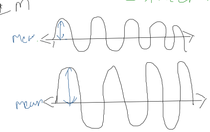
Bear 20 sticks in drum.

Short - F↓ T↑

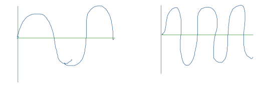
VT - F↑ T↓

Amplitude (A) magnitude of the maximum displacement of a vibrating particle from its mean position.

unit m



$A_2 > A_1$



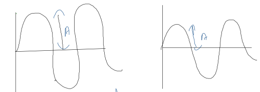
Pitch - determines the shrillness of sound.

loudness - depends upon amplitude.

↑ (Frequency)

F↑ pitch↑

Amplitude↑ loudness↑



Speed of Sound

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

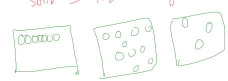
$v = \lambda \times \frac{1}{T}$

$v = \lambda\nu$

speed = wavelength × frequency.

12.2.4 Speed of sound in different media

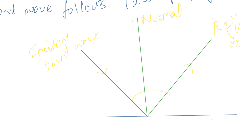
Solid > liquid > gas.



→ Sound speed increases with the temperature.

Reflection of Sound

- Sound wave follows law of reflection



Echo - Repetation of sound because of multiple reflections of sound.

Reverberation - The repeated reflection that results in the persistence of sound is called reverberation.

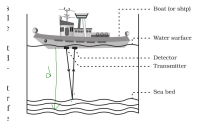
Range of hearing -

audible range: 20Hz to 20 000 Hz
1KHz = 1000Hz

→ Infrasonic sound or Infrasound. (Sound less than 20Hz)

→ Ultrasonic sound or Ultrasound. (Greater than 20 000Hz)

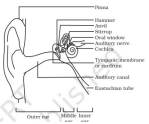
Applications of ultrasound



$V = \frac{d}{t}$

$V = \frac{2xd}{t}$

$2d = V \times t$



2) An echo is heard in 3s. What is the distance of the reflecting surface from the source, speed of sound is 342 ms^{-1}.

Sol:

$S = \frac{d}{T}$

$2xd = S \times T$

$d = \frac{342 \times 3}{2}$

$d = 513m$

1) A sound wave has a V of 20KHz and wavelength 350 cm. How long will it take to travel 1500m?

Frequency (V) = 20 000 Hz

wavelength (λ) = 3.5m

Speed (V) = $\lambda \times V$

= 3.50 x 20 000

= 70 000 ms^{-1}

$t = \frac{d}{V}$

$t = \frac{1500}{70\,000}$

$t = \frac{3}{14}$

$t = 0.2s$