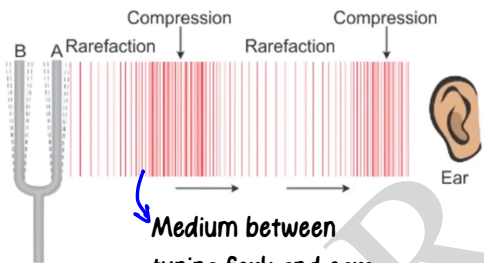
Sound: it is a form of energy

How is sound produced?

By vibrating objects

Example: vocal chords → Vibrate → Produced sound

How sound propagates?



Medium between tuning fork and ears

Types of waves

Sound energy travels in the form of energy

Waves

Mechanical wave

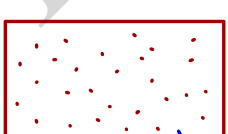
Medium is required to propagate

Ex: Sound waves

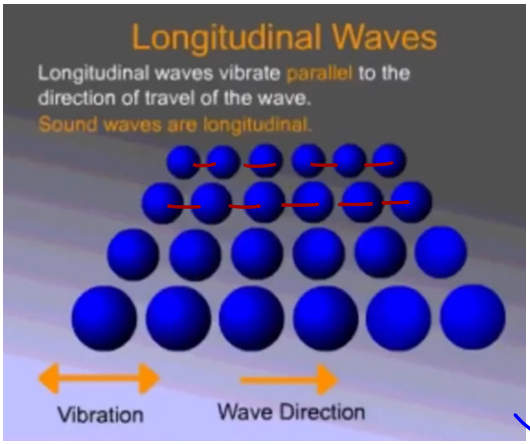
Non-mechanical wave

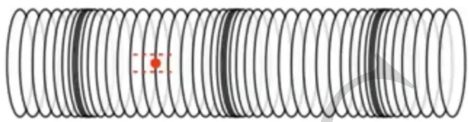
No medium is required to propagate

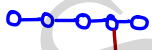
Ex: Light waves



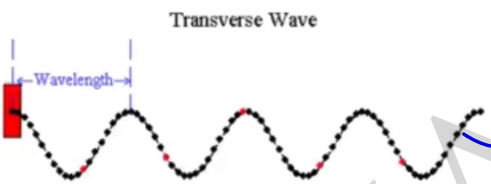
The particles in the medium helps the sound to propagate







Particles do not move



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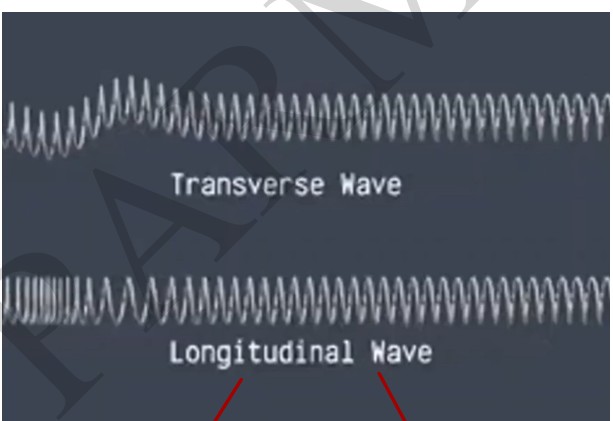


Compression

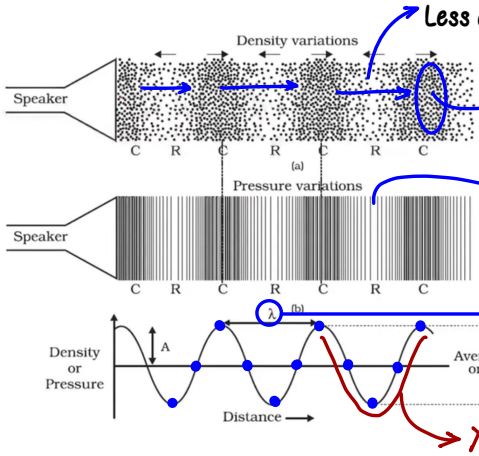
Particles together

Density ↑

Pressure ↑

Rarefaction

Particles far away



Less density

- Particles condensed
- More density

Resting position is where the coils are neither compressed nor rarified

Wavelength

Characteristics of sound waves

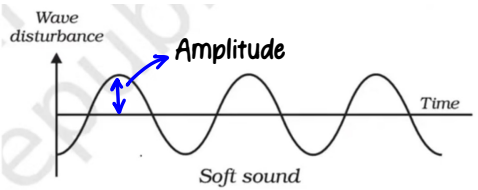
Frequency (ν) $= \frac{1}{\text{Time}}$ → Unit: s^{-1}; Hertz

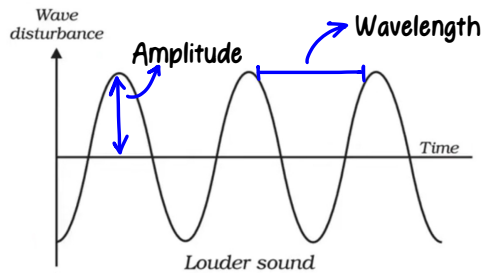
- Determines pitch of a sound
- Girls have high pitch, high shrillness → Vocal cords vibrates quickly

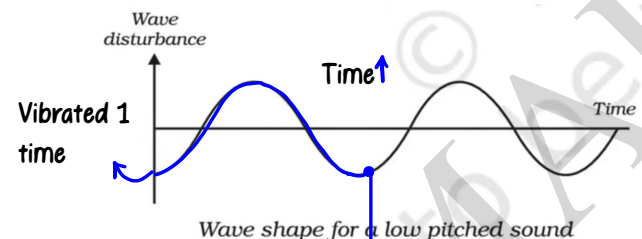
Amplitude: determines Loudness → Unit: dB (decibel)

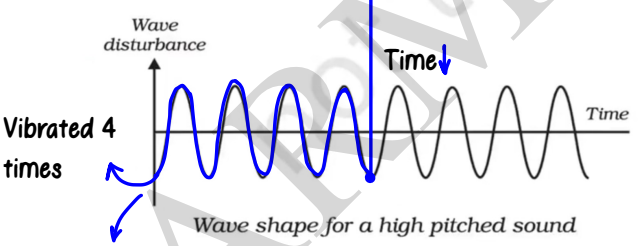
Limit: 0–130 dB (sound above this is considered as noise)

Can be defined as the loudness of the amount of maximum displacement of vibrating particles of the medium from their mean position when the sound is produced









Wave taking less time to vibrate

- Timber: quality of sound
- Note: sound, which is a mixture of several frequencies

Mosquito: frequency↑ Pitch↑
Lion: amplitude↑ Loudness↑

Audible range: 20 Hz–20,000 Hz

- Less than this: infrasonic sound
  - Ex: rhinoceros
- More than this: ultrasonic sound

Mach no = Speed of any body / Speed of sound in that medium

- Subsonic: Mach < 1
- Supersonic: >1 ; ⩽ 5
- Hypersonic: Mach > 5
- Transonic: Mach = 1

Speed of sound

- Solid > Liquid > Gas
- Light = 3×10^8 m/s
  - Speed of light is more than the speed of the sound

Speed of Sound in Different Media at 25 °C

State	Substance	Speed in m/s
Solids	Aluminium	6420
	Nickel	6040
	Steel	5960
	Iron	5950
	Brass	4700
	Glass (Flint)	3980
Liquids	Water (Sea)	1531
	Water (Distilled)	1498
	Ethanol	1207
	Methanol	1103
Gases	Hydrogen	1284
	Helium	965
	* Air	346
	Oxygen	316
	Sulphur dioxide	213

Reflection of Sound

Sounds reflection: Echo

It is a reflection of sound that arrives at the listener with the delay after the direct sound

Distinct reflection

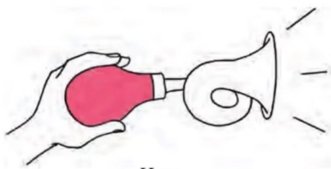
Source → Reflect

Distant: 17.2 m

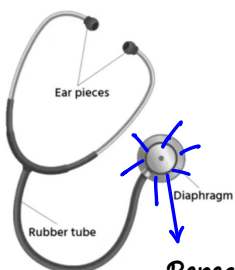
Distinct reflection

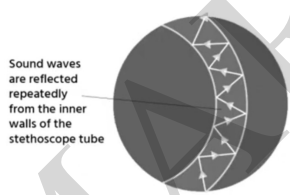
Megaphone

Reverberation: repeated reflection of sound



Horn





Repeated sound reflection

Penetrating power is very high

Applications of Ultrasonic sounds

- Produced by bats, dolphins
- Ultrasound is banned in gender determination
- To monitor growth and development of fetus
- Used to identify kidney stones and to break kidney stones
- To identify the conditions of our internal organs

SONAR: Sound Navigation and Ranging

Device that is used for detecting and locating objects specially underwater by the means of sound waves sent out to be reflected by the objects

One Liners (MCQs)

- Loudness of sound is proportional to the Square of the amplitude of the vibration, producing the sound

- Study of production and propagation of sound waves: Acoustics

- If an object executes 10 oscillations per second, then its frequency in kilohertz is equal to: 0.01
  → $\frac{10}{1000}$

- The approximate speed of sound in distilled water at 25°C (77°F): 1498 m/s

- Sound wave cannot travel through a: wooden hollow pipe placed in vacuum

- The velocity of sound in air is affected by the change in the: Atmospheric pressure, moisture, temperature of air
  → Temp↑ Velocity↑

- V_m = velocity of sound in moist air
  V_d = velocity of sound in dry air
  $V_m > V_d$

- When the temperature increases the frequency of the sound from an organ pipe Increases

- Stationary waves of frequency 3000 Hz are formed in a medium in which the velocity of sound is 1200 m/s. The distance between a node and the neighbouring anti node is?
  ↓
  → $V = n\lambda$
  $1200 = 300 \times \lambda$
  $\lambda = 4$