

SOUND - FORMULA SHEET

1. WAVELENGTH (λ)

$$\lambda = \frac{v}{f}$$

λ = Wavelength (m)

v = Speed of sound (m s^{-1})

f = Frequency (Hz)

Also,

$$v = f \lambda$$

2. FREQUENCY (f)

$$f = \frac{1}{T}$$

f = Frequency (Hz)

T = Time period (s)

Also,

$$T = \frac{1}{f}$$

3. AMPLITUDE (A)

It is the maximum displacement from the mean (equilibrium) position.

$$I \propto A^2$$

I = Intensity (loudness)

A = Amplitude

Intensity is proportional to the square of amplitude.

$$\frac{I_1}{I_2} = \frac{A_1^2}{A_2^2}$$

4. SPEED OF SOUND (v)

- In a medium,

$$v = \frac{\text{distance}}{\text{time}}$$

v = Speed (m s^{-1})

distance = Distance travelled (m)

time = Time taken (s)

- Relation between v , f and λ ,

$$v = f \lambda$$

Speed of sound in different mediums (at 25°C)

Air	$\approx 344 \text{ m s}^{-1}$
Water	$\approx 1480 \text{ m s}^{-1}$
Aluminium	$\approx 6420 \text{ m s}^{-1}$
Steel	$\approx 5960 \text{ m s}^{-1}$

5. ECHO

- Minimum distance (d) of reflecting surface to hear a distinct echo,

$$d = \frac{v t}{2}$$

v = Speed of sound (m s^{-1})

t = Time gap between original sound and echo (s)

For air at 25°C ,

$$v \approx 344 \text{ m s}^{-1}$$

$$d(\text{min}) = \frac{344 \times t}{2}$$

$$= 172 t \text{ (metre)}$$

6. TIME TAKEN FOR SOUND TO TRAVEL

- Time taken by sound to travel a distance d ,

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

t = Time (s)

d = Distance (m)

v = Speed of sound (m s^{-1})

7. NUMBER OF VIBRATIONS (N)

- Number of vibrations in time t ,

$$N = f \times t$$

N = Number of vibrations

f = Frequency (Hz)

t = Time (s)

In 1 minute (60 s),

$$N = f \times 60$$

CHAPTER - SOUND

① INTRODUCTION

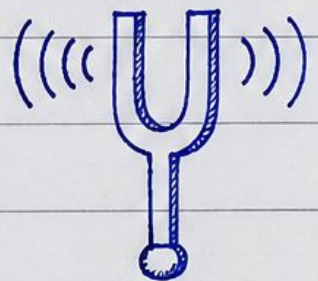
- Sound is a form of energy that produces the sensation of hearing in our ears.
- It is produced when an object vibrates.
- Sound needs a medium to travel (Solid, liquid or gas).



Sound

② PRODUCTION OF SOUND

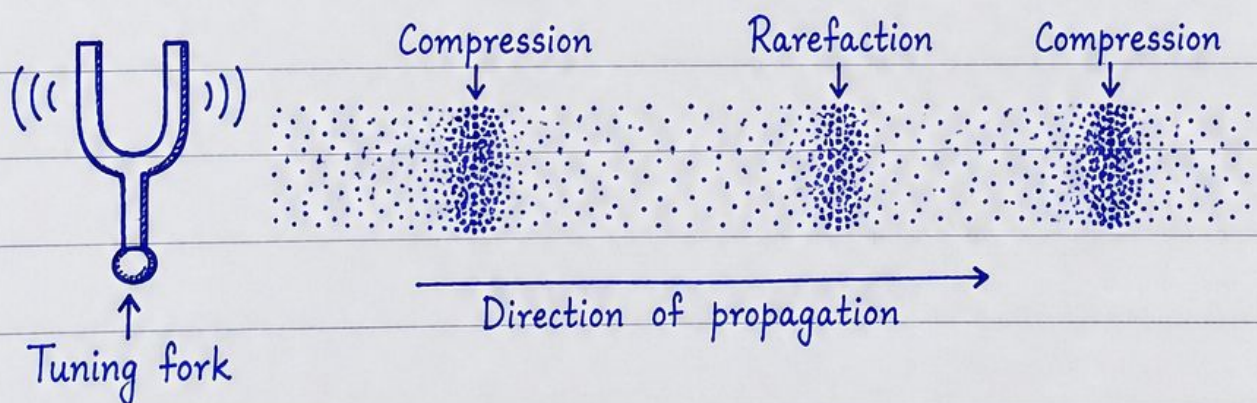
- Sound is produced by the vibrations of objects.
- When an object vibrates, it sets the particles of the surrounding medium into vibration.
- These vibrating particles pass the energy from one particle to another.
- This produces sound.



Vibrating Tuning Fork

③ PROPAGATION OF SOUND

- The process by which sound travels from the source of production to the listener is called propagation of sound.
- Key Points:
 - Sound is a mechanical wave.
 - It needs a material medium (solid, liquid or gas) to travel.
 - Sound cannot travel in vacuum (e.g., outer space).
 - Sound travels in the form of longitudinal waves.



- Thus, sound propagates by creating successive compressions and rarefactions in the medium.

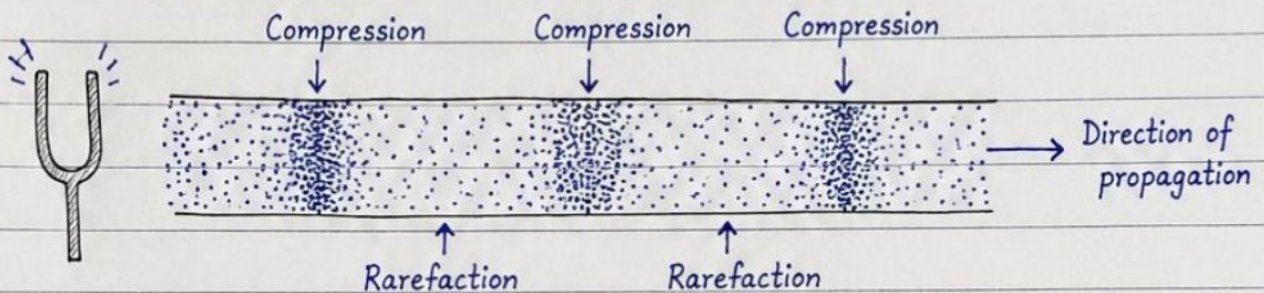
Class 9 Sound : Exercises

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1. What is sound and how is it produced?

- Sound is a form of energy which produces the sensation of hearing in our ears.
- It is produced by the vibration of objects.

2. Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.



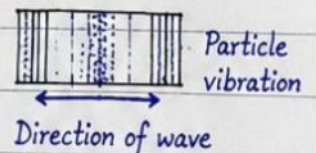
- When the source vibrates, it pushes the air particles together to form compressions.
- When it moves backward, the particles move apart to form rarefactions.

3. Cite an experiment to show that sound needs a material medium for its propagation.

- Experiment: Take an electric bell inside a glass jar. When air is pumped out, the bell can no longer be heard. This shows that sound cannot travel in vacuum.

4. Why is sound wave called a longitudinal wave?

- Because the particles of the medium vibrate to and fro parallel to the direction of propagation of the wave.



5. Which characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room?

- The characteristic is quality or timbre of sound.
- It is due to the combination of different frequencies produced by the voice.

6. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?

- Light travels much faster ($\sim 3 \times 10^8$ m/s) than sound (≈ 340 m/s).
- So, the light from the flash reaches us first, while the sound (thunder) takes time to reach us.