

# CLASS 9 SCIENCE

## CHAPTER 10

### SOUND WAVES: CHARACTERISTICS & APPLICATIONS

### FREE COLORFUL PRACTICE WORKSHEETS + ANSWER KEY

**Chapter Focus:** Production and propagation of sound • longitudinal waves • compressions and rarefactions • wavelength, frequency and time period • amplitude, intensity, pitch and loudness • speed of sound • human hearing • reflection, echo and reverberation • echolocation and SONAR

**Name:** \_\_\_\_\_ **Class:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**How to use:** Complete each worksheet independently. Show working for numerical questions and use the answer key for self-checking.

**WORKSHEET 1**

## Production &amp; Propagation of Sound

**Core idea:** Sound is produced by vibrating objects and requires a material medium for propagation. Sound is therefore a mechanical wave.

**A. Fill in the blanks.**

1. Sound is produced by \_\_\_\_\_ objects.
2. A tuning fork produces sound when its prongs \_\_\_\_\_.
3. The human voice is produced by vibrations of the \_\_\_\_\_ cords.
4. Sound needs a material \_\_\_\_\_ for propagation.
5. Sound cannot travel through a \_\_\_\_\_.

**B. MCQs**

6. Which action produces sound?

- ☐ Making an object vibrate  
 ☐ Stopping all motion  
 ☐ Removing the medium  
 ☐ Cooling the object

7. Which can transmit sound?

- ☐ Vacuum  
 ☐ Air  
 ☐ Empty space  
 ☐ Perfect vacuum

8. Why is sound called a mechanical wave?

- ☐ It needs a material medium  
 ☐ It travels through vacuum  
 ☐ It is made of light  
 ☐ It has no energy

**C. Explain**

9. Why can a vibrating ruler produce sound when its free end is plucked?

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10. Explain why astronauts cannot hear ordinary sounds directly through the vacuum of space.

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**WORKSHEET 2**

Longitudinal Waves, Compressions &amp; Rarefactions

**Key idea:** Sound is a longitudinal wave. Particles of the medium oscillate about their mean positions. Compressions and rarefactions travel through the medium and transfer energy.

**A. Match**

|                      |                                              |
|----------------------|----------------------------------------------|
| 1. Compression       | a. Low-density region                        |
| 2. Rarefaction       | b. High-density region                       |
| 3. Longitudinal wave | c. Particles vibrate parallel to propagation |
| 4. Sound wave        | d. Transfers energy through a medium         |

**B. Fill in the blanks**

5. A region of high particle density is called a \_\_\_\_\_.
6. A region of low particle density is called a \_\_\_\_\_.
7. In a longitudinal wave, particles vibrate \_\_\_\_\_ to the direction of propagation.
8. Sound transfers \_\_\_\_\_ from one place to another.

**C. Diagram practice**

9. Draw a labelled longitudinal sound wave showing at least two compressions (C) and two rarefactions (R).

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10. Differentiate between compression and rarefaction.

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**WORKSHEET 3**

Wavelength, Frequency &amp; Time Period

**Formula box:**  $v$  = number of oscillations / time;  $T = 1/v$ . Wavelength  $\lambda$  is the distance between two successive corresponding points such as consecutive compressions.

**A. Complete**

1. SI unit of frequency = \_\_\_\_\_.
2. SI unit of time period = \_\_\_\_\_.
3. Symbol for wavelength = \_\_\_\_\_.
4. Frequency means the number of complete \_\_\_\_\_ per second.
5. Time period is the time taken for \_\_\_\_\_ complete oscillation.

**B. Numericals**

6. 20 compressions pass a point in 4 s. Find the frequency.

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7. A source makes 60 vibrations in 3 s. Find its frequency.

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8. A sound has frequency 50 Hz. Find its time period.

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9. A sound has frequency 200 Hz. Find its time period.

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10. A wave has frequency 25 Hz. How many oscillations occur in 8 s?

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**C. Reasoning**

11. What happens to time period when frequency increases?

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12. A source has frequency 500 Hz. Is one vibration completed in more or less than 1 second?

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**WORKSHEET 4**

Amplitude, Pitch, Loudness &amp; Intensity

**Remember:** Frequency is mainly related to pitch. Amplitude is generally related to loudness. Intensity is a measurable sound-energy quantity and is not identical to loudness.

**A. MCQs**

- Pitch mainly depends on: ☐ frequency ☐ amplitude ☐ speed only ☐ distance
- Loudness is generally related to: ☐ amplitude ☐ frequency only ☐ time period only ☐ wavelength only
- A higher-frequency sound generally has: ☐ higher pitch ☐ lower pitch ☐ no pitch ☐ zero amplitude
- A larger amplitude generally produces: ☐ louder sound ☐ lower frequency automatically ☐ no sound ☐ higher speed automatically
- Intensity is: ☐ a measurable sound-energy quantity ☐ the same as pitch ☐ a type of frequency ☐ a type of wavelength

**B. Compare**

- Pitch vs loudness

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- Frequency vs amplitude

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- Intensity vs loudness

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**C. Application**

- Two sound waves have the same frequency but different amplitudes. Which characteristic will differ in general?

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- Two sounds have different frequencies but equal amplitudes. Which characteristic will mainly differ?

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**WORKSHEET 5**

Speed of Sound &amp; Wave Formulae

**Formula sheet:**  $v = \lambda \nu$     $\lambda = v/\nu$     $\nu = v/\lambda$     $T = 1/\nu$ . For an ordinary fixed medium, sound speed depends mainly on the medium.**A. Calculate**1.  $\lambda=2$  m and frequency=170 Hz. Find speed.

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2. Speed=340 m/s and frequency=100 Hz. Find wavelength.

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3. Speed=344 m/s and  $\lambda=3.44$  m. Find frequency.

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4. Frequency=50 Hz and speed=350 m/s. Find wavelength.

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5.  $\lambda=0.5$  m and speed=340 m/s. Find frequency.

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**B. Concept check**

6. Write the relationship between speed, wavelength and frequency.

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7. In a fixed ordinary medium, does increasing frequency automatically make sound travel faster? Explain.

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8. Among solids, liquids and gases, where is sound fastest according to the chapter revision?

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**WORKSHEET 6**

Human Hearing, Reflection, Echo &amp; Reverberation

**Key ideas:** The usual human audible range is about 20 Hz–20 kHz. Reflection occurs when sound bounces back. The chapter uses 0.1 s as the key criterion for a distinct echo. Reverberation is persistence caused by multiple reflections.

**A. Identify**

1. 10 Hz sound → \_\_\_\_\_
2. 500 Hz sound → \_\_\_\_\_
3. 25,000 Hz sound → \_\_\_\_\_
4. Frequency below 20 Hz → \_\_\_\_\_
5. Frequency above 20 kHz → \_\_\_\_\_

**B. MCQs**

6. Reflection of sound means: ☐ sound bounces back from a surface ☐ sound becomes light ☐ sound disappears ☐ sound stops vibrating
7. A distinct echo is associated with a time gap of about: ☐ 0.01 s ☐ 0.1 s or more ☐ 0 s ☐ 1 ms only
8. Reverberation is mainly due to: ☐ multiple reflections ☐ one isolated vibration ☐ electron flow ☐ vacuum

**C. Echo numericals**

9. A reflected sound is heard 2 s after production. If speed is 340 m/s, find the distance of the reflecting surface.

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10. A reflected sound returns after 0.08 s. Is it a distinct echo by the 0.1 s criterion? Explain.

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11. Why is echo distance  $d = vt/2$  rather than  $vt$ ?

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**WORKSHEET 7**

## Echolocation &amp; SONAR

**Echolocation:** locating objects using reflected sound. **SONAR:** Sound Navigation and Ranging; it uses ultrasonic waves in water to determine distance, direction and speed of underwater objects.

**A. Complete**

1. Echolocation uses \_\_\_\_\_ sound waves.
2. SONAR stands for Sound Navigation and \_\_\_\_\_.
3. SONAR sends \_\_\_\_\_ waves into water.
4. The reflected wave is called an \_\_\_\_\_.
5. SONAR can help locate submarines and \_\_\_\_\_.

**B. Numericals**

6. A SONAR signal returns after 4 s. If speed in seawater is 1500 m/s, find depth.

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7. A sonar signal returns after 0.9 s at 1530 m/s. Find distance to the object.

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8. A ship detects an echo after 5 s. If speed is 1525 m/s, find depth of the wreckage.

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**C. Application**

9. How can echolocation help an animal navigate in darkness?

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10. Give two uses of SONAR.

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**WORKSHEET 8**

Complete Chapter Revision Test

**Suggested time:** 45–50 minutes. Complete independently before checking the answer key.**Section A — MCQs**

1. Sound is produced by: ☐ vibration ☐ light ☐ heat only ☐ vacuum
2. Sound cannot travel through: ☐ solid ☐ liquid ☐ gas ☐ vacuum
3. Sound in a medium is a: ☐ longitudinal mechanical wave ☐ transverse light wave ☐ chemical reaction ☐ stationary particle
4. Frequency is measured in: ☐ metre ☐ second ☐ hertz ☐ newton
5. Pitch is mainly related to: ☐ frequency ☐ amplitude ☐ distance ☐ intensity only
6. Loudness is generally related to: ☐ amplitude ☐ frequency only ☐ wavelength only ☐ speed only
7. A distinct echo requires a sufficient time gap between direct and reflected sound. ☐ True ☐ False

**Section B — Fill in the blanks**

8. Sound transfers \_\_\_\_\_ through a medium.
9. Distance between successive compressions is the \_\_\_\_\_.
10. Number of oscillations per second is \_\_\_\_\_.
11. Time period  $T =$  \_\_\_\_\_.
12. Frequency below 20 Hz is called \_\_\_\_\_.
13. Frequency above 20 kHz is called \_\_\_\_\_.

**Section C — Numericals**

14. A source makes 300 vibrations in 5 s. Find frequency.

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15. A sound has frequency 100 Hz. Find time period.

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16. A sound wave has speed 340 m/s and frequency 200 Hz. Find wavelength.

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17. An echo returns after 2.4 s. Take speed as 340 m/s. Find distance of the reflecting surface.

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18. A sonar signal returns after 5 s in seawater at 1525 m/s. Find depth.

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**Section D — Short answer**

19. Why is sound called a longitudinal mechanical wave?

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20. Differentiate echo and reverberation.

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21. Explain the difference between pitch and loudness.

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22. Describe one use of echolocation and two uses of SONAR.

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23. Write the four main formula relationships used in this chapter.

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## ANSWER KEY

**Complete answer key:** Use for self-checking, classroom correction and revision.

### Worksheet 1

1. vibrating; 2. vibrate; 3. vocal; 4. medium; 5. vacuum. 6. Making an object vibrate; 7. Air; 8. It needs a material medium. 9. The plucked ruler vibrates and disturbs the surrounding medium. 10. Vacuum has no material medium to carry the sound disturbance.

### Worksheet 2

1-b; 2-a; 3-c; 4-d. 5. compression; 6. rarefaction; 7. parallel; 8. energy. 9. Diagram should alternate C and R. 10. Compression is a high-density/high-pressure region; rarefaction is a low-density/low-pressure region.

### Worksheet 3

1. Hz; 2. s; 3.  $\lambda$ ; 4. oscillations; 5. one. 6. 5 Hz; 7. 20 Hz; 8. 0.02 s; 9. 0.005 s; 10. 200 oscillations. 11. Time period decreases. 12. Less than 1 s;  $T=0.002$  s.

### Worksheet 4

1. frequency; 2. amplitude; 3. higher pitch; 4. louder sound; 5. measurable sound-energy quantity. 6. Pitch mainly depends on frequency; loudness generally on amplitude. 7. Frequency is oscillations per second; amplitude is maximum density variation. 8. Intensity is measurable while loudness is a perception. 9. Loudness; 10. pitch.

### Worksheet 5

1. 340 m/s; 2. 3.4 m; 3. 100 Hz; 4. 7 m; 5. 680 Hz. 6.  $v=\lambda v$ . 7. No; in a fixed ordinary medium speed depends mainly on the medium. 8. Solids.

### Worksheet 6

1. infrasound; 2. audible sound; 3. ultrasound; 4. infrasound; 5. ultrasound. 6. sound bounces back from a surface; 7. 0.1 s or more; 8. multiple reflections. 9.  $d=340 \times 2/2=340$  m. 10. No distinct echo by the 0.1 s criterion. 11. Echo time is a round trip, so one-way distance is half of  $vt$ .

### Worksheet 7

1. reflected; 2. Ranging; 3. ultrasonic; 4. echo; 5. shipwrecks/submarines. 6.  $d=1500 \times 4/2=3000$  m. 7.  $d=1530 \times 0.9/2=688.5$  m. 8.  $d=1525 \times 5/2=3812.5$  m. 9. The animal emits sound, receives its reflection and interprets the echo. 10. Locating underwater objects and measuring underwater depth.

### Worksheet 8

1. vibration; 2. vacuum; 3. longitudinal mechanical wave; 4. hertz; 5. frequency; 6. amplitude; 7. True. 8. energy; 9. wavelength; 10. frequency; 11.  $1/v$ ; 12. infrasound; 13. ultrasound. 14. 60 Hz; 15. 0.01 s; 16. 1.7 m; 17. 408 m; 18. 3812.5 m. 19. Sound needs a material medium and particles oscillate parallel to propagation. 20. Echo is distinct reflected sound; reverberation is persistence due to multiple reflections. 21. Pitch relates mainly to frequency; loudness generally to amplitude. 22. Echolocation helps navigation/hunting; SONAR locates underwater objects and measures depth. 23.  $v=\lambda v$ ;  $\lambda=v/v$ ;  $v=v/\lambda$ ;  $T=1/v$ .

**Fix applied:** The original Chapter 10 file began with Worksheet 1 questions without a visible **WORKSHEET 1** heading. Worksheet 4 also continued onto a separate page without its heading. This corrected version gives Worksheet 1 a proper heading, keeps Worksheet 4 together, clearly labels all 8 worksheets, and places the answer key after the revision test.