

CLASS 9 SCIENCE — CHAPTER 10

NCERT SOLUTIONS

Sound Waves: Characteristics and Applications

New NCERT *Exploration* Textbook | 2026–27

The exercise has **15 questions**.

Q1. Sound as a Mechanical Wave

Question:

Which observation best supports the idea that sound is a mechanical wave?

- (i) Sound shows reflection
- (ii) Sound needs a medium to propagate
- (iii) Sound has frequency
- (iv) Sound carries energy

 **Answer: (ii) Sound needs a medium to propagate.**

Explanation:

A **mechanical wave** requires a material medium for its propagation.

Sound can travel through:

-  Solids
-  Liquids
-  Gases

But sound **cannot travel through vacuum**.

Therefore, the best evidence that sound is a mechanical wave is that it needs a medium.



Q2. Effect of Increasing Frequency

Question:

For a sound wave propagating in a medium, increasing its frequency will increase:

- (i) wavelength
- (ii) speed
- (iii) number of compressions per second
- (iv) time period



Answer: (iii) Number of compressions per second



Explanation:

Frequency is the number of complete oscillations or compressions passing a fixed point in one second.

Therefore:

Higher frequency → More compressions per second

Also:

$$T = 1/v$$

So, increasing frequency actually **decreases** the time period.



Q3. Frequency of Sound

Question:

If **20 compressions** pass a point in **4 seconds**, find the frequency.

Given:

Number of compressions = 20

Time = 4 s

Formula:

Frequency = Number of oscillations / Time

Calculation:

Frequency = $20 / 4$

✓ **Frequency = 5 Hz**



Q4. Echo or Reverberation?

Question:

In a room, reflected sound reaches the ear **0.05 s** after its production. Will it produce an echo or reverberation?

Given:

Time gap = **0.05 s**

For a distinct echo, the reflected sound should reach the ear after approximately:

0.1 s or more

Here:

$0.05 \text{ s} < 0.1 \text{ s}$

Therefore, the original and reflected sounds are not heard separately.

✓ **Answer:**

Reverberation



Q5. Comparing Two Sound Waves

Question:

Two sound waves are represented in Fig. 10.30. If the X- and Y-axis scales are the same, which wave has:

(i) Greater wavelength?

(ii) Smaller amplitude?

✓ **Answer:**

(i) **Greater wavelength** → **Wave (a)**

(ii) **Smaller amplitude** → **Wave (a)**

🧠 **Remember:**

Wavelength = distance between two consecutive corresponding points.

Amplitude = maximum change from the average density.

Therefore, from the given graphs:

Wave (a) has both greater wavelength and smaller amplitude.



Q6. Frequency of Three Sound Waves

Question:

Three sound waves A, B and C are represented in Fig. 10.31.

The frequency of:

- A = maximum
- C = minimum

Identify the curves.

✓ **Answer:**

● **A** → **Green curve**

● **B** → **Red curve**

● **C** → **Blue curve**

Why?

For the same distance:

More oscillations → Higher frequency

Fewer oscillations → Lower frequency

Therefore:

A = maximum frequency

C = minimum frequency



Q7. Draw a Sound Wave

Question:

Draw a graph representing a sound wave for which:

- Density amplitude = **3 units**
- Wavelength = **4 cm**

Answer:

Draw a **density vs distance** graph.

The graph should have:

-  Horizontal axis → **Distance (cm)**
-  Vertical axis → **Density**
- Average density as the middle line
- Maximum density = **3 units above** the average
- Minimum density = **3 units below** the average
- Distance between two successive crests = **4 cm**

★ Therefore:

Amplitude = 3 units

Wavelength = 4 cm



Q8. Spacecraft Explosion in a Movie

Question:

A movie shows an explosion of a spacecraft in space. A flash of light and sound are shown at the same time. What are the errors?

✗ Error 1: Sound cannot travel through outer space

Outer space is nearly a vacuum.

Sound is a **mechanical wave** and needs a medium.

Therefore:

Sound cannot travel directly through space.

✗ Error 2: Light and sound do not reach an observer at the same time

Even when sound has a medium through which to travel:

Speed of light > Speed of sound

Therefore, an observer would see the flash **before** hearing the sound.

✓ Answer:

The two errors are:

1. **Sound cannot propagate through the vacuum of space.**
 2. **Light travels much faster than sound, so the flash would be seen before the sound was heard.**
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Q9. Time Period of a Sound Wave

Question:

A sound wave has wavelength **3.44 m** and travels with speed **344 m/s**. Find its time period.

Given:

Wavelength:

$$\lambda = 3.44 \text{ m}$$

Speed:

$$v = 344 \text{ m/s}$$

Formula:

$$v = \lambda \nu$$

Therefore:

$$\nu = v/\lambda$$

Step 1: Find frequency

$$\nu = 344 / 3.44$$

$$\nu = 100 \text{ Hz}$$

Step 2: Find time period

Formula:

$$T = 1/\nu$$

$$T = 1/100$$

$$\checkmark T = 0.01 \text{ s}$$



Q10. SONAR and Sunken Ship

Question:

A ship sends a sonar signal and receives an echo after **5 s**.

Speed of ultrasonic wave in seawater:

1525 m/s

Find the approximate depth of the wreckage.

Given:

Total time = **5 s**

Speed = **1525 m/s**

⚠ The sonar signal travels:

Ship → Wreckage → Ship

Therefore, the 5 s is the **round-trip time**.

Step 1: One-way time

One-way time = $5 / 2$

= 2.5 s

Step 2: Find depth

Formula:

Distance = Speed × Time

Distance = 1525×2.5

= 3812.5 m

✅ **Answer:**

Depth = 3812.5 m



Q11. Ultrasonic Parking Sensor

Question:

An ultrasonic parking sensor detects an obstacle **1.2 m** away.

Speed of ultrasonic wave:

345 m/s

Find the time taken by the wave to travel to the obstacle and return.

Given:

One-way distance = **1.2 m**

Round-trip distance:

$$2 \times 1.2 = 2.4 \text{ m}$$

Formula:

Time = Distance / Speed

$$t = 2.4 / 345$$

$$t = 0.006956... \text{ s}$$

✓ **Answer:**

$$t \approx 0.007 \text{ s}$$



Q12. Speed of Sound at Different Temperatures

Question:

Speed of sound is:

At **0°C = 331 m/s**

At **22°C = 344 m/s**

How much extra time will thunder take to travel **1720 m** when temperature changes from 22°C to 0°C?

At 22°C:

Formula:

$$t = \text{Distance} / \text{Speed}$$

$$t_1 = 1720 / 344$$

$$t_1 = 5.00 \text{ s}$$

At 0°C:

$$t_2 = 1720 / 331$$

$$t_2 \approx 5.196 \text{ s}$$

Extra time:

$$\text{Extra time} = 5.196 - 5.00$$

$$= 0.196 \text{ s}$$

 **Answer:**

Approximately 0.20 s extra



Q13. Wavelength and Frequency from Graph

Question:

The variation of density for a sound wave travelling at **340 m/s** is shown in Fig. 10.32. Calculate:

1. Wavelength
2. Frequency

From the graph:

Wavelength:

$$\lambda = 0.04 \text{ m}$$

Frequency:

Formula:

$$v = \lambda \nu$$

Therefore:

$$\nu = v/\lambda$$

$$\nu = 340 / 0.04$$

$$\nu = 8500 \text{ Hz}$$

 Answers:

Wavelength = 0.04 m

Frequency = 8500 Hz



Q14. Two Sound Waves A and B

Two sound waves travel with speed:

$$v = 345 \text{ m/s}$$

From Fig. 10.33:

Wave A:

$$\lambda = 0.025 \text{ m}$$

Wave B:

$$\lambda = 0.05 \text{ m}$$

Wave A

Formula:

$$v = v/\lambda$$

$$v = 345 / 0.025$$

$$v = 13,800 \text{ Hz}$$

Therefore:

$$A \rightarrow \lambda = 0.025 \text{ m}$$

$$A \rightarrow v = 13,800 \text{ Hz}$$

Wave B

$$v = 345 / 0.05$$

$$v = 6900 \text{ Hz}$$

Therefore:

$$B \rightarrow \lambda = 0.05 \text{ m}$$

$$B \rightarrow v = 6900 \text{ Hz}$$

 **Answer:**

Wave	Wavelength	Frequenc y
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A 0.025 m 13,800 Hz

B 0.05 m 6,900 Hz



Q15. Sound in Air and Water

Question:

Two identical sound sources are placed at A and B:

- One in **air**
- One in **water**

Both sounds travel to a cliff and return.

The time taken by sound to return to A is **4.5 times** the time taken to return to B.

Find the ratio of the speeds of sound in air and water.

Given:

$$t_{\text{air}} = 4.5 \times t_{\text{water}}$$

For the same distance:

$$\text{Speed} \propto 1/\text{Time}$$

Therefore:

$$v_{\text{air}} / v_{\text{water}} = t_{\text{water}} / t_{\text{air}}$$

So:

$$v_{\text{air}} / v_{\text{water}} = 1 / 4.5$$

Convert:

$$1 / 4.5 = 2 / 9$$



Answer:

Speed of sound in air : Speed of sound in water = 2 : 9

CHAPTER 10 — COMPLETE ANSWER KEY

Q	Answer
1	(ii)
2	(iii)
3	5 Hz
4	Reverberation
5	(i) Wave (a) ; (ii) Wave (a)
6	A → Green, B → Red, C → Blue
7	Amplitude = 3 units , wavelength = 4 cm
8	Sound cannot travel through vacuum; light reaches observer before sound
9	0.01 s
10	3812.5 m
11	0.007 s
12	≈ 0.20 s extra
13	0.04 m, 8500 Hz
14	A: 0.025 m, 13,800 Hz ; B: 0.05 m, 6900 Hz
15	2 : 9

The textbook answer key confirms the Chapter 10 exercise answers, including Q1–Q3, Q5–Q6 and Q9–Q15.



CHAPTER 10 — IMPORTANT FORMULAS



Wave Speed

$$v = \lambda \nu$$



Frequency

$$\nu = 1/T$$



Time Period

$$T = 1/\nu$$



Wavelength

$$\lambda = v/\nu$$



Frequency

$$\nu = v/\lambda$$



Echo / SONAR

$$\text{Distance} = v \times t / 2$$

The 2 is used because the sound travels to the reflecting surface and then returns.



Remember:

Higher frequency → Higher pitch

Greater amplitude → Louder sound

Higher frequency → More compressions per second

Sound needs a medium.

Sound cannot travel through vacuum.

Sound travels fastest in solids, slower in liquids and slowest in gases.

Echo = distinct reflected sound

Reverberation = persistence of sound due to repeated reflections

Infrasound: frequency < 20 Hz

Audible sound: 20 Hz to 20,000 Hz

Ultrasound: frequency $> 20,000$ Hz