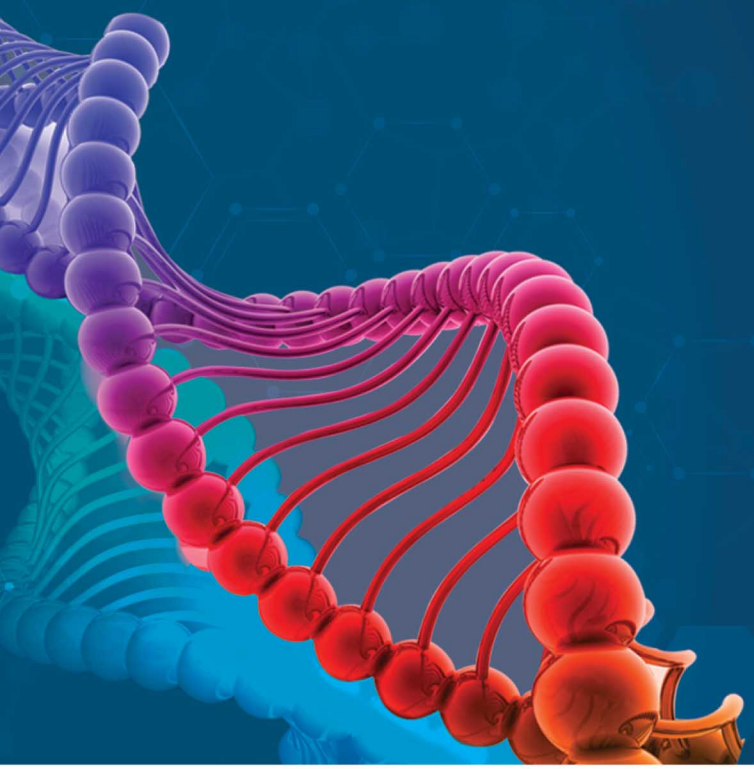
SAMPLE CONTENT

# SCIENCE

# NCERT

## Textbook & Exemplar

## Problems-Solutions



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**Reading between the lines:** To provide additional conceptual info about a particular concept

**Caution:** To apprise students of commonly made mistakes while solving mcqs

**Connection:** To interlink related concepts from different chapters

**Class IX**

Target Publications® Pvt. Ltd.

**Written as per the latest rationalised textbook 2023-24 and Exemplar Problems prescribed by the National Council of Educational Research and Training (NCERT).**

# SCIENCE
# NCERT
## Textbook & Exemplar
## Problems - Solutions
## Class IX



### Salient Features

- Written as per the Latest Syllabus
- Complete coverage of NCERT Intext Questions and Exercise Questions
- Contains NCERT Exemplar Questions pertaining to the most recent NCERT textbook
- Quick Review at the beginning of each chapter to facilitate quick revision
- **Important inclusions**:
  - **Reading between the lines** for concept elaboration
  - **Caution** apprises students about commonly made mistakes
  - **Connections** to interlink concepts covered in different chapters

Printed at: **Print to Print,** Mumbai



**TEID: 2627**

P.O. No. 7915

# PREFACE

Target's **''Science NCERT Textbook and Exemplar Problems - Solutions: Class IX''** is created as a go-to tool to find solutions to all the Intext questions, Exercise questions and relevant Exemplar problems at one place.

The science textbook developed by The National Council of Educational Research and Training (NCERT) and Exemplar Problems for Science developed by NCERT and the Department of Education in Science and Mathematics (DESM) contain a variety of questions in the form of MCQs, Short answers, and Long answers. The number of questions designed for a chapter is a blend of theoretical, numerical and graphical questions. These questions not only give ample practice to the students but also challenge them to analyse, evaluate, and apply the concepts they have learned, taking a leap in their thinking process.

Studying these questions systematically prepares a student for Annual examination and various competitive examinations, as their level of difficulty fosters a strong foundation of the subject.

Each chapter in the book begins with a **Quick Review** that offers a crisp overview of the entire chapter.

NCERT Intext Questions are marked with their respective textbook page numbers so that they can be promptly located by students. NCERT Exercise Questions are arranged as per their original sequence in the textbook. NCERT Exemplar Questions which are based on the concepts covered in the most recent NCERT textbook, are arranged as per their original sequence in the Exemplar textbook.

In addition to precise solutions, to boost comprehensive understanding of concepts, '**Reading between the lines'** has been provided wherever necessary. The feature is meant to elucidate a concept that is not part of the answer but vital for the complete understanding of the concept or answer. **'Caution'** is added to make students watchful against commonly made mistakes. Also, '**Connections'** are furnished to enable students to perceive the interlinking of concepts covered in different chapters and prepare them for possible coalition questions. In the answers, the '**Key Words/Points'** are underlined to highlight the important concepts.

We hope that this book would not only enhance thinking and learning ability of a student but also help building up fundamental knowledge.

Publisher

**Edition:** First

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*A book affects eternity; one can never tell where its influence stops.*

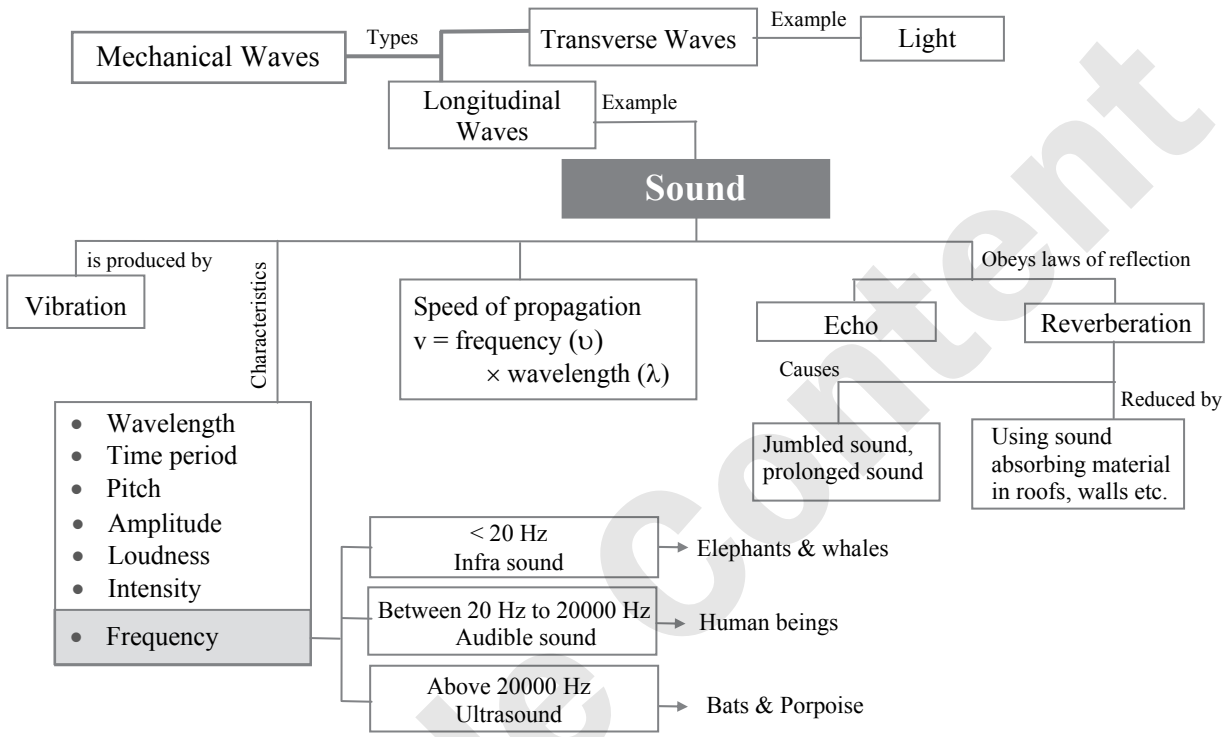
# CONTENTS



***Note:*** *NCERT Exemplar Chapter 7 (Diversity in Living Organisms), Chapter 13 (Why Do We Fall ill) and Chapter 14 (Natural Resources) are NOT the part of the rationalised NCERT textbook (2023-24).*

# 11 Sound

## QUICK REVIEW




## NCERT INTEXT QUESTIONS

### I. Textbook Page. No. 129

**1. How does the sound produced by a vibrating object in a medium reach your ear?**

**Ans:**

i. When the object vibrates, it sets the particles of the medium around it vibrating.

ii. The particles do not travel from the vibrating object to the ear.

iii. A particle of the medium in contact with the vibrating object is first displaced from its equilibrium position.

iv. This vibrating particle then exerts force on the adjacent particle which then gets displaced form its position of rest.

v. After displacing the first particle, the first particle comes back to its original position.

vi. This process continuous in the medium till the sound reaches your ear.

**2. Explain how sound is produced by your school bell.**

**Ans:**

i. When gong of the bell is struck by hammer, the bell starts vibrating.

ii. Vibrating objects produce sound, hence the bell produces sound.

**3. Why are sound waves called mechanical waves?**

**Ans:** Sound waves are produced by the motion of particles of a medium and it requires material medium for their propagation. Hence, sound waves are called as mechanical wave.

**4. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?**

**Ans:**

i. No, we won't be able to hear any sound produced by our friend on the moon.

ii. Sound requires a material medium for its propagation.

iii. Moon has no atmosphere. Hence, sound cannot be heard on the moon due to absence of medium.

## II. Textbook Page. No. 132

**1. Which wave property determines**

**i. loudness ii. pitch?**

**Ans:**

i. Amplitude determines loudness of wave.

ii. Frequency determines the pitch of the wave.

**2. Guess which sound has a higher pitch: guitar or car horn?**

**Ans:** Since the frequency of guitar is higher than that of car horn. The pitch of guitar sound is higher.

## III. Textbook Page. No. 132

**1. What are wavelength, frequency, time period and amplitude of a sound wave?**

**Ans:**

i. The distance between two consecutive compressions or two consecutive rarefactions is called wavelength.

ii. The number of oscillations per unit time is called the frequency of wave.

iii. The time taken by two consecutive compressions or rarefactions to cross a fixed point is called time period of wave.

iv. The magnitude of maximum displacement of particle in the medium on either side of the mean value is called amplitude of the wave.

**2. How are the wavelength and frequency of a sound wave related to its speed?**

**Ans:** Relation between speed, frequency and wavelength of sound wave is given by,

speed = frequency × wavelength, i.e., $v = \upsilon\lambda$

**3. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.**

***Solution:***

*Given:* Frequency ($\upsilon$) = 220 Hz,
Velocity (v) = 440 m/s.

*To find:* Wavelength ($\lambda$)

*Formula:* $v = \upsilon\lambda$

*Calculation:* From formula,

$$\lambda = \frac{v}{\upsilon} = \frac{440}{220}$$

$$= \mathbf{2\ m}$$

**Ans:** The wavelength of the sound wave is **2 m**.

**4. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?**

***Solution:***

*Given:* Frequency ($\upsilon$) = 500 Hz,
Distance (d) = 450 m.

*To find:* Time period (T)

*Formula:* $\text{Time period} = \frac{1}{\text{frequency}}$

*Calculation:* Time interval between two successive compressions is inversely proportional to frequency.
From formula,

$$T = \frac{1}{500} = \mathbf{2 \times 10^{-3}\ s}$$

**Ans:** The time interval between two successive compression is $\mathbf{2 \times 10^{-3}\ s}$.

## IV. Textbook Page no. 133

**1. Distinguish between loudness and intensity of sound.**

**Ans:**

| | Loudness | Intensity |
|---|---|---|
| i. | Loudness is the measure of the response of the ear to the sounds. | Intensity is the amount of sound energy passing per second through a unit area. |
| ii. | It depends on the sensitivity of human ear. | It does not depend on the sensitivity of human ear. |
| iii. | Loudness cannot be measured. | Intensity is measured in decibel (dB). |

## V. Textbook Page. No. 133

**1. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?**

**Ans:** Sound travels fastest in solids. Hence, sound travel fastest in iron in this case at a given temperature.

## VI. Textbook Page. No. 134

**1. An echo is heard in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 m $s^{-1}$?**

***Solution:***

*Given:* Time (t) = 3 s,
Speed of sound (v) = 342 m $s^{-1}$.

*To find:* Distance (d)

*Formula:* $d = \frac{vt}{2}$

*Calculation:* From formula,

$d = \frac{342 \times 3}{2} = \mathbf{513\ m}$

**Ans:** The distance of the reflecting surface from the source is **513 m**.

## VII. Textbook Page. No. 135

**1. Why are the ceilings of concert halls curved?**

**Ans:** Ceilings of concert halls and cinema halls are curved to avoid undesirable reverberation; otherwise pitch of the sound will not be heard distinctly.

## VIII. Textbook Page. No. 136

**1. What is the audible range of the average human ear?**

**Ans:** The audible range of sound for human ear is 20 Hz to 20 kHz.

**2. What is the range of frequencies associated with**

**i. Infrasound? ii. Ultrasound?**

**Ans:**

i. Frequencies less than 20 Hz are associated with Infrasound.

ii. Frequencies greater than 20 kHz are associated with Ultrasound.

## NCERT EXERCISE QUESTIONS

**1. What is sound and how is it produced?**

**Ans:**

i. Sound is a form of energy which provides the sensation of hearing.

ii. Sound is produced when an object is disturbed or set into vibrations.

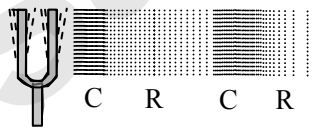
**2. Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.**

**Ans:**

i. When a tuning fork is set into vibrations and the prongs move forward, it creates a region of high pressure and density called as compression.

ii. When the prong moves backward, it creates a region of low pressure and density called as rarefaction.

iii. A series of compression and rarefaction are created when the object moves back and forth rapidly as shown in the figure given below.




**Vibrations produced by tuning fork**

**3. Why sound wave is called a longitudinal wave?**

**Ans:** During transmission of sound waves, the individual particles of the medium move in a direction parallel to direction of propagation of disturbance. Hence, sound waves are said to be longitudinal waves.

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

**Ans:** The quality or timber of sound enables us to identify the voice of our friend while sitting with others in a dark room.

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

**Ans:** Speed of light in air is much greater than the speed of sound in air. Thus, we see the flash few seconds before the thunder is heard.

***Reading between the lines – Q.5.***

*The speed of light = $3 \times 10^8$ m/s.*
*The speed of sound = 343 m/s.*
*The speed of light is roughly one million times faster than the speed of sound.*

**6. A person has a hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as 344 m $s^{-1}$.**

***Solution:***

*Given:* Speed of sound in air (v) = 344 $ms^{-1}$,
Minimum frequency ($\upsilon_1$) = 20 Hz,
Maximum frequency ($\upsilon_2$) = 20 kHz
$= 20 \times 10^3$ Hz.

*To find:*
i. Wavelength of sound waves at 20 Hz ($\lambda_1$)
ii. Wavelength of sound waves at 20 kHz ($\lambda_2$)

*Formula:* $\lambda = \frac{v}{\upsilon}$

*Calculation:* From formula,

i. At 20 Hz,

$\lambda_1 = \frac{344}{20}$ = **17.2 m**

ii. At 20 kHz,

$\lambda_2 = \frac{344}{20 \times 10^3}$ = **$17.2 \times 10^{-3}$ m**

**Ans:** i. Wavelength of sound waves at 20 Hz is **17.2 m.**

ii. Wavelength of sound waves at 20 kHz is **$17.2 \times 10^{-3}$ m.**

**7. Two children are at opposite ends of an aluminum rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in air and in aluminum to reach the second child.**

***Solution:***

Let 'd' be the distance travelled by sound,

When sound travel in aluminum,

$t_{Al} = \frac{d}{v_{Al}}$ ….(i)

where,

$t_{Al}$ = time for which sound travel in aluminum.

$v_{Al}$ = Velocity of sound in aluminum.

$t_{Air} = \frac{d}{v_{Air}}$ ….(ii)

where,

$t_{Air}$ = time for which sound travel in air.

$v_{Air}$ = Velocity of sound in air.

Dividing equation (ii) by equation (i)

$\frac{t_{Air}}{t_{Al}} = \frac{d / v_{Air}}{d / v_{Al}} = \frac{v_{Al}}{v_{Air}}$

Velocity of sound in aluminum ($v_{Al}$) = 6420 $ms^{-1}$.

Velocity of sound in air ($v_{Air}$) = 346 $ms^{-1}$.

$\therefore \quad \frac{t_{Air}}{t_{Al}} = \frac{6420}{346} = \frac{\mathbf{18.55}}{\mathbf{1}}$

**Ans:** The ratio of time taken by the sound wave in air and in aluminum is **18.55: 1**.

**8. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?**

**Ans:** Number of vibrations in time t is given by frequency × time.

Hence, number of vibrations in one minute is $100 \times 60 = 6000$

**9. Does sound follow the same laws of reflection as light does? Explain.**

**Ans:** Yes, sound obeys the law of reflection as follows:

i. The direction in which sound is incident and reflected makes equal angles with the normal.

ii. The point of incidence, the normal, the incident wave and the reflected wave lie in the same plane.

iii. The incident and reflected sound waves are on the opposite sides of the normal.

**10. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?**

**Ans:**

i. Time taken by echo is given by $t = \frac{2d}{v}$

Speed of sound increases with the increase in temperature.

ii. On a hotter day, speed of sound will be higher, hence time taken for echo will decrease.

iii. If time taken between reflected and original sound is less than 0.1 s, then echo is not heard.

**11. Give two practical applications of reflection of sound waves.**

**Ans:** Stethoscope and megaphones.

**12. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given, g = 10 m $s^{-2}$ and speed of sound = 340 m $s^{-1}$.**

***Solution:***

Time taken to hear the splash (t)

= Time taken by stone to reach pond ($t_1$) + Time taken by splash to reach the tower ($t_2$)

$\therefore \quad t = t_1 + t_2$

For time t,

From second kinematical equation,

$s = ut + \frac{1}{2}at^2$

Here s = 500 m, u = 0 (stone initially at rest),

$a = g = 10\ m/s^2$, $t = t_1$.

$\therefore \quad 500 = 0 \times t_1 + \frac{1}{2} \times 10 \times t_1^2$

$\therefore \quad t_1^2 = 100$

$\therefore \quad t_1 = 10$ s

For $t_2$,

$\therefore \quad t_2 = \frac{\text{distance}}{\text{speed}} = \frac{500}{340} = 1.47$ s

$\therefore \quad t = t_1 + t_2 = 10 + 1.47 =$ **11.47 s**

**Ans:** The splash sound will be heard after **11.47 s**.

***Connections – Q.12.***

*In Chapter 7, you have studied the 'Equations of Motion'.*

**13. A sound wave travels at a speed of 339 $ms^{-1}$. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?**

***Solution:***

*Given:* Velocity of sound (v) = 339 $ms^{-1}$, Wavelength of sound wave ($\lambda$) = 1.5 cm = $1.5 \times 10^{-2}$ m.

*To find:* Frequency ($\upsilon$)

*Formula:* $\upsilon = \frac{v}{\lambda}$

*Calculation:* From formula,

$$\upsilon = \frac{339}{1.5 \times 10^{-2}} = \mathbf{22600\ Hz}$$

**Ans:** The frequency of the wave is **22600 Hz.** It is greater than audible range (20 Hz – 20000 Hz), hence **it will not be audible.**

**14. What is reverberation? How can it be reduced?**

**Ans:**

i. Repeated reflections of sound waves from the walls combine to build up what seems like a continuous sound. This result in persistence of sound called reverberation.

ii. It can be reduced by covering the roof and walls of the hall with absorbing material.

**15. What is loudness of sound? What factors does it depend on?**

**Ans:**

i. Loudness is the measure of the response of the ear to sounds.

ii. It depends upon the amplitude of vibrating body and sensitivity of human ear.

**16. How is ultrasound used for cleaning?**

**Ans:** The object to be cleaned is kept in a solution and high frequency ultrasonic waves are passed through it, the dirt comes out to the surface and the object gets cleaned.

**17. Explain how defects in a metal block can be detected using ultrasound.**

**Ans:**

i. When ultrasonic waves are allowed to pass through a metal block, these transmitted waves are detected using detector.

ii. If the waves pass through it and are received by the detector, then the block is without deformity.

iii. If the waves are reflected back, then there is a small crack or deformity.

iv. In this way, defects in a metal block can be detected using ultrasound.

## NCERT EXEMPLAR QUESTIONS

### Multiple Choice Questions

1. Note is a sound
   (A) of mixture of several frequencies.
   (B) of mixture of two frequencies only.
   (C) of a single frequency.
   (D) always unpleasant to listen.

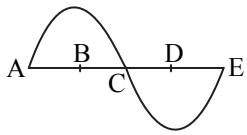
2. A key of a mechanical piano struck gently and then struck again but much harder this time. In the second case
   (A) sound will be louder but pitch will not be different.
   (B) sound will be louder and pitch will also be higher.
   (C) sound will be louder but pitch will be lower.
   (D) both loudness and pitch will remain unaffected.

***[Note:** Q.3 is based on the concepts that are not the part of the latest NCERT textbook.**]***

4. Sound travels in air if
   (A) particles of medium travel from one place to another.
   (B) there is no moisture in the atmosphere.
   (C) there is disturbance in the air particles.
   (D) both particles as well as disturbance travel from one place to another.

5. When we change feeble sound to loud sound we increase its
   (A) frequency (B) amplitude
   (C) velocity (D) wavelength

6. In the curve, half the wavelength is
   (A) A B
   (B) B D
   (C) D E
   (D) A E




7. Earthquake produces which kind of sound before the main shock wave begins
   (A) ultrasound
   (B) infrasound
   (C) audible sound
   (D) none of the above

8. Infrasound can be heard by
   (A) dog (B) bat
   (C) rhinoceros (D) human beings

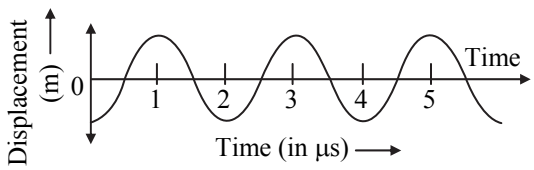
9. Before playing the orchestra in a musical concert, a sitarist tries to adjust the tension and pluck the string suitably. By doing so, he is adjusting
   (A) intensity of sound only.
   (B) amplitude of sound only.
   (C) frequency of the sitar string with the frequency of other musical instruments.
   (D) loudness of sound.

**Answers:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | (C) | 2. | (A) | 4. | (C) | 5. | (B) |
| 6. | (B) | 7. | (B) | 8. | (C) | 9. | (C) |

## Short Answer Questions

**10. The given graph shows the displacement versus time relation for a disturbance travelling with velocity of 1500 $ms^{-1}$. Calculate the wavelength of the disturbance.**




***Solution:***

*Given:* Velocity (v) = 1500 $ms^{-1}$,

*To find:* Wavelength (λ)

*Formulae:* i. $\upsilon = \frac{1}{T}$

ii. $v = n\lambda$

*Calculation:* From the above graph,

Time period (T) = $2 \times 10^{-6}$ s.

From formula (i),

$$\upsilon = \frac{1}{T} = \frac{1}{2\times10^{-6}} = 5 \times 10^5 \text{ Hz}$$

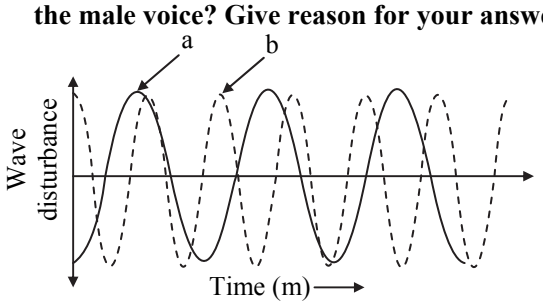
From formula (ii),

Wavelength is given by,

$$\lambda = \frac{v}{\upsilon} = \frac{1500}{5\times10^5} = \mathbf{3 \times 10^{-3} \text{ m} = 3 \text{ mm}}$$

**Ans:** The wavelength of the disturbance is **3 mm**.

**11. Which of the below two graphs (a) and (b) representing the human voice is likely to be the male voice? Give reason for your answer.**




**Ans:** Since the male voice has less pitch or frequency as compared to female, Graph (a) represents the male voice.

**12. A girl is sitting in the middle of a park of dimension 12 m × 12 m. On the left side of it there is a building adjoining the park and on right side of the park, there is a road adjoining the park. A sound is produced on the road by a cracker. Is it possible for the girl to hear the echo of this sound? Explain your answer.**

**Ans:** Echo can be heard only if the time gap between the original sound and the reflected sound received by the sitting is 0.1 second

∴ Minimum distance = velocity of sound × time
= 344 × 0.1
= 34.4 m

But the distance travelled by the sound reflected from the building and then reaching the girl will be 12 m which is less than the required distance. Hence no echo can be heard.

**13. Why do we hear the sound produced by the humming bees while the sound of vibrations of pendulum is not heard?**

**Ans:** In case of pendulum, the frequency is below 20 Hz which does not come in audible range whereas, humming bees produce sound by vibrating their wings come in the audible range.

**14. If any explosion takes place at the bottom of a lake, what type of shock waves in water will take place?**

**Ans:** Longitudinal waves.

**15. Sound produced by a thunderstorm is heard 10 s after the lightning is seen. Calculate the approximate distance of the thunder cloud. (Given speed of sound = 340 m $s^{-1}$.)**

***Solution:***

*Given:* Time (t) = 10 s,
Velocity (v) = 340 m $s^{-1}$.

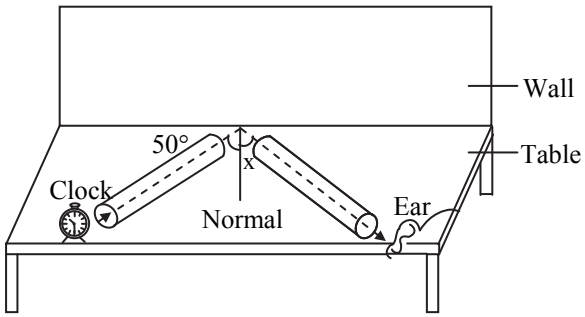
*To find:* Distance (d)

*Formula:* $v = \frac{d}{t}$

*Calculation:* From formula,
Distance = velocity × time
= 340 × 10
= **3400 m**

**Ans:** The approximate distance of the thunder cloud is **3400 m**.

**16. For hearing the loudest ticking sound heard by the ear, find the angle *x* in the below diagram.**




***Solution:***

Let ∠i be the angle made by the clock and normal.

From the above diagram,

∠i + 50° = 90°

∴ ∠i = 90 – 50° = 40°

According to law of reflections,

∠i = ∠r = 40°

From the above diagram,

∠r = x

∴ x = **40°**

**Ans:** The value of angle x is **40°**.

**17. Why is the ceiling and wall behind the stage of good conference halls or concert halls made curved?**

**Ans:**

i. The design of ceiling and wall in a good conference hall is to ensure proper sound at every seat of the conference hall.

ii. The ceiling and the wall are made curved, so that the reflected sound from them can reach to the audience evenly.

## Long Answer Questions

**18. Represent graphically by two separate diagrams in each case:**

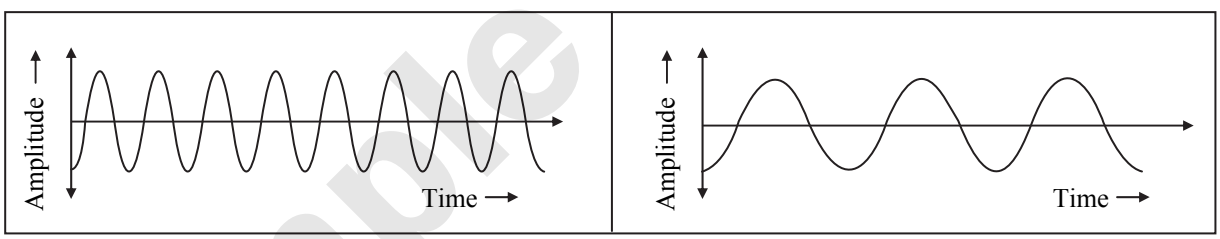
**i. Two sound waves having the same amplitude but different frequencies.**

**ii. Two sound waves having the same frequency but different amplitudes.**

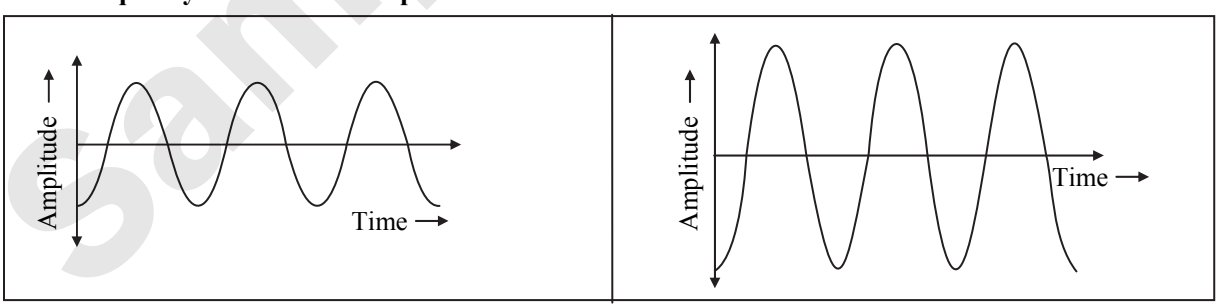
**iii. Two sound waves having different amplitudes and also different wavelengths.**

**Ans:**

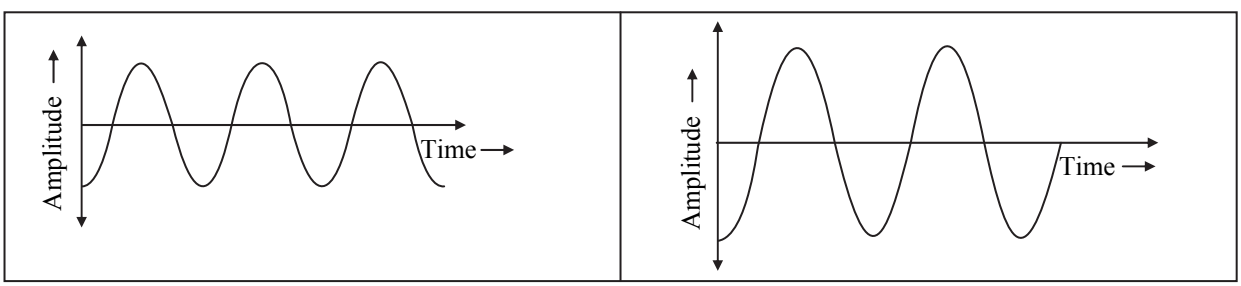
**i. Same amplitude but different frequency**




**ii. Same frequency but different amplitude**




**iii. Different amplitude and different wavelengths**



**19. Establish the relationship between speed of sound, its wavelength and frequency. If velocity of sound in air is 340 $ms^{-1}$, calculate**

**i. Wavelength when frequency is 256 Hz.**

**ii. Frequency when wavelength is 0.85 m.**

**Ans:** Relationship between speed, frequency and wavelength of sound wave is given by,

speed = frequency × wavelength

i.e., $v = \nu\lambda$ ….(1)

i. *Given*: $v = 340\ ms^{-1}$,

$\nu = 256$ Hz.

From equation (1),

$\lambda = \frac{v}{\upsilon} = \frac{340}{256} =$ **1.33 m**

ii. *Given*: $v = 340\ ms^{-1}$,

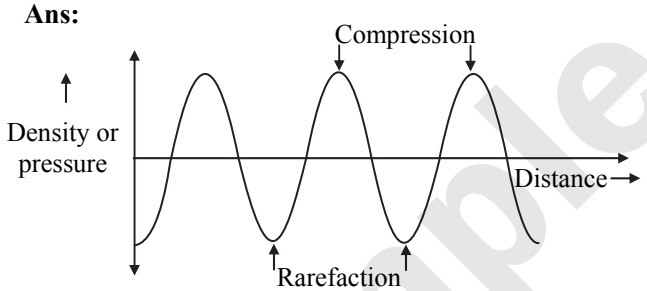
$\lambda = 0.85$ m.

From equation (1),

$\upsilon = \frac{v}{\lambda} = \frac{340}{0.85} =$ **400 Hz**

**20. Draw a curve showing density or pressure variations with respect to distance for a disturbance produced by sound. Mark the position of compression and rarefaction on this curve. Also define wavelengths and time period using this curve.**

**Ans:**




The distance between two consecutive compressions or two consecutive rarefactions is called wavelength.

The time taken by two consecutive compressions or rarefactions to cross a fixed point is called time period of wave.

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