11 Sound

Fastrack Revision

- **Sound:** It is a form of energy that produces a sensation of hearing in our ears.
- **Vibration:** It is a kind of rapid to and fro motion of an object.

Knowledge BOOSTER

Sound waves are characterised by the to and fro motion of the particles in a medium about their mean position and so are called mechanical waves. They cannot travel through vacuum.

- **Production of Sound:** Sound is produced by vibrating objects. Such objects are the source of all sounds, *e.g.*, a stretched rubber band when plucked vibrates and produces sound. We can also produce sound by plucking, scratching, rubbing, blowing or shaking different objects.

Knowledge BOOSTER

The sound of the human voice is produced due to vibrations in the vocal cords.

- **Wave:** A wave is a disturbance that moves through a medium when the particles of the medium set neighbouring particles into motion. The particles of the medium do not move forward themselves, but the disturbance is carried forward.
- **Types of Waves:** Waves are of two types: longitudinal waves and transverse waves.
  - **Longitudinal Waves:** The waves in which the individual particles of medium move in a direction parallel to the direction of propagation of the disturbance *i.e.*, particles oscillate back and forth about their position of rest.

Knowledge BOOSTER

Longitudinal waves can be produced in solids, liquids as well as gases but transverse waves can be produced only in solids and liquids.

  - **Transverse Waves:** The waves in which the individual particles of the medium move about its mean position in a direction perpendicular to the direction of wave propagation *i.e.*, particles oscillate up and down about their mean position.
- **Compression:** A region of high pressure formed when a vibrating object moves forward to push and compress the air in front of it.
- **Rarefaction:** A region of low pressure formed when the vibrating object moves backwards.
- **Crest:** It is the highest point on the wave where the displacement of the medium is at its maximum.
- **Trough:** It is the lowest point on the depression or hollow of a transverse wave.
- **Wavelength:** It is the distance between two consecutive compressions (C) or two consecutive rarefactions (R). It is represented by λ and its SI unit is metre (m).
- **Amplitude:** It is the magnitude of the maximum disturbance in the medium on either side of the mean value.
- **One oscillation:** The change in density from the maximum value, to the minimum value, then again to the maximum value makes one complete oscillation.
- **Time Period:** It is the time taken to complete one oscillation or the time taken by two consecutive compressions or rarefactions to cross a fixed point. SI unit of time period (T) is second (s).
- **Frequency:** It is the number of oscillations per unit time. It is denoted by ν(nu) and its SI unit is Hertz (Hz) (vibrations per second). A sound of single frequency is called a tone. The sound which is produced due to mixture of several frequencies is called a note.
- **Speed:** It is defined as the distance which a point on a wave (compression or a rarefaction), travels per unit time. Its SI unit is metre per second (m s^{-1}).

  Speed = Wavelength × Frequency
- **Characteristics of Sound:** Sound has the characteristics such as loudness, pitch and timbre or quality which are determined by the corresponding wave properties.
- **Loudness:** It is the measure of sound energy reaching the ear per second and is measured in decibel (dB). It depends on the amplitude of sound waves.
- **Intensity of Sound:** It is the amount of sound energy passing each second through unit area. Its SI unit is watt per metre square (W m^{-2}).
- **Pitch:** It is the characteristic to distinguish between different sounds of the same loudness. It depends on the frequency of vibration.

Knowledge BOOSTER

If the frequency is high, the sound has high pitch and if the frequency is low, the sound has low pitch.

- **Timbre or Quality:** It is the characteristic of sound that enables us to distinguish one sound from another having the same pitch and loudness.
- **Speed of Sound:** It is more in solids, less in liquids and least in gases. The speed of sound depends on the temperature of the medium. If the temperature of the medium is more, the speed of sound is more.

Knowledge BOOSTER

The speed of sound in air is about 344 $m\ s^{-1}$ at 22°C and 331 $m\ s^{-1}$ at 0°C and the speed of light in air is $3 \times 10^8\ m\ s^{-1}$.

- **Reflection of Sound:** It is the phenomena of bouncing back of sound when it strikes a hard surface.
- **Laws of Reflection of Sound**
  - The incident sound wave, reflected sound wave and the normal at the point of incidence, all lie in the same plane.
  - The angle of incidence of sound is equal to the angle of reflection of sound.
- **Echo:** It is the repetition of sound caused by reflection of sound waves. We can hear the original sound and the echo separately only if there is a time interval of at least 0.1 second between them. The minimum distance from a sound reflecting surface to hear an echo is 17.2 metres.
- **Reverberation:** It is the persistence of sound in a big hall due to repeated reflections from the walls, ceiling and floor.
- **Sound Board:** It is a concave board placed behind the stage in big halls, so that sound after reflecting from it, evenly spreads across the hall.

Knowledge BOOSTER

Stethoscope is a medical instrument used by the doctors for listening to the sounds produced within the human body mainly in the heart and lungs.

- **Audible Range:** It is the average frequency range over which the human ear is sensitive. For human beings, its range is 20 Hz-20000 Hz.
- **Infrasonic Sound:** It is the sound of frequencies lower than 20 Hz. For example, vibrations of a pendulum, earthquakes and some animals like whales and elephants produce infrasonic sounds. Rhinoceroses communicate using infrasound of frequency as low as 5 Hz.
- **Ultrasonic Sound:** It is the sound of frequencies higher than 20000 Hz (20 kHz). Dolphins, bats, porpoises and rats can produced ultrasonic sounds.
- **Hearing Aid:** It is an electronic, battery operated device for amplifying sound that is usually worn in or behind the ear of a person with hearing loss.
- **Applications of Ultrasound**
  - It is used to clean parts located in hard to reach places such as spiral tubes, odd-shaped machines.
  - It is used for detecting cracks and flaws in metal blocks.
  - It is used to investigate the internal organs of the human body such as liver, gall bladder, uterus, kidney, etc.
  - It is used to break small 'stones' formed in the kidneys into fine grains.
  - Ultrasonography is used for examination of the foetus during pregnancy.

Knowledge BOOSTER

Echocardiography is a technique used to diagnose the heart diseases by internal scanning of heart.

- **Echolocation:** It is the method used by animals like bats, porpoises and dolphins to locate the objects by hearing the echoes of their ultrasonic squeaks.

Practice Exercise

Multiple Choice Questions

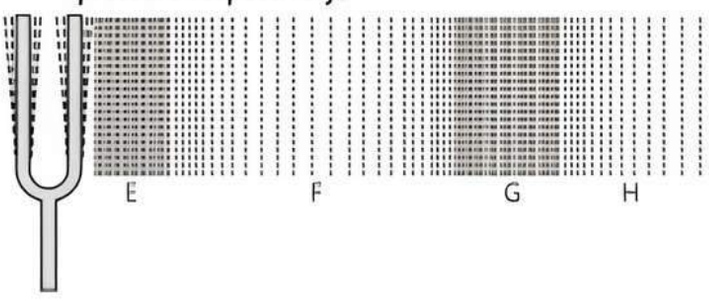
Q 1. Sound is produced due to:

a. propagation of compound
b. density of the medium
c. vibration of different objects
d. None of the above

Q 2. Sounds is produced by ..... the objects.

a. rubbing b. shaking
c. blowing d. All of these

Q 3. In the figure given below, which of the following points shows the region of high density and low pressure respectively?



	High density	Low pressure
a.	*F* and *H*	*E* and *G*
b.	*E* and *G*	*E* and *G*
c.	*E* and *G*	*F* and *H*
d.	*F* and *H*	*F* and *H*

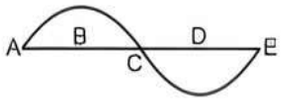
Q 4. A longitudinal wave consist of:

a. crest and troughs in the medium
b. compressions and rarefactions in the medium
c. Both a. and b.
d. crest and trough in the vacuum

Q 5. When a stone is dropped on the surface of still water, the waves produced on the surface of water is:

a. stationary b. longitudinal
c. transverse d. None of these

Q 6. In the given curve, half the wavelength is:



a. *AB* b. *BD*
c. *DE* d. *AE*

Q 7. When we change feeble sound to loud sound, we increase its: *(NCERT EXEMPLAR)*

a. frequency b. amplitude
c. velocity d. wavelength

Q 8. Frequency (ν) and the period (T) are related as:

a. $\nu \times T = 1$ b. $\nu / T = 1$
c. $\nu = \frac{\lambda}{T}$ d. All of these

Q 9. The ..... of sound depends on amplitude of vibration of the source.

a. loudness b. pitch
c. timbre d. frequency

Q 10. The linear distance between a consecutive compression and a rarefaction in longitudinal wave is:

a. λ b. $\frac{\lambda}{2}$
c. $\frac{\lambda}{4}$ d. $\frac{2\lambda}{2}$

Q 11. Speed of sound depends upon:

a. temperature of source producing sound
b. pressure of the medium
c. temperature of the medium
d. temperature and pressure of medium

Q 12. When we go from solid to gaseous state, then the speed of sound:

a. increases b. increases or decreases
c. decreases d. constant

Q 13. Pitch of sound is determined by:

a. amplitude of the wave
b. vibration of the wave
c. frequency of sound wave
d. All of the above

Q 14. 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

Q 15. It is possible to recognise a person by hearing his voice even if he is hidden behind a solid wall. This is due to the fact that his sound has a:

a. definite pitch b. definite quality
c. definite loudness d. None of these

Q 16. A sound wave travels at a speed of 339 m/s. If its wavelength is 1.5 cm, what is the frequency of the wave?

a. 26000 Hz b. 2200 Hz
c. 2260 Hz d. 22600 Hz

Q 17. A longitudinal wave travels at a speed of 0.3 m s^{-1} and the frequency of wave is 20 Hz. Find the separation between two consecutive compressions.

a. 0.5 cm b. 1 cm c. 1.5 cm d. 2 cm

Q 18. The sensation of sound persists in our brain for about:

a. 0.1 s b. 1 s c. 0.2 s d. 2 s

Q 19. A boy shouts inside a deep well and hears the echo 0.4 s after shouting. If the speed of sound is 340 m s^{-1}, find the depth of water level in the well.

a. 78 m b. 88 m
c. 68 m d. 58 m

Q 20. Earthquake produces which kind of sound before the main shock wave begins:

a. ultrasound b. infrasound
c. audible sound d. None of these

Q 21. Dolphins, bats and porpoises use ..... for navigation and location of food in the dark.

a. ultrasound b. infrasound
c. Both a. and b. d. None of these

Q 22. Infrasound can be heard by: *(NCERT EXEMPLAR)*

a. dog b. bat
c. rhinoceros d. tiger

Q 23. The use of ultrasound waves to form the image of the heart is called:

a. ultrasonography
b. echoranging
c. echocardinology
d. echocardiography

Q 24. Which of the following are applications of ultrasound?

(i) To examine the foetus during pregnancy.
(ii) To detect cracks and flaws in metal blocks.
(iii) To break small stones formed in kidneys.

a. (i) and (ii) b. (ii) and (iii)
c. (i) and (iii) d. (i), (ii) and (iii)

Assertion & Reason Type Questions

Directions (Q. Nos. 25-31): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:*

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 25. **Assertion (A):** The sound of the human voice is produced due to vibrations in the vocal cords.

Reason (R): Vibrations means a kind of rapid to and fro motion of an object.

Q 26. **Assertion (A):** When lightning strikes, the sound is heard a little after the flash is seen.

Reason (R): The velocity of light is greater than that of the sound.

Q 27. **Assertion (A):** Light is a transverse wave and not a mechanical wave.

Reason (R): Particles of the medium vibrate up and down at right angles to the direction in which the transverse waves are propagated.

Q 28. **Assertion (A):** Sound waves are mechanical waves.
Reason (R): Sound waves require a material medium for their propagation and they cannot propagate through vacuum.

Q 29. **Assertion (A):** Intensity of sound wave does not change when the listener moves towards or away from the stationary source.
Reason (R): The motion of listener causes the apparent change in wavelength.

Q 30. **Assertion (A):** To hear an distinct echo the time interval between the original sound and reflected one must be at least 0.1 s.
Reason (R): The sensation of sound persists in our brain for about 0.1 s.

Q 31. **Assertion (A):** Roof and walls of the auditorium are generally covered with compressed fibre board and draperies.
Reason (R): This is done to prevent reverberation.

Answers

1. (c) vibration of different objects
2. (d) All of these
3. (c) *E* and *G* *F* and *H*
   Region of high density is compression and region of low pressure is rarefaction.
4. (c) Both a. and b.
5. (c) transverse
6. (b) BD
   Here, $AE = \lambda$
   $\Rightarrow$ $AC = CE = \lambda/2$ and $AB = BC = CD = DE$
   Also, $BD = BC + CD = \frac{\lambda}{4} + \frac{\lambda}{4} = \frac{\lambda}{2}$.
7. (b) amplitude
   Loudness of sound is directly proportional to the square of amplitude of sound wave.
8. (a) $v \times T = 1$
   $v = \frac{1}{T}$ or $v \times T = 1$
9. (a) loudness
10. (b) $\frac{\lambda}{2}$
    The distance between two consecutive compressions or two consecutive rarefactions is called the wavelength. Therefore, distance between a consecutive compression and a rarefaction is half of the wavelength, *i.e.*, $\frac{\lambda}{2}$.
11. (c) temperature of the medium
12. (c) decreases
13. (c) frequency of sound wave
14. (a) of mixture of several frequencies
15. (b) definite quality
16. (d) 22600 Hz
    Given, $v = 339$ m/s
    $\lambda = 1.5$ cm $= 0.015$
    $v = \frac{v}{\lambda} = \frac{339}{0.015} = 22600$ Hz
17. (c) 1.5 cm
    Given, $v = 0.3$ m/s and $\nu = 20$ Hz
    $\lambda = \frac{v}{\nu} = \frac{0.3}{20} = 0.015$ m $= 1.5$ cm
18. (a) 0.1 s
19. (c) 68 m
    $t = 0.4$ s, $v = 340$ m/s
    $2d = t \times v = 0.4 \times 340 = 136$ m
    $\Rightarrow$ $d = \frac{136}{2}$ m $= 68$ m.
20. (b) infrasound
21. (a) ultrasound
22. (c) rhinoceros
23. (d) echocardiography
24. (d) (I), (II) and (III)
25. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
26. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
27. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
28. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
29. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
30. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
31. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Case Study Based Questions

Case Study 1

Mechanical waves are classified as longitudinal waves and transverse waves. Longitudinal waves are the waves where the individual particles of the medium move in a direction parallel to the direction of propagation of the disturbance. The particles do not move from one place to another but they simply oscillate back and forth about their position of rest. Some examples of longitudinal waves are sound waves, seismic P-waves and ultrasound waves.

Read the given passage carefully and give the answer of the following questions:

Q 1. Which of the following is not a longitudinal wave?

a. Seismic P-wave b. Light
c. Sound d. Ultrasound

Q 2. When slinky is stretched out in a horizontal direction and first coils are vibrated horizontally, then which waves are generated?

a. Longitudinal waves b. Transverse waves
c. Surface waves d. None of these

Q 3. Which of the following statements is correct about sound waves and light waves?

a. Sound waves are longitudinal and light waves are transverse.
b. Both are longitudinal waves.
c. Sound waves are transverse and light waves are longitudinal.
d. Both are transverse waves.

Q 4. Consider the following statements:

(i) Sound waves oscillate back and forth about their position of rest.
(ii) Sound waves cannot travel through vacuum.
(iii) Sound waves are produced by oscillating charged particles only.
(iv) Sound waves are electromagnetic waves.

Which of the following statements are correct?

a. (i), (ii) and (iv) b. (ii) and (iii)
c. (i) and (ii) d. (i), (ii), (iii) and (iv)

Q 5. In case of longitudinal waves, the particles of medium vibrate:

a. at right angles to the direction of wave propagation
b. opposite to the direction of wave propagation
c. in the direction of wave propagation
d. None of the above

Answers

1. (b) Light
2. (a) Longitudinal waves
3. (a) Sound waves are longitudinal and light waves are transverse.
4. (c) (i) and (ii)
5. (c) in the direction of wave propagation

Case Study 2

There are five main characteristics of sound waves: wavelength, amplitude, frequency, time period and speed. The distance between two consecutive compressions or two consecutive rarefactions is called the wavelength. The magnitude of the maximum disturbance in the medium on either side of the mean value is called the amplitude of the wave. The number of complete oscillations per unit time is called the frequency. The time taken by the wave for one complete oscillation of the density or pressure of the medium is called the time period.

Read the given passage carefully and give the answer of the following questions:

Q 1. What is the range of wavelengths of audible sound in air? (velocity of sound in air is 340 m/s)

a. 0.17 m to 170 m b. 0.17 m to 17 m
c. 0.017 m to 1.7 m d. 0.017 m to 17 m

Q 2. If the time period of a wave increases, then its frequency will:

a. increase
b. decrease
c. remain the same
d. first increases then decreases

Q 3. Waves from sitar wire and veena wire are distinguished by (of same frequency):

a. Loudness b. Pitch
c. Quality d. Both b. and c.

Q 4. On the basis of the following features identify the correct option.

I. It is one of the characteristics of sound.
II. It distinguishes an acute or a shrill note from a dull or flat note.

a. Loudness b. Quality
c. Pitch d. Both a. and b.

Q. 5. The loudness of sound decreases with an:

(i) Increase in the distance between the ear and the source.
(ii) Decrease in the amplitude of the vibrating body.
(iii) Increase in frequency of sound.
(iv) Decrease in frequency.

a. (i) and (iv) b. (ii) and (iii)
c. (i), (iii) and (iv) d. (i) and (ii)

Answers

1. (d) 0.017m to 17m
The audible range of sound for human beings extends from about 20 Hz to 20000 Hz.
Let, $f_1 = 20$ Hz and $f_2 = 20000$ Hz
Velocity of sound in air, $v = 340$ m/s

$$\lambda_1 = \frac{v}{f_1} \qquad \lambda_2 = \frac{v}{f_2}$$

$$\lambda_1 = \frac{340}{20} \qquad \lambda_2 = \frac{340}{20000}$$

$$\lambda_1 = 17 \text{ m} \qquad \lambda_2 = 0.017 \text{ m}$$

The range of wavelengths of audible sound in air is 0.017 m to 17 m.

2. (b) decrease
Frequency is inversely proportional to the time period of the wave. So when time period increases, then the frequency will decrease.

3. (c) Quality
The quality or timber of sound is that characteristic which enables us to distinguish one sound from another having the same pitch and loudness.

4. (c) Pitch
Pitch is a characteristic of a sound wave that distinguishes an acute or a shrill note from a dull or flat note.

5. (d) (i) and (ii)
The loudness or softness of a sound is determined basically by its amplitude. A sound wave spreads out from its source. As it moves away from the source its amplitude as well as its loudness decreases.

Case Study 3

Two friends Shefali and Anuj make a toy telephone by joining two plastic cups through a long string. They both stand apart. Anuj speaks softly into one cup and Shefali hears by putting her ear in the other cup. Now, Shefali speaks and Anuj listens.

Read the given passage carefully and give the answer of the following questions:

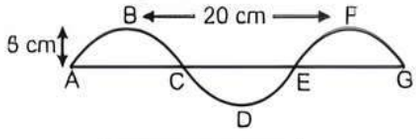
Q 1. What type of waves are produced by voice of Anuj and Shefali in the air inside the plastic cup?

Q 2. What type of waves are produced in the string?

Q 3. Give one difference between these types of waves.

Q 4. Why is sound wave called a longitudinal wave?

Q 5. Waves of frequency 100 Hz are produced in a string as shown in figure. Give its amplitude and wavelength.



Answers

1. Longitudinal waves
2. Transverse waves
3. In longitudinal wave, particles vibrate parallel to the direction of wave propagation. In transverse wave, particles vibrate perpendicular to the direction of wave propagation.
4. The sound wave is called a longitudinal wave because in a sound wave, the particles of the medium move in a direction parallel to the direction of propagation of the disturbance.
5. Amplitude = 5 cm (maximum displacement from mean position)
Wavelength = 20 cm (Distance between two crests or troughs)

Case Study 4

Aarav who is a student of class IX, went to a fair with his cousins. In the fair, he observed that many shopkeepers were shouting through a large, cone-shaped, battery-less, amplifying device to make announcements for getting customers. The hand-held device was making their voice too loud.

Read the given passage carefully and give the answer of the following questions:

Q 1. What do you think was the device being used by the shopkeepers to amplify their voice?

Q 2. What is the other name of this device?

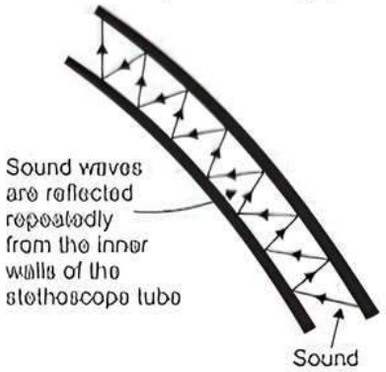
Q 3. State the principle on which this device works.

Q 4. Name one very useful medical instrument which works on the same principle as the device discussed in this passage. Draw a labelled diagram to show the multiple reflections of sound in a part of this instrument.

Q 5. Name two musical instruments which works on the same principle as the device discussed in this passage.

Answers

1. The device being used by the shopkeepers to amplify their voice was megaphone.
2. Megaphones are also known as loudhailers.
3. Megaphone works on the principle of 'multiple reflections of sound'.
4. A stethoscope works on the same principle (multiple reflections of sound) as the megaphone.



Multiple reflections of sound waves in a part of stethoscope tube

5. Trumpets and *shehnai*

Case Study 5

Three different vibrating objects produce three types of sounds X, Y and Z. Sounds X and Y cannot be heard by a man having normal range of hearing but sound Z can be heard easily. The sound X is used in hospitals to break kidney stones of a patient into fine grains which then get flushed out with urine. The sound Y is similar to that which is produced during an earthquake before the main shock wave is generated.

Read the given passage carefully and give the answer of the following questions:

Q 1. What type of sounds are (i) *X*, (ii) *Y* and (iii) *Z*?

Q 2. Name one animal which play games by producing sound like *X*.

Q 3. Name two animals in a zoo which can produce sound like *Y*.

Q 4. What is the frequency range of sounds like *Z*?

Answers

1. (i) *X* is an ultrasonic sound (ii) *Y* is an infrasonic sound (iii) *Z* is an audible sound
2. Rats play games by producing ultrasound.
3. Elephants and rhinoceroses produce sound in the infrasound range.
4. Frequency range of *Z* is between 20 Hz and 20000 Hz.

Very Short Answer Type Questions

Q 1. What is sound and how is it produced? *(NCERT EXERCISE)*

Ans. Sound is a form of energy, which produces the sensation of hearing in our ears. Sound is produced by vibrating objects. We can also produce sound by plucking, scratching, subbing, blowing or shaking different objects.

Q 2. Name the organ which vibrates to produce voice when we speak.

Ans. Vocal cord vibrates to produce voice when we speak.

Q 3. Why are sound waves called mechanical waves? *(NCERT INTEXT)*

Ans. Sound waves are called mechanical waves because they are produced by the motion of particles of a medium and need a material medium (solid, liquid or gas) for their propagation.

Q 4. Give one example each of transverse and longitudinal wave.

Ans. Transverse Wave – Light

Longitudinal Wave – Sound

Q 5. If a freely suspended vertical spring is pulled in the downward direction and then released, which type of waves are produced in spring?

Ans. In this case, longitudinal waves are produced in spring.

Q 6. If any explosion takes place at the bottom of a lake, what type of shock waves in water will be produced? *(NCERT EXEMPLAR)*

Ans. Longitudinal waves will get produced in water if any explosion takes place at the bottom of a lake.

Q 7. How are wavelength, speed and time period of a sound wave related to each other?

Ans. The relation is $v = \lambda/T$, where v is the speed, λ is wavelength and T is the time period of a sound wave.

Q 8. Which wave property determines *(NCERT INTEXT)*
(i) loudness and (ii) pitch?

Ans. (i) Loudness of sound wave is determined by its amplitude.

(ii) Pitch of the sound wave is determined by its frequency.

Q 9. Guess which sound has a higher pitch, guitar or car horn?

Ans. Pitch of guitar sound is higher because the frequency of sound produced by guitar is higher than that of car horn.

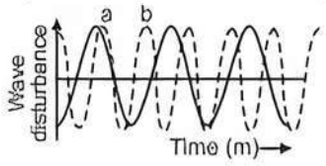
Q 10. Which characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room? *(NCERT EXERCISE)*

Ans. Timbre, a quality of sound is the characteristic by which we can identify the person by his voice.

Q 11. Why do we hear up to a large distance if a table is banged upon hard?

Ans. When we hit the table hard, the table top vibrates with larger amplitude and hence a loud sound is produced because loudness depends on amplitude.

Q 12. Which of the below two graph '*a*' and '*b*' representing the human voice is likely to be the male voice? Give reason for your answer. *(NCERT EXEMPLAR)*



Ans. Male voice has low pitch (frequency) as compared to female voice. The frequency of '*b*' is more than of '*a*'. Hence, 'a' represents the male voice.

Q 13. Calculate the wavelength of a sound wave whose frequency is 200 Hz and speed is 440 m s^{-1} in a given medium. *(NCERT INTEXT)*

Ans. Given, frequency, $\nu = 200$ Hz, velocity, $v = 440$ m s^{-1}

According to the relation, $v = \nu\lambda \Rightarrow \lambda = \frac{v}{\nu}$

$$= \frac{440}{200} = 2.2 \text{ m}$$

Q 14. 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? *(NCERT INTEXT)*

Sol. The time interval between two successive compressions or rarefactions is equal to the time period of the wave.

$$\therefore \text{Time period} = \frac{1}{\text{Frequency}} = \frac{1}{500} = 0.002 \text{ s} = 2 \text{ m/s}$$

Q 15. Which has a higher pitch, whistle or a drum?

Ans. Whistle has a higher pitch because air column in whistle vibrate more number of times as compared to a stretched drum.

Q 16. In which of the three media air, water or iron, does sound travel the fastest at a particular temperature? *(NCERT INTEXT)*

Ans. Sound waves travel fastest in solid medium, *i.e.*, out of the given media, sound wave will travel fastest in iron.

Q 17. What happens to the speed of sound when it goes from solid to gaseous state?

Ans. The speed of sound decreases when it goes from solid to gaseous state.

Q 18. Why do we hear the sound of an approaching car before the car reaches us?

Ans. This is because the speed of sound is much greater than the speed of car.

Q 19. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

(NCERT EXERCISE)

Sol. Given, frequency, $\nu = 100$ Hz.

We know that,

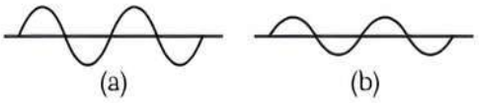
Number of oscillations in 1 s = 100

∴ Number of oscillations in 1 min (60 s)

$= 100 \times 60 = 6000$

Thus, the source of sound vibrates 6000 times in a minute.

Q 20. Two waves are shown below. Which of the two corresponds to lower decibel level?



(a) (b)

Ans. Low amplitude corresponds to lower decibel level. Therefore, wave (b) corresponds to lower decibel level.

Q 21. Name the phenomenon responsible for rolling of thunder.

Ans. Rolling of thunder is due to multiple reflections of sound from reflecting surfaces such as clouds and land.

Q 22. What is reverberation?

Ans. The persistence of sound in an auditorium is the result of repeated reflections of sound and is called reverberation.

Q 23. Give two practical applications of reflection of sound waves. *(NCERT EXEMPLAR)*

Ans. Two practical applications of reflection of sound are:

(i) Musical instruments (trumpets and *shehanais*)

(ii) Stethoscope

Q 24. Why should the curved sound board be placed behind the stage?

Ans. It is because sound waves spread evenly across the width of the hall after reflection from curved sound board.

Q 25. What is the audible range of the average human ear? *(NCERT INTEXT)*

Ans. The audible range of hearing for average human ear is in the frequency range of 20 Hz-20 kHz.

Q 26. What is the range of frequencies associated with: *(NCERT INTEXT)*

(i) Infrasound? and (ii) Ultrasound?

Ans. (i) Sound waves with frequencies below the audible range (20 Hz) are termed 'infrasound'.

(ii) Sound waves with frequencies higher than 20 kHz are called 'ultrasound'.

Q 27. What kind of waves are produced in an earthquake before the main shock wave begins?

Ans. Infrasonic waves are produced in an earthquake before the main shock wave begins.

Q 28. Define the term 'echocardiography'.

Ans. The use of ultrasound waves to produce images of the heart is called echocardiography.

Short Answer Type-I Questions

Q 1. How does the sound produced by a vibrating object in a medium reach your ear? *(NCERT INTEXT)*

Ans. Sound is produced by vibrating objects. When an object vibrates, it sets the particles of the medium around it in vibration. There vibrations are passed or transmitted to neighbouring particles in all directions. In this way, vibrations produced by an object are transferred from one particle to another till it reaches our ear.

Q 2. What is meant by 'Compression' and 'Rarefaction' of a longitudinal wave?

Ans. When a vibrating object moves forward, it pushes and compresses the air in front of it creating a region of high pressure. This region is called compression.

When the vibrating object moves backward, it creates a region of low pressure called rarefaction.

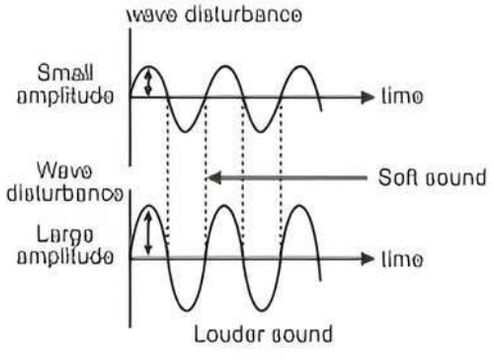
Q 3. What is loudness of sound? What factors does it depend on? *(NCERT EXERCISE)*

Ans. Loudness of a sound is a measure of the sound energy reaching the ear per second.

The loudness of sound depends on the amplitude of vibration of the source producing the sound wave, *i.e.*, greater the amplitude of sound waves, louder the sound will be.

Q 4. Draw a graph showing sounds produced by persons with soft and loud voices.

Ans. Graphs showing sounds produced by persons with soft and loud voices.



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

Ans. Thunder is heard few seconds after the flash is seen because speed of light in atmosphere (or air) is 3×10^8 m s^{-1} which is very high as compared to the speed of sound which is only 330 m s^{-1}. So, sound of thunder reaches us later than the flash.

Q 6. The successive crest and trough of a wave are 30 cm apart. Find the wavelength. Also, find the frequency of wave if 10 crests and 10 troughs are produced in 2 s.

Sol. Wavelength = Distance between two successive crests

$= 2 \times 30$ cm $= 60$ cm $= 0.6$ m

Waves produced in 2 s = 10

Waves produced in 1s $= \frac{10}{2} = 5$

So, the frequency is 5 Hz.

Q 7. What is meant by intensity of sound? How is it different from loudness?

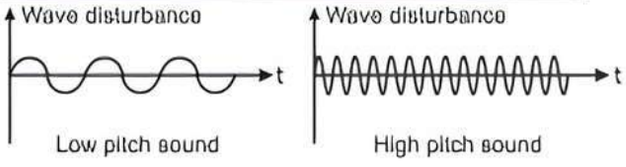
Ans. Intensity can be defined as the amount of sound energy passing each second through unit area. It is different from loudness because loudness is a subjective quantity, *i.e.*, a sound can be loud for one person but not for some other person whereas intensity is an objective quantity, *i.e.*, it doesn't vary from person to person.

Q 8. Differentiate between low and high pitch sound using neat and labelled diagram.

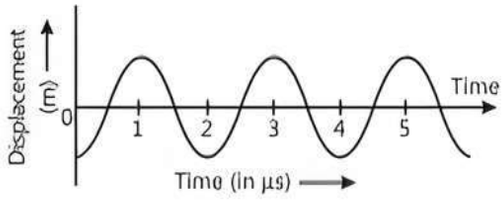
Or

Draw a graph for a wave representing wave disturbance and time for a sound changing from low pitch to high pitch, keeping the amplitude of the sound undisturbed.

Ans. Pitch of a sound depends on the frequency of vibration. Low pitch sound has a low frequency whereas high pitch sound has a higher frequency.



Q 9. The given graph (figure) shows the displacement versus time relation for a disturbance travelling with velocity of 1500 m s^{-1}. Calculate the wavelength of the disturbance. *(NCERT EXEMPLAR)*



Sol. From the graph,

Time taken to complete one cycle is 2μs.

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

$$\text{Frequency } (f) = 1/T = \frac{1}{2 \times 10^{-6}} = 5 \times 10^{5} \text{ Hz}$$

$$\text{Wavelength } (\lambda) = v/f = \frac{1500}{5 \times 10^{5}} = 3 \times 10^{-3} \text{ m}$$

Q 10. A sound wave has a frequency of 3 kHz and a wavelength of 45 cm. How long will it take to travel 1.8 km?

Sol. Given, frequency $(f) = 3$ kHz $= 3000$ Hz

Wavelength $(\lambda) = 45$ cm $= 0.45$ m

and $d = 1.8$ km $= 1800$ m

Speed of sound wave

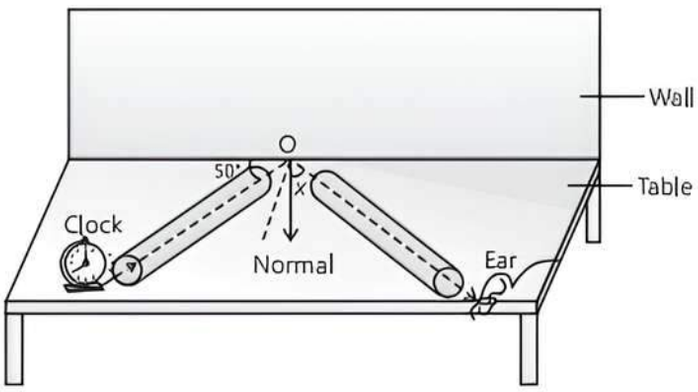
$$v = f\lambda = 3000 \times 0.45 = 1350 \text{ m/s}$$

Time taken to travel 1.8 km

$$= \frac{d}{v} = \frac{1800}{1350} = 1.33 \text{ s}$$

Q 11. For hearing the loudest ticking sound heard by the ear, find the angle x in the given figure.

(NCERT EXEMPLAR)

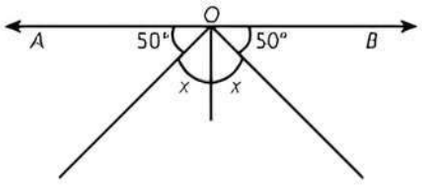


Sol. As per the laws of reflection, the angle of incidence (x) is always equal to the angle of reflection (x).

Since, AOB is a straight line.

$\therefore$ $\angle AOB = 180°$

$\therefore$ $50° + x + x + 50° = 180°$



[$\because$ sum of all angle which lie on the same side of a line is 180°]

$$2x + 100° = 180°$$

$$\Rightarrow \quad 2x = 180° - 100° \Rightarrow 2x = 80°$$

$$\Rightarrow \quad x = \frac{80°}{2} \Rightarrow x = 40°$$

Hence, the value of x is 40°

Q 12. An echo returned in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 ms^{-1}? *(NCERT INTEXT)*

Sol. Given, speed of sound $(v) = 342$ ms^{-1}

Time taken, $(t) = 3$ s

So, distance travelled by sound $(s) = v \times t$

$= 342 \times 3 = 1026$ m

Hence, distance between reflecting surface and source should be $= \frac{1026}{2} = 513$ m.

Q 13. 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. *(NCERT EXEMPLAR)*

Ans. We know that for hearing echo, the total distance covered by the sound from the point of generation to the reflecting surface and back should be at least 34.4 m.

But in this case the distance travelled by the sound reflected from the building and then reaching to the girl will be 18 m (12 + 6), which is much smaller than the required distance. Therefore, no echo can be heard.

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

Ans. The persistence of a sound in an auditorium or big hall due to repeated reflections of sound from the walls, ceiling and floor of the wall is known as reverberation. It can be reduced by covering the roofs and walls of the hall by sound absorbing materials, like compressed fibreboard, rough plaster or draperies.

Q 15. Explain how, flaws (or cracks) in a metal block can be detected by using ultrasound.

Ans. Ultrasound waves are made to pass through one face of the metal block (to be tested) and ultrasound detectors are placed on the opposite face of the metal block to detect the transmitted ultrasound waves.

(i) If the ultrasound waves pass uninterrupted through all the parts of the metal block, then the metal block is flawless (or defect-free) having no internal cracks, etc.

(ii) If, however, ultrasound waves are not able to pass through a part of the metal block and get reflected back, then there is a flaw or defect in the metal block (like a crack or a hole).

Q 16. Why do we hear the sound produced by the humming bees while the sound of vibrations of pendulum is not heard? *(NCERT EXEMPLAR)*

Ans. Humming bees produce sound by vibrating their wings which is in the audible range. In case of pendulum, the frequency is below 20 Hz which does not come in the audible range. So, we hear the sound produced by the humming bees but not that of the vibrations of pendulum.

Q 17. What is echo ranging? State any one application of this technique.

Ans. Echo ranging is the process of determination of distance between observer and an object on the basis of time interval between the transmission and reception of ultrasound. It is used to locate underwater hills, submarine, icebergs, etc.

Short Answer Type-II Questions

Q 1. Define wave motion. Write its four characteristics.

Ans. Wave motion is a mode of transfer of energy from place to place periodically without any material transport.

The four characteristics of wave motion are:

(i) It is the disturbance that travels forward through the medium but not through its particles.

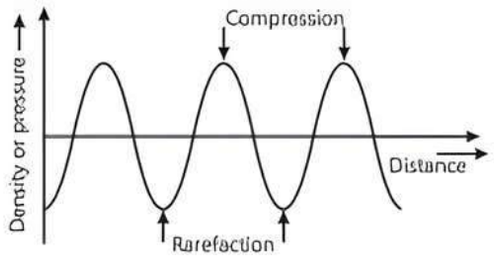
(ii) Each particle receives vibrations a little later than its preceding particle.

(iii) The wave velocity is different from the velocity of the particles with which they vibrate about their mean positions.

(iv) The wave velocity remains constant in a given medium while the particle velocity changes continuously during its vibrations about the mean position.

Q 2. 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 wavelength and time period using this curve. *(NCERT EXEMPLAR)*

Ans. Curve showing density or pressure variations with respect to distance is as shown below:



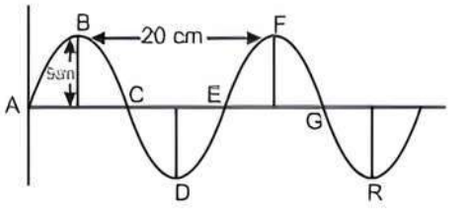
Wavelength is the distance between two consecutive compressions or two consecutive rarefactions.

Time period is the time taken by two consecutive compressions or rarefactions to cross a fixed point.

Q 3. Waves of frequency 100 Hz are produced in a string as shown in the figure. Give its:

(i) Amplitude **(ii) Wavelength**

(iii) Velocity **(iv) Nature**



Ans. From the figure, we get

(i) Amplitude = 5 cm

(ii) Wavelength = 20 cm

(iii) Velocity $(v) = \lambda f = 20 \times 10^{-2} \times 100 = 20\ m\ s^{-1}$

(iv) The waves in the string are transverse in nature.

Q 4. (i) Define frequency of a sound wave and give its SI unit.

(ii) Why are the roof and walls of an auditorium/ hall generally covered with sound absorbent materials?

Ans. (i) The number of complete oscillations occurred in one second is known as frequency (f). Its SI unit is Hertz (Hz).

(ii) The roofs and walls of an auditorium/hall are generally covered with sound absorbent materials like compressed fibreboard to reduce reverberation. These materials reduce the formation of multiple echoes by absorbing sound waves.

Q 5. Define the terms 'tone' and 'note'. A person is listening to a sound of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions reaching his ears from the source?

Ans. A sound of single frequency is known as tone.
The sound which is produced due to a mixture of several frequencies is called a note.

Given, frequency of sound, $f = 500$ Hz

We know that, $T = \frac{1}{f} = \frac{1}{500} = 0.002$ s

Hence, the time interval between successive compressions is 0.002 s.

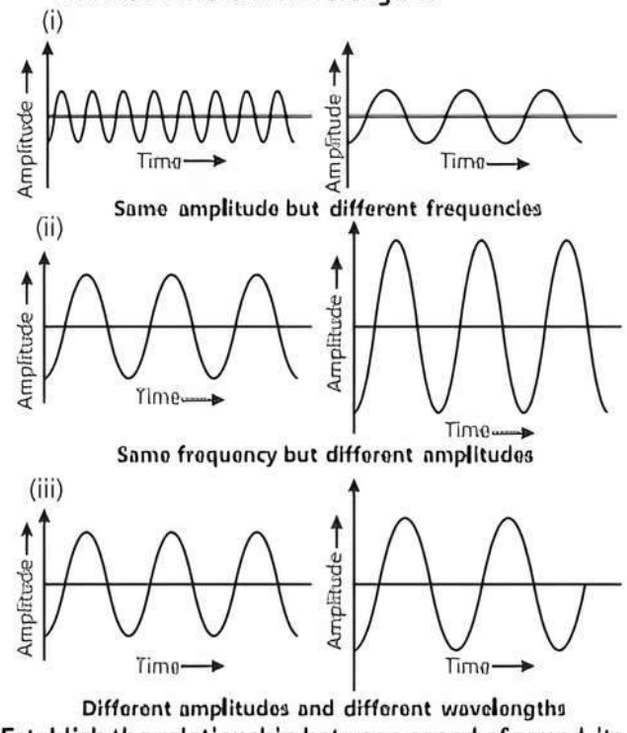
Q 6. Represent graphically by two separate diagrams in each case. *(NCERT EXEMPLAR)*

(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.



Q 7. Establish the relationship between speed of sound, its wavelength and frequency. If velocity of sound in air is 340 m s^{-1}, calculate:

(I) Wavelength when frequency is 256 Hz.

(II) Frequency when wavelength is 0.85 m.

(NCERT EXEMPLAR)

Sol. We know that,

$$\text{Speed, } v = \frac{\text{distance}}{\text{time}} = \frac{\lambda}{T} \Rightarrow v = \lambda\nu \qquad \left[\because \frac{1}{T} = \nu\right]$$

or speed = wavelength × frequency

(I) Given, velocity, $v = 340$ m s^{-1}

Frequency, $f = 256$ Hz

$$\therefore \quad \lambda = \frac{v}{f} = \frac{340}{256} = 1.33\text{m}$$

Hence, wavelength is 1.33 m.

(II) Given, wavelength, $\lambda = 0.85$ m

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

$$= \frac{340}{0.85} = 400 \text{ Hz}$$

Hence, frequency is 400 Hz.

Q 8. Distinguish between loudness and intensity of sound. *(NCERT INTEXT)*

Ans. Difference between loudness and intensity.

Basis of Difference	Loudness	Intensity
Type	It is a subjective quantity. A sound may be loud for one person but may be feeble for another person.	It is an objective physical quantity which does not change for person to person.
Definition	Loudness is a physiological response of the ear to the intensity of sound.	The amount of sound energy passing each second through unit area is called intensity of sound.
Unit	Loudness of sound is measured by the unit decibel (dB).	Intensity of sound is measured by the unit watts per square metre (W/w^2).
Depends on	It depends on the sensitivity of ears.	It does not depend on the sensitivity of ears.

Q 9. A construction worker's helmet slips and falls when he is 78.4 m above the ground. He hears the sound of the helmet hitting the ground 4.23 seconds after it slipped. Find the speed of sound in air.

Ans. Given, $h = 78.4$ m, $u = 0$, $g = 9.8$ m s^{-2}

From equation of motion, $h = ut + \frac{1}{2}gt^2$

$$78.4 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$$

or $$78.4 \times 2 = 9.8\, t^2$$

or $$t^2 = \frac{78.4 \times 2}{7.8} = 16$$

or $$t = 4$$

So, the time taken by the helmet to reach the ground = 4s

∴ The time taken by sound to travel 78.4 m

$$= 4.23 - 4 = 0.23 \text{ s}$$

$$\text{Speed of sound} = \frac{78.4}{0.23} = 340.87 \text{ms}^{-1}$$

Hence, the speed of sound in air is 340.87 m s^{-1}.

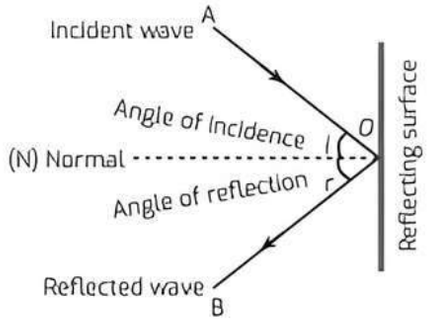
Q 10. When a workman hammers to one end of the long iron pipeline, an observer places his ear on the other end of pipeline, how he can distinctly hear two sounds? Justify your answer.

Ans. The sound of hammering to one end will be heard by the observer in the other end of the pipeline due to propagation of sound through iron. Also, the sound of hammering will be propagated through air to reach the observer.

The observer hears distinctly two sounds one through the iron pipeline and the other travelling through air as sound travels faster in iron than in air.

Q 11. Does sound follow the same laws of reflection as light does? Explain. *(NCERT EXERCISE)*

Ans. Yes, sound wave follows the same laws as in case of laws of reflection of light.



The laws of reflection of sound are as follows:

(i) The incident sound wave (*AO*), the reflected sound wave (*OB*) and the normal (*ON*) at the point of incidence, all lie in the same plane.

(ii) The angle of incidence ($\angle AON$) of sound is equal to the angle of reflection ($\angle NOB$) of sound.

Q 12. An echo is heard on a day when temperature is about 22 °C. Will echo be heard sooner or later, if the temperature increases to 40 °C?

Ans. Echo will be heard sooner when temperature is 22 °C than the echo heard when the temperature increases to 40 °C. This is so because the speed of sound increases with increase in temperature.

Also, speed of sound in air $\propto \frac{1}{\text{time}}$

Therefore, if the speed of sound increases, then the time after which the echo will be heard decreases.

Q 13. What is ultrasound? What is its use in industry? Why cannot we use longer wavelength for such uses?

Ans. Ultrasound: Ultrasound is the sound of frequency greater than 20000 Hz. In industry, it is used for the following purposes:

(i) Cleaning parts located in hard-to-reach places, such as spiral tubes, electronic components, odd-shaped parts, etc.

(ii) Detecting cracks and flaws in metal blocks used in construction of large structures such as bridges, machines, buildings, etc.

We cannot use longer wavelengths for such uses as they might bend around the corners of defective location and enter the detector.

Q 14. Write three medical applications of ultrasound.

Ans. Medical applications of ultrasound are:

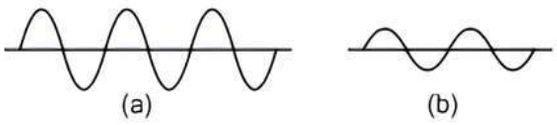
(i) Echocardiography: Ultrasonic waves are made to reflect from various parts of heart and form image of heart. This is called echocardiography.

(ii) Ultrasonography: Ultrasound scanner helps to obtain images of internal body organs in a technique called ultrasonography. It is used for examination of fetus, stones in gall bladder or kidney and tumors in different organs.

(iii) Ultrasound is used to break small stones in kidney into fine grains which are later flushed out with urine.

Long Answer Type Questions

Q 1. Two waves are shown below:



(i) Which of the two waves corresponds to lower decibel level?

(ii) Name the characteristics of sound the graphs represent.

(iii) Define these characteristics.

(iv) Explain the reason why sound of school bell is heard over long distance while that of a blow by hand on a wooden desk remains limited to room.

Ans. (i) The sound wave having less amplitude corresponds to lower decibel level. Therefore, wave (b) corresponds to lower decibel level.

(ii) The graphs show amplitude, wavelength, time period and frequency of the sound.

(iii) **Wavelength:** The distance between two consecutive compressions or two consecutive rarefactions is called wavelength.

Frequency: The number of complete oscillations per unit time is known as frequency.

Time Period: Time taken by the wave for one complete oscillation to take place is known as time period.

Amplitude: The magnitude of the maximum disturbance in the medium on either side of the mean value is called the amplitude of the wave.

(iv) Amplitude of vibrations produced by school bell is greater. Therefore, wave travels a longer distance in the surroundings.

But amplitude of sound produced due to a blow by hand on a wooden desk is small, so waves travel to a lesser distance and gradually diminish.

Q 2. (i) In the musical instrument jal-tarang, the bowl contain different amounts of water.

(a) Which of the bowls produces a low pitch sound?

(b) Which of the bowls produces a high pitch sound?

(c) Which wave property determines the pitch?

(ii) A ship sends out ultrasound that returns from the sea bed and is detected after 1.71 s. If the speed of ultrasound through sea water is 1531 ms^{-1}, what is the distance of the sea bed from the ship?

Ans. (i) (a) The bowl that contains the maximum quantity of water produces low pitch sound.

(b) The bowl that contains the least quantity of water produces high pitch sound.

(c) Frequency of sound wave determines the pitch.

(ii) Given, $t = 1.71$ s

$v = 1531\ ms^{-1}$

Let distance of sea bed from ship be 'd'.

$\therefore$ Distance travelled by ultrasound = $2d$

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

or $d = \frac{t \times v}{2} = \frac{1.71 \times 1531}{2}$

$= 1309$ m

Hence, distance of the sea bed from the ship is 1309 m.

Q 3. (i) Distinguish between music and noise.

(ii) Three persons *A*, *B* and *C* are made to hear a sound travelling through different media as given below:

Persons	Medium
A	Iron Rod
B	Air
C	Water

Who will hear the sound first and why?

(iii) 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? (Take $g = 10\ m\ s^{-2}$ and speed of sound $= 340\ m\ s^{-1}$)

Ans. (i) Difference between music and noise:

Basis of Difference	Music	Noise
Effect	Music is pleasant to listen to our ears.	Noise produces an unpleasant effect.
Frequency	Frequency is high and produces regular waveform.	Frequency is low and has irregular waveform.
Example	Sound produced by guitar, flute, etc.	Sound produced by vehicles, bursting of crackers, etc.

(ii) 'A' will hear the sound first because speed of light is maximum in solids.

(iii) Given, distance covered by the stone, $h = 500$ m.

Initial velocity, $u = 0\ m\ s^{-1}$

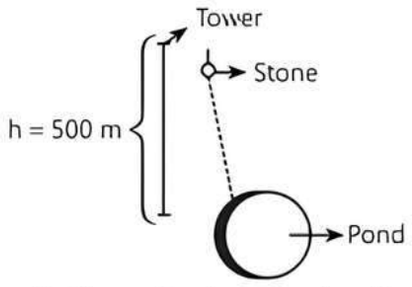
Acceleration due of gravity, $g = 10\ m\ s^{-2}$

From equation of motion,

$$h = ut + \frac{1}{2}gt^2$$

$$500 = 0 \times t + \frac{1}{2} \times 10 \times t^2$$

or $$\frac{500}{5} = t^2 \Rightarrow t = 10\ s$$



Thus, in 10 sec, the stone reaches the pond.

Given, speed of sound $= 340\ m\ s^{-1}$

Time taken by sound to cover a distance of 500 m

$$= \frac{500}{340} = 1.47 s$$

So, total time taken = 10 + 1.47 = 11.47 s

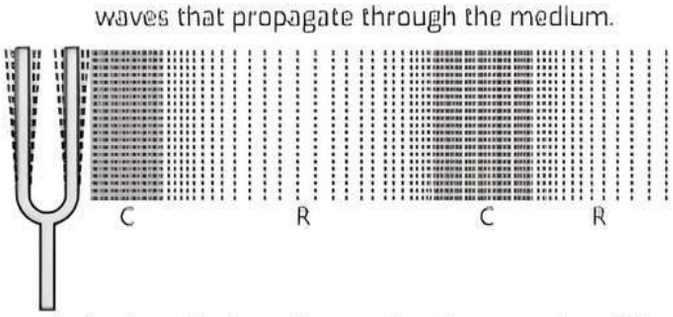
Hence, in 11.47 s, the splash will be heard at the top.

Q 4. (i) Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.

(ii) Distinguish between echo and reverberation.

(iii) Two sounds *A* and *B* are of different pitch. *B* appears to be heavier as compared to *A*. What can be said about their comparative frequencies?

Ans. (i) **Production of Compressions and Rarefactions in Air:** When a vibrating object moves forward, it pushes the air in front of it creating a region of high pressure. This region is called compression. This compression starts to move away from the vibrating object. When the vibrating object moves backward, it creates a region of low pressure called rarefaction. As the object moves back and forth rapidly, a series of compressions and rarefactions is created. These make the sound waves that propagate through the medium.



A vibrating object creating a series of compressions (C) and rarefactions (R) in the medium

(ii) Echo is caused by the reflection of sound from the given surfaces whereas reverberation is the persistence of sound caused by multiple reflections of sound.

(iii) Since, *B* has a heavier sound, its pitch is lower than that of *A*. Thus, its frequency is less than that of *A*.

Q 5. (i) Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of time taken by the sound wave in air and in aluminium to reach the second child.

(ii) How is ultrasound used for cleaning?

Ans. (i) We know that, speed of sound in air,

$$v_1 = 346 \text{ m s}^{-1}$$

Speed of sound in aluminium,

$$v_2 = 6420 \text{ m s}^{-1}$$

Let the length of the aluminium rod = x m

$$\because \quad \text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\text{Time taken in air} = \frac{x}{346} \text{ sec} \quad [\because \text{Distance} = x \text{ m}]$$

$$\text{Time taken in aluminium} = \frac{x}{6420} \text{ sec}$$

Hence, the required ratio

$$= \frac{\frac{x}{346}}{\frac{x}{6420}} = \frac{x}{346} \times \frac{6420}{x} = 3210 : 173$$

(ii) Ultrasound is used to clean various parts which are located in hard-to-reach places *i.e.*, spiral tube, odd shaped parts, electronic components, etc. The objects to be cleaned are placed in a cleaning solution and ultrasonic waves are sent into the solution. Due to the high frequency of ultrasound, the dust particles or grease get removed easily and the objects, thus, get thoroughly cleaned.

Chapter Test

Multiple Choice Questions

Q 1. If amplitude of sound is doubled, then its:

a. velocity is doubled
b. frequency is doubled
c. wavelength is doubled
d. None of the above

Q 2. A man stands in front of a hill and fires a gun. He hears an echo after 1.5 sec. The distance of the hill from the man is:
(Velocity of sound in air = 330 m/s)

a. 220 m
b. 247.5 m
c. 268.5 m
d. 495 m

Q 3. A sound wave completes 24 cycles in 0.8 s. The frequency of the wave is:

a. 30 Hz
b. 8 Hz
c. 24 Hz
d. 20 Hz

Q 4. Sound travels at a speed of 344 m s^{-1} in air. This means that:

a. the source of sound moves 344 m in one second
b. the listener moves 344 m in one second
c. air moves 324 m in one second
d. the disturbance in air moves 344 m in one second

Assertion and Reason Type Questions

Directions (Q. Nos. 5-6): *Each of the following questions consists of two statements, one is* ***Assertion*** *(A) and the other is* ***Reason*** *(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:*

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 5. Assertion (A): The audible range of sound for human beings is from 20 Hz to 20000 Hz.
Reason (R): For a human being, it is difficult to hear ultrasonic sound while easy to hear infrasonic sound.

Q 6. Assertion (A): Sound wave is a longitudinal wave.
Reason (R): Sound wave can be produced in all the three media such as solids, liquids and gases.

Case Study Based Question

Q 7. Veena's elder sister Rashmi, who is four months pregnant, has come to stay with them for a week, Veena's mother, Mrs Nirmala, wanted to take Rashmi to a gynaecologist for a prenatal (before birth) medical check-up. Veena also accompanied them to the hospital. The gynaecologist carried out the required physical examination of Rashmi and then recommended a particular scan to be done.

Read the given passage carefully and give the answer of the following questions:

(i) What type of scan was recommended by gynaecologist for Rashmi? Name the machine used for this purpose.
(ii) Why was the above scan recommended?
(iii) State the principle of working of the scanning machine briefly. What is this technique known as?
(iv) Write two more uses of the above machine.

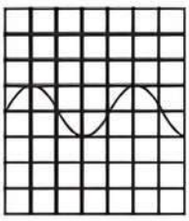
Very Short Answer Type Questions

Q 8. Name the sounds of the frequencies given below: 10 Hz, 1000 Hz, 200 kHz, 5 MHz

Q 9. A sound wave travels at a speed of 339 m s^{-1}. If its wavelength is 1.5 cm, then what is the frequency of the wave?

Short Answer Type-I Questions

Q 10. The given figure shows a trace of a sound wave which is produced by a particular tuning fork.



(i) Draw a trace of the sound wave which has a higher frequency than that shown in the figure.

(ii) Draw trace of sound wave which has a larger amplitude than that shown in the figure.

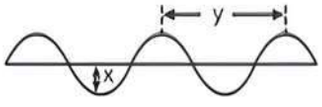
Q 11. A person has hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? (Take speed of sound in air as 344 m s^{-1})

Q 12. Why are ceilings of concert halls and conference halls made curved? Explain with a diagram.

Short Answer Type-II Questions

Q 13. What are the conditions necessary for the formation of echo?

Q 14. A sound wave travelling in a medium is represented as shown in the figure.



(i) Which letter represents the amplitude of sound wave?

(ii) Which letter represents the wavelength of wave?

(iii) What is the frequency of the source of sound if the vibrating source of sound makes 360 oscillations in 2 minutes?

Q 15. (i) What is a stethoscope? Name the principle on which a stethoscope works.

(ii) Explain the working of a soundboard with the help of a labelled diagram.

Long Answer Type Questions

Q 16. (i) 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.

(ii) Establish the relationship between speed of sound, its wavelength and frequency of velocity of sound in air is 340 m s^{-1}. Calculate:

(a) wavelength when frequency is 256 Hz.

(b) frequency when wavelength is 0.85 m.

Q 17. (i) Describe the following characteristics of sound:

(a) Loudness (b) Pitch (c) Quality

(ii) The sound of an explosion on the surface of lake is heard by a boatman 100 m away and a diver 100 m below the point of explosion. Of the two persons mentioned (boatman or diver) who would hear the sound first? And why?