CHAPTER – 6 SOUND [EXERCISE SOLUTIONS]

Think and Answer [Page No. 111]

**1. Consider the following sound waves marked A, B, C and D :**
(a) Which two waves represent sounds of the same loudness but different pitch?
(b) Which two waves represent sounds of the same frequency but different loudness?
(c) State whether all these sound waves have been produced by the same vibrating body or different vibrating bodies?
(d) Which vibrating body/bodies could have generated the sound waves shown here?
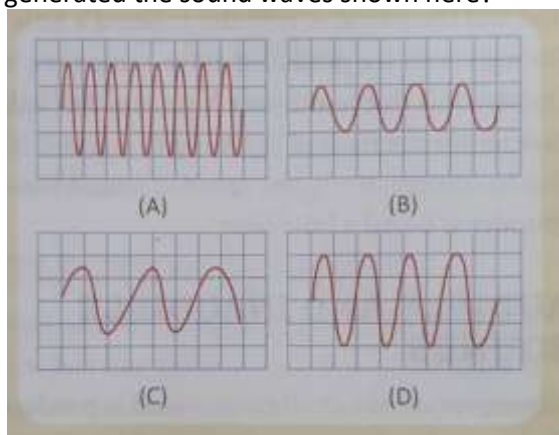
Answer : (a) A and D
(b) B and D
(c) Same vibrating body because waveform is similar.
(d) Tunning fork.

Test Your Understanding [Page No. 113]

Answer the following Questions :
1. Which of the following cannot transmit sound?
(a) Water   **(b)** Vacuum
(c) Aluminium   **(d)** Oxygen gas
Answer : (b) Vacuum

2. Out of solids, liquids and gases :
(a) in which medium sound travels slowest?
(b) in which medium sound travels fastest?
Answer : (a) gases
(b) solids

3. By how much will the loudness of a sound change when the amplitude of vibrations is :
(a) doubled?
(b) halved?

Answer : (a) If the amplitude of vibrations is doubled (made 2 times), then the loudness will become four times [because $(2)^2 = 4$]
(b) And if the amplitude of vibrations is halved (made 1/2), then the loudness will become one-fourth [because $(1/2)^2 = ¼$]

4. Why do we not hear the screams of a bat?
Answer : Bats produce ultrasonic sound and thus humans cannot hear them.

5. Arrange the following sounds in the order of increasing frequencies (keeping the sound of lowest frequency first) :
a. Baby's voice
b. Man's voice
c. Woman's voice
Answer : Man's voice > Women's voice > Baby's voice

EXERCISES
[OBJECTIVE TYPE QUESTIONS]
A. Choose the correct option :
1. When sound travels through air, the air particles
(a) Vibrate perpendicular to the direction of wave propagation
(b) Vibrate along the direction of wave propagation
(c) Vibrate but not in any fixed direction
(d) Do not vibrate
Answer : (b) Vibrate along the direction of wave propagation

2. Which of the following is not a characteristic of a musical sound?
(a) Pitch   **(b)** Wavelength
(c) Quality   **(d)** Loudness
Answer : (b) Wavelength

3. The frequency which is not audible to the human ear is
(a) 50 Hz   **(b)** 500 Hz
(c) 5000 Hz   **(d)** 50,000 Hz
Answer : (d) 50,000 Hz

4. Sound wave and light wave both
(a) have similar wavelength
(b) Obey the laws of reflection
(c) Travel as longitudinal waves
(d) Travel through vacuum
Answer : (c) Travel as longitudinal waves

5. The unit of frequency of sound is
(a) Metre/second   (b) Metre/second^2
(c) Hertz   (d) None of these
Answer : (c) Hertz

6. Echo is a type of
(a) Reflected sound   (b) Refracted sound
(c) Polarised sound   (d) None of these
Answer : (a) Reflected sound

7. Which one of the following materials will reflect sound better?
(a) Thermocol   (b) Curtains made of cloth
(c) Steel   (d) Paper
Answer : (c) Steel

8. The method of detecting the presence, position and direction of motion of distant objects by reflecting a beam of sound wave is
(a) RADAR   (b) SONAR
(c) MIR   (d) CRO
Answer : (b) SONAR

9. In SONAR, we use
(a) Ultrasonic waves   (b) Infrasonic waves
(c) Radio waves   (d) Audible sound waves
Answer : (a) Ultrasonic waves

B. Fill in the blanks :
1. Sound is produced when objects…………..
Answer : vibrate

2. Sound travels……………..in steel than in air.
Answer : faster

3. The number of oscillations per second is called…………..
Answer : frequency

4. Sound cannot travel in……………….
Answer : vacuum

5. The unit to measure intensity of sound is……………

Answer : decibels

6. The pitch or shrillness of the sound is decided by the……………of vibration.
Answer : frequency

7. The loudness of sound is decided by the……………..of vibration.
Answer : amplitude

8. The time taken to complete one oscillation is called………………
Answer : period

C. Write T for true and F for false statements.
1. Sound cannot travel through gases.
Answer : False

2. Sound waves are the longitudinal waves.
Answer : True

3. The small metal ball of pendulum is called bob.
Answer : True

4. The minimum displacement of a vibrating object from its central position is called the amplitude of vibrations.
Answer : False

5. The loudness of sound is expressed in the Hertz.
Answer : False

6. The pitch of a sound is directly proportional to its frequency.
Answer : True

7. A bat produce ultrasonic sound during screaming.
Answer : True

8. Noise is produced by the regular vibrations.
Answer : False

9. Carpets are put on the floor to reflect sound and reduce reverberations.
Answer : False

10. We can hear more clearly in a room having curtains because curtains are good reflectors of sound.
Answer : True

D. Match the columns.

1. Sound is produced when objects	a. Reflected
2. Sound can be	b. Vibrates
3. Echo is a type of	c. Hertz
4. Human ear can hear the sound waves of frequency	d. Time period
5. Some animals can hear sounds of frequency	e. Between 20-20,000 hertz
6. Frequency is the inverse of	f. Higher than 20,000 hertz
7. The unit of frequency	g. Reflected sound

Answer : 1- (b), 2 – (a), 3 – (g), 4 – (e), 5 – (f), 6 – (d), 7 – (c)

E. Name the following :
1. The sounds having too low frequencies
Answer : Infrasound

2. The region of a sound wave in which air particles are crowded together, creating a region of high pressure
Answer : Compressions

3. The unpleasant sound
Answer : Noise

4. The number of vibrations produced by a vibrating object in 1 s
Answer : Frequency

5. The repetition of sound caused by the reflection of sound waves
Answer : Echo

SUBJECTIVE TYPE QUESTIONS
F. Answer the following questions in short.
1. How is sound produced?
Answer : Sound is a type of energy made by vibrations. When an object vibrates, it causes movement in surrounding air molecules. These molecules bump into the molecules close to them, causing them to vibrate as well. This makes them bump into more nearby air molecules.

2. What should an object do to produce sound?
Answer : Sound is produced by the vibration of an object. When an object vibrates then the air around it also starts vibrating in exactly the same way and carries sound to our ears through the vibration of its molecules.
A sound wave travels from the sound producing object to our ears, through the air.

3. What brings the sound of a ringing telephone bell to our ears?
Answer : Air brings the vibrating sound waves of telephone bell to our ear. Air is the medium.

4. (a) What is the name of the strings in the human voice box which vibrate to produce sound?
(b) What makes these strings vibrate?
Answer : (a) Vocal cords of the human voice box vibrate to produce sound.
(b) The vocal cords are stretched across the larynx and they vibrate to produce sound.

5. Why are the voices of men, women and children different?
Answer : The main reason for the difference in voices is length of vocal cords. The longest vocal cord present in men and the shorter vocal cord is for women. Children have the smallest vocal cord.

6. If you want to hear a train approaching from far away, why is it more convenient to put the ear to the track?
Answer : We hear the vibrations from the ground when we put our ear at the tract so that we can hear a train approaching from far away.

7. (a) What is a vibration (or an oscillation)? Define 'amplitude' of vibration of an object.
(b) What is the frequency of a vibrating body whose time-period is 0.05 second?
Answer : (a) The to and fro motion of an object is called as oscillation or vibration.

The maximum distance to which the bob of a vibrating pendulum goes from its central position is called amplitude of vibrations (or amplitude of oscillations).
(b) The wave frequency is 20 Hz.

8. What is meant by the (a) 'pitch' of sound, and **(b)** 'quality' of sound?
Answer : (a) Pitch is that characteristic of sound by which we can distinguish between different sounds of the same loudness.
(b) Quality is that characteristic of sound which enables us to distinguish between the sounds produced by different sound producing objects (like different musical instruments) even if they are of same loudness and pitch.

9. How can reverberations in a big hall or auditorium be reduced?
Answer : The excessive reverberations in big halls and auditoriums are reduced (or controlled) by using various tgypes of sound-absorbing materials.
Some of the methods used for reduing excessive reverberation in big halls and auditorium are :
(i) Panels made of sound-absorbing materials (like compressed fibreboard or felt) are put on the walls and ceiling of big halls and auditoriums to reduce reverberations.
(ii) Carpets are put on the floor to absorb sound and reduce reverberations.
(iii) Heavy curtains are put on doors and windows to absorb sound and reduce reverberations.
(iv) The material having sound-absorbing properties is used for making the seats in a big hall or auditroium to reduce reverberations.

10. What is meant by the 'loudness' of sound? On what factor does the loudness of a sound depend?
Answer : Sounds are produced by vibrating objects. If more energy is supplied to an object by plucking it or hitting it more strongly, then the object will vibrate with a greater amplitude and produce a louder sound.
The loudness of sound depends on the amplitude of vibrations of the vibrating object. Greater the amplitude of vibrations, louder the sound will be.

11. What is rarefaction?
Answer : A rarefaction is defined as the region in a longitudinal wave where the particles are apart from each other.

12. Write the relationship between frequency and time period.
Answer : 'Time-period is the time required to make 1 vibration' and 'frequency is the number of vibrations made in 1 second'. This means that time-period is equal to the reciprocal (or inverse) of frequency.
Time-period = 1/Frequency
This is the reation between the 'Time-period' and 'Frequency' of vibrations (or oscillations).

13. What is frequency?
Answer : The number of vibrations made per second by a vibrating body is called the frequency of vibration. 'Per second' means in 'one second'.

14. What is an echo?
Answer : The repetition of sound caused by the reflection of sound waves is called an echo.

15. Write the full form of SONAR.
Answer : 'SONAR' stands for 'Sound Navigation And Reflecting'.

G. Answer the following questions in detail.
1. What is sound? How is it produced and transmitted?
Answer : The sensation felt by our ears is called sound. Sound is a form of energy. Sound is produced by the vibrations of an object. When an object vibrates back and forth in air, then the molecules of air close to this object also start vibrating back and forth with the same frequency. These vibrating air molecules pass on their motion to the next layer of air molecules due to which they also start vibrating back and forth. This process goes on and on. And ultimately, all the air molecules around the sound producing object start vibrating back and forth (just like the vibrating object). When the vibrating air

molecules fall on our ears, the ears feel these vibrations as sound.

2. What are longitudinal waves?

Answer : Sound waves are the longitudinal waves because particles of the medium through which the sound is travelled, vibrate parallel to the direction that the sound wave moves. A vibrating string can create longitudinal waves.

3. Explain compression and rarefaction with a diagram.

Answer : As the vibrating string moves in the forward direction, it begins to push upon surrounding air molecules, moving them to the right towards their nearest neighbour. This causes the air molecules to the right of the string to be compressed into a small region of space. This is known as compressions. As the vibrating string moves in the reverse direction (leftward), it lowers the pressure of the air immediately to its right, thus causing air molecules to move back leftward. The lower pressure to the right of the string causes air molecules in that region immediately to the right of the string to expand into a large region of space. This is known as rarefaction.
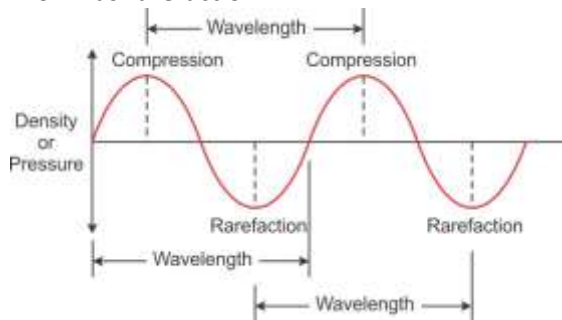
4. How can the pitch of sound produced in a piano be changed?

Answer : In a piano, the string is struck to make the string vibrate and produce sound. The pitch of sound produced can be changed by stretching or loosening the strings of piano.

5. Explain why you can predict the arrival of a train by placing your ear on the rails without seeing it.

Answer : Sound requires medium to travel because molecules of medium help in propagation of sound waves. Sound of arriving train can be heard better through railway tracks rather than air, because sound waves travel 15 times faster through the metal railway tracks in comparison to air.
Thus, arrival of train can be predicted better from railway tracks than air.

6. Write the approximate speed of sound in (a) air, (b) water and (c) steel.

Answer : (a) 343 m/s
(b) 1498 m/s
(c) 5130 m/s

7. During a thunderstorm, the sound of thunder is heard after the lightning is seen. Why?

Answer : The flash of lightning is seen first but the sound of thunder is heard a little later (though lightning and thunder take place in the sky at the same time and the same distance from us) because the belocity of light in air 3 x 10^8 m/s while the velocity of sound in air is 343 m/s.

8. (a) What is an echo? How is echo formed?
(b) What is the minimum distance in air required from a sound reflecting surface to hear an echo (at 20^{0}C)?
(c) A man standing 825 metres away from a cliff (steep rock) fires a gun. After how long will he hear its echo? Speed of sound in air is 330 m/s.

Answer : (a) The repetition of sound caused by the reflection of sound waves is called an echo.
When a person shouts in a big empty hall, we first hear his original sound. After a little while, we hear the reflected sound of shout. This 'reflected sound' is an 'echo'. So, when we hear an echo, we are actually hearing a reflected sound, a short while after the original sound.
(b) We know that the speed of sound in air (at 20^{0}C) is 344 metres per second. Thus, the distance travelled by sound in 1/10th of a second is 34.4 metres. But this distance is travelled by sound in going from us (the source of sound) to the sound reflecting surface (like a wall), and then coming back to

us. So, our distance from the sound reflecting surface (like a wall, etc.) to hear an echo should be half of 34.4 metres which is 34.4/2 = 17.2 metres.

(c) Distance of the man from the cliff (d) = 825m

Speed of sound (v) = 330 m/s

By the echo formula,

$$2d = vt$$
$$t = 2d/v$$
$$t = 2 \times 825/330$$
$$t = 1650/330$$
$$t = 5 \text{ sec}$$

9. (a) What is sonar? Explain its use.

(b) A sonar station picks up a return signal after 3 seconds. How far away is the object? (speed of sound in water = 1440 m/s).

Answer : (a) The word 'SONAR' stands for 'Sound Navigation And Ranging'. Sonar is an apparatus (or device) which is used to find the depth of a sea or to locate the under-water things like shoals of fish, shipwrecks, and enemy submarines.

(b) Sonar picks up the return signal after 3 seconds.

Therefore, time for one side is 3/2 = 1.5 sec

Speed of sound in water = 1440 m/s

Let the distance of the object be d metre then, we know that,

Speed = Distance/Time

Distance = Speed x Time

d = 1440 x 1.5

d = 2160 m

Numerical Based Questions

1. A ship sends out a sound signal straight down and receives its echo after one second. What is the depth of the sea at this spot? (Speed of sound in water = 1430 m/s)

Answer : Velocity of sound in water = 1430 m/s

Time = 1 second

By the echo formula,

$$2d = vt$$
$$d = 1430 \times \frac{1}{2}$$
$$d = 715 \text{ metres}$$

2. Pendulum A makes 15 oscillations in 5 seconds and pendulum B makes 8 oscillations in 4 seconds. Which has higher frequency? Express the frequency of each pendulum in hertz.

Answer : Frequency = Total osciallations/Time take

Pendulum A

15 oscillations in 5 seconds (given)

Number of oscillations in 1 second = 15/5 = 3 Hz

Thus, frequency = 3 Hz

Pendulum B

8 oscillations in 4 seconds (given)

Number of oscillations in 1 second = 8/4 = 2 Hz.

Frequency = 2 Hz

Therefore, Pendulum A has a higher frequency.

3. The frequency of a vibration is the inverse of its time period. What is the time period of a pendulum which is vibrating as 10 hertz?

Answer : Time period of Pendulum = 1/f

= 1/10 = 0.1 s

4. The speed of sound in water is 1500 m/s. how far away from an under-sea rock should a deep sea diver be, so that he can hear his own echo? The diver hears echo in 3 sec.

Answer : Speed of sound in water = 1500 m/s

t = 3 seconds

By Echo formula,

$$2d = vt$$
$$d = vt/2$$
$$d = 1500 \times 3/2$$
$$d = 2250 \text{ m}$$

5. The deepest part of the oceans in the world is the Mariana Trench in the Pacific Ocean which is 11,033 metres deep. If you were on a ship above this trench and send a sound signal straight down to the water, how long will it take for the echo to reach you? (Speed of sound in water is 1500 m/s).

Answer : d = 11033 m

Speed of sound in water = 1500 m/s

t = ?

By Echo formula,

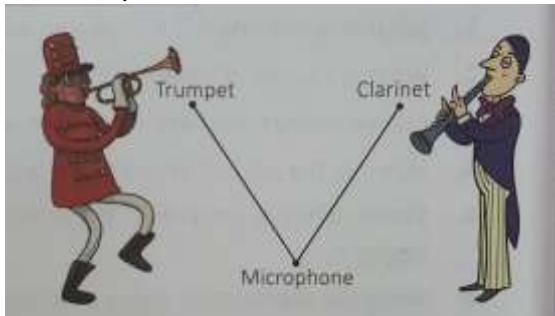$$2d = vt$$
$$t = 2d/v$$
$$t = 2 \times 11033/1500$$
$$t = 22066/1500$$
$$t = 14.7 \text{ seconds}$$

1. Choose the correct option.
A trumpeter and a clarinetist are standing well apart and playing a tune in unisonj (the same notes together). A microphone is placed in a hall at the same distance from both of them as shown in the figure. If the trumpster is playing louder than the clarinetist, the correct statement is

a. A loud sound from the trumpet reaches the microphone before the same softer note from the clarinet.
b. The microphone receives sound energy from the trumpet at a greater average rate than it does from the clarinet.
c. Waves from the trumpet and the clarinet arrive at the microphone in phase.
d. none of these.
Answer : **(b)** The microphone receives sound energy from the trumpet at a greater average rate than it does from the clarinet.

2. The graph given below shows the displacement versus time relation for a sound wave travelling with velocity of 1000 ms^{-1}. What is the wavelength of the wave?
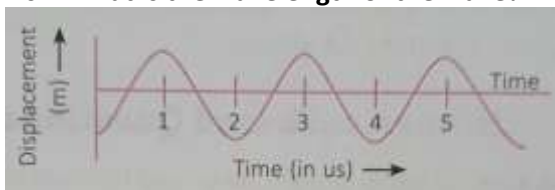
Answer : Velocity (v) = 1000 ms^{-1}
Time period (T) = time taken to complete one cycle

$\qquad$ = 2 us
$\qquad$ = 2 x 10^{-6} sec
We know that,
$\qquad$ λ = v x T
$\qquad$ λ = 1000 ms^{-1} x 2 x 10^{-6} s
$\qquad$ λ = 2 x 10^{-3} m
where λ= wavelength

3. What does this picture show?
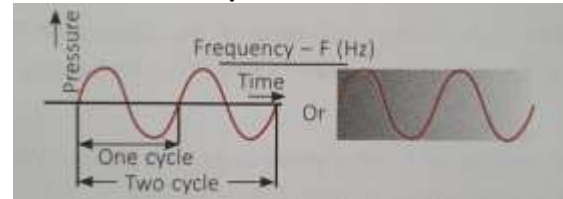
Answer : Displacement time-graph is shown here which can be used to calculate frequency of vibrating body.

1. Three different vibrating objects produce three types of sounds X, y and Z. The 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 can be heard by a bat whereas the sound Y can be heard by a rhinoceros. What type of sounds are X, Y and Z?
Answer : X is ultrasonic sound
Y is infrasonic sound
Z is not mentioned in the question but I think it is normal sound having the frequency range from 20hz to 20,000hz
So, Z = sonic waves or audible waves.

2. Your parents are going to buy a house. They have been offered one house on the roadside and another house three lanes away from the roadside. Which house would you suggest your parents should buy? Explain your answer.
Answer : I would suggest my parents to buy a house which is three lanes away from the roadside. This is because the house on the roadside would receive a lot of noise pollution due to honking of vehicles. As the intensity of sound decreases as distance increases, the house farther from the roadside is recommended.