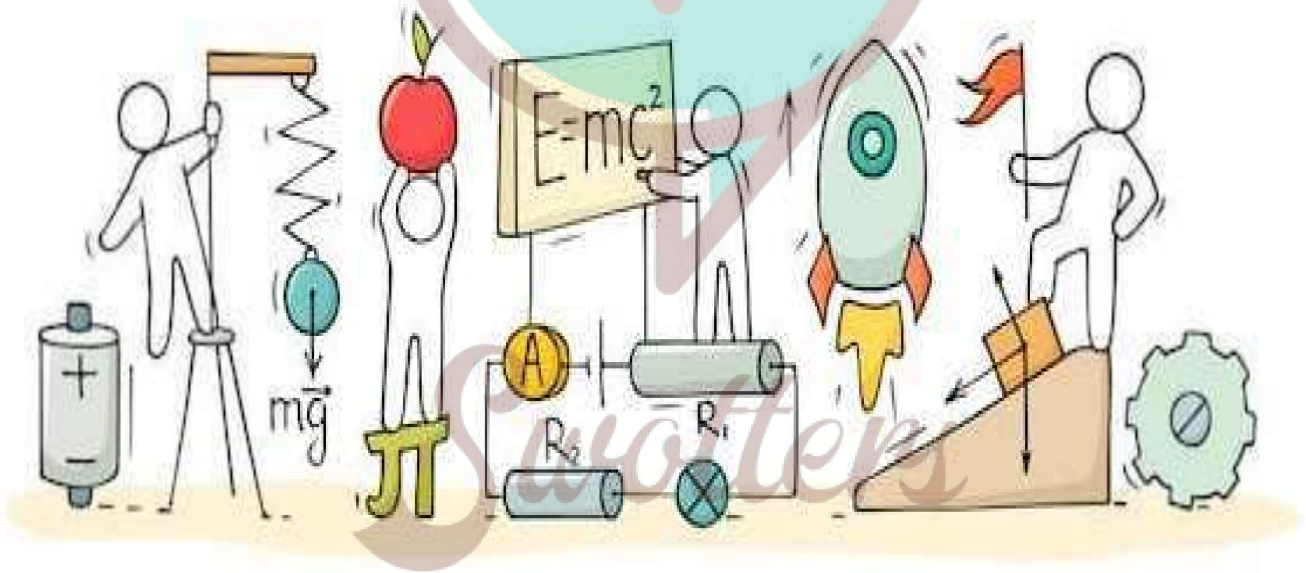
PHYSICS

Chapter 12: Sound



Important Question

➢ 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 mush 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

3. In SONAR, we use

(a) ultrasonic waves

(b) infrasonic waves

(c) radio waves

(d) audible sound waves

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) disturbance moves

(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

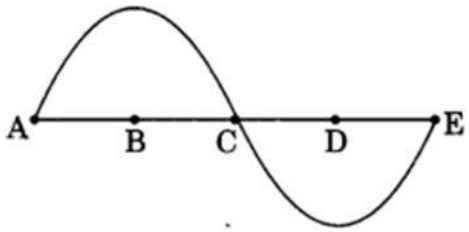
(a) frequency

(b) amplitude

(c) velocity

(d) wavelength

6. In the curve half the wavelength is



(a) AB

(b) BD

(c) DE

(d) AE

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

➢ Very Short Question:

1. What are longitudinal waves?

2. What are transverse waves?

3. Define wavelength. What is its symbol and its SI unit?

4. Define frequency. What is its symbol and its SI unit?

5. What is one hertz?

6. Define amplitude. What is its symbol and its SI unit?

7. What is 'audible' sound?

8. What do you mean by an echo?

9. What do you understand by the terms "compression" and rarefaction?

A region of low pressure of a medium when a sound wave travels through it is called rarefaction.

10. What do you understand by the pitch of a sound?

➢ Short Questions:

1. State law of conservation of energy and law of conservation of mechanical energy.

2. Define (a) 1 joule (b) 1 watt.

3. Write down SI unit of the following quantities.

(a) work

(b) kinetic energy

(c) potential energy

(d) power

4. What is the sequence of energy change that takes place in the production of electricity from adam?

5. A light and a heavy object have the same momentum. Find out the ratio of their kinetic energies. Which one has larger kinetic energy?

6. Why a man does not do work when he moves on a level road while carrying a box on his head?

7. If an electric iron of 1200 W is used for 30 minutes every day, find electric energy consumed in the month of April.

8. What is work done by a force of gravity in the following cases?

(a) Satellite moving around the Earth in a circular orbit of radius 35000 km.

(b) A stone of mass 250 g is thrown up through a height of 2.5 m.

➢ Long Questions:

1. State the conditions for positive, negative, and zero work. Give at least one example of each.

2. Give a reason for the following:

(a) A bullet is released on firing the pistol.

(b) An arrow moves forward when released from the stretched bow.

(c) Winding the spring of a toy car makes it to run on the ground.

(d) Falling water from a dam generates electricity.

(e) Winding the spring of our watch, the hands of the watch movement.

3. State the law of conservation of energy. Show that the energy of a freely falling body is conserved.

➢ Assertion Reason Questions:

1. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both Assertion and Reason are correct, and reason is the correct explanation for assertion.

   b. Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.

   c. Assertion is true but Reason is false.

   d. Both Assertion and Reason are false.

   Assertion: When any objects vibrates that time it produces sound.

   Reason: Vibration means a kind of rapid to and from motion of an object.

2. For two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both Assertion and Reason are correct, and reason is the correct explanation for assertion.

   b. Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.

   c. Assertion is true but Reason is false.

   d. Both Assertion and Reason are false.

   Assertion: When any objects vibrates that time it produces sound.

   Reason: vibration is the process in which two objects strikes on each other.

➢ Case Study Questions:

1. Sound is produced by vibrating objects. The matter or substance through which sound is transmitted is called a medium. It can be solid, liquid or gas. Sound moves through a medium from the point of generation to the listener. When an object vibrates, it sets the particles of the medium around it vibrating. The particles do not travel all the way from the vibrating object to the ear. Sound waves are characterized by the motion of particles in the medium and are called mechanical waves. 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 a compression(C).When the

vibrating object moves backwards, it creates a region of low pressure called rare faction (R). Hence sound is longitudinal wave.

(i) Sound waves are:

(a) Mechanical waves

(b) Electromagnetic wave

(c) Transverse waves

(d) None of these

(ii) Sound travel in medium with:

(a) Compression and rare fraction

(b) Crest and trough

(c) Both can be possible

(d) None of these

(iii) Compression is the region of:

(a) High pressure

(b) Low pressure

(c) Medium pressure

(d) None of these

(iv) What is sound and how is it produced?

(v) Why sound wave is called as longitudinal wave?

2. 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. This is exactly how a sound wave propagates; hence sound waves are longitudinal waves. There is also another type of wave, called a transverse wave. In a transverse wave particles do not oscillate along the direction of wave propagation but oscillate up and down about their mean position as the wave travels. Thus, a transverse wave is the one in which the individual particles of the medium move about their mean positions in a direction perpendicular to the direction of wave propagation.

(i) Sound waves are:

(a) Transverse waves

(b) Longitudinal wave

(c) Both a and b

(d) None of these

(ii) Light is:

(a) Transverse waves

(b) Longitudinal wave

(c) Both a and b

(d) None of these

(iii) In case of Longitudinal waves:

(a) The particles do not move fromone place to another but they simply oscillateback and forth about their position of rest

(b) The particles move fromone place to another

(c) The particles move up and down.

(d) None of these

(iv) When stone is dropped in water; waves are generated of which types?

(v) Differentiate between longitudinal wave and transverse waves.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (c) of a single frequency
2. (a) sound will be louder but pitch will not be different
3. (c) radio waves
4. (d) both particles as well as disturbance travel from one place to another.
5. (b) amplitude
6. (b) BD
7. (a) ultrasound
8. (c) rhinoceros
9. (c) frequency of the sitar string with the frequency of other musical instruments

➢ Very Short Answers:

1. Answer: A wave in which the particles of the medium vibrate back and forth in the 'same direction' in which the wave is moving, is called as a longitudinal wave.
2. Answer: A wave in which the particles of the medium, vibrate up and down 'at right angle' to the direction in which the wave is moving, is called a transverse wave.
3. Answer: The distance between two consecutive compressions (C) or two consecutive rarefactions (R) is called the wavelength. The wavelength is denoted by (Greek letter 'lambda'). Its SI unit is the meter (m).
4. Answer: The number of complete waves (or cycles) produced per second is called a

frequency of sound waves. It is denoted by f. The SI unit of frequency is hertz (Hz).

5. Answer: A vibrating body producing 1 wave per second is said to have a frequency of 1 Hz.
6. Answer: The magnitude of the maximum disturbance in the medium on either side of the mean value is called the amplitude of wave. It is denoted by A. The SI unit is the metre (m).
7. Answer: The sound which we are able to hear is called 'audible' sound. The audible range of sound for human beings extends from about 20 Hz to 20000 Hz.
8. Answer: The repetition of sound caused by the reflection of sound waves is called an 'echo'.
9. Answer: A region of high pressure of a medium when a sound wave travels through it is called compression.

   A region of low pressure of a medium when a sound wave travels through it is called rarefaction.
10. Answer: Pitch of a sound is the characteristic of sound that depends on the frequency received by a human ear.

➢ Short Answers:

Answer: The sensation felt by our ears is called sound. A sound is a form of energy which makes us hear. When an object is set into vibrations, the sound is produced. For example, the vibrating diaphragm of a drum produces sound, the vibrating string of a guitar produces sound, the vibrating diaphragm of speakers of a radio produce sound, the vibrating end of a drilling machine produces sound, etc.

Answer: The conditions to hear an echo are:

i. Echo can be heard only if it is produced at least $\frac{1}{10}$ th of a second (0.1 s) after the original sound.

ii. The speed of sound in air is 344 m/s. Let us calculate the minimum distance from the reflecting surface, which is necessary to hear an echo.

$$\text{Speed} = \frac{\text{distance travelled}}{\text{Time taken}}$$

$$\text{Thus,} \quad 344 = \frac{\text{distance travelled}}{\frac{1}{10}}$$

∴ Distance travelled = 344 x $\frac{1}{10}$ = 34.4 metres

Thus, the distance travelled by the sound in $\frac{1}{10}$ th of a second is 34.4 m. This means that the minimum distance between the source of the sound and the listeners should be 17.2 metres.

iii. Echo can be heard only if the reflecting surface is large.

Answer: Bats search out prey and fly in the dark night by emitting and detecting reflections of ultrasonic waves. The high-pitched ultrasonic squeaks of the bat are reflected from the obstacles or prey and returned to bat's ear. The nature of reflections tells the bat where the obstacle or prey is and what it is like.

Answer: A certain amount of reverberation improves the quality of sound of orchestral and choral music. However excessive reverberation makes the speech or music indistinct.

Answer: A megaphone works on the principle of reflection of sound. In this instrument, a tube followed by a conical opening reflects sound successively to guide most of the sound from the source in the forward direction towards the audience.

Answer:

Given,

velocity of sound, υ = 340 m/s

1. v = 256 Hz

using, $\upsilon = \lambda v$

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

2. $\lambda = 0.85$

using, $u = \lambda v$

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

7. 30 waves pass through a point in 3 seconds. If the distance between two crests is 2 m. Calculate

(a) frequency

(b) wavelength.

Answer:

30 waves in 3 seconds

$\upsilon = \frac{30}{3} = 10Hz$

$\therefore \lambda = 2m.$

8. What is the reflection of sound? State the laws of reflection.

Answer: The bouncing back of sound from a hard surface is called a reflection of sound. The laws of reflection are:

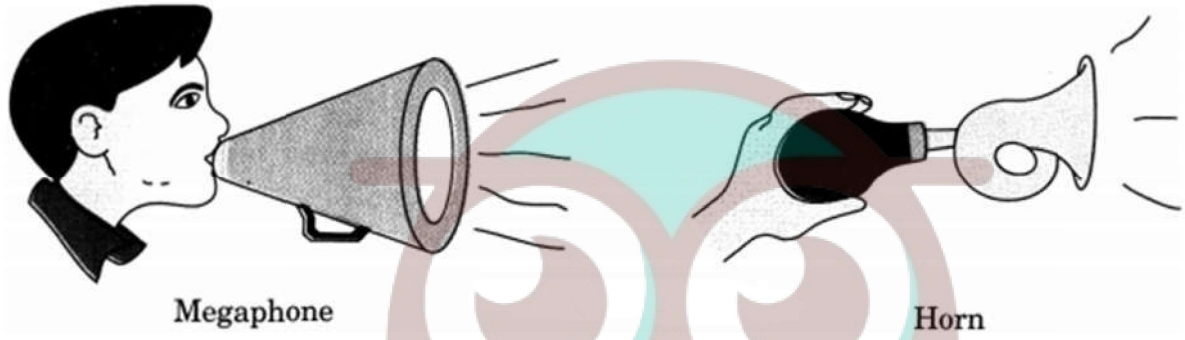
i. The incident sound wave, the reflected sound wave and the normal at the point of incidence, all lie in the same plane.

ii. The angle of incidence of sound is always equal to the angle of reflection of sound.

➢ Long Answers:

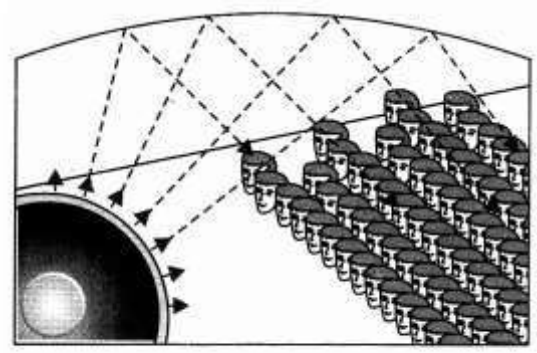
1. Answer:

i. Megaphone and a bulb horn: Megaphones or loudhailers, horns, musical instruments such as trumpets and she Hana is, are all designed to send sound in a particular direction without spreading it in all directions, as shown in the figure. In these instruments, a tube followed by a conical opening reflects sound successively to guide most of the sound waves from the source in the forward direction towards the audience.

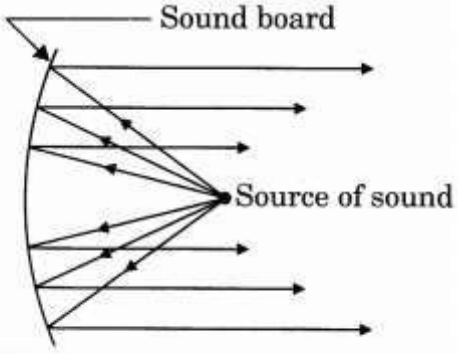


ii. Stethoscope: Stethoscope is a medical instrument used for listening to sounds produced within the body, chiefly in the heart or lungs. In stethoscopes, the sound of the patient's heartbeat reaches the doctor's ears by multiple reflections of sound, as shown in the figure.

iii. Soundboard: Generally the ceiling of concert halls, conference halls and cinema halls are curved so that sound after reflection reaches all corners of the hall, as shown in the figure. Sometimes a curved soundboard may be placed behind the stage so that the sound, after reflecting from the soundboard, spreads evenly across the width of the hail (Fig).



Curved ceiling of a conference hall



Sound board used in a big hall

2. Answer:

Ultrasounds are high-frequency waves. Ultrasounds are able to travel along well-defined paths even in the presence of obstacles. Ultrasounds are used extensively in industries and for medical purposes.

i. Ultrasound is generally used to clean parts located in hard-to-reach places, for example, spiral tube, odd-shaped parts, electronic components, etc. Objects to be cleaned are placed in a cleaning solution and ultrasonic waves are sent into the solution. Due to high frequency, the particles of dust, grease and dirt get detached and drop out. The objects thus get thoroughly cleaned.

ii. Ultrasounds can be used to detect cracks and flaws in metal blocks. Metallic components are generally used in the construction of big structures like buildings, bridges, machines and also scientific equipment. The cracks or holes inside the metal blocks, which are invisible from outside reduces the strength of the structure.

Ultrasonic waves are allowed to pass through the metal block and detectors are used to detect the transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect.

iii. Ultrasonic waves are made to reflect from various parts of the heart and form the image of the heart. This technique is called 'echocardiography'.

vi. An ultrasound scanner is an instrument which uses ultrasonic waves from getting images of internal organs of the human body. A doctor may image the patient's organs such as liver, gall bladder, uterus, kidney, etc. It helps the doctor to detect abnormalities, such as stones in the gall bladder and kidney or tumours in different organs.

In this technique, the ultrasonic waves travel through the tissues of the body and get reflected from a region where there is a change of tissue density. These waves are then converted into electrical signals that are used to generate images of the organ.

These images are then displayed on a monitor or printed on a film. This technique is called 'ultrasonography'. Ulträsonography is also used for examination of the foetus during pregnancy to detect congenital defects and growth abnormalities.

v. Ultrasound may be employed to break small 'stones' formed in the kidneys into fine grains. These grains later get flushed out with urine.

➢ Assertion Reason Answer:

1. (b) Both Assertion and Reason are correct, and reason is not the correct explanation for assertion.
2. (a) Both Assertion and Reason are correct, and reason is the correct explanation for assertion.

➢ Case Study Answers:

1.

(i) (a) Mechanical waves

(ii) (a) Compression and rare fraction

(iii) (a) High pressure

(iv) Sound is vibrations created by object. When body vibrates, it forces the adjacent particles of the medium to vibrate. This results in disturbance in the medium, which travels as waves an reaches the ear hence sound is produced.

(v) The vibration of medium that travels parallel to direction of wave or along in the direction of the wave is called longitudinal wave. The direction of particles of medium vibrates parallel to direction of propagation of disturbance. Therefore a sound is called longitudinal waves.

2.

(i) (b) Longitudinal wave

(ii) (a) Transverse waves

(iii) (a) The particles do not move from one place to another but they simply oscillate back and forth about their position of rest

(iv) When stone is dropped in water. Waves are generated where water particles are moving up and down and propagated away from dropping point .hence this is sign of transverse waves. Hence transverse waves are produced when stone is dropped in water.

(v) Following are differentiated points:

No	Longitudinal waves	Transverse waves
1	The medium, in the case of a longitudinal wave, moves in the same way to wave direction	The medium, in case of a transverse wave, moves perpendicular to wave direction
2	This wave is made up of compressions and rarefactions	This wave is made up of crests and troughs
3	example of a longitudinal wave is sound wave	An example of a transverse wave is the Light