PRACTICE PAPER 12 (2024-25)

CHAPTER 11 SOUND (ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : IX **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

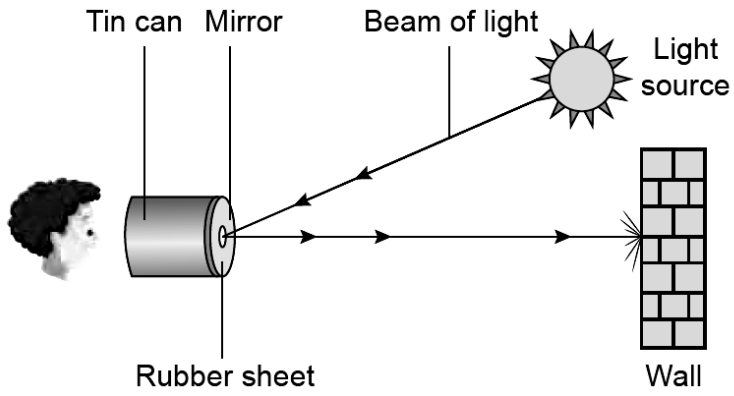
Questions 1 to 10 carry 1 mark each.

1. Crests and troughs are not formed in which type of waves:
(I) Transverse waves
(II) Longitudinal waves
(III) Electromagnetic waves
(IV) Sound waves
Options:
(a) (II) and (IV) (b) Only (I) and (II) (c) (I), (III) and (IV) (d) (II) and (IV)
Ans. (d) (II) and (IV)
A crest and trough make up a transversal. The largest upward displacement is at the crest, whereas the maximum downward displacement is at the trough.
A longitudinal wave's wavelength must be measured differently because it does not have crests and troughs. A longitudinal wave is made up of a sequence of compressions and rarefactions that repeats itself.
The crests and troughs are also formed in electromagnetic waves comparable to those of ocean waves.

2. Most television sets these days can be operated through a REMOTE CONTROL. How do most 'remotes' communicate with TV sets?
(a) Using radio waves (b) Using infrared rays
(c) Using ultraviolet rays (d) Using microwaves
Ans. (b) Using infrared rays
TV remote controls work using a type of light called infrared. The remote control has an LED present in it which flashes too quickly and emit a message which in turn, is picked up by the TV. Here, the remove is the transmitter and TV is receiver.

3. If the speed of the wave is 120 m/s and its frequency is 2000 Hz, then wavelength for this wave in cm will be:
(a) 6 (b) 0.6 (c) 60 (d) 600
Ans. (a) 6
Speed of wave, $v = 120$m/s
Frequency, $\nu = 2000$ Hz
Wavelength of wave is given by: $\lambda = v/\nu$
$\Rightarrow \lambda = 120/2000 = 0.06$ m
$\Rightarrow \lambda = 6$ cm

4. A student performs an experiment using the setup as shown.



The tin can is cut open from its bottom and a rubber sheet is stretched to cover it. A small mirror is glued to the rubber sheet. What would happen to the circular spot of light on the wall when the student speaks into the open end of the tin can?

(a) The sound produced vibrates the rubber diaphragm, which causes the movement of the light spot on the wall.

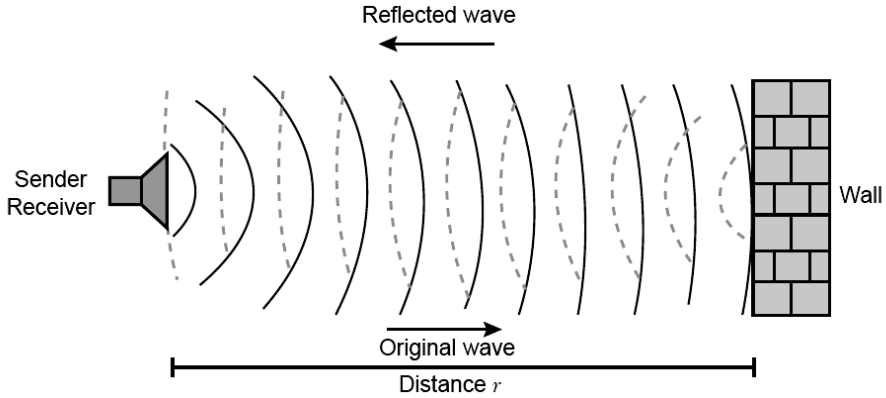
(b) The sound produced vibrates the rubber diaphragm, which causes the light spot to appear dim due to the scattering of light.

(c) The sound produced vibrates the surface of the mirror, which causes a change in the color of the light spot on the wall.

(d) The sound produced vibrates the walls of the tin can, which causes the light spot to appear diffused due to the scattering of light.

Ans. (a) The sound produced vibrates the rubber diaphragm, which causes the movement of the light spot on the wall.

5. The image shows reflection of sound by a wall



What change would cause reverberation of the sound?

(a) Polishing the surface of the wall.

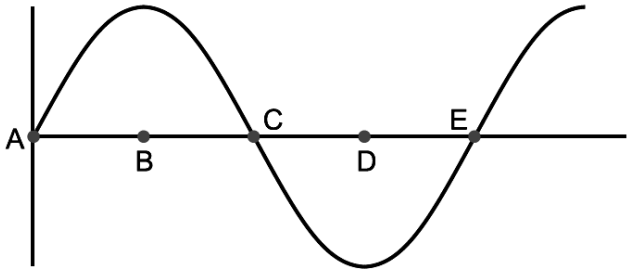
(b) Erecting a wall behind the receiver.

(c) Placing the sender closer to the wall.

(d) Increasing the frequency of the emitted sound.

Ans. (b) Erecting a wall behind the receiver.

6. In the curve shown in figure half the wavelength is



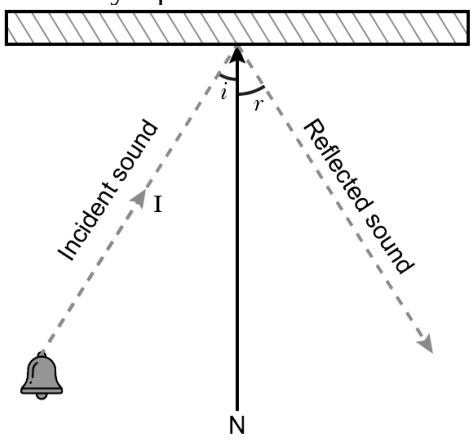
(a) AB (b) BD (c) DE (d) AE

Ans. (b) BD

Wavelength is the distance between two consecutive troughs or crests. In the given graph, half the wavelength will be BD.

7. Which one of the following statements is incorrect?
(a) A sound of single frequency is called a tone.
(b) The sound which is produced due to a mixture of several frequencies is called a note and is pleasant to listen to.
(c) A high pitch sound corresponds to more number of compressions and refractions passing a fixed point per unit time.
(d) The quality or timber of sound is that characteristic which enables us to distinguish one sound from another having the different pitch and loudness.
Ans. (d) The quality or timber of sound is that characteristic which enables us to distinguish one sound from another having the different pitch and loudness.
The quality or timbre of sound is that characteristic of sound which enable us to distinguish between different sounds of same pitch and loudness.

8. The image shows reflection of sound by a polished wall.



Based on the image, what can be inferred about how sound reflects off the polished wall?
(a) The reflected sound follows the path of the incident sound.
(b) The angle of incidence (i) is equal to the angle of reflection (r).
(c) The angle of incidence (i) is smaller than the angle of reflection (r).
(d) The reflected sound follows a shorter path than that of the incident sound.
Ans. (b) The angle of incidence (i) is equal to the angle of reflection (r).

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. Assertion (A): Transverse waves are not produced in liquids and gases.
Reason (R): Light waves are transverse wave.
Ans. (b) Both A and R are true but R is not the correct explanation of A.
Transverse waves travel in the form of crests and troughs involving a change in shape of medium. As liquids and gases do not possess the elasticity of shape, thus transverse waves cannot be produced in liquids and gases.

10. Assertion (A): Infrasonic waves are longitudinal waves of frequency greater than 20,000 Hz.
Reason (R): The maximum frequency of audible sound waves is 20,000 Hz.
Ans. (d) A is false but R is true.
Ultrasonic waves are longitudinal waves of frequency greater than 20,000 Hz.

SECTION – B

Questions 11 to 14 carry 2 marks each.

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

Ans. **Wavelength:** The distance between two consecutive compressions or two consecutive rarefactions is known as the wavelength. Its SI unit is metre (m).

Frequency: The number of complete oscillations per second is known as the frequency of a sound wave. It is measured in hertz (Hz).

Amplitude: The maximum height reached by the crest or trough of a sound wave is called its amplitude.

OR

Why is sound wave called a longitudinal wave?

Ans. The vibration of the medium that travels along or parallel to the direction of the wave is called a longitudinal wave. In a sound wave, the particles of the medium vibrate in the direction parallel to the direction of the propagation of disturbance. Hence, a sound wave is called a longitudinal wave.

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

Ans. Frequency of the sound wave, ν = 220 Hz

Speed of the sound wave, v = 440 m s^{-1}

For a sound wave,

Speed = Wavelength × Frequency

$v = \lambda \times \nu$

$\therefore \lambda = \frac{v}{\nu} = \frac{440}{220} = 2m$

Hence, the wavelength of the sound wave is 2 m.

13. 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 m s^{-1}?

Ans. Speed of sound, v = 342 m s^{-1}

Echo returns in time, t = 3 s

Distance travelled by sound = v × t = 342 × 3 = 1026 m

In the given time interval, sound has to travel a distance that is twice the distance of the reflecting surface and the source.

Hence, the distance of the reflecting surface from the source $= \frac{1026}{2} = 513m$

OR

A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Ans. Time taken by the sonar pulse to return, t = 1.02 s

Speed of sound in salt water, v = 1531 m s^{-1}

Distance of the cliff from the submarine = Speed of sound × Time taken

Distance of the cliff from the submarine $= 1.02 \times 1531 = 1561.62m$

Distance travelled by the sonar pulse during its transmission and reception in water = 2 × Actual distance = 2d

$$\text{Actual distance, } d = \frac{\text{Distance of the cliff from the submarine}}{2}$$

$$= \frac{1561.62}{2} = 780.31m$$

14. When we put our ear to a railway track, we can hear the sound of an approaching train even when the train is far off but its sound cannot be heard through air. Why?

Ans. Sound travels about 15 times faster in iron (or steel) than in air. So, sound travels much faster through the railway track made of steel than through air. That is why, we can hear the sound of an approaching train through the railway track even when the train is far off but its sound cannot be heard through air.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. (i) Explain the terms crests and troughs of a wave.
(ii) Why is the ceiling and wall behind the stage of good conference halls or concert halls made curved?
Ans. (i) The elevation or hump in a transverse wave is called crest. It is that part of the transverse wave which is above the line of zero disturbance of the medium.
The depression or hollow in a transverse wave is called trough. It is that part of the transverse wave which is below the line of zero disturbance.
(ii) Ceiling and walls are made curved so that sound after reflection reaches the target audience.

OR

A person has a hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as 344 m s^{-1}.
Ans. For a sound wave,
Speed = Wavelength × Frequency
$v = \lambda \times \nu$
Given that the speed of sound in air = 344 m/s
(i) For, ν_1 = 20 Hz

$$\lambda_1 = \frac{v}{\nu_1} = \frac{344}{20} = 1.72m$$

(ii) For, ν_2 = 20,000 Hz

$$\lambda_2 = \frac{v}{\nu_2} = \frac{344}{20,000} = 0.0172m$$

Hence, for humans, the wavelength range for hearing is 0.0172 m to 17.2 m.

16. What is reverberation? How can it be reduced?
Ans. Persistence of sound (after the source stops producing sound) due to repeated reflection is known as reverberation. As the source produces sound, it starts travelling in all directions. Once it reaches the wall of a room, it is partly reflected back from the wall. This reflected sound reaches the other wall and again gets reflected partly. Due to this, sound can be heard even after the source has ceased to produce sound.

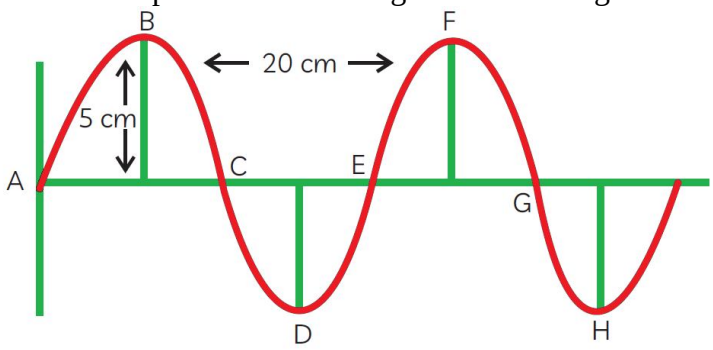
To reduce reverberations, sound must be absorbed as it reaches the walls and the ceiling of a room. Sound absorbing materials like fibreboard, rough plastic, heavy curtains, and cushioned seats can be used to reduce reverberation.

OR

Give reasons for the following:
(i) The reverberation time of a hall used for speeches should be very short.
(ii) A vibrating body produces sound. However no sound is heard when a simple pendulum oscillates in air.
(iii) Sounds of same loudness and pitch but produced by different musical instruments like a violin and flute are distinguishable.
Ans. (i) If the reverberation time of a hall is long, then the multiple echoes will interfere with original sound. For this reason nothing will be heard distinctly. So, the reverberation time of the hall should be very short.
(ii) A sound is heard only if the body vibrates with a frequency more than 20 Hz and less than 20,000 Hz. The pendulum oscillates with a frequency less than 20 Hz. Hence, no sound is heard.

(iii) This is due to the quality or timbre of sound waves.

17. Waves of frequency 100 Hz are produced in a string as shown in figure.

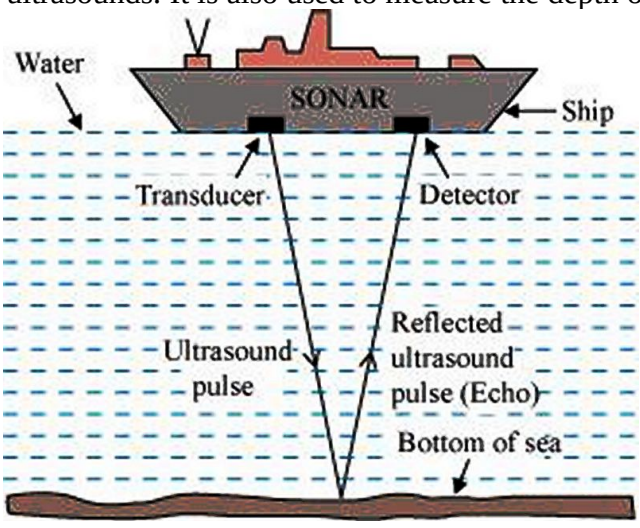


Give its: (a) Amplitude (b) Wavelength (c) Velocity
Ans. (a) The amplitude of a wave is its maximum displacement.
The wave's amplitude from the given figure is 5 cm.
(b) The wavelength of a wave is the distance between two consecutive crests and troughs.
The wave's wavelength, as shown in the diagram, is 20 cm (0.2 m).
(c) A wave's velocity is given by:
Velocity = wavelength × frequency
Frequency of wave = 100 Hz (given)
$v = 0.2 \times 100 = 20$ m/s

SECTION – D

Questions 18 carry 5 marks each.

18. Explain the working and application of a sonar with the help of diagram.
Ans. SONAR is an acronym for Sound Navigation And Ranging. It is an acoustic device used to measure the depth, direction, and speed of under-water objects such as submarines and ship wrecks with the help of ultrasounds. It is also used to measure the depth of seas and oceans.

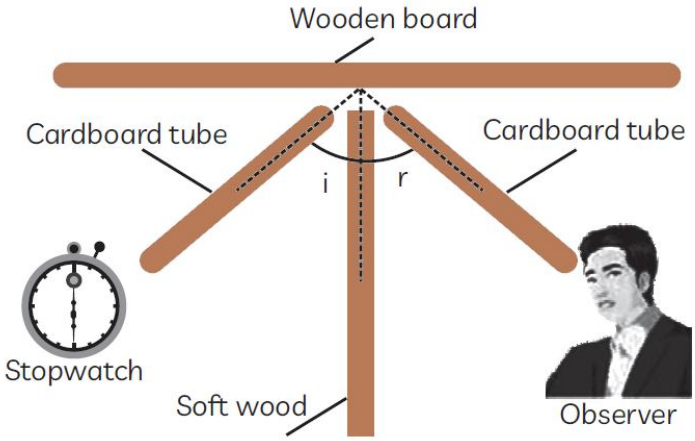


A beam of ultrasonic sound is produced and transmitted by the transducer (it is a device that produces ultrasonic sound) of the SONAR, which travels through sea water. The echo produced by the reflection of this ultrasonic sound is detected and recorded by the detector, which is converted into electrical signals. The distance (d) of the under-water object is calculated from the time (t) taken by the echo to return with speed (v) is given by $2d = v \times t$. This method of measuring distance is also known as 'echo-ranging'.

OR

(a) What is meant by the reflection of sound waves?
(b) Describe an activity to study the reflection of sound.
Ans. (a) Reflection is the phenomenon of reversion of a wave going from one medium to the same medium after striking the second medium.

(b) Take two identical pipes. Arrange them on a table near a wall. Keep a clock near the open end of one of the pipes and try to hear the sound of the clock through the other pipe. Adjust the position of the pipes so that you can best hear the sound of the clock. Measure the angle of incidence and angle of reflection, you will find that both the angles would be the same which is the law of reflection of sound.



SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the following information and answer the questions based on information and related studied concepts.

Lata, while visiting London, attended an opera performance. Its architecture and furnishings appealed her. The draperies, cushions, and curtains on the curved ceiling were all arranged correctly. Behind the stage, she noticed a soundboard. She was now curious as to whether each of these decorations was placed for the benefit of the hall's aesthetics or for a scientific cause.

(a) In an opera house, what are the functions of curtains, pillows, and draperies? (1)

(b) What are the benefits of the curved ceiling and soundboard? (2)

(c) Loudhailers and horns are designed to send sound in a particular direction without spreading in all directions as shown in the given figures. Justify the above statement. (1)

Ans. (a) Materials such as curtains, drapes, and cushions work as sound absorbent and decrease reverberation.

(b) Soundboards and curved cutting in the ceilings focus the sound so that it reaches all four corners of the auditorium and is uniformly distributed across the width.

The hall's walls and ceiling are also curved to reduce reverberation and increase sound quality by preventing numerous reflections of sound waves.

(c) In loudhailers and horns, a tube followed by a conical opening reflects sound successively to guide most of the sound waves from the source in forward direction towards the audience.

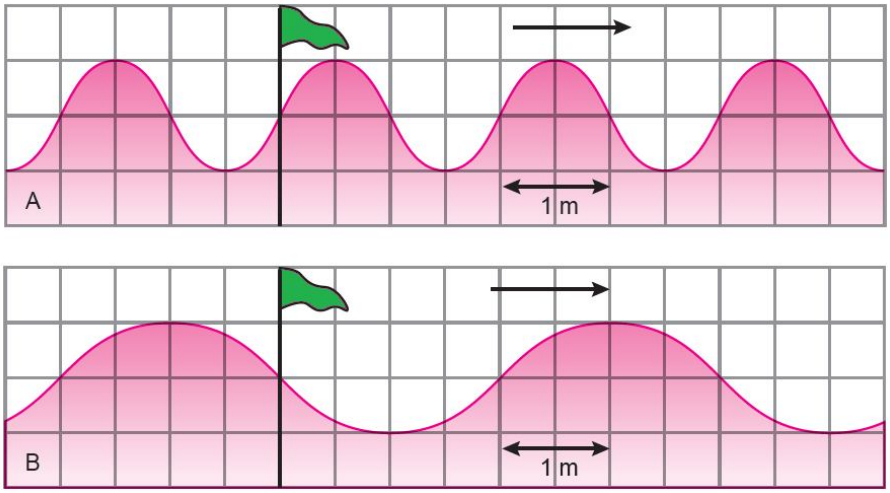
20. Read the given passage and answer the questions that follow based on the passage and related studied concepts.

If you drop a stone into a pond, ripples spread across the surface. The tiny waves carry energy but there is no flow of water across the pond. This wave effect is the result of up and down motions in the water. Waves are not only found on water. Sound travels as waves, so does light. Sound is a longitudinal wave form which travel by forming compressions and rarefaction along the direction of propagation. The speed of the waves is measured in m/s. Frequency is the number of waves passing any point per second. If the frequency is 5 Hz, then its time period is 1/5 s (0.2 s).

The distance between two consecutive compressions or two consecutive rarefactions is called the wavelength of the wave. Amplitude is the maximum distance that a point moves from its rest position when a wave passes. The speed, frequency and wavelength of any set of waves are linked by the equation :

Speed = Frequency × Wavelength

The waves in A below are travelling across water.



(i) What is the wavelength and amplitude of the waves in A? (1)

(ii) If two waves pass the flag every second, what is the frequency? (1)

(iii) Use the wave equation to calculate the speed of the waves in A. What is the wavelength of the waves in diagram B given above? (2)

Ans. (i) Wavelength = 2 m, Amplitude = 1 m

(ii) 2 Hz

(iii) Speed = Frequency × wavelength

Speed = 2 × 2 = 4 m/s

Wavelength = 4 m