Sound

Periodic Test

Q.1. What is an echo?

Answer: An echo is the sound produced by the reflection of sound waves from a surface and back to the listener.

Q.2. What is reverberation?

Answer: The repeated reflection of sound that causes its persistence until it is reduced to an inaudible value is called reverberation.

Q.3. What is SONAR?

Answer: SONAR stands for Sound Navigation And Ranging. It is a device used to measure the distance, direction and speed of underwater.

Q.4. Sound is produced by a vibrating source. Why then a vibrating pendulum does not produce any sound?

Answer: The audible range of a normal human being is 20 Hz to 20 KHz. But a vibrating pendulum does not produce sound in this range. So, we are not able to hear this.

Q.5. What is the audible range for a normal human being?

Answer: The audible range of a normal human being is 20 Hz to 20 KHz.

Q.6. Give Reasons for the Following:

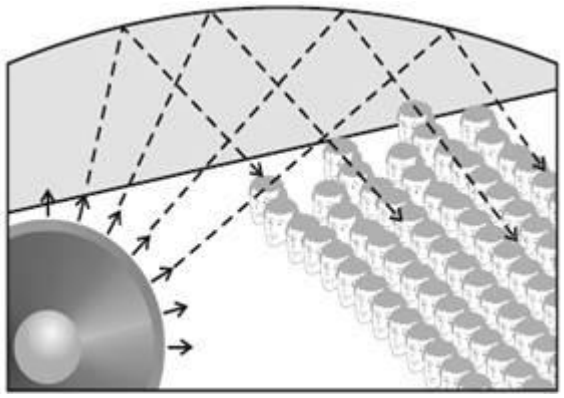
Why sound waves are called mechanical waves?

Answer: The waves that require a medium to propagate are called mechanical waves. They require a medium to transport energy from one point to another. Sound waves are characterised by their motion in a medium. They cannot travel in vacuum (without any medium). So, they are called mechanical waves.

Q.7. Give Reasons for the Following:

Why are ceilings of concert halls curved?

Answer: The audience in a concert hall should hear the sound clearly. Thus, the ceilings of a concert hall are made curved. It is done so that the sound after reflection reaches every corner of the concert hall and the audience can listen to it clearly.



Q.8. Give Reasons for the Following:

Why sound wave is called a longitudinal wave?

Answer: In a longitudinal wave, the individual particles of the medium move in a direction parallel to the direction of propagation of the disturbance. The particles oscillate back and forth on their position of rest. A sound wave propagates in the same way. So, they are called longitudinal waves.

Q.9. Give Reasons for the Following:

Why echoes can't be heard in a small room?

Answer: A sound persists in our ear for 0.1 s. At temperature 22℃ in air and speed of sound 344 ms^{-1}, the total distance covered by sound between the point of generation and reflecting surface should be at least (344 m/s) x0.1 s = 34.4 m. Thus, the minimum distance between the point of generation and reflecting surface should be half of it i.e. 17.2 m. So, we cannot hear an echo in a small room as the minimum distance for the echo will not be satisfied. But we can hear an echo in a long gallery and big halls.

Q.10. Give Reasons for the Following:

Why echoes in the long gallery and big halls can be heard?

Answer: A sound persists in our ear for 0.1 s. At temperature 22℃ in air and speed of sound 344 ms^{-1}, the total distance covered by sound from the point of generation and reflecting surface and back should be at least (344 m/s) x0.1 s = 34.4 m. Thus, the minimum distance between point of generation and reflecting surface should be half of it i.e. 17.2 m. So, in a long gallery and big halls, we can hear the echo due to the distance between the point of generation and reflecting surface more than the minimum distance required in given conditions.

Q.11. Transverse waves and longitudinal waves.

Answer: Transverse wave: In a transverse wave, particles oscillate up and down about their mean position in a direction perpendicular to the direction of propagation of wave. e.g. light waves

Longitudinal wave: In a longitudinal wave, the individual particles of the medium move in a direction parallel to the direction of propagation of the wave. The particles oscillate back and forth about their position of rest. e.g. Sound wave

Q.12. Crest and trough.

Answer: Crest: It is the highest point the medium rises to while propagation of wave.

Trough: It is the lowest point a medium fall to while propagation of wave.

Q.13. Infrasonic vibrations and ultrasonic vibrations.

Answer: Infrasonic vibrations: Their frequency is below 20 Hz.

Ultrasonic vibrations: Their frequency is above 20 KHz.

Q.14. Compression and rarefaction.

Answer: Compressions: The particles are closest to each other in this. The density of the medium is maximum at compression.

Rarefaction: The particles are farthest from each other. The density of the medium is minimum for rarefaction.

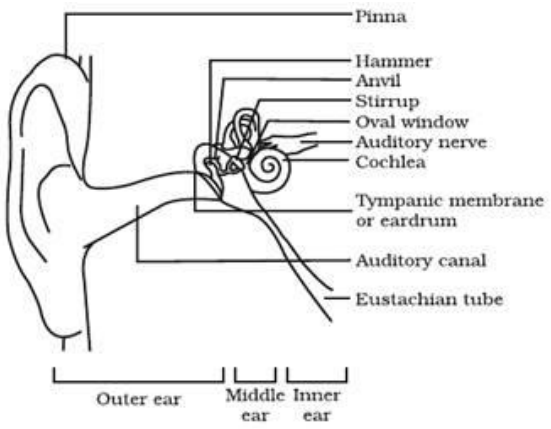
Q.15. Loudness and intensity of sound.

Answer: Loudness defines how loud a sound is to a listener.

Intensity is a measure of the energy contained in a wave. Its unit is decibel(dB).

Q.16. With the help of a labelled diagram, explain the working of the human ear.

Answer:



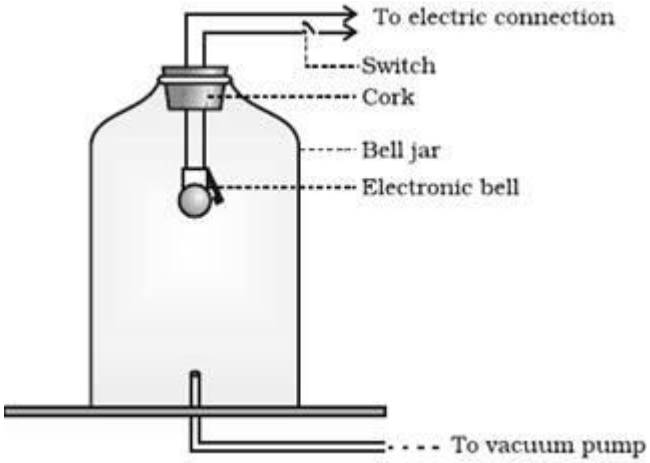
Working of human ear:

The outer ear is called ‘pinna’. It collects the sound from the surroundings. The auditory canal passes this sound to a thin membrane called the eardrum or tympanic membrane.

When a compression or rarefaction of the medium reaches the eardrum, it moves inward or outward. In this way, the eardrum vibrates. These vibrations are amplified several times by three bones- the hammer, anvil and stirrup in the middle ear. The middle ear transmits the amplified pressure variations to the inner ear. The cochlea converts these variations into the electrical signals in inner ear. These signals are sent to the brain via the auditory nerve. The brain interprets them as sound.

Q.17. Illustrate with the help of an experiment that sound requires a medium to propagate.

Answer:



● Take an electric bell and an airtight bell jar.

● Suspend the bell inside the bell jar.

● Connect a vacuum pump to the bell jar as shown in the figure.

● Press the switch to hear the bell.

● Now, start the vacuum pump.

● When the air in the jar is pumped out gradually, the sound becomes fainter even though the same current is passing through the bell.

● As the amount of air decreases inside the bell jar, the sound becomes fainter.

● When there is no air inside the jar, there is no sound of the bell.

This shows that sound requires a medium to propagate.

Q.18. A sound wave of length 70 cm travels 840 m in 25 seconds. What is the velocity and frequency of sound?

Answer:

Given,

distance travelled = 840 m

time taken = 2.5 sec

length of wave = 70 cm = 0.7 m

$$\text{velocity of wave} = \frac{\text{distance}}{\text{time}} = \frac{840}{2.5} = 336\ \text{ms}^{-1}$$

$$\text{frequency} = \frac{\text{velocity}}{\text{wavelength}} = \frac{336}{0.7} = 480\ \text{Hz}$$

Q.19. An echo is heard after 0.8 seconds, when a person fires a cracker 132.8 m from a high building. Calculate the speed of sound.

Answer:

Given,

time for echo = 0.8 sec

height of building = 132.8 m

distance travelled by sound = 2×height

distance travelled = 2×132.8 = 265.6 m

$$\text{speed of sound} = \frac{\text{distance}}{\text{time}} = \frac{265.6}{0.8} = 332\ \text{ms}^{-1}$$

Q.20. A source of wave produces, 40 crests and 40 troughs in 0.4 seconds. Find the frequency of the wave.

Answer:

Given,

There are 40 crests and 40 troughs.

One crest and one trough constitutes one cycle.

So, total number of cycles = 40

One cycle denotes one time period.

$$\text{Time period} = \frac{\text{Total time}}{\text{No. of cycles}} = \frac{0.4}{40} = 0.01\ \text{s}$$

$$\text{frequency} = \frac{1}{\text{Time period}} = \frac{1}{0.01} = 100 \text{ Hz}$$

Q.21. Why an echo is not heard when distance between source of sound and reflecting body is 10 m?

Answer: A sound persists in our ear for 0.1 s. At temperature 22℃ in air and speed of sound 344 ms^{-1}, the total distance covered by sound between the point of generation and reflecting surface should be at least (344 m/s) x 0.1 s = 34.4 m. Thus, the minimum distance between point of generation and reflecting surface should be half of it i.e. 17.2 m. So, we cannot hear echo in a smaller room of 10 m.

Q.22. The distance between the crest and trough of a transverse wave is 15 cm, what is the velocity of the wave if its frequency is 1000 Hz?

Answer: Distance between crest and trough is called its wavelength.

Given,

wavelength = 15 cm = 0.15 m

frequency = 1000 Hz

velocity = wavelength × frequency

velocity = 0.15×1000 = 150 ms^{-1}

Q.23. Two astronauts cannot hear each other on the moon. Why?

Answer: Sound is a mechanical wave and requires medium to propagate. As the moon has no atmosphere, it has absence of air. So, there is no medium for sound to propagate. So, two astronauts cannot hear each other on the moon.

Q.24. Sometimes our dog beings to bark without any reason. Can you explain, why?

Answer: Dogs can hear sounds which are beyond our audible range. So, whenever they hear a sound which is inaudible to us, they bark in a response to it.

Q.25. In which case is the speed of sound more; the humming of a bee or the roaring of a lion?

Answer: The speed of sound does not depend on the amplitude of the sound. So, both the sounds- the humming of bee and the roaring of a lion travel at the same speed but differ in loudness due to difference in amplitudes.

Q.26. When is the velocity of sound more; during winters or during summers?

Answer: The speed of sound depends on the properties of a medium. It travels faster when the temperature is high as the particles vibrate more due to the heat energy provided to them.

Q.27. Can elephants hear frequencies less than 20 Hz?

Answer: Elephants are able to hear the infrasound range. This range lies below 20 Hz. So, they are able to hear sound below 20 Hz.

Comprehensive Exercises (MCQ)

Q.1. Which of the following are transferred from one place to another place by the waves?

A. mass

B. Wavelength

C. Velocity

D. energy

Answer: Energy is transferred from one place to another by the propagation of waves.

Q.2. Sound waves are:

A. transverse

B. longitudinal

C. partly transverse and partly longitudinal

D. none of these

Answer: In a longitudinal wave, the individual particles of the medium move in a direction parallel to the direction of propagation of the disturbance. The particles oscillate back and forth on their position of rest. Sound waves are longitudinal waves.

Q.3. On a slinky we can produce:

A. transverse waves only

B. longitudinal waves only

C. both transverse and longitudinal waves

D. neither transverse nor longitudinal waves

Answer: A slinky produces transverse waves when one end is fixed and the other end is stretched and given a jerk at right angle to its length.

It produces longitudinal waves when compressions are given at regular intervals of time at its free end.

Q.4. The distance between consecutive crests is:

A. one wavelength

B. half a wavelength

C. one-fourth wavelength

D. twice wavelength

Answer: The distance between consecutive crests is called one wavelength.

Q.5. Hertz is a unit of:

A. time period

B. wavelength

C. frequency

D. wave speed

Answer: Hertz is a unit of frequency named after H.R. Hertz.

Q.6. If the density of a medium through which sound is propagation is minimum, then this point is called:

A. rarefaction

B. crest

C. compression

D. trough

Answer: A rarefaction during the propagation of sound wave takes place when the density of the medium is minimum.

A compression during the propagation of sound wave takes place when the density of the medium is maximum.

Q.7. The audible range for a normal human being is:

A. 10 Hz to 20,000 Hz

B. 20 Hz to 20 KHz

C. 10 Hz to 50 KHz

D. 20 Hz to 1000 Hz

Answer: The audible range for a normal human being is 20 Hz to 20 KHz.

Q.8. Ultrasonic are not used in:

A. SONAR

B. sibigraphy

C. CUSA

D. radio waves

Answer: Ultrasonic are used in SONAR, sibigraphy, CUSA but not radio waves.

Q.9. A bomb explodes on the Moon, how long will the sound of explosion take to reach the Earth?

A. 10 s

B. 1000 s

C. 1 day

D. none of these

Answer: As the moon has no atmosphere, there is absence of air. Sound cannot travel without medium because it is mechanical wave. So, it will never be able to reach earth due to vacuum between earth and moon in space.

Q.10. The walls of a hall built for musical concert should:

A. amplify sound

B. reflect sound

C. transmit sound

D. absorb sound

Answer: The walls of a hall built for musical concert should be able to absorb sound and reduce reverberation.

Q.11. In an orchestra, the musical sounds of different instruments are distinguished from one another by the characteristic of:

A. loudness

B. pitch

C. quality or timbre

D. all the three

Answer: Quality or timbre is the property of sound which distinguishes it from other sounds.

Q.12. The bells of a temple are made of large size. It is for:

A. producing sound of high pitch

B. producing loud sound

C. producing sound of high quality

D. enhancing the beauty

Answer: A larger bell has low resonant frequency and the sound is able to travel more distance and is louder.

Q.13. An astronaut cannot hear his companion on the surface of the Moon because:

A. frequencies produced are above the audio frequencies

B. there is no medium for sound propagation

C. temperature is too low during night and high during day

D. there are too many crates on the surface of the Moon

Answer: As the moon has no atmosphere, there is absence of air. Sound cannot travel without medium because it is mechanical wave. So, an astronaut cannot hear his companion on the surface of the Moon.

Q.14. The loudness of a sound depends upon:

A. amplitude

B. pitch

C. velocity

D. wavelength

Answer: The loudness of a sound is directly proportional to its amplitude.

Q.15. In the bell jar experiment, as air is removed from the jar:

A. intensity of sound falls

B. speed of sound falls

C. intensity of sound increases

D. speed of sound increases

Answer: Sound requires medium to propagate. So, it faints as the air is removed from jar and its intensity decreases.

Comprehensive Exercises (T/F)

Q.1. Write true of false for the following statements:

Sound waves are transverse whereas light waves are longitudinal in nature.

Answer: False

Explanation: Sound waves are longitudinal waves. They propagate when the particles of the medium oscillate back and forth about their position of rest and do not move from one place to another.

Light waves are transverse wave but the particles in oscillation are not of the medium as it is not a mechanical wave.

Q.2. Write true of false for the following statements:

Distance between a crest and the next trough in a wave motion is λ/4.

Answer: False

Explanation: Distance between a crest and the next trough in a wave motion is 3λ/2.

Q.3. Write true of false for the following statements:

The audible range of frequencies is 20 Hz-20 KHz.

Answer: True

Explanation: Human ears can detect frequencies of 20 Hz to 20 kHz only.

Q.4. Write true of false for the following statements:

The frequency of a sounding body of time period 0.01 sec is 100 Hz.

Answer: True

Explanation:

$$\mathbf{frequency(f)} = \frac{\mathbf{1}}{\mathbf{Time\ period(T)}}$$

Given,

Time period(T) = 0.01 sec

Frequency(f) =?

$$\Rightarrow \mathbf{f} = \frac{\mathbf{1}}{\mathbf{0.01\ s}} = \mathbf{100\ Hz}$$

Q.5. Write true of false for the following statements:

The minimum distance between a source and the reflector of sound should be 34 m.

Answer: False

Explanation: The total distance covered by the sound from the point of generation and reflecting surface and back should be at least (344 m/s) x0.1 s = 34.4 m. Thus, the minimum distance between point of generation and reflecting surface should be half of it i.e. 17.2 m.

Q.6. Write true of false for the following statements:

Sound waves travel faster in air than in water.

Answer: False

Explanation: The speed of sound decreases as we go from solid to gaseous state. Thus, sound travels faster in water than in air.

Q.7. Write true of false for the following statements:

Sound travels faster at a higher temperature than at a lower temperature.

Answer: True

Explanation: The speed of sound depends on the properties of a medium. It travels faster at a higher temperature than at a lower temperature.

Q.8. Write true of false for the following statements:

Sound and light travel in a medium in the form of crests and troughs and rarefactions and compressions respectively.

Answer: False

Explanation: Only sound travels in a medium in the form of crests and troughs. Light travels in the form of wave.

Q.9. Write true of false for the following statements:

Light waves require no medium for their propagation.

Answer: True

Explanation: Light is not a mechanical wave. They can travel without any medium.

Q.10. Write true of false for the following statements:

Sound produced by a sounding body of frequency 300 Hz covers 34 m in the time the sounding body produces 30 vibrations.

Answer: True

Explanation:

Given,

Frequency(f) = 300 Hz

No. of vibration = 30

Distance travelled by sound = 34 m

$$\text{frequency(f)} = \frac{1}{\text{Time period(T)}}$$

$$\Rightarrow T = \frac{1}{f}$$

$$\Rightarrow T = \frac{1}{300} = 0.0033 \text{ sec}$$

After 30 vibrations,

Total time taken = No. of vib.×Time period

$$\text{Total time taken} = 30 \times \frac{1}{300} = 0.1 \text{ s}$$

Distance travelled = speed â time

Distance = 340×0.1 = 34 m

Q.11. Write true of false for the following statements:

Velocity of sound in air is more for higher frequency than for lower frequency.

Answer: False

Explanation: In a given medium, the speed of sound is almost same for all frequencies.

$$\text{speed}(\upsilon) = \text{wavelength}(\lambda) \times \text{frequency(f)}$$

In a given medium, if the wavelength is same then the speed increases with frequency.

Q.12. Write true of false for the following statements:

The wavelength of 5 MHz ultrasound in a medium where the velocity is 1540 m s^{-1} is 0.3 mm.

Answer: False

Explanation:

wavelength of ultrasound = 5 MHz

velocity of ultrasound = 1540 ms-1

Then, for sound wave

$$\text{velocity}(\upsilon) = \text{wavelength}(\lambda) \times \text{frequency}(f)$$

$$\Rightarrow \text{frequency}(f) = \frac{\text{velocity}}{\text{wavelength}} = \frac{1540}{5 \times 10^6} = 3.08 \times 10^{-4}\text{m} = 0.03\ \text{mm}$$