Sound

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:

Q1. Which of the following is not a longitudinal wave?

a. Seismic P-wave

b. Light

c. Sound

d. Ultrasound

Q2. 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

Q3. 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.

Q4. 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)

c. (i) and (ii)

b. (ii) and (iii)

d. (i), (ii), (iii) and (iv)

Q5. 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

Solutions

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:

Q1. 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

Q2. 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

Q3. Waves from sitar wire and veena wire are distinguished by (of same frequency):

a. Loudness

b. Pitch

c. Quality

d. Both b. and c.

Q4. 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.

Q5. 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)

Solutions

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

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

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

$\lambda_1 = 17\ m$ $\lambda_2 = 0.017\ m$

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:

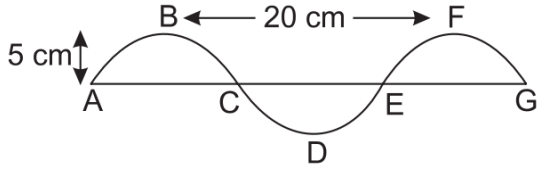
Q1. What type of waves are produced by voice of Anuj and Shefali in the air inside the plastic cup?

Q2. What type of waves are produced in the string?

Q3. Give one difference between these types of waves.

Q4. Why is sound wave called a longitudinal wave?

Q5. Waves of frequency 100 Hz are produced in a string as shown in figure. Give its amplitude and wavelength.



Solutions

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:

Q1. What do you think was the device being used by the shopkeepers to amplify their voice?

Q2. What is the other name of this device?

Q3. State the principle on which this device works.

Q4. 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.

Q5. Name two musical instruments which works on the same principle as the device discussed in this passage.

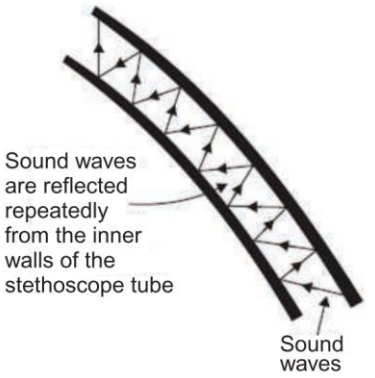
Solutions

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:

Q1. What type of sounds are (i) X, (ii) Y and (iii) Z?

Q2. Name one animal which play games by producing sound like X.

Q3. Name two animals in a zoo which can produce sound like Y.

Q4. What is the frequency range of sounds like Z?

Solutions

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.