Study of Sound

Exercises

Q. 1 A. Fill in the blanks and explain.

Sound does not travel through ……

Answer : Vacuum

Explanation: Sound is a mechanical wave. As all mechanical waves require a material medium to travel, sound can also travel only in material media. As vacuum is not a material medium, sound cannot travel in vacuum.

Q. 1 B. Fill in the blanks and explain.

The velocity of sound in steel is ..... than the velocity of sand in water.

Answer : greater

Explanation: Velocity of sound in solids>liquids>gases. Therefore, velocity of sound in steel is greater than velocity of sound in water.

Q. 1 C. Fill in the blanks and explain.

The incidence of …… in daily life shows that the velocity of sound is less than the velocity of light

Answer : lightning during thunders

Explanation: During thundering, we observe lighting first and the sound is heard later. This proves that velocity of light is greater than velocity of sound.

Q. 1 D. Fill in the blanks and explain.

To discover a sunken ship or objects deep inside the sea, ... technology is used.

Answer : SONAR(Sound Navigation and Ranging)

Explanation: SONAR is used to determine the direction, distance and speed of an underwater object with the help of ultra sonic sound waves.

Q. 2. Explain giving scientific reasons.

A. The roof of a movie theatre and a conference hall is curved.
B. The intensity of reverberation is higher in a closed and empty house.
C. We cannot hear the echo produced in a classroom

Answer : A. Reason: Sound waves get reflected from the roof multiple times. This causes a single sound to be heard continuously. This is called reverberation. The time between successive reflections of a particular sound wave reaching us becomes smaller and the reflected sounds get mixed up and produce a continuous sound of increased loudness which cannot be deciphered clearly. To avoid this phenomenon, the roof of a movie theatre and conference hall is curved.

B. Reason: In a closed room, there are many objects or obstructions acting as sound absorbers. So the amount of sound getting reflected is very less. But in case of an empty room there are no obstructions. So, sound gets reflected multiple times leading to greater intensity of reverberation.

C. Reason: The dimensions of a classroom usually do not exceed 17.2m. If the dimensions are greater than 17.2m , echo is produced. So echo is not produced in a classroom.

Q. 3. Answer the following questions in your own words.

A. What is an echo? What factors are important to get a distinct echo?
B. Study the construction of the Golghumat at Vijapur and discuss the reasons for the multiple echoes produced there.
C. What should be the dimensions and the shape of classrooms so that no echo can be produced there?

Answer : A. Echo: An echo is the repetition of original sound because of reflection by a surface.

Factors important to get a distinct echo:

The velocity of sound at 22^0C temperature is 344 m/s. Our brain retains a sound for 0.1 sec. So to hear a distinct echo, the time taken by the starting sound to get reflected should be greater than 0.1 sec. So the distance between the listener and the reflecting surface at this temperature should be

$d = v \times t$

$= 344 \text{ m/s} \times 0.1 \text{ s}$

$= 34.4 \text{ m}.$

This is the distance required by the starting sound to reach the reflecting surface, get reflected and reach the listener. So, the distance between the listener and reflecting surface should be atleast half of the above calculated distance i.e. 17.2km.

B. In GolGumbaz and Vijaypur the reason for multiple echoes produced is due to multiple reflections of sound by the tomb. The sound produced gets reflected several times throughout the tomb which is responsible for echos.

C. A classroom should be rectangular in shape and its dimensions should be less than 17.2m for an echo to be not produced at normal room temperature.

Sound absorbing material like should be also used for soundproofing the room.

Q. 4. Where and why are sound absorbing materials used?

Answer : Sound absorbing materials are used in buildings and offices to prevent transmission or reflection of sound. They prevent leakage of sound to other rooms. Sound absorbing materials also prevent echoes.

Q. 5 A. Solve the following examples.

The speed of sound in air at 0^0C is 332 m/s. If it increases at the rate of 0.6 m/s per degree, what will be the temperature when the velocity has increased to 344 m/s?

Answer : Given:

Speed of sound in air at 0^0C = 332m/s

Speed increases at a rate of 0.6m/s per degree

Temperature at 344 m/s = T^0c

Difference in velocities = 344 m/s - 332 m/s

= 12 m/s

Increase in temperature corresponding to the increase in velocity =

12/0.6 = 20^0C

Therefore temperature at velocity 344m/s = 0^0C + 20^0C = 20^0C

Q. 5 B. Solve the following examples.

Nita heard the sound of lightning after 4 seconds of seeing it. What was the distance of the lightning from her?

Answer : Given:

Velocity of sound in air (v) = 340 m/s^2

Time taken for the sound to reach the receiver(t) = 4 sec

Distance of the source from receiver (d) = v × t

= 340 × 4

= 1360 m/s

Q. 5 C. Solve the following examples.

Sunil is standing between two walls. The wall closest to him is at a distance of 360 m. If he shouts, he hears the first echo after 4 s and another after another 2 seconds.

1. What is the velocity of sound in air?
2. What is the distance between the two walls?

Answer : Given:

Distance of nearest wall from the man (d) = 360m

Time after which the man hears the first echo (t_1) = 4s

Time after which the man hears the second echo (t_2) = 4s+2s = 6s

1.Distance travelled by sound when man hears the first echo = $2d_1$ = 720m

Velocity of sound = Distance travelled by sound/Time taken

= 720/4

= 180 m/s

2. Let distance between two walls = x m

Distance between second wall and the man(d_2) = (x-360)m

Time taken for the second echo to reach the man (t_2) = 6s

Distance travelled by the sound = $2d_2$

Velocity of sound = Distance travelled by sound/Time taken

180 = (2(x-360))/6

x = 900 m

Therefore, distance between the two walls (x) = 900m

Q. 5 D. Solve the following examples.

Hydrogen gas is filled in two identical bottles, A and B, at the same temperature. The mass of hydrogen in the two bottles is 12gm and 48 gm respectively. In which bottle will sound travel faster? How many times as fast as the other?

Answer : Given:

Mass of hydrogen in bottle A (M_A) = 12gm

Mass of hydrogen in bottle B (M_B) = 48gm

We know that mass $m \propto \rho$

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So $\rho_A/\rho_B = M_A/M_B$

We know that $v \propto \frac{1}{\sqrt{\rho}} \propto \frac{1}{\sqrt{M}}$

Therefore $\frac{v_A}{v_B} = \sqrt{\frac{M_B}{M_A}}$

$$\frac{v_A}{v_B} = \sqrt{\frac{48}{12}} = 2$$

So, $v_A = 2v_B$

So velocity in bottle B is two times the velocity in bottle A.

Q. 5 E. Solve the following examples.

Helium gas is filled in two identical bottles A and B. The mass of the gas in the two bottles is 10 gm and 40 gm respectively. If the speed of sound is the same in both bottles, what conclusions will you draw?

Answer : Given:

Mass of helium in bottle A = 10 gm

Mass of helium in bottle B = 40 gm

Velocity of helium in bottle A = Velocity of helium in bottle B

$=> v_A = v_B = v$

We know that

$$v \propto \sqrt{\frac{T}{M}}$$

T = Temperature

So

$$\frac{T_A}{M_A} = \frac{T_B}{M_B}$$

$$\frac{T_A}{T_B} = \frac{M_A}{M_B}$$

$$\frac{T_A}{T_B} = \frac{10}{40} = \frac{1}{4}$$

Temperature in bottle A is less than temperature in bottle B.