KitabCd Academy

CLASS-9-CHAPTER-12-STUDY OF SOUND

Solutions

Science & Technology

Based on Maharashtra Board Syllabus 2020-2021

Class-9-Chapter-12-Study of Sound

Question 1.

Fill in the blanks and explain.

a. Sound does not travel through .....

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

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

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

Answer :

a. Sound does not travel through **vacuum**.

b. The velocity of sound in steel is **greater** than the velocity of sound in water.

c. The incidence of **thunderstorm** in daily life shows that the velocity of sound is less than the velocity of light.

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

Question 2.

Explain giving scientific reasons.

a. The roof of a movie theatre and a conference hall is curved.

Answer :

The persistence of sound due to repeated reflection of sound in a big hall or an auditorium is called reverberation.

The roof of a movie theatre and a conference hall is curved to avoid undesirable reverberation. Otherwise, pitch of music will not be heard distinctly.

b. The intensity of reverberation is higher in a closed and empty house.

Answer :

In an empty house, there is no sound absorbers present such as furniture, curtains etc. In a closed and empty house, there is absorption of sound only by the floor, walls and the ceiling. Hence, the intensity of reverberation is higher.

c. We cannot hear the echo produced in a classroom.

Answer :

To hear distinct echo, the minimum distance between the source of sound and obstacle should be 17.2 m (assuming room temperature as 22°C). The classrooms are designed in such a way that, this condition is not satisfied in our classroom as the ceiling is not so high and the distance between the walls are less than 17.2 m. Hence, we cannot hear echo produced in our classroom

Question 3.

Answer the following questions in your own words.

a. What is an echo? What factors are important to get a distinct echo?

Answer :

The repetition of sound caused by its reflection off a hard surface is known as echo.

Factors important to get a distinct echo are:

The sensation of sound lasts in our brain for about 0.1 s. The distance covered by sound in this time = speed of sound x time = 344 m/s x 0.1 s = 34.4 m as the speed of sound in air at 22°C is 344 m/ s.

Total distance (source to obstacle and back),

34.4 m = 2 x distance between the source and obstacle.

∴ Distance between the source and obstacle = 34.4m/2 = 17.2 m

This gives the minimum distance between the source and obstacle for hearing distinct echo in the present case.

b. Study the construction of the Golghumat at Vijapur and discuss the reasons for the multiple echoes produced there.

Answer :

- An echo can be heard multiple times in the golghumat located in Vijaypur, Karnataka because of multiple or continuous reflections on its surfaces.
- Golghumbat has a central dome which stands without any support. The sound produced here gets reflected throughout the dome producing the echo at least three to four times in a second.
- If the surroundings inside the architecture are very quiet, then we would be able to hear echo at least seven to ten times.
- So, this central dome is the main reason for the production of multiple echoes in Golghumat.

c. What should be the dimensions and the shape of classrooms so that no echo can be produced there?

Answer :

For no echo to be produced in a classroom, the classroom should be square shaped with distance between the opposite walls and height of ceiling is less than 17.2 m. Also, the ceiling should be curved shaped so that the reflection of sound wave is uniform throughout the room.

Question 4.

Where and why are sound absorbing materials used?

Answer :

The sound absorbing materials are used on the roofs and walls of auditoriums, concert halls, theatres, etc. to avoid production of echo.

Question 5.

Solve the following examples.

a. The speed of sound in air at 0°C 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 :

In this case, v at t°C = (v at 0°C)+ (0.6 t) m/s

Hence, by the data given,

344 = 332 + 0.6 t

$\therefore$ t= $\frac{344-332}{0.6} = \frac{12}{0.6}$ = **20°C**

This will be the required temperature

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

(The velocity of sound in air is 340 m/s.)

Answer :

Given : t= 4 s, v (sound) = 340 m/s

The speed of light in air is about 3 x 10^8 m/s.

This is far greater than v (sound) in air.

Hence, the required distance,

S = vt =340 x 4 =**1360 m**

c. 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 : Time to hear first echo t_1= 4s, Time taken to hear second echo t_2= 4 s + 2 s = 6 s

Time required for first echo to be heard 4s = 2 x time required to reach the first wall (t_1)

t_1 =4/2 s = 2s

Time required for second echo to be heard 6s = 2 x time required to reach the second wall (t_2)

t_2 =6/2 s = 3s

Velocity of sound in air,

V = s/t = $\frac{660}{\frac{4}{2}}$ m/s = 330 m/s

Distance between the two walls,

= $s_1 + s_2$

= $vt_1 + vt_2$

= $v(t_1 + t_2)$

= 330(2+3)

=330 x 5 **= 1650 m**

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

Answer :

The velocity of sound in gas is related to density of gas as

$v \propto \frac{1}{\sqrt{\rho}}$ .....(i)

and the velocity of sound in gas is related to temperature of gas as

$v \propto \sqrt{T}$ .....(ii)

from eq. (i) and (ii), we get

$v \propto \sqrt{\frac{T}{\rho}} \propto \sqrt{\frac{VT}{M}}$ ……..(as $\rho = \frac{M}{V}$)

Now, the two bottles given are identical i.e. the volumes of gases are same. Let the volume of the bottle be *V*. Let M_1 and M_2 be the masses of the gases in bottles A and B, respectively and v_1 and v_2 be the velocity of the sound in the two bottles, respectively. Since, the temperature of gas in both the bottles are same, let that common temperature be *T*. Therefore,

$v_1/v_2 = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{48}{12}} = 2$

$v_1 = 2v_2$

Thus, the sound travels 2 times faster in bottle A.

e. 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 :

For ref. see above solved example.

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

The bottle are identical, this means the volumes of the gases are equal. Let the volume of the bottle be *V*. Let M_1 and M_2 be the masses of gases in bottles A and B, respectively and v_1 and v_2 be the velocity of the sound in A and B bottles, respectively. Also, let T_1 and T_2 be their respective temperatures. Therefore,

$v_1 \propto \sqrt{\frac{VT_1}{M_1}}$ & $v_2 \propto \sqrt{\frac{VT_2}{M_2}}$

since the speed of the sound is same

$\therefore \sqrt{\frac{VT_1}{M_1}} = \sqrt{\frac{VT_2}{M_2}}$

$\therefore T_2 = \frac{T1M2}{M1} = \frac{T_1 \times 40}{10} = 4T_1$

$\therefore$ **Temperature of B is 4 times the temperature of A.**

QR Code for Class-9-Science-all chapters