NCERT solutions for class 9 science chapter 12 Sound

Q1. How does the sound produced by a vibrating object in a medium reach your ear?

Answer:

Objects when vibrating, produce vibration to the neighboring particles of the medium. These vibrating particle forces the adjacent particles to vibrate.

This way vibrations are produced by an object is transferred from one particle to the other till the vibration reaches our ear.

Q. Explain how sound is produced by your school bell.

Answer:

When the school bell vibrates, it pushes the adjacent particles of air to vibrate. This causes the disturbance in the wave when the bell moves forward it pushes the air particles in front of it and creates a region of high pressure known as compression and when the bell moves backward, it creates a region of low pressure known as rarefaction.

The continuous forward and backward movement of the bell produces a series of compression and rarefaction. This makes the sound of a bell to propagate through the air.

Q2. Why are sound waves called mechanical waves?

Answer:

The sound waves are mechanical waves because they need a material medium to propagate.

Q3. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Answer:

No, we cannot hear any sound on the Moon because Moon does not have an atmosphere and sound needs a medium for propagation.

Topic 12.2.2 Sound waves are Longitudinal Waves

Q1. Which wave property determines (a) loudness, (b) pitch?

Answer:

(a) The loudness of a sound depends on its amplitude. Higher the amplitude, the sound produced will also be loud.

(b) The pitch of a sound is determined by its frequency. If the frequency of sound is high then, the sound produced will be high pitched.

Q2. Guess which sound has a higher pitch: guitar or car horn?

Answer:

The guitar has higher pitch since, the frequency of the wave determines pitch, i.e., higher the frequency of a wave, more, is its pitch.

The frequency of vibration of the particle is more in case of the guitar than the car horn.

Hence, the guitar will produce a higher pitch than the car horn.

NCERT solutions for class 9 science chapter 12 Sound

Topic 12.2.3 Characteristics of a sound

Q1. What are wavelength, frequency, time period and amplitude of a sound wave?

Answer:

The wavelength of the sound wave is the distance between the two consecutive compressions or rarefactions. The SI unit is a meter (m).

Frequency is the number of complete oscillations per second and it is measured in Hertz (Hz).

Time period: is the time taken to complete one complete oscillation. It is measured in seconds.

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

Q2. How are the wavelength and frequency of a sound wave related to its speed?

Answer:

Velocity, frequency, and wavelength are related to each other as follows:

$$Velocity(v) = Wavelength(\lambda) \times Frequency(\nu)$$

$$v = \lambda \times \nu$$

Above equation is known as the wave equation and applicable to all types of wave.

Q3. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Answer:

Given a sound wave whose frequency is $220Hz$ and speed is $440\ m/s$, then its wavelength will be:

As velocity is given by,

$$v = \lambda \times \nu$$

Then $\lambda = \frac{v}{\nu}$

Or, $\lambda = \frac{440\ m/s}{220\ Hz} = 2\ m$.

Thus, the wavelength of the given sound wave is 2m.

Q4. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?

Answer:

Given,

The frequency of the sound wave, $f = 500Hz$.

Hence, the time period,

$$T = \frac{1}{f} = \frac{1}{500Hz} = 0.002\ s$$

Therefore, the time interval between successive compressions from the source of sound is equal to the time period of sound waves.

CBSE NCERT solutions for class 9 science chapter 12 Sound

Topic 12.2.3 Characteristics of a sound

Q1. Distinguish between loudness and intensity of sound.

Answer:

The **Intensity of sound** is defined as the sound power per unit area in a direction perpendicular to that area. The SI unit of intensity is the watt per square meter (W/m^2) .

The **loudness of sound** refers to how loud or soft a sound seems to a listener and is determined by the intensity or the amount of energy. The unit of intensity is the decibel (dB).

Higher the decibel level sound waves have greater intensity and sounds are louder.

Free NCERT solutions for class 9 science chapter 12 Sound

Topic 12.2.4 Speed of sound in different media

Q1. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Answer:

The speed of the sound depends on the nature of the medium. The speed of sound is fastest in the case of solids and decreases further in liquids followed by gases.

Therefore, in iron, the speed of sound is the fastest at a given temperature.

NCERT solutions for class 9 science chapter 12 Sound

Topic 12.3 Reflection of Sound

Q1. An echo is heard in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is $342\ m\ s^{-1}$?

Answer:

Given the speed of sound is $342\ m\ s^{-1}$.

The time taken by the sound to travel from the source to the reflecting surface will be half of this time:

$= \frac{3}{2} seconds$

Hence,

$Distance = Speed \times Time$

Substituting the values in the equation, we get the distance,

$$Distance = 342\ m/s \times 1.5s = 513\ m$$

Solutions for NCERT class 9 science chapter 12 Sound

Topic 12.3.3 Uses of multiple reflections of sound

Q1. Why are the ceilings of concert halls curved?

Answer:

The sound after reflection reaches every corner of the concert hall and the audience can hear properly and clearly.

Topic 12.4 Range of Hearing

Q1. What is the audible range of the average human ear?

Answer:

The audible range of an average human ear lies between frequency 20Hz to 20,000Hz.

Humans cannot hear sounds of frequency having above or below this range.

Q2. (a) What is the range of frequencies associated with

- Infrasound?

Answer:

The infrasonic sounds lie below 20 Hertz frequency which is inaudible for human ears.

Q2.(b) What is the range of frequencies associated with

- Ultrasound?

Answer:

The ultrasonic sounds have frequencies higher than 20,000 Hertz, which is also not audible for humans.

CBSE NCERT solutions for class 9 science chapter 12 Sound

Topic 12.5.1 Sonar

Q1. A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in saltwater is 1531 m/s, how far away is the cliff?

Answer:

Given,

The time taken by the SONAR pulse to go from the submarine to cliff will be half of this time:

$= \frac{1.02}{2} = 0.51\ second.$

And we know that, $Distance = Speed \times Time$

Substituting the values in the above equation, we obtain

$Distance = 1531\ m/s \times 0.51s = 780.8\ m$

NCERT solutions for class 9 science chapter 12 Sound: Solved Excercise Questions

Q.1. What is sound and how is it produced?

Answer:

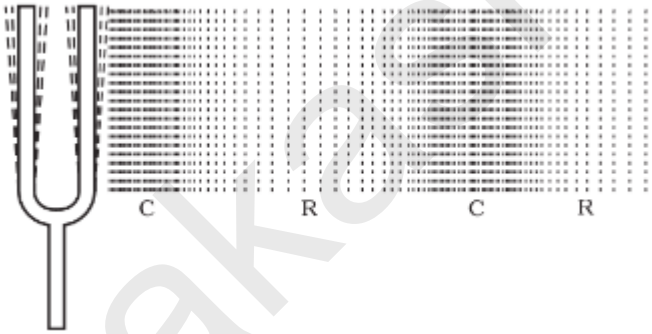
A sound is a form of energy that is produced by the vibrations of objects.

It is produced by the to and fro motion of the object. The vibrations are created which causes a disturbance in the adjacent particles of the medium. The disturbance travels in the waveform and creates sound.

Q2. Describe with the help of a diagram, how compressions and rarefactions are produced in the air near a source of so the sound.

Answer:

The compression and rarefactions produced in air near the source of sound (Here the prong) are shown in the diagram below:



Here C is for Compression and R is for Rarefaction.

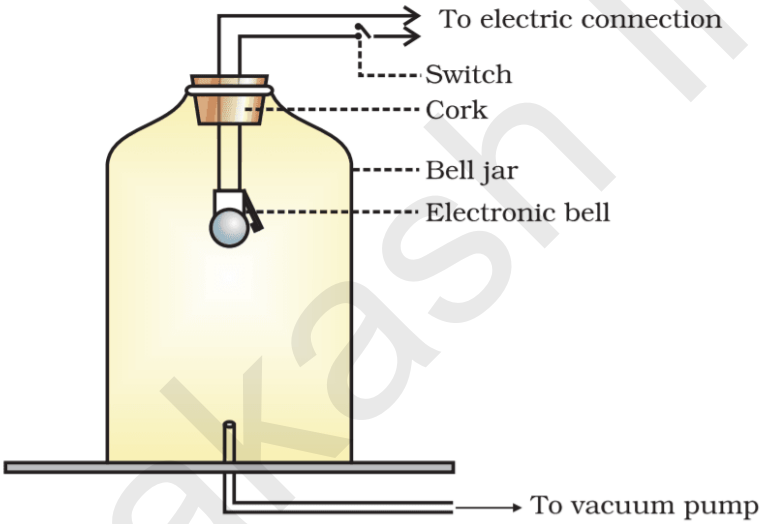
Q3. Cite an experiment to show that sound needs a material medium for its propagation.

Answer:

Bell jar experiment showing sound cannot travel in a vacuum :

Take an electric bell and an airtight glass bell jar. The electric bell is suspended inside the airtight bell jar. The bell jar is connected to a vacuum pump. If you press the switch you will be able to hear the bell. Now start the vacuum pump. When the air in the jar is pumped out gradually, the sound becomes fainter, although the same current is passing through the bell. After some time when less air is left inside the bell jar, you will hear a very feeble sound. And finally, when there is no air present inside the jar, there is no sound detectable.

This proves sound needs a material medium to propagate and cannot propagate through the vacuum.



Q4. Why is a sound wave called a longitudinal wave?

Answer:

longitudinal waves are formed When oscillation is created parallel to the disturbance of the particles of the medium in the direction of propagation and since the sound waves also create oscillations in the particles of the medium parallel to the disturbance in the direction of propagation.

Therefore, sound waves are called a longitudinal wave .

Q5. Which characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room?

Answer:

The quality of timber of the sound is that characteristic which enables us to distinguish one sound from another having the same pitch and loudness.

Thus, because of the difference in timbre and pitch of the sound wave, we can identify the voices of friends.

Q6. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?

Answer:

This happens because of the difference in the velocities of light and sound waves. Light travels much faster than the sound. That is the reason why we hear the thunder a few seconds after the flash of thunder is seen instead of both are produced simultaneously.

Q7. 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 $344\ m\ s^{-1}$.

Answer:

Taking the speed of the sound in air as $344\ m/s.$

Then,

we know: $Speed = Wavelength \times Frequency$

Or, $v = \lambda \times \nu$

Hence,

For $\nu = 20\ Hz$,

$$\lambda_1 = \frac{v}{\nu_1} = \frac{344}{20} = 17.2\ m$$

and for $\nu = 20,000\ Hz$

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

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

Q8. Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in air and in aluminium to reach the second child.

(Given: Speed of sound in air is $346\ m/s$; Speed of sound in aluminium is $6240\ m/s$)

Answer:

Here, let us assume the length of the rod be $'l'$.

Then,

Time taken by the sound wave in air:

$(Given : v_{air} = 346\ m/s)$

$$Time = \frac{Distance}{Speed}$$

$$t_{air} = \frac{l}{346} seconds$$

Time taken by the sound wave in Aluminium to reach from one end to the other end,

$(Given : v_{aluminium} = 6420\ m/s)$

$$t_{aluminium} = \frac{l}{6420} seconds$$

Therefore, the ratio of the time taken by the sound wave in air and in aluminium will be:

$$\frac{t_{air}}{t_{aluminium}} = \frac{\frac{l}{346}}{\frac{l}{6420}} = \frac{6420}{346} = \frac{18.55}{1}$$

Hence, the ratio is $18.55 : 1$ **.**

Q9. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

Answer:

Given the frequency of the sound wave is 100Hz.

Frequency is the number of oscillations per second.

So, 100Hz means that 100 oscillations are done in 1 second.

Thus, in a minute, the number of oscillations would be,

$= 100 \times 60 = 6000$

Q10. Does sound follow the same laws of reflection as light does? Explain.

Answer:

Yes, the sound wave also follows the same laws of reflection as light does. Which are as follows:

(i) The angle of incidence of the sound wave and the angle of reflection of the sound wave to the normal is equal.

(ii) The incident sound wave, the reflected sound wave and the normal at the point of incidence, all lie in the same plane.

Q11. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?

Answer:

Listening to the sound of echo depends upon the time interval between the source of a sound and the reflecting sound which should be at least 0.1 seconds.

The speed of the sound increases with an increase in the temperature of the medium. Hence, on a hotter day, the time interval between the source sound and the reflected sound will decrease.

Therefore, we cannot listen to the echo unless the interval is greater than 0.1 seconds.

Q12. Give two practical applications of reflection of sound waves.

Answer:

Two practical applications of sound waves are :

(i) In stethoscope, the sound of the patient's heartbeat reaches the doctor's ears by multiple reflections throughout the pipe of the stethoscope of sound.

(ii) Horns, megaphones or loudhailers are designed to send sound in a particular direction without spreading it in all directions. There is a conical opening which reflects the sound waves and guides most of the sound waves from the source.

Q13. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given,

$g = 10\ m\ s^{-2}$ and speed of sound = $340\ m\ s^{-1}$.

Answer:

Given the height of the tower, $s = 500\ m$,

and the velocity of the sound, $v = 340\ m/s$,

Acceleration due to gravity, $g = 10\ ms^{-2}$

Let the initial velocity of the stone, $u = 0$, as the stone is initially at rest.

Let the time taken by the stone to fall to the base of the tower be t_1

Now, according to the IInd Equation of Motion:

$$s = ut_1 + \frac{1}{2}gt_1^2$$

$$500 = 0 \times t_1 + \frac{1}{2} \times 10 \times t_1^2$$

$$t_1^2 = 100$$

$$t_1 = 10sec\ .$$

Now, the time taken by the sound to reach the top from the base of the tower,

$$t_2 = \frac{500}{340}sec = 1.47sec$$

Therefore, the splash is heard at the top after time, t

Calculating $t = t_1 + t_2 = 10 + 1.47 = 11.47sec.$

Q14. A sound wave travels at a speed of $339\ m\ s^{-1}$. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?

Answer:

Given,

The speed with which sound travels is $339\ m\ s^{-1}$.

and the wavelength is 1.5 cm.

Then we know the relation,

$$v = \lambda \times \nu$$

Where, v is velocity, λ is the wavelength, and ν is the frequency of the wave.

Hence,

$$\nu = \frac{v}{\lambda} = \frac{339\ m/s}{0.015m} = 22600Hz.$$

Calculated frequency is out of audible range of human ears which
is $20Hz\ to\ 20,000Hz.$

Therefore, it is inaudible.

Q.15. What is reverberation? How can it be reduced?

Answer:

Reverberation is the repeated reflection after the source stops producing a sound which is also known as persistence of sound. When the wave reaches the wall of a room, it is partly reflected back from the wall. This reflected sound then 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 the reverberation, sound must have to be absorbed as it reaches the walls and the ceilings of a room. Materials like wood, fibreboard, rough plastic, heavy curtains, and some seats can be used to reduce the reverberations.

Q16. What is the loudness of sound? What factors does it depend on?

Answer:

Loudness is a physiological response of the ear to the intensity of sound which enables us to distinguish between a soft sound and a loud sound.

The loudness or softness of a sound is determined basically by its amplitude and loudness is proportional to the square of the amplitude of the vibrations.

Where greater the amplitude of vibrations, the louder the sound is produced.

Q17. Explain how bats use ultrasound to catch prey.

Answer:

Bats emits very high frequencies sounds from their mouth which when touches the prey, and gets reflected back to the bat. Then the bat detects these waves and estimates the distance and the direction of the prey.

Q18. How is ultrasound used for cleaning?

Answer:

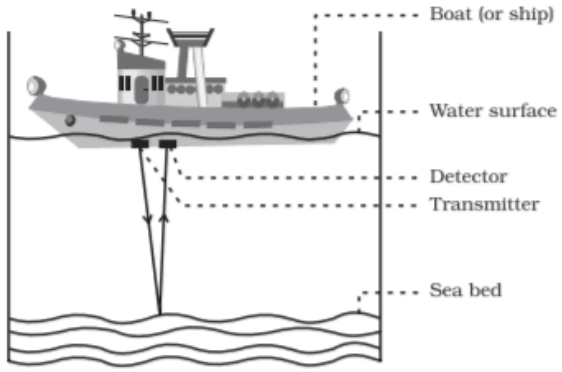
The object to be cleaned is first put in the cleaning solution and then the ultrasonic waves are passed through that solution. The high-frequency ultrasonic waves are capable to remove the dirt from the objects very easily.

Q19. Explain the working and application of a sonar.

Answer:

Working of SONOR:

Sonar consists of a transmitter and a detector and is installed in a boat or a ship, as shown in Figure below:



The transmitter produces and transmits ultrasonic waves. These waves travel through water and after striking the object on the seabed, get reflected back and are sensed by the detector. The detector converts the ultrasonic waves into electrical signals which are appropriately interpreted. The distance of the object that reflected the sound wave can be calculated by knowing the speed of sound in water and the time interval between the transmission and reception of the ultrasound.

Applications of SONOR:

The sonar technique is used to determine the depth of the sea and to locate underwater hills, valleys, submarine, icebergs, sunken ship etc.

Q20. A sonar device on a submarine sends out a signal and receives an echo 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625 m.

Answer:

Given the distance of the object is 3625 m from the submarine and the time taken is 5 seconds.

But the time gave includes of both journey downward and upward,

hence the time taken will be half of this time.

$t = \frac{5}{2} sec$

And as $Speed = \frac{Distance}{Time}$

Putting the values in the equation, we get

$Speed = \frac{3625}{\frac{5}{2}} = 1450\ m/s$

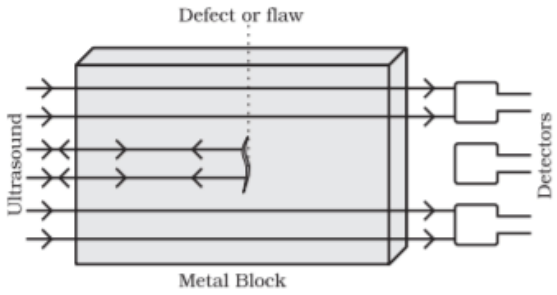
Therefore, the speed of sound is 1450 m/s.

Q21. Explain how defects in a metal block can be detected using ultrasound.

Answer:

Ultrasounds can be used to detect cracks and flaws in metal blocks. Metallic components are generally used in the construction of big structures like buildings, bridges, machines and also scientific equipment. The cracks or holes inside the metal blocks, which are invisible from outside reduces the strength of the structure. Ultrasonic

waves are allowed to pass through the metal block and detectors are used to detect the transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect, as shown



Ultrasound is reflected back from the defective locations inside a metal block.

Q22. Explain how the human ear works.

Answer:

The outer ear is called ‘pinna’. It collects the sound from the surroundings. The collected sound passes through the auditory canal. At the end of the auditory canal, there is a thin membrane called the eardrum or tympanic membrane. When compression of the medium reaches the eardrum the pressure on the outside of the membrane increases and forces the eardrum inward. Similarly, the eardrum moves outward when a rarefaction reaches it. In this way, the eardrum vibrates. The 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 received from the sound wave to the inner ear. In the inner ear, the pressure variations are turned into electrical signals by the cochlea. These electrical signals are sent to the brain via the auditory nerve, and the brain interprets them as sound.