**NCERT Solutions for Class 9 Science Chapter 11:** The greatest tools for improving pupils' conceptual understanding of the subject are sound. They include solutions to the problems presented in the textbook in a style that makes sense to the pupils. NCERT Solutions serve as reference books for questions about specific topics.

Together with MCQs and significant questions addressed by subject matter experts, they also include several lengthy, succinct responses. Every effort is taken to produce high-quality content that contains all the pertinent data. From the standpoint of the test, the Chapter Sound is crucial. As a result, NCERT Solutions Class 9 Science has collated and given all that is significant.

After studying each chapter, it is suggested that the students self-evaluate by working through the NCERT Solutions Class 9. As a result, they will become aware of their weaknesses and try to address them in time for the exams.

# NCERT Solutions for Class 9 Science Chapter 11 Overview

Chapter 11 of the NCERT Science textbook for Class 9 is titled "Sound." This chapter explores the fundamental aspects of sound, including its nature, how it is produced, and how it travels. It begins by explaining that sound is a form of energy that travels through a medium, such as air, water, or solids, in the form of vibrations. The chapter covers key concepts like the production of sound, the propagation of sound waves, and the characteristics of sound, such as pitch, loudness, and quality.

It also delves into the speed of sound in different media and discusses practical applications and phenomena related to sound, such as echoes and sound reflection. Through various activities and experiments, the chapter helps students understand how sound works and its importance in everyday life.

# NCERT Solutions for Class 9 Science Chapter 11

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

**Solution:**

When something vibrates, the medium's surrounding particles must also vibrate. Next to vibrating particles, other particles are compelled to vibrate as well. As a result, sound waves generated by vibrating objects propagate across a medium, passing through particles before reaching your ears.

**Section 12.2 Page: 163**

**1. Explain how sound is produced by your school bell.**

**Solution:**

The school bell vibrates when struck with a hammer, moving forward and backward and causing compression and rarefaction. This is how the school bell makes sound.

**2. Why are sound waves called mechanical waves?**

**Solution:**

In order for sound waves to interact with the particles in them, they need a medium to propagate through. Sound waves are hence referred to as mechanical waves.

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

**Solution:**

No. For sound waves to travel, they need a medium. I will not be able to hear my friend's sound since there is no atmosphere on the moon and sound cannot pass through a vacuum.

**Section 12.2.3 Page: 166**

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

**Solution:**

(a) Amplitude: There is a direct correlation between a sound's amplitude and loudness. The sound is louder when the amplitude is larger.

(b) Frequency: There is a direct correlation between a sound's pitch and frequency. A high pitch corresponds to a high frequency of sound.

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

**Solution:**

A sound's frequency and pitch are exactly proportionate. As a result, the guitar's pitch is higher than a car horn's.

**3. What are the wavelength, frequency, time period and amplitude of a sound wave?**

**Solution:**

(a) Wavelength: The separation between two successive compressions or rarefactions is known as the wavelength. The metre (m) is the wavelength unit in the SI.

(b) Frequency - The number of oscillations per second is the definition of frequency. The hertz (Hz) is the SI unit of frequency.

(c) Amplitude - The highest point a sound wave's trough or crest can reach is known as its amplitude.

(d) Time period: This is the amount of time needed to produce a single full cycle of a sound wave.

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

**Solution:**

Wavelength, speed, and frequency are related in the following way:

Speed = Wavelength x Frequency

$v = \lambda v$

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

**Solution:**

Given that,

Frequency of sound wave = 220 Hz

Speed of sound wave = 440 m/s

Calculate wavelength.

We know that

Speed = Wavelength × Frequency

$v = \lambda v$

440 = Wavelength × 220

Wavelength = 440/220

Wavelength = 2

Therefore, the wavelength of the sound wave = 2 metres

**6. 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?**

**Solution:**

The time interval between successive compressions from the source is equal to the time period, and the time period is reciprocal to the frequency. Therefore, it can be calculated as follows:

$T = 1/F$

$T = 1/500$

$T = 0.002$ s

**7. Distinguish between loudness and intensity of sound.**

**Solution:**

The intensity of a sound wave is the quantity of sound energy that travels across a space in a second. The definition of loudness is its amplitude.

**Section 12.2.4 Page: 167**

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

**Solution:**

Sound travels faster in solids when compared to any other medium. Therefore, at a particular temperature, sound travels fastest in iron and slowest in gas.

**Section 12.3.2 Page: 168**

**1. 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 $ms^{-1}$?**

**Solution:**

Speed of sound (v) = 342 $ms^{-1}$

Echo returns in time (t) = 3 s

Distance travelled by sound = $v \times t = 342 \times 3 = 1026$ m

In the given interval of time, sound must travel a distance which is twice the distance between the reflecting surface and the source.

Therefore, the distance of the reflecting surface from the source =1026/2 = 513 m

**Section 12.3.3 Page: 169**

**1. Why are the ceilings of concert halls curved?**

**Solution:**

The ceilings of concert halls are curved to spread sound uniformly in all directions after reflecting from the walls.

**Section 12.4 Page: 170**

**1. What is the audible range of the average human ear?**

**Solution:**

20 Hz to 20,000 Hz. Any sound less than 20 Hz or greater than 20,000 Hz frequency is not audible to human ears.

**2. What is the range of frequencies associated with (a) Infrasound? (b) Ultrasound?**

**Solution:**

(a) 20 Hz

(b) 20,000 Hz

**Section 12.5.1 Page: 172**

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

**Solution:**

Time (t) taken by the sonar pulse to return = 1.02 s

Speed (v) of sound in salt water = 1531 m $s^{-1}$

Distance travelled by sonar pulse = Speed of sound × Time taken

= 1531 x 1.02 = 1561.62 m

Distance of the cliff from the submarine = (Total distance travelled by sonar pulse) / 2

= 1561.62 / 2

= 780.81 m.

**Exercise Questions Page: 174**

**1. What is sound, and how is it produced?**

**Solution:**

Vibrations result in sound production. A body's vibrations cause the medium's nearby particles to vibrate as well. This causes a disruption in the medium, which makes its way to the ear in the form of waves. As a result, sound is generated.

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

**Solution:**

The school bell vibrates when struck with a hammer, moving forward and backward and causing compression and rarefaction. Its forward motion generates tremendous pressure in its immediate vicinity. Compression refers to this area of intense pressure. Its retrograde motion produces a zone of low pressure around it. We refer to this area as rarefaction.

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

**Solution:**

Take an electric bell and hang it inside an empty bell jar which is fitted with a vacuum pump (as shown in the figure below).

First, there's the sound of the bell ringing. Now use the vacuum pump to remove some air from the bell jar. You'll notice that the bell's clanging becomes quieter. After some time, if you continue to pump air out of the bell jar, the glass jar will eventually run out of air. Try ringing the bell now. You can see that the bell prong is still vibrating even if there is no sound. A vacuum is created in the bell jar when there is no air within. A hoover is incompatible with sound travel. This experiment so demonstrates that sound propagation requires a material medium.

**4. Why is a sound wave called a longitudinal wave?**

**Solution:**

A longitudinal wave is defined as the vibration of the medium that moves either parallel to or in the direction of the wave. The medium's particle direction vibrates in a direction parallel to the disturbance's propagation direction. As a result, a longitudinal wave is what is known as a sound wave.

**5. Which characteristics of the sound help you to identify your friend by his voice while sitting with others in a dark room?**

**Solution:**

A trait that aids in recognising a specific person's voice is sound quality. Even though the pitch and loudness of two people are the same, their characteristics will change.

**6. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen. Why?**

**Solution:**

The speed of light is 3 × 108 m/s, while the speed of sound is 344 m/s. In relation to light, the speed of light is lower. This explains why thunder travels slower to Earth than light, even though light travels quicker. Therefore, every time we hear thunder, lighting is visible beforehand.

**7. 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 $s^{-1}$.**

**Solution:**

For sound waves,

Speed = Wavelength × frequency

$v = \lambda \times v$

Speed of sound wave in air = 344 m/s

(a) For v = 20 Hz

$\lambda_1 = v/v_1 = 344/20 = 17.2$ m

(b) For $v_2$ = 20,000 Hz

$\lambda_2 = v/v_2 = 344/20{,}000 = 0.0172$ m

Therefore, for human beings, the hearing wavelength is in the range of 0.0172 m to 17.2 m.

**8. 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 the air and in aluminium to reach the second child.**

**Solution:**

Consider the length of the aluminium rod = d

Speed of sound wave at 25° C, V Al = 6420 ms-1

Time taken to reach the other end is,

T Al = d/ (V Al) = d/6420

Speed of sound in air, V air = 346 ms-1

Time taken by sound to each other end is,

T air = d/ (V air) = d/346

Therefore, the ratio of time taken by sound in aluminium and air is,

T air / t Al = 6420 / 346 = 18.55

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

**Solution:**

Frequency = (Number of oscillations) / Total time

Number of oscillations = Frequency × Total time

Given,

Frequency of sound = 100 Hz

Total time = 1 min (1 min = 60 s)

Number of oscillations or vibrations = 100 × 60 = 6000

The source vibrates 6000 times in a minute and produces a frequency of 100 Hz.

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

**Solution:**

Indeed. Similar to light, sound is governed by the principles of reflection. At the point of incidence, the incident and reflected sound waves form an equal angle with the surface normal. Furthermore, all three components of the sound wave—the incident, the reflected, and the normal to the point of incidence—lie in the same plane.

**11. 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 an echo sound on a hotter day?**

**Solution:**

When there is a minimum of 0.1 seconds of delay between the original sound and the reflected sound, an echo is audible. In a medium with increasing temperature, sound travels faster. An

echo is only detectable if there is a time difference of more than 0.1 seconds between the reflected and original sounds. On a hotter day, this time difference will decrease.

**12. Give two practical applications of the reflection of sound waves.**

**Solution:**

(i) Reflection of sound is used to measure the speed and distance of underwater objects. This method is called SONAR.

(ii) Working of a stethoscope – The sound of a patient's heartbeat reaches the doctor's ear through multiple reflections of sound.

**13. 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 $s^{-1}$.**

**Solution:**

Height (s) of tower = 500 m

Velocity (v) of sound = 340 m $s^{-1}$

Acceleration (g) due to gravity = 10 m $s^{-1}$

Initial velocity (u) of the stone = 0

Time ($t_1$) taken by the stone to fall to the tower base:

As per the second equation of motion,

$s= ut_1 + (½)\ g\ (t_1)^2$

$500 = 0 \times t_1 + (½)\ 10\ (t_1)^2$

$(t_1)^2 = 100$

$t_1 = 10$ s

Time ($t_2$) taken by sound to reach the top from the tower base = 500/340 = 1.47 s

$t = t_1 + t_2$

$t = 10 + 1.47$

$t = 11.47$ s

**14. 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?**

**Solution:**

Speed (v) of sound = 339 m $s^{-1}$

Wavelength (λ) of sound = 1.5 cm = 0.015 m

Speed of sound = Wavelength × Frequency

v = v = λ X v

v = v / λ = 339 / 0.015 = 22600 Hz

The frequency of audible sound for human beings lies between the ranges of 20 Hz to 20,000 Hz. The frequency of the given sound is more than 20,000 Hz; therefore, it is not audible.

**Page: 175**

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

**Solution:**

Reverberation is the constant, multiple sound reflections in a large, confined environment. It can be decreased by using sound-absorbing materials, including loose woollens and fibre boards, to cover the walls and ceilings of enclosed places.

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

**Solution:**

High volumes have a lot of energy. The relationship between loudness and vibration amplitude is direct. It is directly proportional to the square of the sound waves' amplitude.

**17. Explain how bats use ultrasound to catch prey.**

**Solution:**

Ultrasonic squeaks with a high pitch can be produced by bats. These screeches are reflected off of things, such as prey, and end up back in their ears. This aids a bat in determining the distance to its prey.

**18. How is ultrasound used for cleaning?**

**Solution:**

After placing dirty objects in a cleaning solution, the solution is subjected to ultrasonic sound waves. The dirt is helped to separate off the objects by the high frequency of the ultrasonic waves. This is one application of ultrasonic cleaning technology.

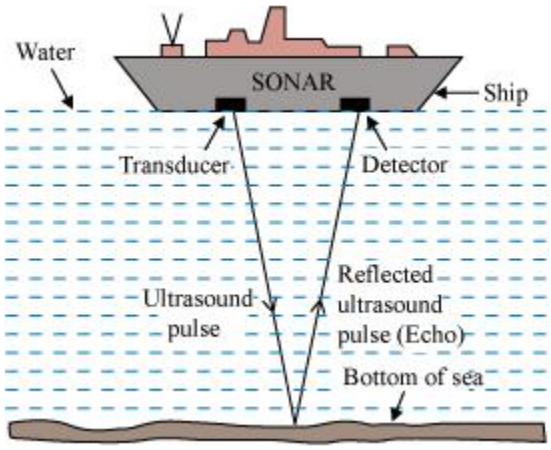
**19. Explain the working and application of a sonar.**

**Solution:**

Sound Navigation and Ranging is shortened to SONAR. It is an acoustic instrument that uses ultrasonic waves to measure the direction, speed, and depth of submerged objects, including shipwrecks and submarines.

It's also used to figure out how deep seas and oceans are.

Through the transducer, an ultrasonic sound beam is created and transmitted through the saltwater. The detector picks up and records the echo that is created when it reflects. After that, electrical signals are created from it. The time (represented as "t") needed for the echo to return with speed (represented as "v") is used to compute the underwater object's distance, denoted by "d." This formula is stated as,




**20. 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.**

**Solution:**

Time (t) taken to hear the echo = 5 s

Distance (d) of an object from submarine = 3625 m

Total distance travelled by SONAR during reception and transmission in water = 2d

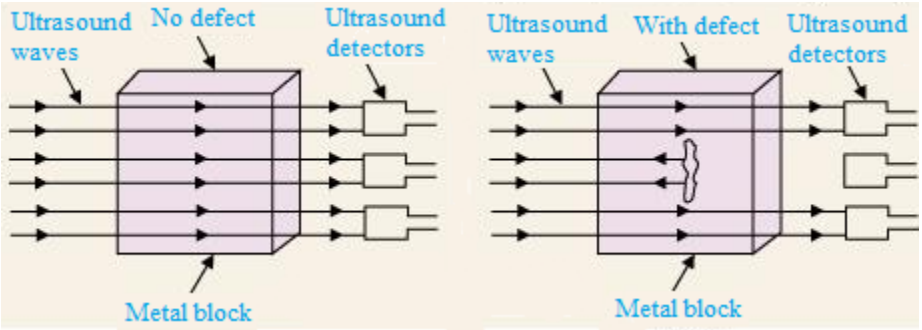
Velocity (v) of sound in water = 2d/t = (2 × 3625) / 5

= 1450 $ms^{-1}$

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

**Solution:**

Ultrasound waves cannot go through faulty metal blocks and be reflected back. This method is applied to the identification of flaws in metal blocks. As illustrated in the picture, assemble the apparatus so that detectors are positioned on one end of a metal block and ultrasound is passed through the other. The metal block's damaged portion cannot be identified by the detector because ultrasonic waves cannot flow through it. In this manner, ultrasonography can be used to identify flaws in metal blocks.

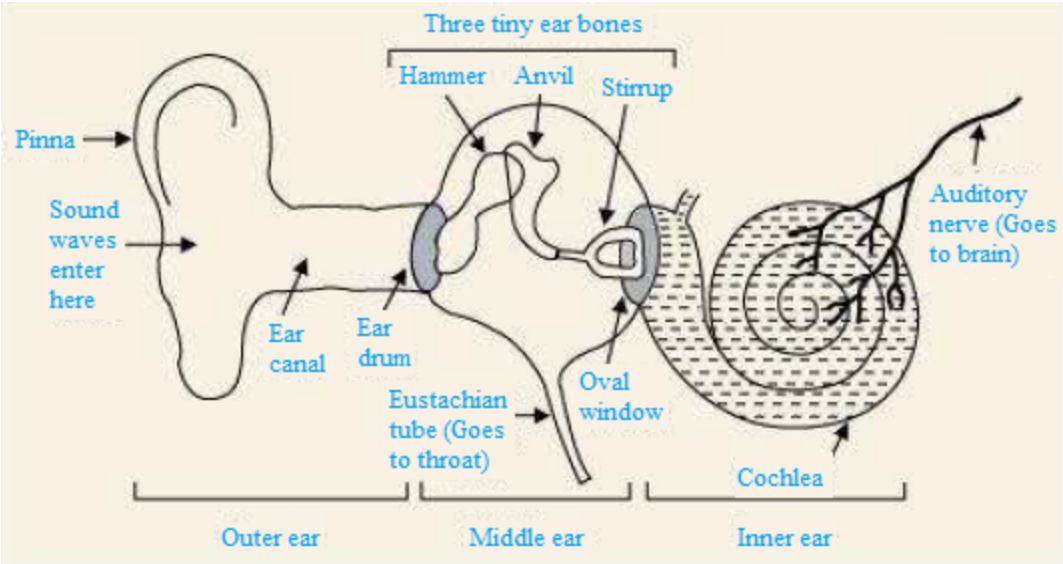



**22. Explain how the human ear works.**

**Solution:**

The pinna gathers different sounds made by particles in our environment and sends them to the eardrum via the ear canal. The moment sound waves strike the eardrum, it starts to vibrate rapidly back and forth. The tiny bone hammer begins to vibrate in response to the vibrating eardrum. The second bone anvil transfers these vibrations from the hammer to the third bone stirrup.

To transmit its vibration to the cochlea, the stirrup hits the oval window membrane. The cochlea's liquid causes electrical impulses to be produced in the nerve cells. The auditory nerve sends these electrical signals to the brain. Our sense of hearing results from the brain's interpretation of them as sound.




# Benefits of NCERT Solutions for Class 9 Science Chapter 11

The NCERT Solutions for Class 9 Science Chapter 11, "Sound," offer several benefits to students:

**Clear Understanding**: The solutions provide detailed explanations and step-by-step methods to solve problems related to sound. This helps in understanding complex concepts like the nature of sound waves, their propagation, and characteristics like pitch and loudness.

**Practice and Reinforcement**: By working through these solutions, students can practice various types of questions and problems. This reinforces their learning and helps in better retention of the chapter's concepts.

**Improved Problem-Solving Skills**: The solutions include a variety of problems that challenge students to apply their knowledge in different contexts. This enhances their problem-solving skills and prepares them for exams.

**Conceptual Clarity**: The solutions break down the concepts into simpler parts, making it easier for students to grasp and remember. They provide a clear understanding of how sound is produced, how it travels, and the factors affecting its speed and quality.

**Preparation for Exams**: With the solutions, students can review and practice important questions that are likely to appear in exams. This helps in better exam preparation and boosts confidence.