Important Questions for Class 9

Science

Chapter 11 - Sound

Very Short Answer Type Questions **1 Mark**

1. Guess which sound has a higher pitch: guitar or carhorn?

Ans: When the ear reacts to the wavelength of the sound known as pitch. Higher the frequency, the higher the pitch will be. Comparatively, the guitar works on higher frequency so the pitch of the guitar will be higher.

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

Ans: The utmost speed of sound is in solids which decrease in liquids**.** However**,** sound travels much more slowly in the air. Amongst the given options, the fastest medium for sound is iron.

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

Ans: For the normal human ear, the range of frequencies varies from 20Hz to 20,000 Hz and this is considered an audible range. Lower than 20 Hz and higher than 20K Hz is not audible for humans.

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

Ans: Timbre and pitch are the characteristics of sound which help to identify the sound of different voices. Therefore, because of timbre and pitch, a person can identify the voice of others while sitting in a dark room.

5. 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.

Ans: For $20\,\text{Hz}$ sound waves the wavelength would be

$v = n \times \lambda$

$\lambda = v / n = 344 / 20 = 17.2m$

For 20kHz sound waves the wavelength would be

$v = n \times \lambda$

$\lambda = v / n = 344\,\text{ms}^{-1} / 20000\,\text{Hz} = 0.0172\,\text{m}$

6. 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.

Ans: Since speed of sound in air $= 344\,\text{m/s}$

And speed of sound in aluminium $= 6420\,\text{m/s}$

we know that $v =$ distance/time therefore time $= d / v$

time taken by sound wave in air/time taken by sound wave in aluminium

$= d / 344 : d / 6420 = 6420 / 344 = 18.66 / 1$

The sound will take 18.66 times more time through air than in aluminum in reaching other boys.

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

Ans: By Frequency of source of sound being 100 Hz means, the sound source vibrates 100 times in one second. Therefore, vibrations made by sound source in 1 min (60 sec) will be 6000

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

Ans: Yes, sound follows the same laws of reflection as light does because the directions in which the sound is incident and reflected makes equal angles with the normal to the reflecting surface at the point of incidence. Therefore, all the three are in the same plane.

9. 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 remain the same. Do you hear the echo sound on a hotter day?

Ans: The sensation of sound persists in the human brain for about 0.1s. To hear a distinct echo, the time interval between the original sound and the reflected one must be at least 0.1s.

Therefore, the total distance covered by the sound from the point of generation to the reflecting surface and back should be at least (344 m/s)0.1 s=34.4 m

Thus, for hearing distinct echoes, the minimum distance of the obstacle from the source of sound must be half of this distance, that is, 17.2 m. Speed of sound will increase with the increase in temperature.

Therefore, on a hotter day the speed of sound will be greater hence echoes may be heard more than once because of multiple reflections of sound result will be no distinct echo will be heard by humans.

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

i. Megaphones or loudhailers

Ans: Megaphones or loudhailers, horns, musical instruments such as trumpets are all designed to send sound in a particular direction without spreading it in all directions.

ii. Stethoscope

Ans: Stethoscope is a medical instrument used for listening to sounds produced within the body, chiefly in the heart or lungs. In stethoscopes the sound of the patient's heartbeat reaches the doctor's ears by multiple reflections of sound.

11. 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,and speed of sound.

Ans: According to the question:

$v^2 = u^2 + 2gh$

$v^2 = 0 + 2 \times 10 \times 500$

$v^2 = 10000$

$v^2 = \sqrt{10000} = 100 \text{ ms}^{-1}$

We also know that $v = u + gt = 0 + 10t$

$100 = 10t$ or, Time taken by stone to reach the pond surface $(t) = 100/10 = 10\text{sec}$

Therefore, time taken by sound to reach the top from pond surface $= d/v = 500/340$ $= 1.47\text{sec}$

So the total time taken for splash being heard at the top $= 10 + 1.47 = 11.47\text{s}$

12. 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?

Ans: Since we know that $v = \lambda \text{V}$

$339 = 0.015\text{m} \times \text{v}$

$v = 339/0.015 = 22600\text{Hz}$

Since the resulting frequency is beyond the audible range of human beings $(20\text{Hz}$ to $20\text{kHz})$ therefore sound will not be audible to human ears.

13. What is reverberation? How can it be reduced?

Ans: The repeated reflection of sound by which sound persists for a long time in the environment is called reverberation.

To reduce reverberation, the roof and walls of the auditorium are generally covered with sound-absorbent materials like compressed fibre-board, rough plaster or draperies. The seat materials are also selected on the basis of their sound absorbing properties.

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

Ans: Loudness refers to how loud or soft a sound seems to a listener. The loudness of sound is determined, in turn, by the intensity of the sound waves. Intensity is a measure of the amount of energy in sound waves. The unit of intensity is the decibel (dB). Thus, the intensity of sound waves determines the loudness of sounds. Intensity results from two factors: the amplitude of the sound waves and how far they have travelled from the sound source.

Amplitude is a measure of the size of sound waves.

It depends on the amount of energy that started the waves.

Greater amplitude waves have more energy and greater intensity, so they sound louder.

15. Explain how bats use ultrasound to catch prey.

Ans: The bats use ultrasound to catch prey by using the phenomenon of reflection of sound waves.

The bats produce the ultrasonic wave which gets reflected from the prey and returns to the bats' ears. This allows the bat to find out the distance and position of the prey.

16. How is ultrasound used for cleaning?

Ans: Ultrasound is used to clean 'hard to clean' parts of objects such as spiral tubes, odd-shaped machines etc. The object to be cleaned is placed in a cleaning solution and ultrasound waves are passed into the solution. Due to their high frequency, the ultrasound waves stir up the cleaning solution. The objects thus get thoroughly cleaned.

17. Explain the working and application of a sonar.

Ans: SONAR stands for Sound Navigation and Ranging. It is a device that utilizes ultrasonic waves to estimate and measure the distance, direction and speed of objects underwater.

Working of SONAR:

- It consists of a transmitter and a detector and is installed in a ship or a boat.
- The transmitter in SONAR produces and transmits powerful ultrasonic waves.
- The ultrasonic waves travel through the water and after striking the target the beam is reflected from the seabed and is received by an under-water detector (mounted on the ship).
- The detector then converts the waves into electrical signals which are properly interpreted.
- The time interval between transmission and reception of the signal is also noted.

Applications of SONAR Technology

The basic use of sonar technology is to estimate the depth, range, and direction of arrival of objects. Following are the various different applications of sonar technology:

- Special sonars are used in ships and submarines for underwater communications.
- Medical imaging for the detection of cysts and cancer cells are done using sonar and this method is known as sonogram.

18. 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.

Ans: Distance of object from submarine $= 3625\text{m}$

Therefore, distance travelled by sonar waves $= 2 \times 3625 = 7250\text{m}$

Since, speed = distance / time $= 7250/5 = 1450\text{m/s}$

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

Ans: Defects in metal blocks do not allow ultrasound to pass through them and they are reflected back. This fact is used to detect defects in metal blocks.

Ultrasound is passed through one end of a metal block and a detector is placed on the other end. The defective part of the metal block does not allow ultrasound to pass through it. As a result, it will not be detected by the detector. Hence defects in metal blocks can be detected using ultrasound.

20. Explain how the human ear works.

Ans: The following are the steps to how we hear:

- Sound transfers into the ear canal and causes the eardrum to move.
- The eardrum will vibrate with the different sounds.
- These sound vibrations make their way through the ossicles to the cochlea.
- Sound vibrations make the fluid in the cochlea travel like ocean waves.
- Movement of fluid in turn makes the hair cells, the auditory nerve, pick up any neural signals created by the hair cells. Hair cells at one end of the cochlea transfer low pitch sound information and hair cells at the opposite end transfer high pitch sound information.

The auditory nerve moves signals to the brain where they are then translated into recognizable and meaningful sounds. It is the brain that "hears".

21. Wavelength of sound wave has units: 7

(a) metres

(b) metres/sound

(c) (meters)^2

(d) meters/ second^2

Ans: (a) metres

22. Light is a

(a) Longitudinal wave

(b) Transverse wave

(c) Both

(d) None

Ans: (b) Transverse wave

23. In compression, pressure density is

(a) High

(b) Less

(c) Remains same

(d) May be a) or b) depending upon disturbance

Ans: (a) High

24. Frequency of ultrasonic sound wave is

(a) Greater than 20 HZ

(b) Greater than 20,000 HZ

(c) Greater than 2 HZ

(d) Greater than 2 MHZ

Ans: (b) Greater than 20,000 HZ

25. S. I. units of frequency are:

Ans: The S.I. the derived unit of frequency is Hertz (Hz).. One hertz means that an event repeats once per second. The SI unit for this period is the second.

26. Stethoscopes work on the principle of:

(a) Multiple reflection of sound

(b) Ultrasounds

(c) Both a and b

(d) None of the above

Ans: (a) multiple reflection of sound

27. The Audible Range of the human ear is:

(a) 20 HZ – 20 KHZ

(b) 20 HZ – 20 MHZ

(c) 20HZ – 20,000 HZ

(d) Both a) and b)

Ans: (d) Both a) and b)

28. The order of bones is the human area from outside to inside:

(a) Hammer, stirrup Anvil

(b) Hammer, Anvil and stirrup

(c) Anvil, Stirrup and Hammer

(d) Stirrup, Hammer and Anvil

Ans: (a) Hammer, stirrup Anvil

29. Which of the following is used in echocardiography?

(a) Ultrasound waves

(b) Infrasound waves

(c) X-Ray waves

(d) Both a) and c)

Ans: (a) Ultrasound waves

30. Infrasound is produced by:

(a) Bats

(b) Dogs

(c) Rhinoceros

(d) Rats

Ans: (c) Rhinoceros

31. Speed of sound is maximum in:

(a) Solids

(b) Liquids

(c) Gases

(d) Plasma

Ans: (a) Solids

32. Inner Ear is called as

(a) cochlea

(b) Pinna

(c) Hammer

(d) Anvil

Ans: Cochlea

Short Answer Type Questions **2 Marks**

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

Ans: The sound of the bell depends upon the vibration of the bell when it is rung. When the bell starts ringing, it drives the molecules around the air to vibrate. This produces the wave. So the compression is produced, however, the rarefaction makes the sound echo through the air.

Since, the vibrating molecules put pressure on one another, which in turn air particles are disturbed and start moving forward and backward.

2. Why are sound waves called mechanical waves?

Ans: Mechanical Waves are waves which generate through a medium (solid, liquid, or gas) at a wave speed. A sound wave is an example of a mechanical wave. Sound waves cannot travel through vacuum, It requires some medium to propagate, which could be air, water or metal similar to mechanical waves. That's why; a sound wave is called a mechanical wave.

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

Ans: A sound wave needs a medium to propagate. Be it a solid, gas or liquid medium. The moon resides in vacuum; since it has no air that defines it has no medium to generate the sound waves. So, it is not feasible to hear any sound on the moon.

4. Which wave property determines

(a) Loudness,

Ans: Loudness of the sound is a decibel unit (dB). Loudness is defined as the intensity of the wave or the molecule. The determination of the loudness depends on the magnitude of the wave. Precisely, amplitude of the wave determines the loudness of sound.

(b) Pitch

Ans: Pitch is defined as the response of the sound by ear which goes hand in hand. Higher the pitch, the higher the frequency. So, the pitch of the sound is dependent on the frequency of the sound.

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

Ans: Longer the wavelength, longer will be the frequency waves. In the context of speed, it is dependent upon the medium through which the sound wave is travelling. The more inflexible, inelastic the medium, the faster will the movement of sound.

The equation forms as $v_w = f\lambda$, where v_w is the speed of sound, f is its frequency, and λ is its wavelength.

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

Ans: The wave with the greatest frequency has the shortest wavelength.

We have to calculate the wavelength of the sound with the frequency of 220 Hz and the speed will be 440m/s.

The time interval between successive compressions from the source

$T=1/v=1/500=0.002$ second.

7. 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?

Ans: The time interval between successive compressions from the source

T = 1/v = 1/500 = 0.002 second.

8. Distinguish between loudness and intensity of sound.

Ans: The differences between loudness and intensity are as follows:

Loudness	Intensity
It is the reaction of the ear to sound	It is the physical quantity.
Unit of loudness in decibels.	Unit is watt per meter square for Intensity
Ear power plays a role in hearing loudness.	It is independent from the ability to hear.
Amplitude defines loudness	Intensity is defined by energy

9. An echo returned in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 m/s?

Ans: Speed of sound = distance/time

Therefore, distance travelled by sound during echo $=$ speed $\times$ time $= 342 \times 3 = 1026\,\text{m}$

so the distance of reflecting surface $= 1026/2 = 513\,\text{m}$

10. Why are the ceilings of concert halls curved?

Ans: The curved architecture of any structure helps the sound to reach every end. Concert halls are very big, so the sound might not reach every corner of the hall. This is achieved when the sound generates the reflection technique to reach every corner.

11. What is the range of frequencies associated with

(a) Infrasound

Ans: Infrasound is used for the sound below 20 Hz. Sound at 20-200 Hz is called low-frequency sound. The range of frequency is less than 20 Hz.

(b) Ultrasound

Ans: Ultrasound adds biologically significant sounds ranging from 15 kHz or so up to 200 kHz, which is too high in frequency. So the range for Ultrasound = greater than 20 KHz

12. A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is1531 m/s, how far away is the cliff?

Ans. Distance travelled by a sonar pulse = speed of sound in saltwater $\times$ time $= 1531 \times 1.02 = 1561.62\,\text{m}$

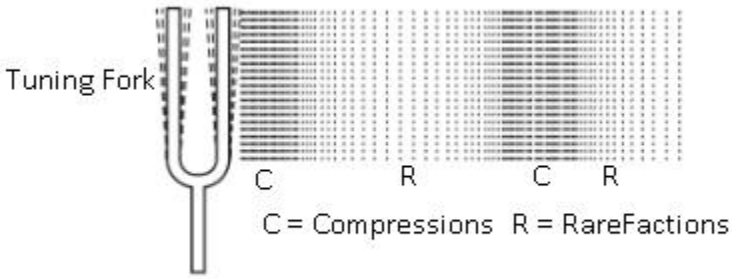
Therefore, the distance of cliff from submarine $= 1561.62 / 2 = 780.81\text{m}$

13. What is sound and how is it produced?

Ans: Sound is the type of energy which is defined by vibrations between any state of medium (Gas, Solid, Liquid). Vibration is the movement of the air particles. The oscillation of a molecule propagates the sound.

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

Ans: Compression and rarefaction are produced because of the movement in the medium caused by sound waves.



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

Ans: The movement of the particle is called vibration. A medium can be anything – a liquid (such as water), a solid (such as the seafloor), or a gas (such as air). A sound wave is called a compressional or longitudinal wave, when it vibrates parallel to the direction in which the sound wave moves.

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

Ans:16: There are many a times we have observed that the thunder is heard few seconds later after the flash

This happens because speed of light in atmosphere for air is

$3\times10^{8}\ m/s^{2}$ which are very high, to that of sound which is only 330 m/s.

This is the reason; the sound of thunder reaches us later than the flash.

17. Differentiate between longitudinal and transverse waves?

Ans: The difference between longitudinal and transverse waves are as follows:

Longitudinal wave	Transverse wave
The medium, in the case of a longitudinal wave, moves in the same way to wave direction	The medium, in case of a transverse wave, moves perpendicular to wave direction
The Polarization or alignment of this wave does not happen	The alignment of this wave is certainly possible
The production of this wave can take place in any medium- solid, gas, or liquid.	The production of this wave can take place in liquid and gas medium only
This wave is made up of compressions and rarefactions	This wave is made up of crests and troughs

18. Define the terms:

a) Wavelength

Ans: It is the distance between two successive crests or troughs of a wave. The direction will be same as the wave

b) Frequency

Ans: It is defined as the number of waves that pass a fixed place in a given amount of time. The Hertz measurement, abbreviated Hz, is the number of waves that pass by per second.

19. An underwater device directs ultrasound of frequency 75 KHZ towards the water surface. What is the wavelength of sound in the air above the water surface and what is its frequency?

Ans: When sound wave travels from one medium to another, the frequency remain unchanged while the wavelength and velocity change Frequency in air $= 75,000 HZ$

Wavelength, $\lambda = \frac{v}{f} = \frac{340}{75,000} = 4.53 \times 10^{-3}$ m

20. What is an echo? Name two areas of its application

Ans: Echo is a sound repetition by sound wave reflection, having a lasting or far reaching impact.

Application of echo: In the medical field, echo uses sound waves to create pictures of the heart's chambers, valves, walls and the blood vessels (aorta, arteries, and veins) attached to the heart for testing purposes. Also, it is used in SONAR and detecting flaws in metal objects.

21.Why are sound waves called mechanical waves?

Ans: Sound needs a medium to propagate, as it does not generate in vacuum. So, all sound waves are examples of mechanical waves. Sound waves are called mechanical waves as it is a wave that is an oscillation of matter.

22. Define:

a) Time period

Ans: The time period is defined as the time taken by a complete cycle of the wave to pass a particular area.

The formula for time is: T (period) = 1 / f (frequency).

λ = c / f = wave speed i.e. c (m/s) / frequency f (Hz).

b) Amplitude of a wave

Ans: The amplitude of a wave is the maximum amount of displacement of a particle on the medium from its static position. Amplitude measures how far a wave rises and dips.

23. What do you understand by the loud and soft sound?

Ans: Sound is a type of vibrating pressure that is transmitted in waves.

Loud sound: Higher the sound, higher will be the amplitude referred to as loud sound.

Soft sound: lower the sound, less will be the amplitude that defines soft sound.

24. What do you understand by low pitched and high pitched sound?

Ans: Low pitched sound: It refers to low sound that defines slower oscillation. A sound that is low-pitched is deep.

High pitched sound: The vibration is that of a pure tone with a frequency equal to 3000 Hz, is considered a high pitched sound as it completes the large number of vibrations in a given time.

26. Why do we see light first and hear the sound later during a thunderstorm?

There are many times we have observed that the thunder is heard a few seconds later after the flash.

This happens because speed of light in atmosphere for air is

3× 108 ms-2 which are very high, to that of sound which is only 330 ms-1.

This is the reason; the sound of thunder reaches us later than the flash.

28. Why are the ceilings of concert halls curved?

The curved architecture of any structure helps the sound to reach every end. Concert halls are very big, so the sound might not reach every corner of the hall.

This is achieved when the sound generates the reflection technique to reach every corner.

Short Answer Type Questions **3 Marks**

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

Ans: Sound waves enter the outer ear and travel through a narrow passageway called the ear canal, which leads to the eardrum. When the sound waves fall on the eardrum, the eardrum starts vibrating back and forth rapidly.

The sound produced by a vibrating object reaches our ear through sound waves which travel in the medium as a series of compressions and rarefactions. The process is repeated further and as a result sound waves propagate in the form of compressions and rarefactions to the listener's ear.

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

Ans: The wavelength of a sound wave is defined as the distance between the identical parts of the wave also called crests and troughs.

The wavelength of the sound wave is calculated as:

Wavelength =velocity of sound/frequency

Frequency is defined as the number of vibrations or oscillations per second i.e. it is the number of complete waves or cycles produced in one second. It refers to how rapidly or slowly the oscillations occur.

Time period is the time taken to complete one vibration/oscillation/complete wave is called time period. It is measured in seconds.

Amplitude is the utmost rearrangement of the particles of the medium from their actual static position.

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

Ans: The Bell-jar experiment shows that sound needs a medium for its propagation. An electric bell and an airtight glass bell jar are required.

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 slowly, the sound becomes dimmer, 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. Now if we evacuate the bell jar no sound is heard.

4. What happens when sound travels in air?

Ans: The air is made up of many tiny particles. The movement propagates through a medium, and then alternate regions of pressure variations are created.

The region where particles come closer to each other (high density) and pressure of air is high is called as compression. The region where particles are far apart from each other (low density) and pressure of air is less is called as rarefaction compression and rarefactions always occur together.

5. Establish the relation for a wave whose velocity = frequency X wavelength.

Ans: The relationship between the propagation speed, frequency, and wavelength is: $v = f\lambda$

For a wave, for one vibration, the distance b/w two consecutive crests or troughs is called its wavelength.

Time required to complete one vibration cycle is called its Time Period (T).

(Frequency) is defined as the no. of vibrations particle covers in 1 second.

6. When a wave travels from one medium to another, the wavelength changes but not the frequency. The wavelength of sound disturbance is 30 cm in air and the wave velocity is 340 m/s. What will be the wavelength of this disturbance in Helium & water? The speed of sound in helium is 970 m/s and 1450 m/s in water?

Ans: $v = \gamma\lambda$

$$1450 = \frac{3400}{3} \times \lambda \frac{(1450 \times 3)}{3400}$$

$$\lambda = 1.28 \text{ m}$$

7. Sound waves of wavelength travel from a medium in which its velocity is v m/s into another medium in which if velocity is 3 v m/s. What is the wavelength of the sound in the second medium?

Ans: Since velocity = wavelength × frequency $v = \lambda f$

$$f = v\lambda$$

Now, when waves move from one medium to another, the frequency remains the same

$$V_1 / \lambda_1 = V_2 / \lambda_2$$

Now, when velocity in first Medium $= \sqrt{1} = \sqrt{\text{velocity in}}$ Second Medium $= 3v$

$$v / \lambda_1 = 3v / \lambda_2$$

$$\lambda_1 / \lambda_2 = 1/3$$
$$\lambda_2 = \lambda_1 = 1/3$$

8. Sound requires a medium to travel? Justify experimentally.

Ans: Sound requires medium for propagation and it can be proved by the following experiment:

1) Take a bell jar and suspend an electric bell in it.

2) The the bell jar is connected to a vacuum pump. Till the air is in the bell jar, the sound of the electric bell is louder.

3) Now, with the help of vacuum pump, pump out the air gradually

4) Now as air is pumped out, the sound of the bell gets fainter and fainter.

5) Now, when the bell jar is completely vacuumed no sound is heard.

6) This shows that air is required for propagation of sound.

9. A cork on the surface of water moves up and down completing five vibrations in 4s. The waves travel from a cork to the shore which is 20 m away in 10 s calculate

Ans: The calculations are:

Required to complete 1 vibrations $\frac{4}{5}\text{sec}$. Time required to complete 1 vibration = Time Period Time Period $(T) = \frac{4}{5}$ second

$\gamma(\text{ frequency }) = 1/T = 5/4./$ second

$\lambda = 1.25/$ second

Distance Travelled $= 20\,\text{m}$

Time taken =10 second Velocity = 20/10 = 2m/s Now, $V = \gamma\lambda$

$$\text{Velocity} = \text{Frequency} \times \text{Wavelength}$$

$2 = 1.25 \times \lambda$

$(2 \times 100)/125 = \lambda$

$200/125 = \lambda$

$1.6m = \lambda$

So, a) Speed = 2 m/s

b) wavelength = 1.6 m

c) Frequency = 1.25/second

10. An observer far away from a railway station hears the train starting. The sound arrives both from the steel rails and through air with a time difference of 3.5 s. How far is the railway station from the observer? The speed of sound in air and steel is 340m/s and 5130 m/s respectively?

Ans: Let distance between railway station and observer = d

Speed of sound in air $= 340\,\text{m/s}$

Time taken by sound in air $= \frac{\text{Distance}}{\text{speed}} = \frac{d}{340}\,\text{m}$

Speed of sound in steel $= 5130\,\text{m/s}$

Time taken by sound in steel $= \frac{d}{5130}\,m$

Time difference between sound in steel and air

$$3.5 = \frac{d}{340} - \frac{d}{5130} \quad 3.5 = \frac{5130d - 340d}{340 \times 5130} \quad 3.5 \times 340 \times 5130 = 4790d \quad \frac{3.5 \times 340 \times 5130}{4790 \times 10} = d \quad 1274.46\,\text{m} = d$$

11. How can ultrasound be used to detect defects in a metal block?

Ans: Ultrasound is those waves which have frequency greater than 20 KHZ. Now, metal blocks are subjected to ultrasound at one end and detectors on the other side If the metal block does not contain any defect then ultrasound travels through and is detected by detectors. If the metal block has any defect, then from that region ultrasound is not detected clearly and rather it is reflected back indicating defects.

12. What is reverberation? What is done to reduce it?

Ans: The repeated reflection of sound that results in the persistence of sound is called as reverberation. Plastics, fiberboards, or curtains are some of the substances that are used to reduce the reverberation of sound. Reduction of reverberation is done by:-

- If a sound is made in a big hall, the sound waves are reflected repeatedly from walls, ceiling and floor of hall, and produces many echoes

- Providing open windows in the space.

13. Discuss briefly the structure and working of the human ear?

Ans: Ear collects sound waves and channels them into the ear canal (external auditory meatus), where the sound is amplified. Sound waves cause the eardrum to vibrate.

Structure of human ear:

Outer ear is called pinna followed by an auditory canal in which ends in a tympanic membrane. The tympanic membrane is then connected to three bones, hammer, anvil and stirrup. After that there is a cochlea connected to an auditory nerve.

Working of the human ear:

The auricle or the pinna collects the sound and the collected sound passes through and reaches the auditory nerve. After which it forces the eardrum (tympanic membrane) to vibrate. The vibrations are then amplified by 3 bones and the pressure variations reach the inner ear after which the cochlea converts them to electrical signals. Auditory nerve carries the electrical signals to the brain and the brain interprets them as sound.

14. A man standing in a valley between two parallel mountains fires a gun and hears an echo at an interval of 2 s and 3.5 s. what is

Ans: The speed of sound is air $=340\,\text{m/s}$

The two mountains are marked as A and B and man is at P.

The first echo comes from mountain A.

Time taken by echo to reach $\text{man}=2\text{s}$

Time taken by sound to trammel from P to $\text{A}=1\text{s}$

Distance travelled by sound in $1\text{S}=340\,\text{m}$

The Distance of A from $\mathbf{P}=340\,\text{m}$

The second Echo comes from mountain B.

Time taken by echo to reach Thomas $= 3.5s$

Time taken by sound to trend from P to $A = 1.75s$

Distance travelled by sound in $1.75\text{sec} = 340 \times 1.75 = 595\text{m}$

Distance of B from $P = 595\text{m}$ Distance between mountains $= 340 + 595 = 935\text{m}$

15. What is SONAR? Write the working?

Ans: SONAR is abbreviation of Sound Navigation and Ranging**.** It is the method used for echoing. Dinars are used to find the depth of the sea or to locate underwater things like shoals of fish, enemy submarines etc.

It is used to navigate or detect and communicate with the objects present under water surface such as oceans by using sound propagation. Sonar works by sending short bursts of ultrasonic sound from a ship into the sea and then picking up the echo produced by reflection of ultrasound from underwater objects like the bottom of sea.