Lakhmir Singh Solutions Class 9 Physics

Chapter 5: Sound

Question 1:

Can sound travel through (a) iron, and (b) water?

ANSWER:

Yes, sound can travel through iron as well as water.

Question 2:

Can sound travel through vacuum?

ANSWER:

No, sound cannot travel through vacuum because sound wave requires a material medium for its propagation.

Question 3:

Name the type of waves which are used by astronauts to communicate with one another on moon (or in outer space).

ANSWER:

Radio waves are used by astronauts to communicate with one another on moon because radio waves do not require any material medium for its propagation.

Question 4:

Name one solid, on liquid and one gas through which sound can travel.

ANSWER:

Sound waves require a material medium for its propagation so that it can travel in all the three states of matter:
solid (iron block), liquid (water), and gas (hydrogen).

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Question 5:

Which of the following cannot transmit sound?
Water, Vacuum, Aluminium, Oxygen gas

ANSWER:

Among the following, vacuum cannot transmit sound because sound waves require a material medium for its propagation.

Question 6:

Name the physical qantity whose SI unit is 'hertz'.

ANSWER:

Frequency is the physical quantity and its SI unit is hertz (Hz).

Question 7:

What is the SI unit of frequency?

ANSWER:

The SI unit of frequency is hertz (Hz).

Question 8:

What type of wave is represented :

(a) by density-distance graph?
(b) by displacement-distance graph?

ANSWER:

(a) Longitudinal waves are represented by density–distance graph.
(b) Transverse waves are represented by displacement–density graph.

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Question 9:

Is the speed of sound more in water or in steel?

ANSWER:

Sound travels faster in steel than in water. In solids, the distances between the molecules are closer and thus the atoms are more densely packed than in liquids. Therefore, the molecules quickly collide with one another and transfer the vibrational energy.

Question 10:

In which medium sound travels faster : air or iron?

ANSWER:

Sound travels faster in iron than in air. In solids, the distances between the molecules are closer and thus the atoms are more densely packed than in gases. Therefore, the molecules quickly collide with one another and transfer the vibrational energy.

Question 11:

In which medium sound travels fastest : air, water or steel?

ANSWER:

Sound travels faster in steel than in water. Similarly, sound travels faster in water than in air. This is because in solids, the distances between the molecules are closer and thus the atoms are more densely packed than in gases and liquids. Therefore, the molecules quickly collide with one another and transfer the vibrational energy. Similarly, in liquids the molecules are closer to one another than in gases.

Question 12:

Out of solids, liquids and gases :

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(a) in which medium sound travels slowest?
(b) in which medium sound travels fastest?

ANSWER:

In solids, the distances between the molecules are closer and thus the atoms are more densely packed than in gases and liquids. Therefore, the molecules quickly collide with one another and transfer the vibrational energy. Similarly, in liquids the molecules are closer to one another than in gases. Therefore, the following data is inferred:

(a) Sound travels slowest in gases.
(b) Sound travels fastest in solids.

Question 13:

Which of the following is the speed of sound in copper and which in aluminium?

(a) 5100 m/s
(b) 1500 m/s
(c) 3750 m/s

ANSWER:

(a) Speed of sound in copper v_{copper} = 3,750 m/s.
(b) Speed of sound in aluminium $v_{aluminium}$ = 5,100 m/s.

Question 14:

If you want to hear a train approaching from far away, why is it more convenient to put the ear to the track?

ANSWER:

It is more convenient to put the ear to the track to hear a train approaching from far away because sound travels faster in solids than in air because the speed of sound is directly proportional to the density of the material medium. In this case, the density of railway track is higher than air. Hence, sound waves travel faster through the railway track.

Question 15:

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What is the speed of sound :

(a) in air?
(b) in water?
(c) in iron?

ANSWER:

Speed of sound in
(a) air is 344 m/s,
(b) water is 1,500 m/s, and
(c) iron is 5,130 m/s.

Question 16:

What name is given to those aircrafts which fly at speeds greater than the speed of sound?

ANSWER:

Supersonic aircraft are aircraft that fly at speeds greater than the speed of sound.

Question 17:

A jet aircraft flies at a speed of 410 m/s. What is this speed known as?

ANSWER:

Supersonic speed, because 410 m/s is higher than the speed of sound in air (340 m/s).

Question 18:

What is meant by supersonic speed?

ANSWER:

Supersonic speed is a rate of travel of an object that exceeds the speed of sound in air.

Question 19:

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State one observation from everyday life which shows that sound travels much more slow than light.

ANSWER:

During rainy season, it is a common observation that the flash of lightning is seen first while the sound of thunder is heard a little later. This is because light (3×10^8 m/s) travels faster than sound (340 m/s) in air.

Question 20:

Name the two types of waves which can be generates in a long flexible spring (or slinky).

ANSWER:

Transverse and longitudinal waves can be generated in a long flexible spring.

Question 21:

A stone is dropped on the surface of water in a pond. Name the type of waves produced.

ANSWER:

Transverse waves are produced when a stone is dropped on the surface of water.

Question 22:

Name the type of waves produced when a tuning fork is struck in air.

ANSWER:

Longitudinal waves are produced when a tuning fork is struck in air.

Question 23:

What is the general name of the waves consisting of :

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(a) compressions and rarefactions?
(b) crests and troughs?

ANSWER:

(a) Longitudinal waves are the general name of compression and rarefaction.
(b) Transverse waves are the general name of crests and troughs.

Question 24:

State the general name of the waves in which the particles of the medium vibrate :

(i) in the same direction as wave.
(ii) at right angles to the direction of wave.

ANSWER:

(a) Longitudinal waves are the waves in which particles of the medium vibrates in the same direction of wave.
(b) Transverse waves are the waves in which particles of the medium vibrates at right angles to the direction of wave.

Question 25:

What type of waves are illustrated by the movement of a rope whose one end is fixed to a pole and the other end is moved up and down?

ANSWER:

Transverse waves are illustrated by a rope whose one end is fixed to a pole and the other end is in motion.

Question 26:

What should an object do to produce sound?

ANSWER:

An object should vibrate in order to produce sound.

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Question 27:

What is the name of the strings which vibrate in our voice box when we talk?

ANSWER:

Vocal cords vibrate in our voice box when we talk.

Question 28:

Name the device which is used to produce sound in laboratory experiments?

ANSWER:

Tuning fork is used to produce sound in laboratory experiments.

Question 29:

What is the nature of sound waves in air?

ANSWER:

The sound waves in air are longitudinal waves because medium particles vibrate in the direction of propagation of the wave.

Question 30:

What conclusion can be obtained from the observation that when the prongs of a sound making tuning fork touch the surface of water in a beaker, the water gets splashed?

ANSWER:

The conclusion from the observation is that the prongs of the tuning fork are vibrating in simple harmonic motion and transmitting energy to the surrounding medium. The prongs move backward and forward continuously to produce compression and rarefaction, which is observed by the splash of water.

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Question 31:

State whether the following statement is true or false :
Sound produced by a vibrating body travels to our ears by the actual movement of air.

ANSWER:

False. The sound produced by a vibrating body is a longitudinal wave where energy is transmitted through the medium by successive compressions and rarefactions.

Question 32:

Which of the following travels slowest in air and which one fastest?
Supersonic aircraft, Light, Sound

ANSWER:

The waves which have the minimum and the maximum speed among the following:
Slowest – Sound.
Fastest – Light.

Question 33:

Which term is used to denote a speed greater than the speed of sound?

ANSWER:

Supersonic is the term used to denote a speed greater than the speed of sound in air.

Question 34:

In which medium sound travels faster : air or hydrogen?

ANSWER:

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Sound travels faster in hydrogen. Speed of sound in hydrogen is 1,284 m/s.

Question 35:

A tuning fork has a number 256 marked on it. What does this number signify?

ANSWER:

The number 256 marked on tuning fork signifies the frequency of tuning fork.

Question 36:

What is the time-period of a tuning fork whose frequency is 200 Hz?

ANSWER:

We have to find the time period of oscillation.
Given: Frequency f = 200 Hz
We know the relation between frequency and time period $T=\frac{1}{f}$T=1f,
where f is the frequency and T the time period.
So,
$T=\frac{1}{200}\text{s} = 5\times10^{-3}\text{s}$T=1200s =5×10-3s

Question 37:

Calculate the frequency of a wave whose time-period is 0.02 s.

ANSWER:

We have to find the frequency of oscillation.
Given: Time period T = 0.02 s
We know the relation between frequency and time period $f=\frac{1}{T}$f=1T,
where f is the frequency and T the time period.
So,
$f=\frac{1}{0.02}\text{Hz} = 50\ \text{Hz}$f=10.02Hz =50 Hz

Question 38:

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What will be the change in the wavelength of a sound wave in air if its frequency is doubled?

ANSWER:

We know the relation between velocity, frequency, and wavelength
$v = f \times \lambda$,
where v is the velocity, *f* the frequency, and λ the wavelength
Velocity of sound is constant for a given condition. Therefore, if wavelength is doubled, frequency is halved.

Question 39:

If 20 waves are produced per second, What is the frequency is hertz?

ANSWER:

If 20 waves are produced per second, the frequency of sound waves is 20 Hz.

Question 40:

Fill in the following blanks with suitable words.
(a) Sound waves are caused by _____.
(b) A sound wave consists of places of higher pressure called _____ and places of lower pressure called _____.
(c) Wave speed in meters per second equals frequency in _____ multiplied by _____ in _____.
(d) Sound cannot travel through _____.
(e) The sound travels _____ in a solid than in a gas.
(f) When the frequency of the sound is increased, the wavelength _____.

ANSWER:

(a) Sound waves are caused by vibrations.
(b) A sound wave consists of places of higher pressure called compressions and places of lower pressure called rarefactions.
(c) Wave speed in meters per second equals frequency in hertz multiplied by wavelength in meters.
(d) Sound cannot travel through vacuum.
(e) The sound travels faster in a solid than in a gas.
(f) When the frequency of the sound is increased, the wavelength decreases.

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Question 41:

What is the vacuum? Explain why, sound cannot travel through vacuum?

ANSWER:

Vacuum is an empty space that is devoid of matter. Sound wave is an example of mechanical wave that requires material medium for its propagation. Thus, sound waves cannot travel through vacuum.

Question 42:

Explain the term 'amplitude' of a wave. Draw the diagram of a wave and mark its amplitude on it.

ANSWER:

The maximum displacement of the oscillating particles of the medium from their original undisturbed positions, when a wave passes through the medium, is called the amplitude of the wave.

Question 43:

(a) Distinguish between longitudinal and transverse waves.
(b) Are sound waves longitudinal or transverse?

ANSWER:

(a)

	Longitudinal waves		Transverse waves
1.	Particles of the medium vibrate back and forth in the same direction in which the wave travels.	1.	Particles of the medium vibrate up and down at right angles to the direction in which the wave travels.
2.	They can be formed in solids, liquids, and gases.	2.	They can be formed in solids and liquids, but not in gases.
3.	Example: Sound waves.	3.	Example: Ripples in water.

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(b) Sound is a longitudinal wave because the particles of the medium vibrate back and forth in the same direction in which the wave travels.

Question 44:

A cricket ball is seen to hit the bat first and the sound of hitting is heard a little later. Why?

ANSWER:

At first, we see the ball hitting the bat and then we hear the sound of hitting because light (3×10^8 m/s) travels faster than sound (340 m/s) in air.
Therefore, we hear the sound of hitting a little later than we see it.

Question 45:

Explain why, the flash of lightning reaches us first and the sound of thunder is heard a little later.

ANSWER:

Since light travels faster than sound, the flash of lightning is seen first and the sound of thunder is heard thereafter.

Question 46:

Explain why, the flash of a gun shot reaches us before the sound of the gun shot.

ANSWER:

Since light travels faster than sound, the flash of gunshot is seen first and the sound of gunshot is heard thereafter.

Question 47:

Which of the following terms apply to sound waves in air and which to water waves?
Transverse, Rarefaction, Trough, Crest, Compression, Longitudinal

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ANSWER:

Sound waves in air are longitudinal in nature because it forms successive compressions and rarefactions due to the continuous pressure variation.
Water waves are transverse in nature because it forms successive crests and troughs.

Question 48:

(a) Name four ways in which sound can be produced.
(b) Calculate the speed of a sound wave whose frequency is 2 kHz and wavelength 65 cm.

ANSWER:

(a) Sound can be produced by the following methods:
(i) By vibrating strings (e.g., sitar)
(ii) By vibrating air column (e.g., flute)
(iii) By vibrating membranes (e.g., drum)
(iv) By vibrating plates (e.g., cymbal)

(b)We have to find the velocity of the sound wave.
Given: Frequency f = 2,000 Hz
Wavelength λ = 0.65 m
We know the relation between velocity, frequency, and wavelength $v = f \times \lambda$,

where v is the velocity, F the frequency, and λ the wavelength.
So,
$v = (2000) \times (0.65)$ m/s
$= 1300$ m/s
Therefore, velocity of sound is 1300 m/s.

Question 49:

If a ringing bicycle bell is held tightly by hand, it stops producing sound. Why?

ANSWER:

This is because when the ringing bell is held tightly with our hand, it stops to vibrate and so do the sound. Hence, sound is produced when an object vibrates.

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Question 50:

Which object is vibrating when the following sounds are produced?

(i) The sound of a *sitar*
(ii) The sound of a *tabla*
(iii) The sound of a tuning fork
(iv) The buzzing of a bee or mosquito
(v) The sound of a flute

ANSWER:

Sound is produced by the following objects:
(i) Vibrating stretched strings of sitar.
(ii) Vibrating stretched membranes of tabla.
(iii) Vibrating prongs of a tuning fork.
(iv) Vibrating wings of mosquito.
(v) Vibrating air columns in flute.

Question 51:

Give reason for the following:
In most of the cases, we cannot see the vibrations of a sound producing object with our eyes.

ANSWER:

Mostly, a sound-producing object vibrates at a faster rate that we cannot see its vibrations with our naked eyes. The time interval between two successive vibrations is less than the persistence of vision. Hence, we see the object in static mode rather than in vibration mode.

Question 52:

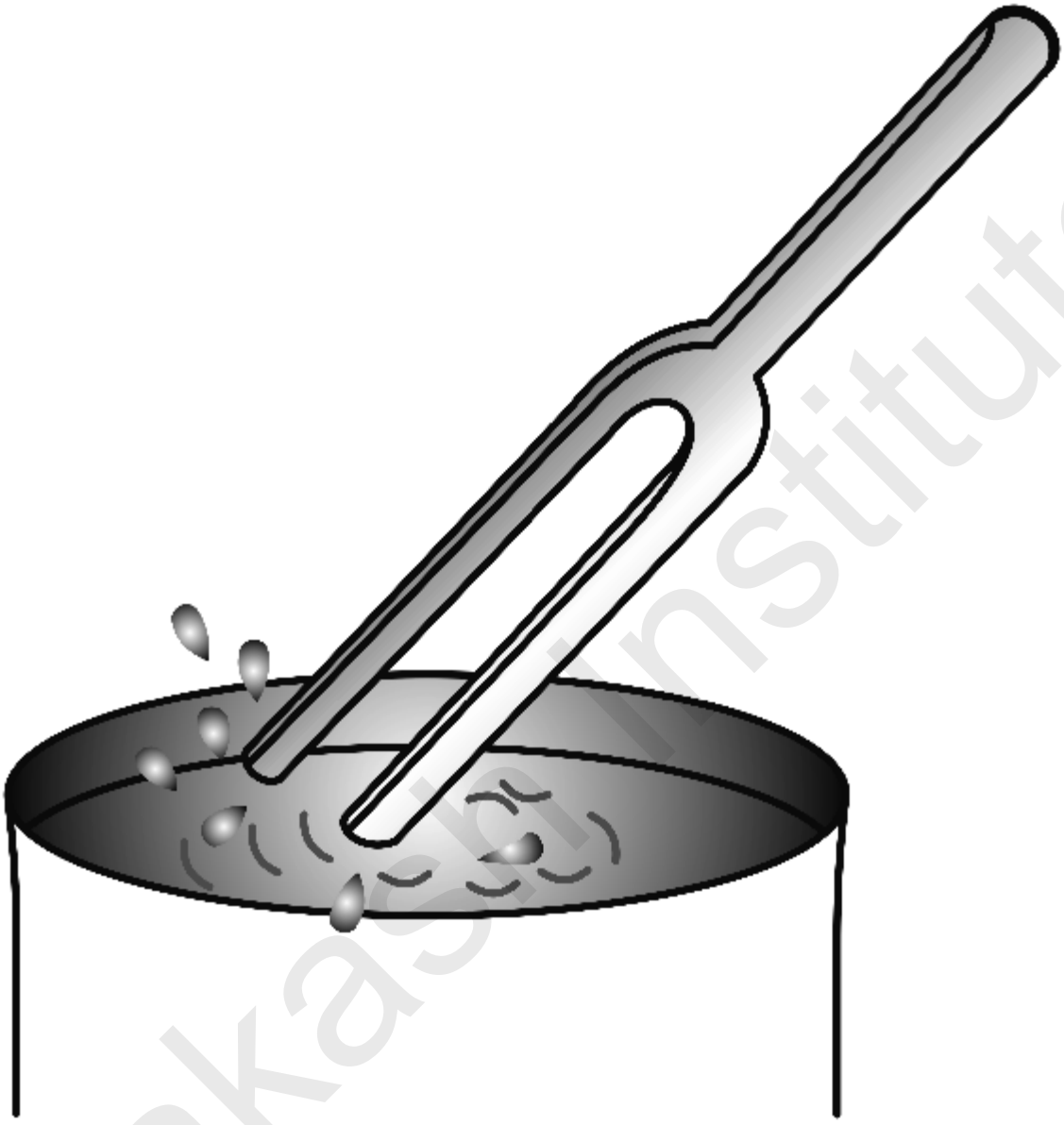
Describe a simple experiment to show that the prongs of a sound producing tuning fork are vibrating.

ANSWER:

We should fill water in a beaker up to its brim. Now we should touch the surface of water with the prongs of a sound-making tuning fork that has been struck on a hard rubber pad earlier. The prongs of tuning fork that produces sound splashes water. This shows that the

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prongs of a sound-producing tuning fork are vibrating or rapidly traveling in forward and backward directions.



The prongs of a sound-producing tuning fork splash water, so they are vibrating.

Question 53:

When we open a gas tap of a few seconds, the sound of escaping gas is heard first but the smell of gas comes later. Why?

ANSWER:

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The sound of a gas travels through the vibrations of air layers, so it reaches the person faster, but the smell of a gas reaches the person through the actual movement of the air layers, so it reaches much slower. In other words, sound of gas propagates through wave and smell of gas propagates through diffusion process. Hence, the sound of gas reaches the person earlier than the smell of gas.

Question 54:

A sound signal of 128 vibrations per second has a wavelength of 2.7 m. Calculate the speed with which the wave travels.

ANSWER:

We have to find the velocity of the sound wave.
Frequency is number of vibrations produced per second.
Given: Frequency f = 128 Hz
Wavelength λ = 2.7 m
We know the relation between velocity, frequency, and wavelength $v = f \times \lambda$,
where v is the velocity, f the frequency, and λ the wavelength.
So,
$v = (128) \times (2.7)$ m/s
$= 345.6$ m/s
Therefore, velocity of sound is 346 m/s .

Question 55:

A wave is moving in air with a velocity of 340 m/s. Calculate the wavelength if its frequency is 512 vibrations/sec.

ANSWER:

We have to find the wavelength of the sound wave.
Given: Frequency f = 512 Hz
Velocity of sound wave v = 340 m/s
We know the relation between velocity, frequency, and wavelength $\lambda = vf$,$\lambda = vf$,
where v is the velocity, f the frequency, and λ the wavelength.
So,
$\lambda = \frac{340}{512} m = 0.664$ m$\lambda = \frac{340}{512} m = 0.664$ m

Therefore, wavelength of the sound wave is 0.66 m.

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Question 56:

Define the 'frequency' and 'time-period' of a wave. What is the relation between the two?

ANSWER:

The number of complete waves or cycles produced in one second is called frequency of the wave.
The time required to produce one complete wave or vibration is called time period of the wave.
We know the relation between frequency and time period $f=\frac{1}{T}$f=1T,
where f is the frequency and T the time period.

Question 57:

Explain why, a ringing bell suspended in a vacuum chamber cannot be heard outside.

ANSWER:

A ringing bell suspended in a vacuum chamber cannot be heard outside because sound wave is an example of mechanical wave and requires material medium for its propagation. Therefore, sound waves cannot travel through vacuum.

Question 58:

The frequency of the sound emitted by the loudspeaker is 1020 Hz. Calculate the wavelength of the sound wave in air in cm where its velocity is 340 m/s.

ANSWER:

We have to find the wavelength of the sound wave. We have frequency and velocity of sound wave.
We know the relation between velocity, frequency, and wavelength $\lambda=\frac{v}{f}$λ=vf,
where v is the velocity, *f* the frequency, and λ the wavelength.
So,
$\lambda=\frac{340}{1020}m = 0.33\ m$λ=3401020m =0.33 m
Therefore, wavelength of the sound wave is 33.3 cm.

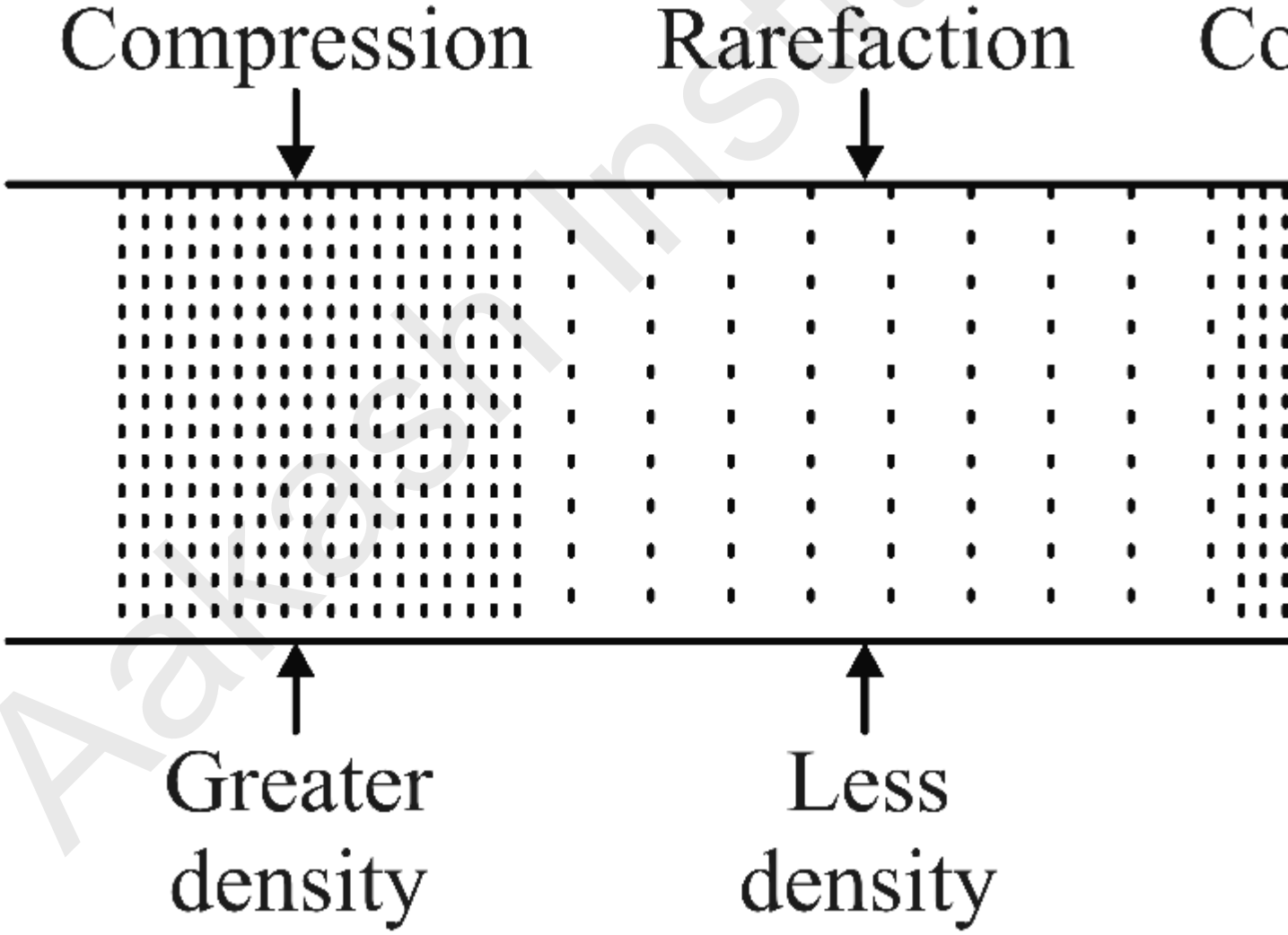
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Question 59:

What is the difference between a compression and a rarefaction in a sound wave? Illustrate your answer with a sketch.

ANSWER:

A longitudinal wave consists of successive compression and rarefaction that is formed due to continuous to and fro motion of a vibrating object.
A compression is that part of a longitudinal wave in which the particles of the medium are closer to one another than they normally are, and there is a momentary reduction in volume of the medium. It is a region of high pressure and high density.
A rarefaction is that part of a longitudinal wave in which the particles of the medium are farther apart than normal, and there is a momentary increase in the volume of the medium. It is a region of low pressure and low density.



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Question 60:

(a) What is sound? What type of waves are sound wave in air?
(b) Describe an experiment to show that sound cannot pass through vacuum.

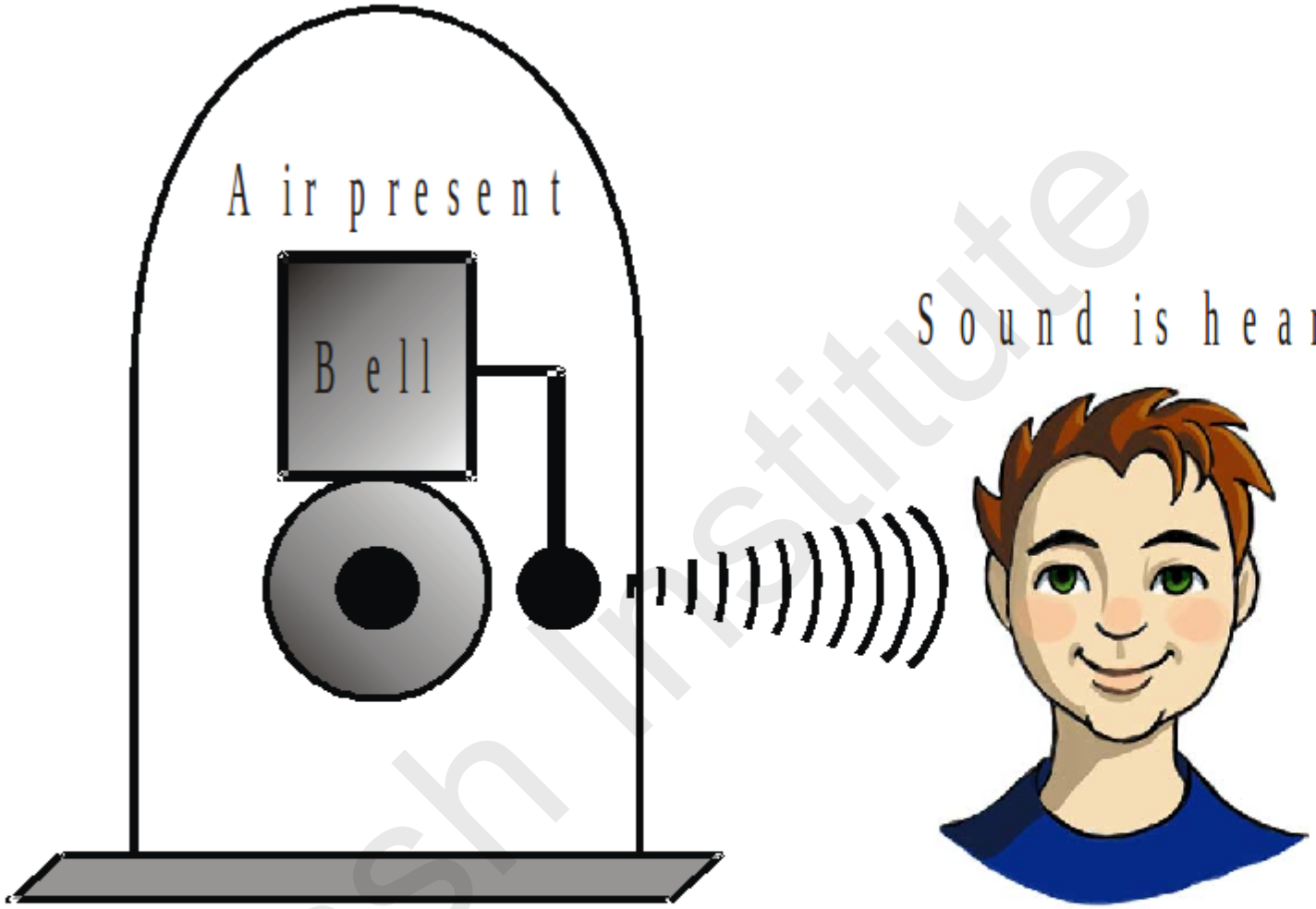
ANSWER:

(a) Sound is a form of energy that makes us to hear. Sound waves are longitudinal waves in air.

(b) Sound cannot travel through vacuum. This can be shown by the following experiment:
(i) A ringing electric bell is placed inside an airtight bell jar containing air. We can hear the sound of the ringing bell clearly. Thus, when air is present as medium in the bell jar, sound can travel through it and reach our ears.
(ii) The bell jar containing a ringing bell is placed over the plate of a vacuum pump. Air is gradually suctioned from the bell jar by switching on the vacuum pump. As large amount of air is suctioned from the bell jar, the sound of the ringing bell weakens. Ultimately, when all the air is suctioned from the bell jar, there is no sound heard. Thus, when vacuum is created in the bell jar, the sound of the ringing bell placed inside it cannot be heard. This shows that

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sound cannot travel through vacuum.



(a) Air present in bell jar :
Sound of bell is heard

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Question 61:

(a) How is sound produced? Explain with the help of an example.
(b) How does sound from a sound producing body travel through air to reach our ears? Illustrate your answer with the help of a labelled diagram.

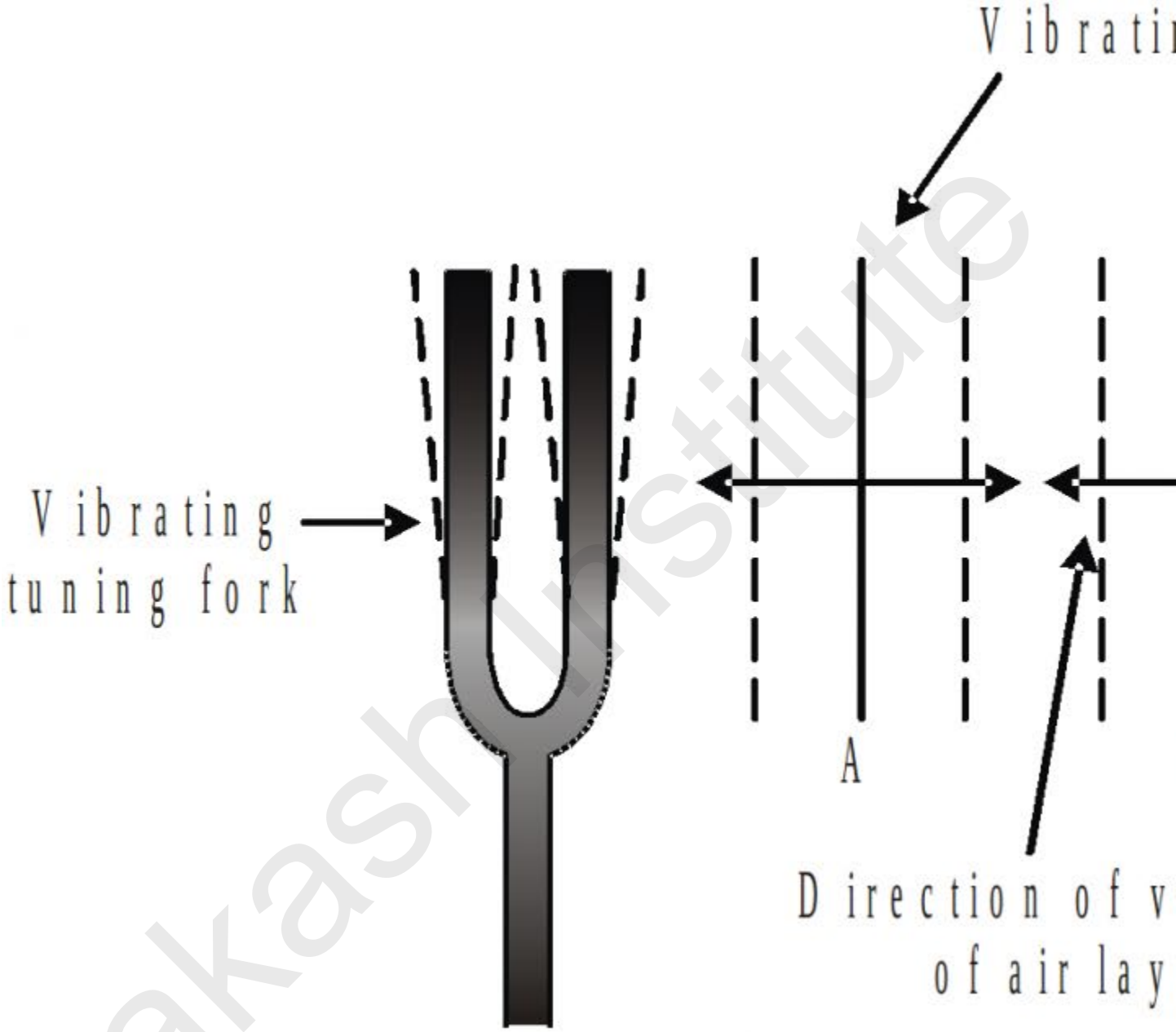
ANSWER:

(a) Sound is produced when an object vibrates and produces continuous compression and rarefaction.
Example: The sound of our voice is produced by the vibrations of two vocal cords in our throat caused by air passing through the lungs.

(b) When an object vibrates, then the air layers around it start to vibrate in exactly the same way and causes successive compression and rarefaction that carry sound waves from the sound-producing object to our ears.
Example: A tuning fork vibrates and produces sound waves in air. Since the prongs of the tuning fork vibrate, the individual layers of air also start to vibrate, creating successive compression and rarefaction. Sound travels in the form of longitudinal waves in which the back and forth vibrations of the air layers are in the same direction as the movement of

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sound wave.



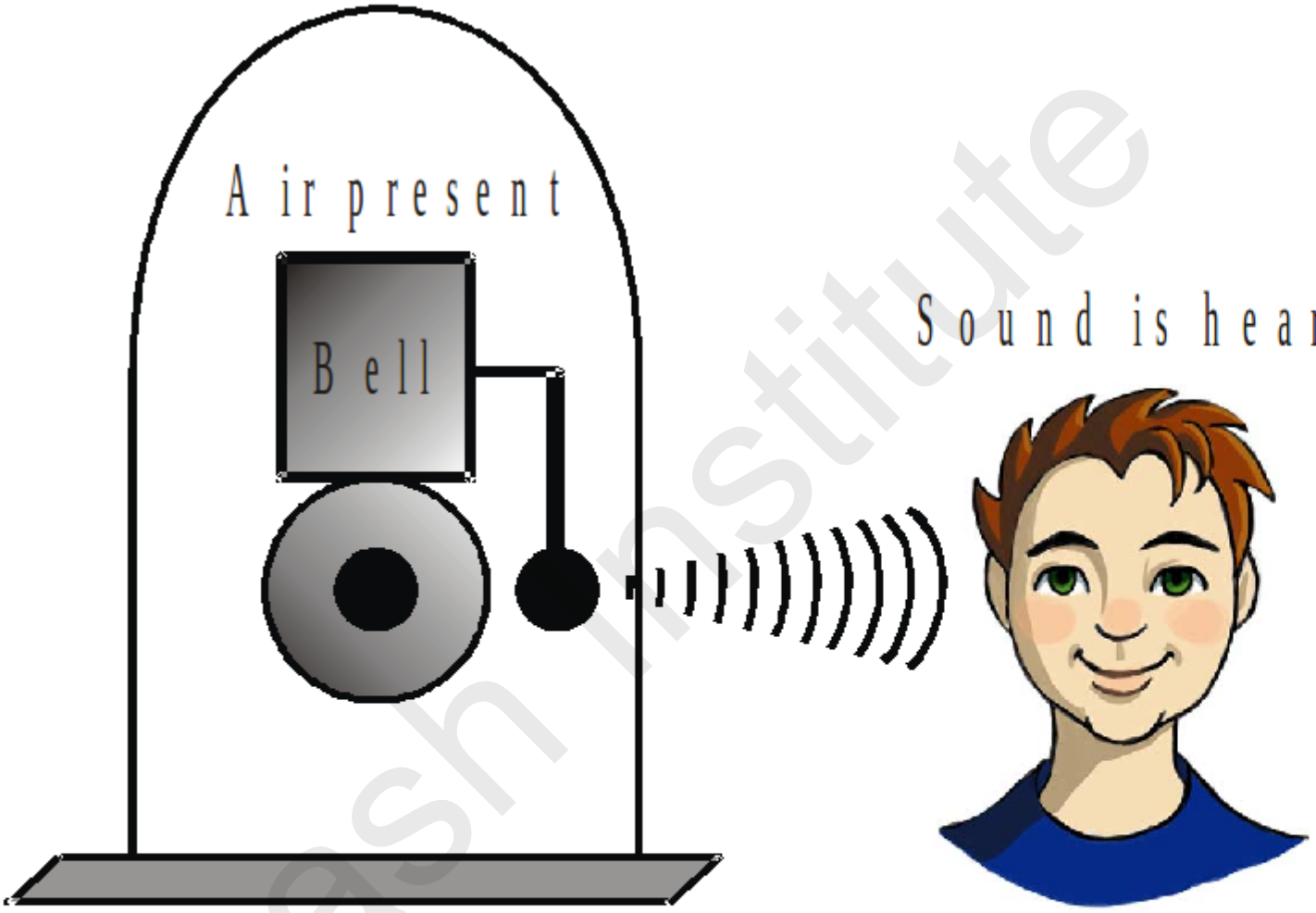
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Question 62:

(a) An electric bell is suspended by thin wires in a glass vessel and set ringing. Describe and explain what happens if the air is gradually pumped out of the glass vessel.
(b) Why cannot a sound be heard on the moon? How do astronauts talk to one another on the surface of moon?

ANSWER:

(a) If the air is gradually pumped out of the glass vessel, no sound of the electric bell can be heard because vacuum is created in the vessel and there are no air molecules to carry sound vibrations. Hence, sound waves require material medium for its propagation.



(a) Air present in bell jar : Sound of bell is heard

(b) Sound cannot be heard on the surface of moon because there is no air on the moon to carry the sound waves. Hence, sound waves cannot be propagated in vacuum.
Astronauts talk to one another on the surface of moon through wireless sets that uses radio

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waves. This is because radio waves can travel through vacuum, whereas sound waves cannot travel through vacuum as they require material medium for their propagation.

Question 63:

(a) Define the terms 'frequency', 'wavelength' and 'velocity' of a sound wave. What is the relation between them?
(b) A body vibrating with a time-period of $\frac{1}{256}$s1256s produces a sound wave which travels in air with a velocity of 350 m/s. Calculate the wavelength.
ANSWER:

(a) Frequency: The number of complete waves or cycles produced in one second.
Wavelength: The minimum distance in which a sound wave repeats itself.
Velocity of a wave: The distance travelled by a wave in one second.
We know the relation between velocity, frequency, and wavelength
$v = f \times \lambda$,
where v is the velocity of sound, F the frequency, and λ the wavelength.

(b) We have to find the wavelength of the sound wave.
Given: Velocity of sound wave v = 350 m/s
We have to first find the frequency of oscillation.
Time period $(T) = \frac{1}{256}$sT=1256s
We know the relation between frequency and time period $f = \frac{1}{T}$f=1T,
where *f* is the frequency and T the time period.
So,
$f = \frac{1}{256}\text{Hz} = 256\ \text{Hz}$f=2561Hz =256 Hz

Now we can calculate wavelength as $\lambda = \frac{v}{f}$λ=vf,
where v is the velocity, *f* the frequency, and λ the wavelength.
So,
$\lambda = \frac{350}{256}\text{m} = 1.367\ \text{m}$λ=350256m =1.367 m
Therefore, velocity of sound is 1.37 m.

Question 64:

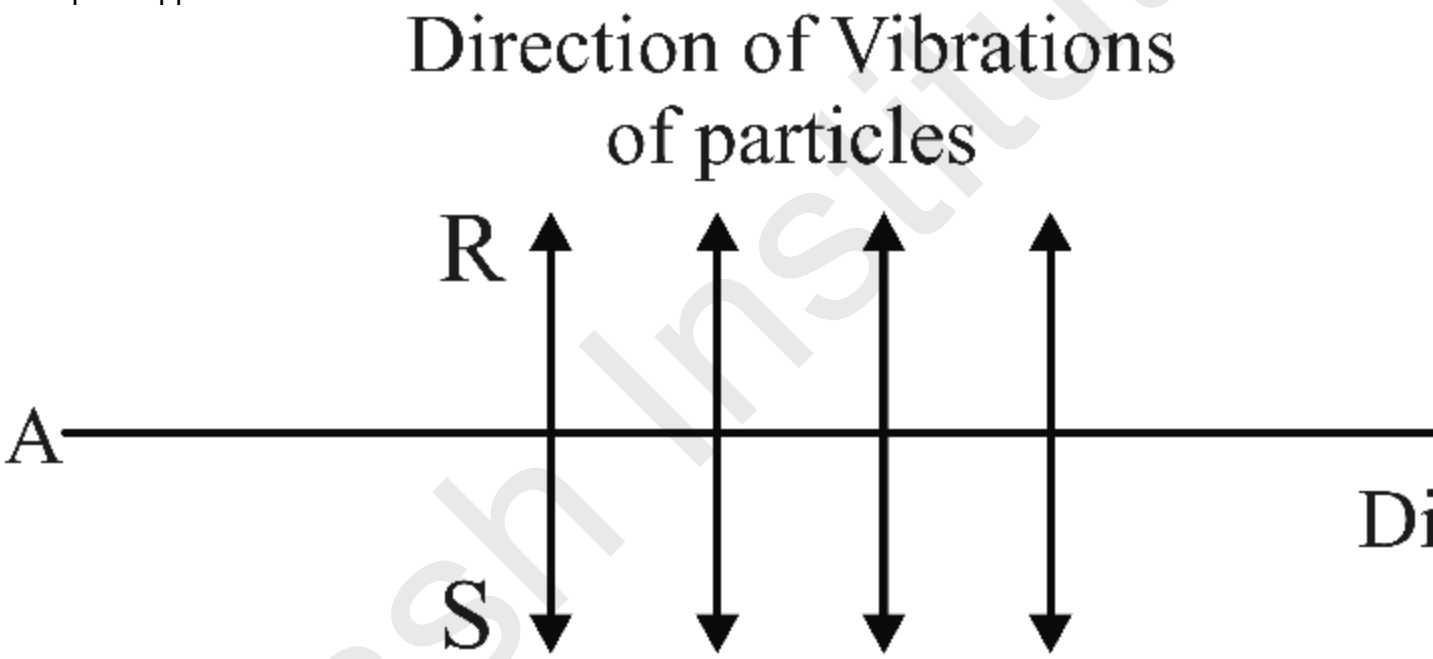
(a) What are longitudinal waves and transverse waves? Explain with the help of labelled diagrams.
(b) Give two examples each of longitudinal waves and transverse waves.

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ANSWER:

(a) *Longitudinal waves*: These are the waves in which medium particles vibrate to and fro in the direction of propagation of the wave. This type of wave can be formed in solid, liquid, and gas.
Example: Sound waves.

Transverse waves: These are the waves in which medium particles vibrate perpendicular to the direction of propagation of wave. This type of wave can be formed only in solid and liquid.
Example: Ripples in water.



(b)Examples of longitudinal waves are:
(i) The waves that travel along a spring when it is pushed and pulled at one end.
(ii) Sound waves in air.
Examples of transverse waves are:
(i) The waves produced by moving one end of a long spring up and down rapidly while the other end is fixed.
(ii) The water waves (or ripples) formed on the surface of water in a pond by throwing a stone in it.

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Question 65:

(a) Explain the terms 'compressions' and 'rarefactions' of a wave. What type of waves consist of compressions and rarefactions.

(b) A worker lives at a distance of 1.32 km from the factory. If the speed of sound in air be 330 m/s, how much time will the sound of factory siren take to reach the worker?

ANSWER:

(a) A longitudinal wave consists of successive compression and rarefaction that is formed due to continuous to and fro motion of a vibrating object.
A compression is that part of a longitudinal wave in which the particles of the medium are closer to one another than they normally are, and there is an instantaneous reduction in the volume of the medium. This is the region of high pressure and density.
A rarefaction is that part of a longitudinal wave in which the particles of the medium are farther apart than normal, and there is an instantaneous increase in the volume of the medium. This is a region of low pressure and density.

(b) We have to calculate the time taken by the sound wave to reach the observer.
Given: Velocity of sound v = 330 m/s
Distance between the observer and the source *d* = 1,320 m.
We know, $\text{Time}=\text{DistanceSpeed}$Time=DistanceSpeed
Therefore, time taken by the sound wave to reach the observer is
$=1320330s= 4\ s$=1320330s= 4 s
So, the time taken is 4 s.

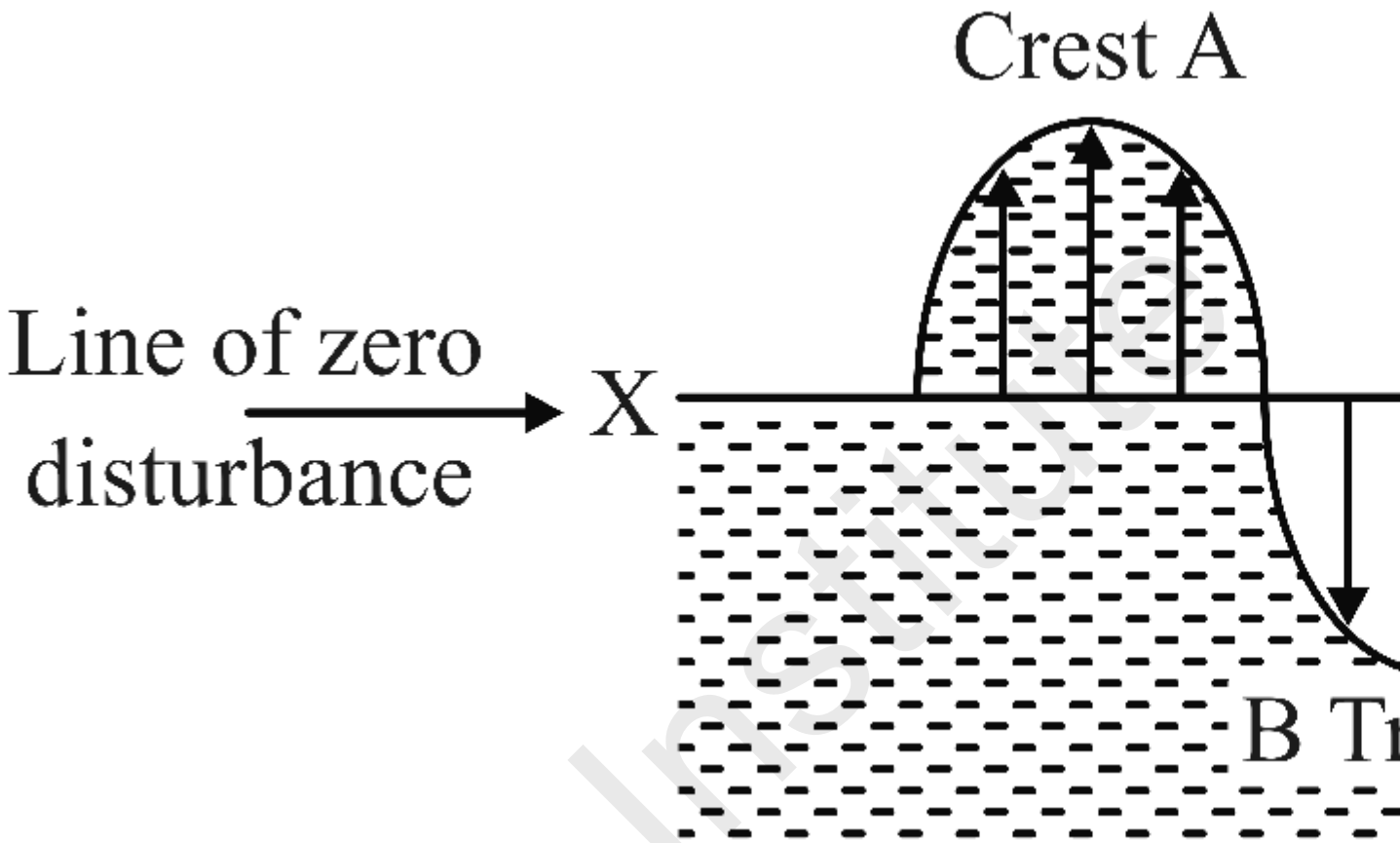
Question 66:

(a) Explain the terms 'crests' and troughs' of a wave? What type of waves consist of crests and troughs?
(b) The flash of a gun is seen by a man 3 seconds before the sound is heard. Calculate the distance of the gun from the man (Speed of sound in air is 332 m/s).

ANSWER:

(a) A transverse wave consists of crests and troughs.
The elevation or hump in a transverse wave is called crest. It is that part of the transverse wave in which all the medium particles are above the line of zero disturbance of the medium.
The depression or hollow in a transverse wave is called trough. It is that part of the transverse wave in which all the medium particles are below the line of zero disturbance of medium.

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(b)We have to find the distance to which the sound will reach in a given time.
Given: Velocity of sound v = 332 m/s
Time *t* = 3 s
So,
Distance = Speed × Time
Therefore, distance covered is
= 332 × 3 m
= 996 m

Question 67:

(a) When we put our ear to a railway line, we can hear the sound of an approaching train even when the train is far off but its sound cannot be heard through the air. Why?
(b) How could you convince a small child that when you speak, it is not necessary for air to travel from you mouth to the ear of listener?

ANSWER:

(a) Sound travels about 15 times faster in iron or steel than in air. We can hear the sound of an approaching train by putting our ear to the railway line made of iron or steel even when

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the train is far away because the sound produced by the motion of train's wheels over the railway line is carried away quickly by the steel rails than in air.

(b) There is no actual movement of air from the sound-producing body to our ear. The air layers only vibrate back and forth and transfer the sound energy from one layer to the next layer and fall on our ears; the eardrums vibrate accordingly and reproduce the sound.

Question 68:

Which of the following statement best describes frequency?
(a) the maximum disturbance caused by a wave
(b) the number of complete vibrations per second
(c) the distance between one crest of a wave and the next one
(d) the distance travelled by a wave per second

ANSWER:

Frequency is defined as number of complete vibrations per second.
Ans: (b) Number of complete vibrations per second.

Question 69:

Which of the following vibrates when a musical note is produced by the cymbals in an orchestra?

(a) stretched strings
(b) stretched membranes
(c) metal plates
(d) air columns

ANSWER:

The metal plates vibrate when a musical note is produced by the cymbals.
Ans: (c) Metal plates.

Question 70:

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If the speed of a wave is 340 m/s and its frequency is 1700 Hz, then λ for this wave in cm will be :

(a) 2
(b) 0.2
(c) 20
(d) 200

ANSWER:

Given: Velocity of the wave = 340 m/s
Frequency of the wave = 1,700 Hz
So, we can find the wavelength by $\lambda = \frac{v}{f}$λ=vf,
where λ is the wavelength, v the velocity, and *f* the frequency.
So,
$\lambda = \frac{340}{1700} \text{m} = 20 \text{ cm}$λ=3401700m =20 cm
Ans: (c) 20 cm.

Question 71:

A musical instrument is producing a continuous note. This note cannot be heard by a person having a normal hearing rang. This note must then be passing through.

(a) water
(b) wax
(c) vacuum
(d) empty vessel

ANSWER:

Sound waves cannot propagate through vacuum.
Ans: (c) Vacuum.

Question 72:

Which one of the following does not consist of transverse waves?

(a) light emitted by a CFL
(b) TV signals from a satellite

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(c) ripples on the surface of a pond
(d) musical notes of an orchestra

ANSWER:

The waves produced by musical instruments are longitudinal in nature.
Ans: (d) Musical notes of an orchestra.

Question 73:

Sound travels in air :

(a) if particles of medium travel from one place to another
(b) if there is no moisture in the atmosphere
(c) is disturbance moves
(d) if both, particles as well s disturbance move from one place to another

ANSWER:

Sound is a longitudinal wave in which the disturbance created by the vibrating body is carried out by the medium without the actual movement of the medium particles.
Ans: (c) If disturbance moves.

Question 74:

In the sound wave produced by a vibrating turning fork shown in the diagram, half the wavelength is represented by :

Figure

(a) AB
(b) BD
(c) DE
(d) AE

ANSWER:

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The distance between successive trough and crest is half the wavelength.
Ans: (b) BD.

Question 75:

The maximum speed of vibrations which produce audible sound will be in :

(a) dry air
(b) sea water
(c) ground glass
(d) human blood

ANSWER:

Velocity of the longitudinal wave is directly proportional to the density of the medium.
Ans: (c) Ground glass.

Question 76:

The sound waves travel fastest :

(a) in solids
(b) in liquids
(c) in gases
(d) in vacuum

ANSWER:

Velocity of the longitudinal wave is directly proportional to the density of the medium.
Ans: (a) In solids.

Question 77:

The speeds of sound in four different media are given below. Which of the following is the most likely speed in m/s with which the two under water whales in a sea talk to each other when separated by a large distance?

(a) 340

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(b) 5170
(c) 1280
(d) 1530

ANSWER:

The speed of water in sound is 1,530 m/s.
Ans: (d) 1,530 m/s.

Question 78:

When the pitch of note produced by a harmonium is lowered, then the wavelength of the note :

(a) decreases
(b) first decreases and then increases
(c) increases
(d) remains the same

ANSWER:

When the pitch of the harmonium is lowered, then the frequency is also lowered.
Wavelength is inversely proportional to the frequency.
Ans: (c) Increases.

Question 79:

The velocities of sound waves in four media P, Q, R and S are 18,000 km/h, 900 km/h, 0 km/h and 1200 km/h respectively. Which medium could be a liquid substance?

(a) P
(b) Q
(c) R
(d) S

ANSWER:

Velocity of sound in liquid medium is intermediate to the velocities in solid and gas medium.
Ans: (d) S.

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Question 80:

Which of the following can produce longitudinal waves as well as transverse waves under different conditions?

(a) water
(b) TV transmitter
(c) Slinky
(d) tuning fork

ANSWER:

Slinky can produce longitudinal as well as transverse waves.
Ans: (c) Slinky.

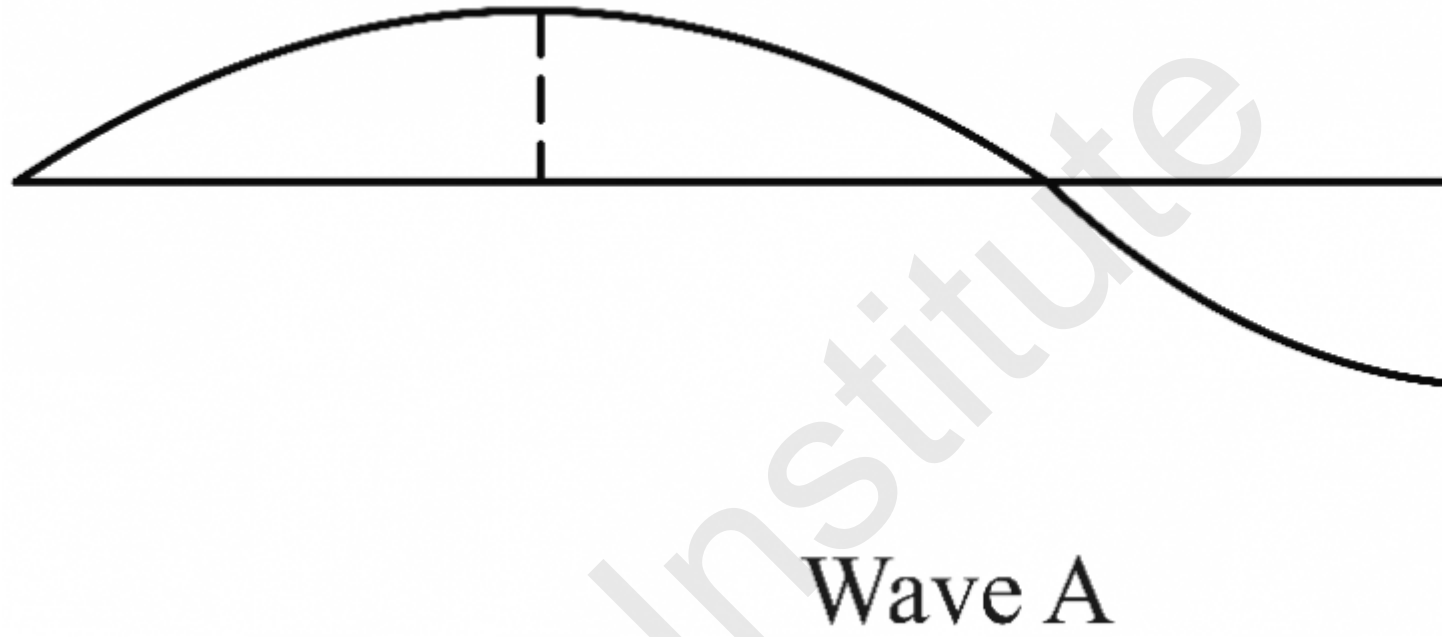
Question 81:

Draw the sketches of two waves A and B such that wave A has twice the wavelength and half the amplitude of wave B.

ANSWER:

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We can conclude that wave B is louder than wave A as loudness of sound is directly proportional to the amplitude of the wave.



Question 82:

A device called oscillator is used to send waves along a stretched string. The string is 20 cm long, and four complete waves fit along its length when the oscillator vibrates 30 times per second. For the waves on the strings.

(a) what is their wavelength?
(b) what is their frequency
(c) what is their speed?

ANSWER:

(a) Given that there are four complete waves. So,
Wavelength=Total length of stringNumber of wavesWavelength=Total length of stringNumber of waves
Therefore,
Wavelength=204cm =5 cm =0.05 mWavelength=204cm =5 cm =0.05 m
(b) We have to calculate frequency. We know,

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Frequency = (Vibration per second) × (Number of complete waves formed)
Therefore frequency,
Frequency = (30) × (4) Hz
= 120 Hz
(c) Now we have to calculate the velocity of the wave.
Given: Frequency f = 120 Hz
Wavelength λ = 0.05 m
We know the relation between velocity, frequency, and wavelength
$v = f \times \lambda$,
where v is the velocity, f the frequency, and λ the wavelength.
Therefore,
v = (120) × (0.05) m/s
= 6 m/s
Therefore, velocity of the wave is 6 m/s.

Question 83:

Through which of the following materials can sound travel?
wood, air, water, steam, ice, hydrogen, steel, diamond.

ANSWER:

Sound is a longitudinal wave that requires material medium for its propagation. Therefore, all the material mediums mentioned can be used as medium for the propagation of sound waves.

Question 84:

A sound producing body is at considerable distance from a man. There can be four different media W, X, Y and Z between the sound producing body and the man. The medium X brings the sound to man most quickly whereas medium Z takes the maximum time. The time taken by medium W in bringing sound to man is less than that of X but more than that of Z. The medium Y, however, fails to bring the sound from the sound producing body to the man. Which medium could be the one :
(a) having on fixed shape and no fixed volume?
(b) having a fixed volume but no fixed shape?
(c) having the same composition as that on the moon?
(d) having a fixed shape and a fixed volume?

ANSWER:

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(a) Z medium has no fixed shape and no fixed volume.
(b) W medium has a fixed volume but no fixed shape.
(c) Y medium has the same composition as that on the moon.
(d) X medium has a fixed shape and a fixed volume.

Question 85:

The longitudinal waves travel in a coiled spring at a rate of 4 m/s. The distance between two consecutive compressions is 20 cm. Find :
(i) Wavelength of the wave (ii) Frequency of the wave

ANSWER:

(i) The distance between two consecutive compressions or rare factions is equal to its wavelength.
Hence, from the diagram of wave we can say that wavelength is 0.2 m.

(ii) Now we have to calculate the frequency of the wave.
Given: Velocity v = 4 m/s
Wavelength λ = 0.2 m
We know the relation between velocity, frequency, and wavelength $f=v\lambda$f=vλ,
where v is the velocity of sound, *f* the frequency, and λ the wavelength.
So,
$f=\frac{40.2}{}Hz = 20\ Hz$f=40.2Hz =20 Hz
Therefore, frequency of the wave is 20 Hz.

Question 1:

Which property of sound leads of the formation of echoes ?

ANSWER:

Echoes are formed due to reflection of sound waves.

Question 2:

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What name is given to the repetition of sound caused by the reflection of sound waves ?

ANSWER:

Echo is the repetition of sound caused by the reflection of sound.

Question 3:

What name is given to the persistence of sound in a big hall or auditorium ?

ANSWER:

Reverberation is the persistence of sound in a particular space after the original sound is produced.

Question 4:

Name three devices which work on the reflection of sound.

ANSWER:

The devices that work on the reflection of sound are
(a) megaphone or bulhhorn,
(b) stethoscope, and
(c) soundboard.

Question 5:

What is the other name of a loud-hailer ?

ANSWER:

Megaphone or bullhorn is also called as loudhailer.

Question 6:

Name the three characteristics of sound.

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ANSWER:

The three characteristics of sound are
(a) loudness,
(b) pitch, and
(c) timbre or quality.

Question 7:

Name the unit used to measure the loudness of sound. Also write its symbol.

ANSWER:

Loudness of sound is measured in decibel. Its symbol is dB.

Question 8:

Name the characteristic which helps us distinguish between a man's voice and a woman's voice, even without seeing them.

ANSWER:

Pitch is the characteristic that helps us to distinguish between a man’s voice and a woman’s voice, even without seeing them.

Question 9:

How does the pitch of a sound depend on frequency ?

ANSWER:

Pitch of a sound is directly proportional to frequency—higher the frequency, higher the pitch of the sound.

Question 10:

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Name the characteristic of sound which depends on (a) amplitude (b) frequency, and (c) waveform.

ANSWER:

(a) Loudness of sound depends on amplitude.
(b) Pitch of sound depends on frequency.
(c) Quality of sound depends on waveform.

Question 11:

Name the characteristic of sound which can distinguish between the 'notes' (musical sounds) played on a flute and a *sitar* (both the notes having the same pitch and loudness).

ANSWER:

Quality or timbre is the characteristic of the sound by which we can distinguish between the ‘notes’ played on a flute and a sitar.

Question 12:

Name the organs of hearing in our body.

ANSWER:

Ear is the organ that is used to hear.

Question 13:

Name that part of ear which vibrates when outside sound falls on it.

ANSWER:

Eardrum is a piece of tissue in the ear that vibrates when sound waves fall on it.

Question 14:

Name the three tiny bones present in the middle part of ear.

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ANSWER:

The three tiny bones in the middle ear are anvil, hammer and stirrup.

Question 15:

There are three small bones in the muddle ear – anvil, hammer and stirrup :
(a) Which of these bones is in touch with ear-drum ?
(b) Which of these bones is in touch with oval window ?

ANSWER:

(a) Hammer is the bone that is in touch with the eardrum.
(b) Stirrup is the bone that is in touch with the oval window.

Question 16:

What is the function of three tiny bones in the ear ?

ANSWER:

The three tiny bones in the middle ear help to strengthen vibrations from the eardrum before passing them onto the inner ear so that a clearer sound is heard.

Question 17:

Name the tube which connects the middle ear to throat.

ANSWER:

Eustachian tube connects the middle ear to throat.

Question 18:

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Name the nerve which carries electrical impulses from the cochlea of ear to the brain.

ANSWER:

Auditory nerve carries the electrical impulses from the cochlea (part of the inner ear) to the brain.

Question 19:

What is the name of passage in outer ear which carries sound waves to the ear-drum ?

ANSWER:

Ear canal is a tube running from the outer ear that carries sound waves to the eardrum.

Question 20:

Why should we not put a pin or pencil in our ears ?

ANSWER:

We should not put a pin or pencil in our ears because they can damage our eardrum and can make us deaf.

Question 21:

What type of scans are used these days to monitor the growth of developing baby in the uterus of the mother ?

ANSWER:

Ultrasound scans are used to monitor the growth of a developing baby in the uterus of a woman.

Question 22:

How is an ultrasound scan for fetus (unborn baby) better than X-ray ?

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ANSWER:

An ultrasound scan for fetus is better than X-rays because X-rays can damage the delicate body cells of the fetus.

Question 23:

What is the name of the device which is used to find the depth of sea (or ocean) by using ultrasonic sound waves ?

ANSWER:

Sonar is a device used to find the depth of a sea through ultrasonic sound waves.

Question 24:

Write the full name of 'SONAR'.

ANSWER:

SONAR is an acronym for SOund Navigation And Ranging.

Question 25:

Name the principle on which a soundboard works.

ANSWER:

Soundboard works on the principle of multiple reflection of sound.

Question 26:

Name the device which is used to address a small gathering of people.

ANSWER:

Megaphone or bullhorn is a device that is used to address a small gathering of people.

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Question 27:

Name the device used by doctors to listen to our heartbeats.

ANSWER:

A stethoscope is a device used by doctors to listen to our heart beats.

Question 28:

What is the shape of a soundboard kept behind the speaker on the stage of a big hall ?

ANSWER:

Soundboard is a concave board that is kept behind the speaker on the stage of a big hall.

Question 29:

Name two sound absorbing materials (or objects) which can make our big room less echoey.

ANSWER:

Curtains and carpets are two sound-absorbing materials that can make big rooms less echoey.

Question 30:

Can we hear (a) infrasonic waves (b) ultrasonic waves ?

ANSWER:

No, we cannot hear infrasonic waves and ultrasonic waves because the frequencies of both these waves fall beyond the human audible range of frequencies.

Question 31:

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What name is given to the sound waves of frequency too low for humans to hear ?

ANSWER:

Infrasonic sound is sound waves that are too low in frequency for human hearing.

Question 32:

What name is given to the sound waves of frequency too high for humans to hear ?

ANSWER:

Ultrasonic sound is sound waves that are too high in frequency for human hearing.

Question 33:

What type of sound waves are produced by a vibrating simple pendulum ?

ANSWER:

Infrasonic sound waves are produced by a vibrating simple pendulum.

Question 34:

What happens to the pitch of a sound if its frequency increases ?

ANSWER:

Pitch of a sound is directly proportional to frequency. As the frequency increases, the pitch of the sound also increases.

Question 35:

What happens to the loudness of a sound if its amplitude decreases ?

ANSWER:

The loudness of a sound decreases with the decrease in the amplitude of sound.

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Question 36:

What name is given to sound waves of frequencies higher than 20 kHz ?

ANSWER:

Ultrasonic sound is sound waves of frequencies higher than 20 kHz.

Question 37:

Fill in the following blanks with suitable words :
(a) An echo is simply a ..... sound.
(b) Pitch of sound depends on .....
(c) Loudness of sound depends on .....
(d) Quality of sound depends on .....
(e) Echoes are caused by the ..... of sound.

ANSWER:

(a) An echo is simply a reflected sound.
(b) Pitch of sound depends on frequency.
(c) Loudness of sound depends on amplitude.
(d) Quality of sound depends on waveform.
(e) Echoes are caused by the reflection of sound.

Question 38:

On which day, a hot day or a cold day, an echo is heard sooner ? Give reason for your answer.

ANSWER:

An echo is heard sooner on a hot day because the speed of sound in air increases with increase in temperature of the propagating medium. Therefore, the speed of sound in air is faster on a hot day and thus echo is heard sooner.

Question 39:

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In which medium, air or water, an echo is heard much sooner ? Why ?

ANSWER:

An echo is heard sooner in water because sound travels faster in water than in air as the speed of sound depends on the density of propagating medium.

Question 40:

What is reverberation ? What will happen if the reverberation time in a big hall is too long ?

ANSWER:

The persistence of sound in a big hall due to repeated reflections from the walls, ceiling, and floor of the hall is called reverberation. If the reverberation is too long in a big hall, then the sound becomes blurred, distorted, and confusing due to overlapping and cannot be heard clearly.

Question 41:

How can reverberations in a big hall or auditorium be reduced ?

ANSWER:

Reverberations in a big hall or auditorium can be reduced by the following ways:
(i) Panels made of sound-absorbing materials should be placed on the walls and ceilings of hall and auditorium.
(ii) Carpets should be placed on the floor to absorb sound and reduce reverberations.
(iii) Heavy curtains should be used to close the doors and windows to absorb sound and reduce reverberations.
(iv) The seats in the hall should be made from materials having sound-absorbing properties.

Question 42:

Why do we hear more clearly in a room with curtains than in a room without curtains ?

ANSWER:

We hear more clearly in a room that is curtained than in a room that is uncurtained because curtains are bad reflectors of sound. They absorb most of the sound falling on them, and

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hence do not produce echoes. On the other hand, in an uncurtained room, there is a greater reflection of sound and thus echoes are formed. These echoes cause a hindrance to hearing. Therefore, we hear more clearly in a room with curtains than in a room without curtains.

Question 43:

What is a megaphone ? Name the principle on which a megaphone works.

Figure

ANSWER:

A megaphone is a large cone-shaped device used for amplifying and directing the voice of a person who speaks into it. A megaphone works on the principle of multiple reflections of sound. It is used for addressing a small gathering of people.

Question 44:

What is a bulb horn ? Name the principle on which a bulb horn works.

ANSWER:

A bullhorn is a cone-shaped wind instrument that is used for signaling in bicycles, cars, buses, trucks, boats, etc. A bullhorn works on the principle of multiple reflections of sound.

Question 45:

What is a stethoscope ? Name the principle on which a stethoscope works.

ANSWER:

Stethoscope is a medical instrument used by doctors to listen to the sounds produced within the human body, mainly in the heart and lungs. It works on the principle of multiple reflections of sound.

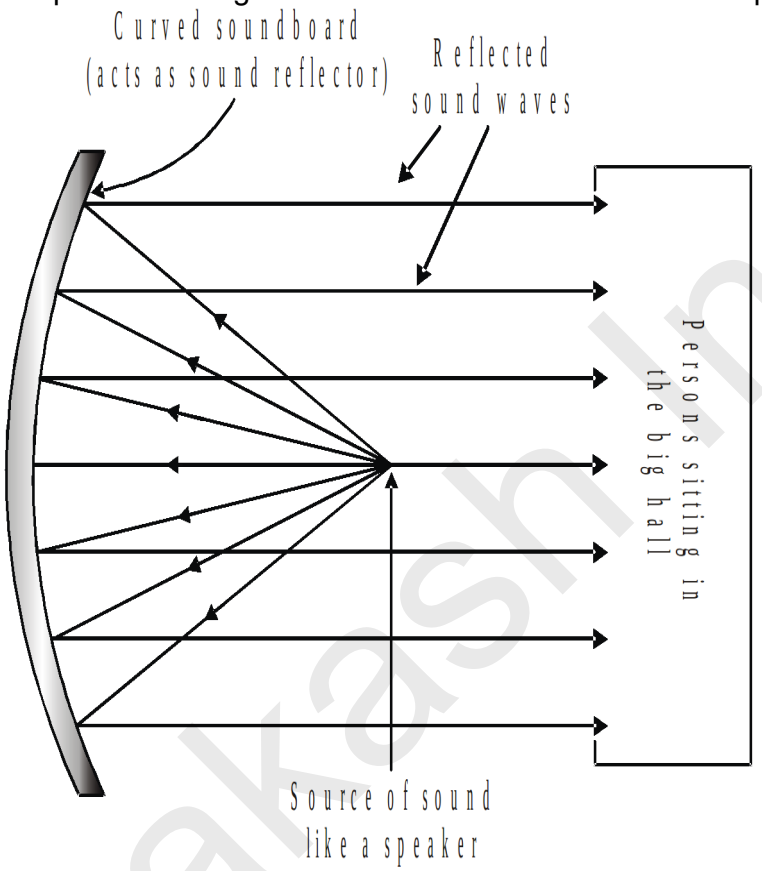
Question 46:

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What is a soundboard ? Explain the working of a soundboard with the help of a labelled diagram.

ANSWER:

A soundboard is a concave board that is placed behind the speaker in large halls or auditoriums so that the speech can be easily heard even by the person sitting at a considerable distance. The soundboard works in the following manner as the speaker is placed at the focus of the concave board. The concave surface of the soundboard reflects the sound of the speaker toward the audience and hence prevents the spreading of sound in various directions. Due to this, sound is distributed uniformly throughout the hall and even the persons sitting at the back of the hall can hear the speech easily.



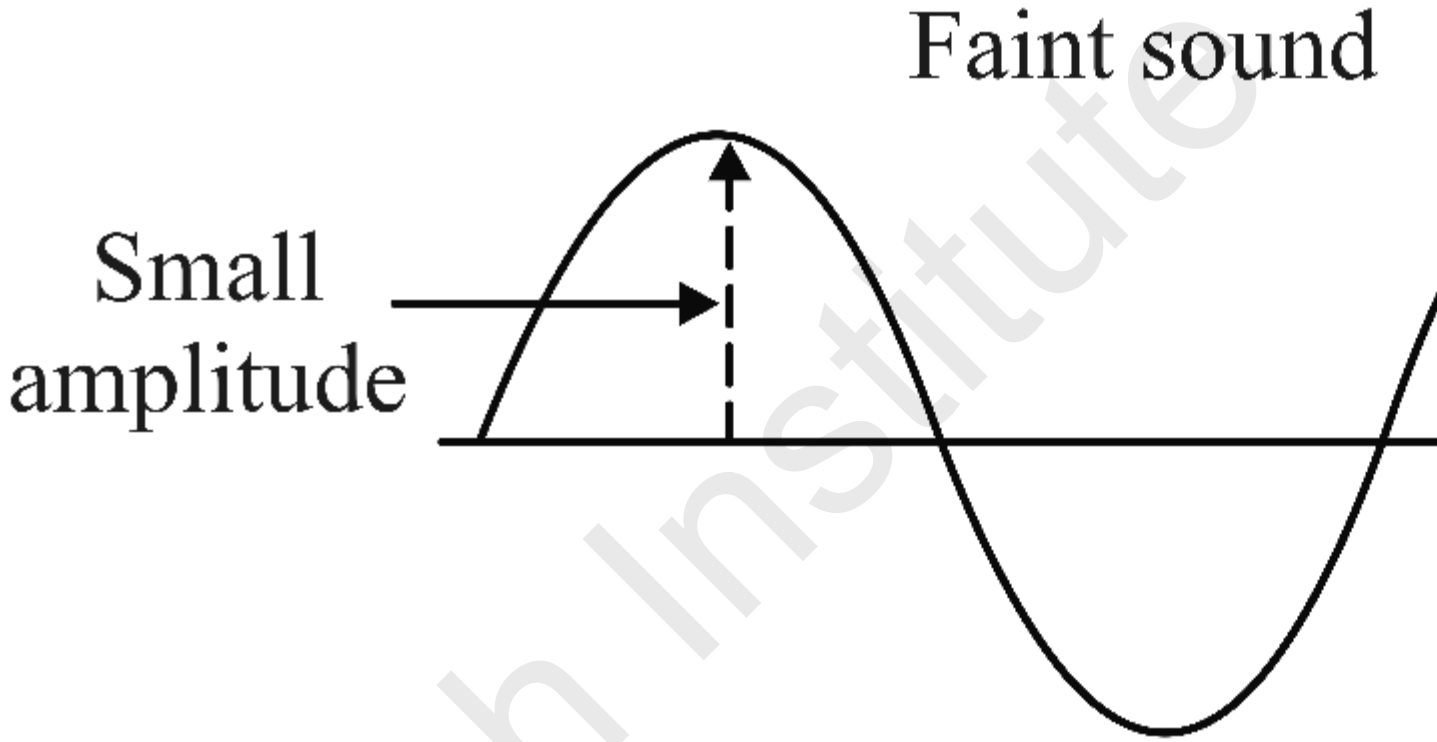
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Question 47:

(a) What is meant by the 'loudness' of sound ? On what factor does the loudness of a sound depend ?
(b) Draw labelled diagrams to represent (a) soft sound, and (b) loud sound, of the same frequency.

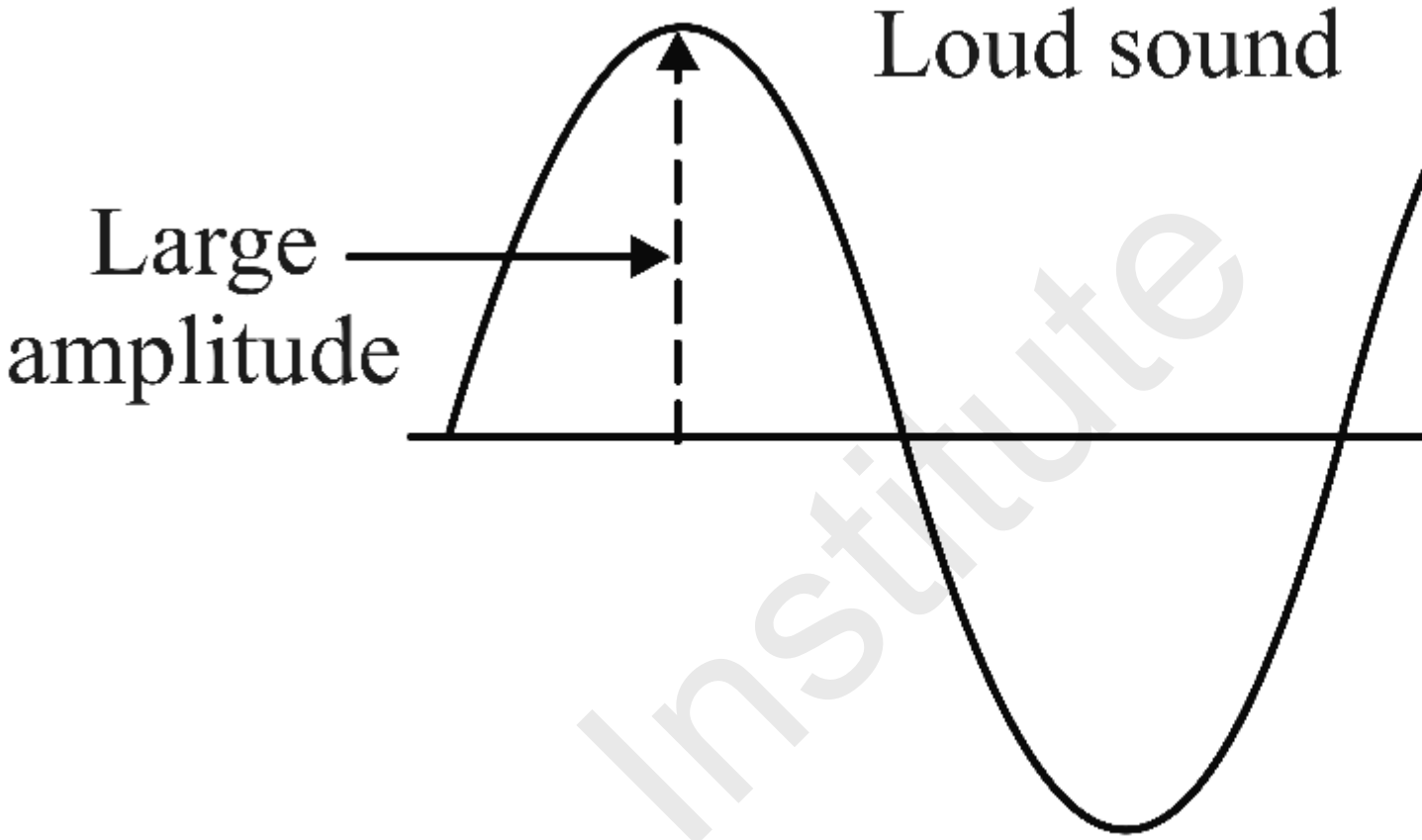
ANSWER:

(a) The loudness of the sound is the measure of sound energy reaching the ear per second. It depends on the amplitude of the sound waves. It is measured in decibel (dB).
(b) On the basis of loudness, sound is classified into two types:
Soft sound: It has smaller amplitude and thus this type of sound has lesser loudness.



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Loud sound: It has higher amplitude and thus this type of sound has greater loudness.



Question 48:

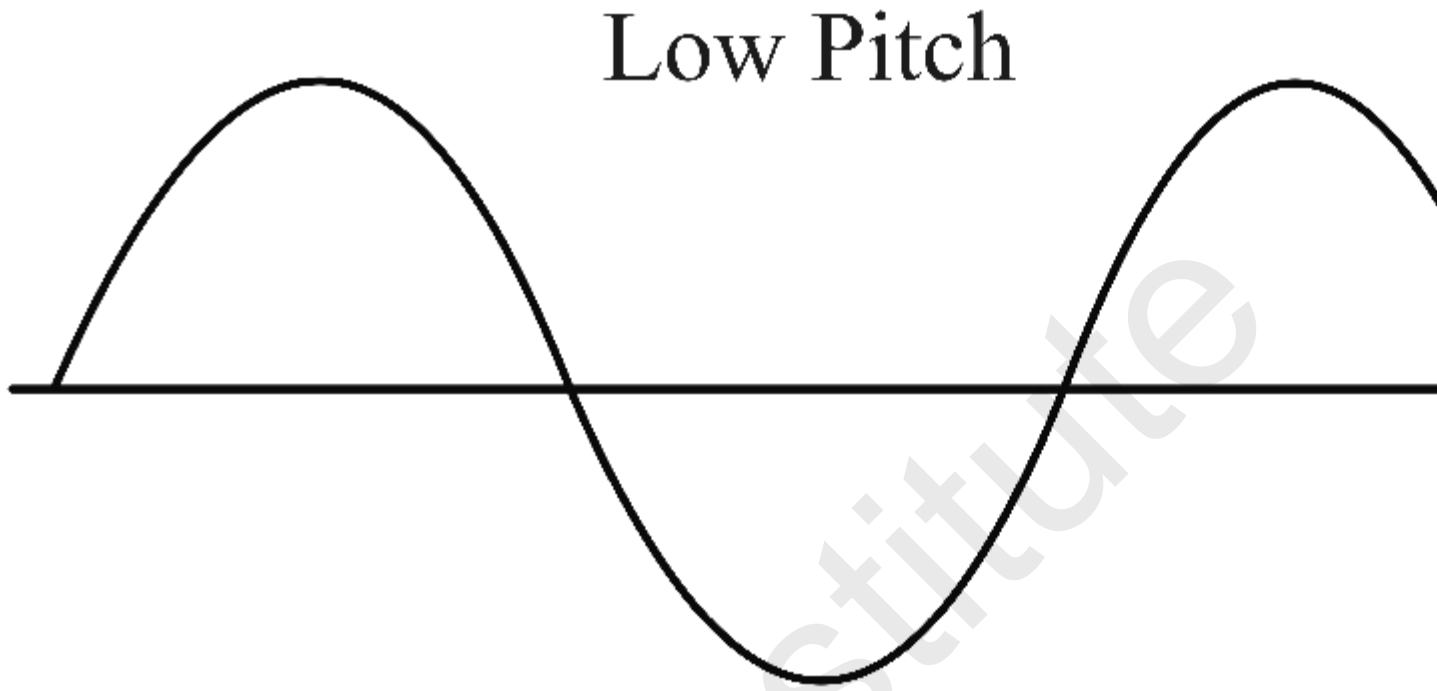
(a) Explain the term 'pitch' of a sound. On what factor does the 'pitch' of a sound depend ?
(b) Draw labelled diagrams to represent sound of (a) low pitch, and (b) high pitch, of the same loudness.

ANSWER:

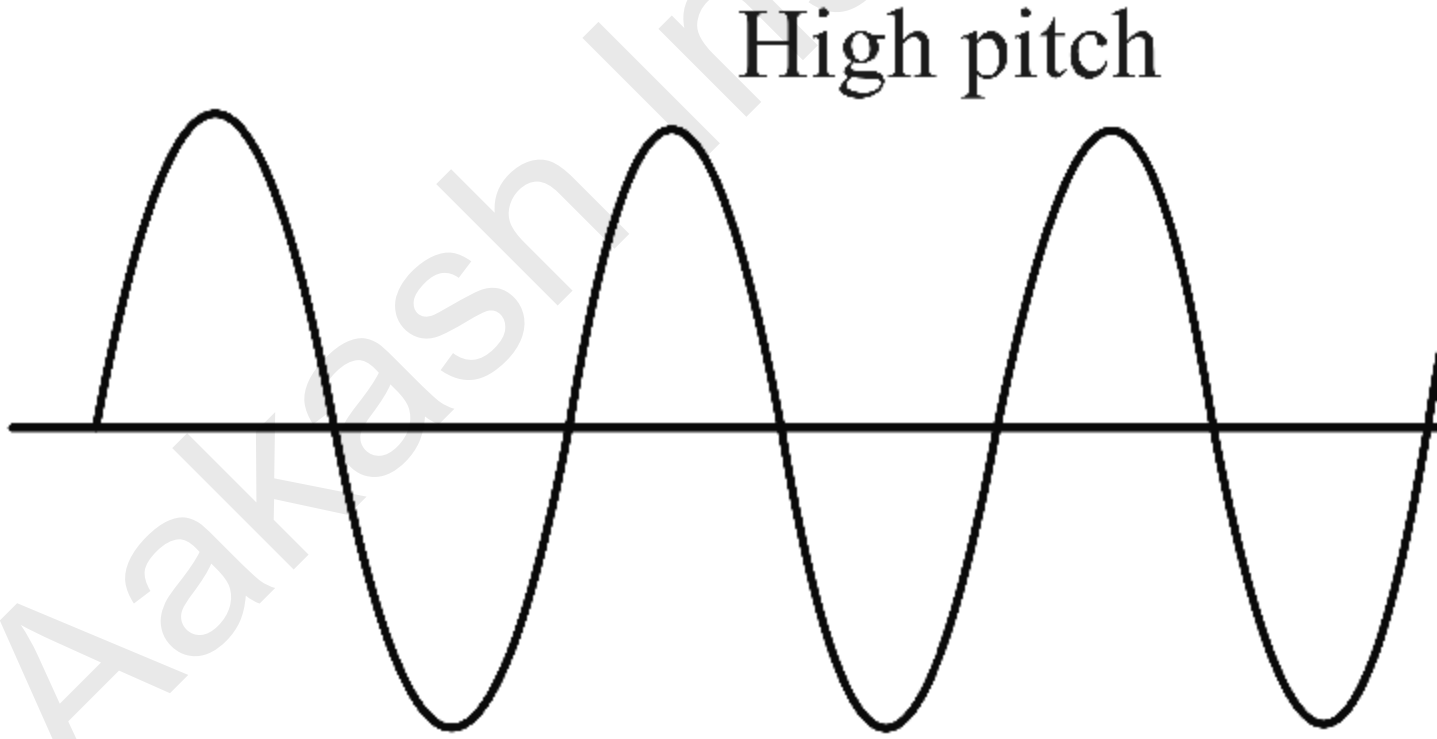
(a) Pitch is a characteristic of the sound by which we can distinguish between different sounds of same loudness. It is the measure of shrillness of a sound. It helps us to distinguish between a man's voice and a woman's voice, even without seeing them. It depends on the frequency of the sound waves. Generally, woman's voice has a higher frequency and hence a higher pitch.

(b) On the basis of loudness, sound is classified into two types:
Low pitch: It has lower frequency and therefore lower pitch.

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High pitch: It has higher frequency and therefore higher pitch.



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Question 49:

What is meant by the quality (or timbre) of sound ? On what factor does the quality (or timbre) of a sound depend ?

ANSWER:

Quality or timbre is a characteristic of sound by which we can distinguish between sounds of same pitch and loudness produced by different musical instruments and different singers. The quality of sound depends on the shape of sound wave or the waveform produced by it.

Question 50:

Explain why, if we strike a table lightly, we hear a soft sound but if we hit the table hard, a loud sound is heard.

ANSWER:

If we strike a table lightly, by applying less energy, the table top vibrates with small amplitude and hence a soft sound is produced. However, if we hit the table hard, by applying greater energy, the table top vibrates with larger amplitude and hence a loud sound is produced, because the amplitude of sound depends on the force with which an object is made to vibrate and finally results in greater loudness.

Question 51:

Give one use of ultrasound in industry and one in hospitals.

ANSWER:

Ultrasound has following uses:
(i) Ultrasound is used in industry for detecting flaws in metal blocks without damaging them.
(ii) Ultrasound is used in hospitals as a medical checkup to investigate the internal organs of the human body such as liver, kidneys, and uterus.
(iii) Ultrasound is used to monitor the growth of fetus inside the mother's uterus.

Question 52:

How is it that bats are able to fly at night without colliding with other objects ?

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ANSWER:

Bats are able to fly at night without colliding with other objects because they emit ultrasonic squeaks and listen to the echoes produced by the reflection of their squeaks from the objects or obstacles in their path. Bats can judge the distance of the object in their path and avoid it by changing the direction using the time taken by the echo to be heard after reflection from the obstacle.

Question 53:

Explain how, bats use ultrasound to catch the prey.

ANSWER:

Bats emit ultrasonic squeaks while flying and listen to the echoes produced by the reflection of their squeaks from their prey. From the time taken by the echo to be heard, bats can judge the distance of the prey in their path and catch them.

Question 54:

Explain how, flaws (or defects) in a metal block can be detected by using ultrasound.

ANSWER:

Ultrasound waves are made to pass through one face of the metal block and ultrasound detectors are placed on the opposite face of the block to detect the transmitted ultrasound. In doing so, we have two possibilities:
(i) If the ultrasound waves pass uninterrupted through all parts of the metal block, then the block is flawless.
(ii) If the ultrasound waves are not able to pass through a part of the metal block and get reflected back, then there is a flaw in the metal block.
Hence, the flaw can be detected without damaging the metal block.

Question 55:

Why are the ceilings of concert halls made curved ? Draw a labelled diagram to illustrate your answer.

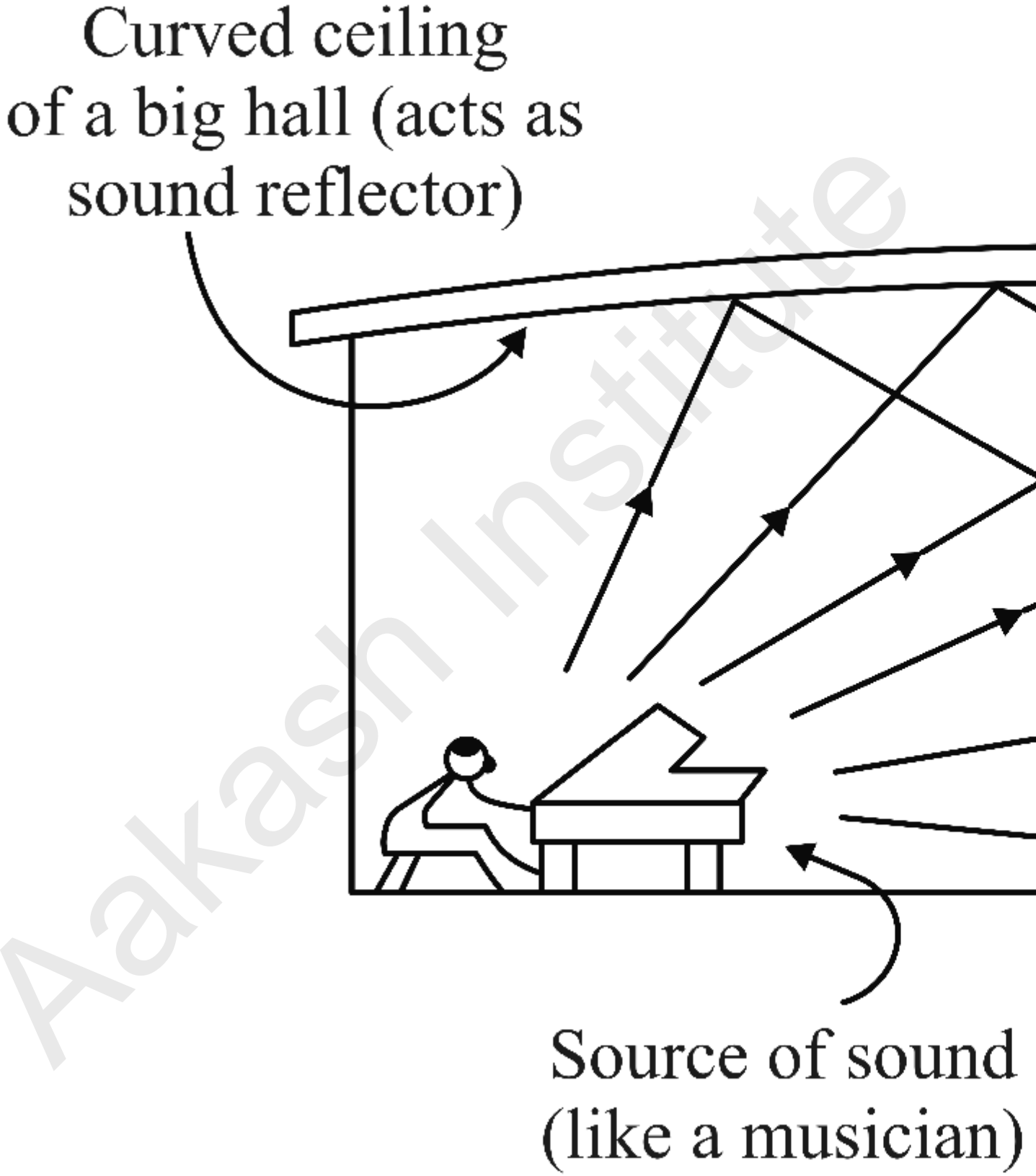
ANSWER:

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The ceilings of the concert hall are made curved so that sound, after reflection from the ceiling, reaches all parts of the hall and the speech can be easily heard even by the person sitting at a considerable distance. The curved surface of the ceiling reflects the sound of the speaker toward the audience and hence prevents the spreading of sound in various directions. Due to this, sound is distributed uniformly throughout the hall and even the

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person sitting at the back of the hall can hear the speech easily.



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Question 56:

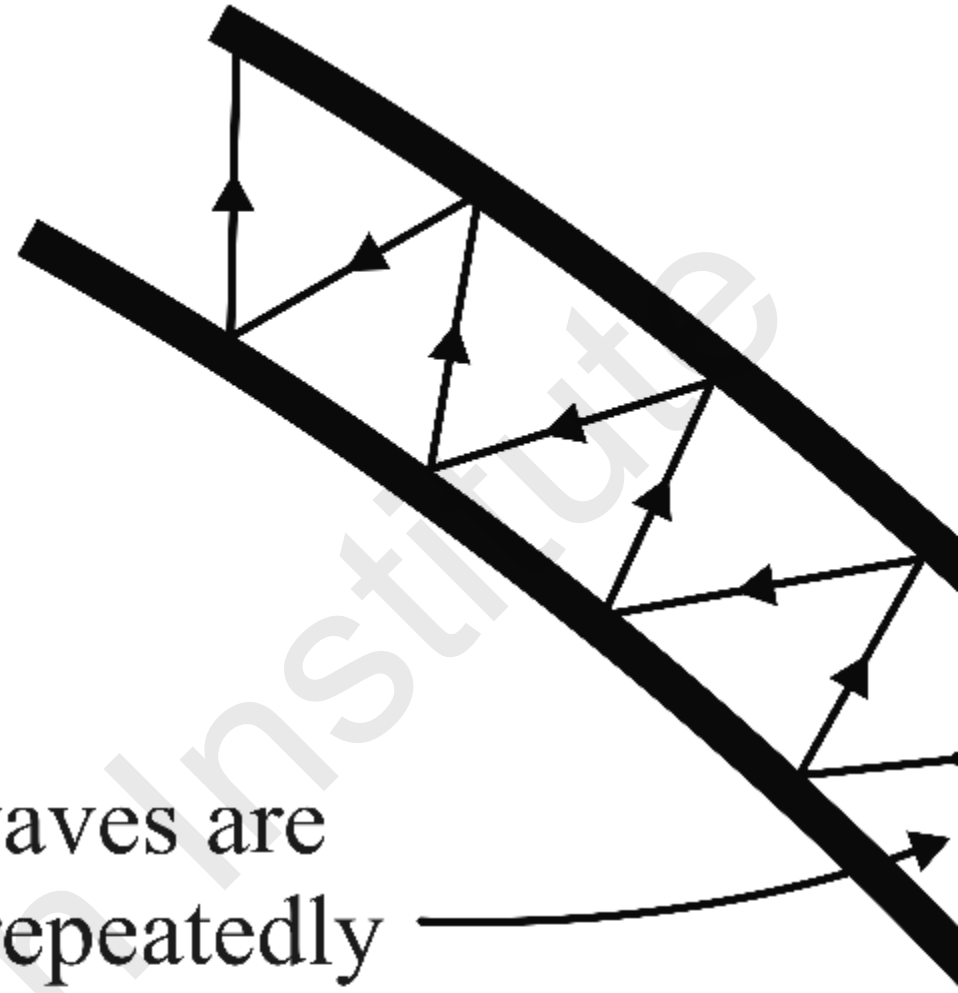
Draw a labelled diagram to show the multiple reflections of sound in a part of the stethoscope tube.

ANSWER:

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We have to show a diagram representing the phenomenon of multiple reflection of sound wave by the inner walls of stethoscope.

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Sound waves are reflected repeatedly from the inner walls of the stethoscope tube

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Question 57:

What is the range of frequencies associated with (a) infrasound (b) audible sound, and (c) ultrasound ?

ANSWER:

(a) Infrasonic sound refers to the sound having frequency lesser than 20 Hz. It is inaudible as its frequency lies below the human audible range of frequencies (20 Hz–20 kHz). These sounds are produced by objects vibrating very slowly. Whales and elephants can produce these sounds.

(b) Audible sounds include sounds of frequencies between 20 Hz and 20,000 Hz, which lies between the human audible range of frequencies.

(c) Ultrasonic sound refers to the sound having frequency higher than 20 kHz. It is inaudible as its frequency lies above the human audible range of frequencies (20 Hz–20 kHz). These sounds are produced by objects vibrating very rapidly. Bats and dolphins can produce these sounds.

Question 58:

(a) What is the difference between infrasonic waves and ultrasonic waves ?
(b) Choose the infrasonic waves and ultrasonic waves from the following frequencies :

(i) 10,000 Hz
(ii) 30,000 Hz
(iii) 18 Hz
(iv) 10 Hz

ANSWER:

(a) Difference between infrasonic and ultrasonic waves

Infrasonic waves	Ultrasonic waves
These waves have frequencies below 20Hz.	These waves have frequencies above 20 kHz.
They are produced by objects vibrating very slowly.	They are produced by objects vibrating very rapidly.

(b)Among the following:

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Infrasonic waves have frequencies of 10 Hz and 18 Hz.
Ultrasonic waves have frequencies of 30,000 Hz and 50,000 Hz.

Question 59:

(a) What is the frequency range of hearing in humans ?
(b) Which of the following sound frequencies cannot be heard by a human ear ?

(i) 10 Hz
(ii) 100 Hz
(iii) 10,000 Hz
(iv) 40,000 Hz

ANSWER:

(a) The frequency range of human hearing is between 20 Hz and 20,000 Hz.
(b) The sound frequencies among the following that cannot be heard by human are 10 Hz, 15 Hz, and 40,000 Hz.

Question 60:

The echo of a sound is heard after 5 seconds. If the speed of sound in air be 342 m/s, calculate the distance of the reflecting surface.

ANSWER:

We have to calculate the distance between the reflecting surface and the observer.
Given: Time taken to hear the echo t = 5 s.
So time taken for sound to reach the reflecting surface $(t_r)=52 s t_r=52 s$
Speed of sound in air v = 342 m/s
Therefore, distance of reflecting surface from the observer is
$=(v)\times(t_r)=(342)\times(52) m=855 \text{ m}=v\times tr=342\times 52 m=855 \text{ m}$

Question 61:

The speed of sound in water is 1500 metres per second. How far away from an under-sea rock should a deep sea diver be so that he can hear his own echo ?

ANSWER:

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We have to calculate the depth in water.
Given: Time taken to hear the echo t = 0.1 s
So time taken for sound to reach the reflecting surface
$(t_r)=0.12s \quad =120s$tr=0.12s =120s
Speed of sound in water v = 1,500 m/s
Therefore, distance of reflecting surface from the observer is
$=(v)\times(t_r)=(1500)\times(120)m=75\ m$=v×tr=1500×120m=75 m

Question 62:

(a) What is meant by 'reflection of sound' ? What type of surfaces are the best for reflecting sound ?
(b) Name any two objects which are good reflectors of sound.
(c) State the laws of reflection of sound.

ANSWER:

(a) The bouncing back of sound when it strikes a hard surface is called reflection of sound. The reflecting surface should be hard and large for sound to reflect from it.

(b) Metal sheet and hardwood are good reflectors of sound as they nearly reflect almost all the sound energy falling on it.

(c) The laws of reflection of sound obey the laws of reflection of light. Hence the laws of reflection of sound are:
(i) The incident sound wave, the reflected sound wave, and the normal to the point of incidence all lie in the same plane.
(ii) The angle of reflection of sound is always equal to the angle of incidence of sound.

Question 63:

(a) What is an echo ? How is echo formed ?
(b) What is the minimum distance in air required from a sound reflecting surface to hear an echo (at 20°C) ?
(c) A man standing 825 metres away from a cliff (steep rock) fires a gun. After how long will he hear its echo ? Speed of sound in air is 330 m/s.

ANSWER:

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(a) The repetition of sound caused by the reflection of sound is called echo. An echo is produced when sound is reflected from a hard surface such as a tall brick wall or a cliff.

(b) The minimum distance in air required from a sound-reflecting surface to hear an echo at 20°C is 17.2 m.

(c) We have to calculate time taken by the sound wave to reach the reflecting surface.

Given: Distance between the observer and reflecting surface d = 825 m
Velocity of sound v = 330 m/s
We know the time taken by sound wave to reach the reflecting surface is,
$t = 2d/v$
$\Rightarrow t = (2)(825)/330$
$\Rightarrow t = 5$ s
This is the required time.

Question 64:

(a) What is ultrasound ? What is the difference between ordinary sound and ultrasound ?
(b) Write any three applications (or uses) of ultrasound.

ANSWER:

(a) Ultrasound waves are high-frequency sound waves. Due to higher frequency, they can penetrate into matter to a large extent.
We can differentiate between ordinary and ultrasonic waves as:

Audible sound waves	Ultrasound waves
They have a frequency range of 20 Hz–20,000 Hz	They have frequencies above 20,000 Hz
These sounds are audible to human ears.	These sounds are inaudible to human ears.

(b) We have the following applications of ultrasound:
(i) Ultrasound is used in industry for detecting flaws in metal blocks without damaging them.
(ii) Ultrasound is used in hospitals as a medical checkup to investigate the internal organs of the human body such as liver, kidneys, and uterus.
(iii) Ultrasound is used to monitor the growth of fetus inside the mother's uterus.

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Question 65:

(a) What are infrasonic waves ? Name two animals which produce infrasonic waves.
(b) What are ultrasonic waves ? Name two animals which can produce ultrasonic waves.
(c) The audible range of frequencies of an average human ear is from 20 Hz to 20 kHz. Calculate the corresponding wavelengths. (Speed of sound in air is 344 ms^{-1})

ANSWER:

(a) Infrasonic sound waves have frequencies lesser than 20 Hz. It is inaudible as its frequency lies below the human audible range of frequencies (20 Hz–20 kHz). These sounds are produced by objects vibrating very slowly. Whales and elephants can produce these sounds.

(b) Ultrasonic sound waves have frequencies higher than 20 kHz. It is inaudible as its frequency lies above the human audible range of frequencies (20 Hz–20 kHz). These sounds are produced by objects vibrating very rapidly. Bats and dolphins can produce these sounds.

(c) We have to calculate the wavelength range of audible sound.
Given: Speed of sound v = 344 m/s
Lower frequency of audible range f_L = 20 Hz
Higher frequency of audible range f_H = 20,000 Hz
We know relation of velocity, frequency, and wavelength $\lambda = vf$ λ=vf,
where v is the velocity, *f* the frequency, and λ the wavelength.
So, wavelength corresponding to the lower frequency is
$\lambda_L = 34420 \quad = 17.2 \text{ m}$ λL=34420 =17.2 m
So, wavelength corresponding to the higher frequency is
$\lambda_H = 34420000 \quad = 0.0172 \text{ m}$ λH=34420000 =0.0172 m
Hence, the range of wavelength in audible region is 17.2 m − 0.0172 m.

Question 66:

(a) Define the following terms : (a) Echolocation (b) Echocardiography, and (c) Ultrasonography.
(b) Name an animal which navigates and finds food by ecolocation.
(c) Which of the two produces ultrasonic waves : porpoise or whale ?

ANSWER:

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(a)
(i) Echolocation: It is the method used by some animals to locate the objects by hearing the echoes of their ultrasonic squeaks. This method is used by bats and dolphins in finding their way and detecting their prey.

(ii) *Echocardiography* is a method used to investigate the action of the heart by using ultrasound waves.

(iii) *Ultrasonography* is a technique of obtaining pictures of internal organs of the body by using echoes of ultrasound pulses.

(b) Bats navigate and find their food by echolocation. They produce echoes by their ultrasonic squeaks.

(c) Porpoise produces ultrasonic waves.

Question 67:

(a) What is sonar ? Explain its use.
(b) A sonar station picks up a return signal after 3 seconds. How far away is the object ? (Speed of sound in water = 1440 m/s).

ANSWER:

(a) SONAR is an acronym for SOund Navigation And Ranging. Sonar is an apparatus that is used to find the depth of a sea or to locate the underwater things like shoals of fish, shipwrecks, and enemy submarines.

(b)We have to calculate the depth using a sonar signal.
Given: Time taken to listen to the return signal t = 3 s
So time taken to reach the depth $(t_D) = 32 s$ $t_D = 32 s$
Speed of sound in water v = 1,440 m/s
So the depth can be calculated as
$= v \times t_D$
= 1440 × 1.5 m
= 2160 m

Question 68:

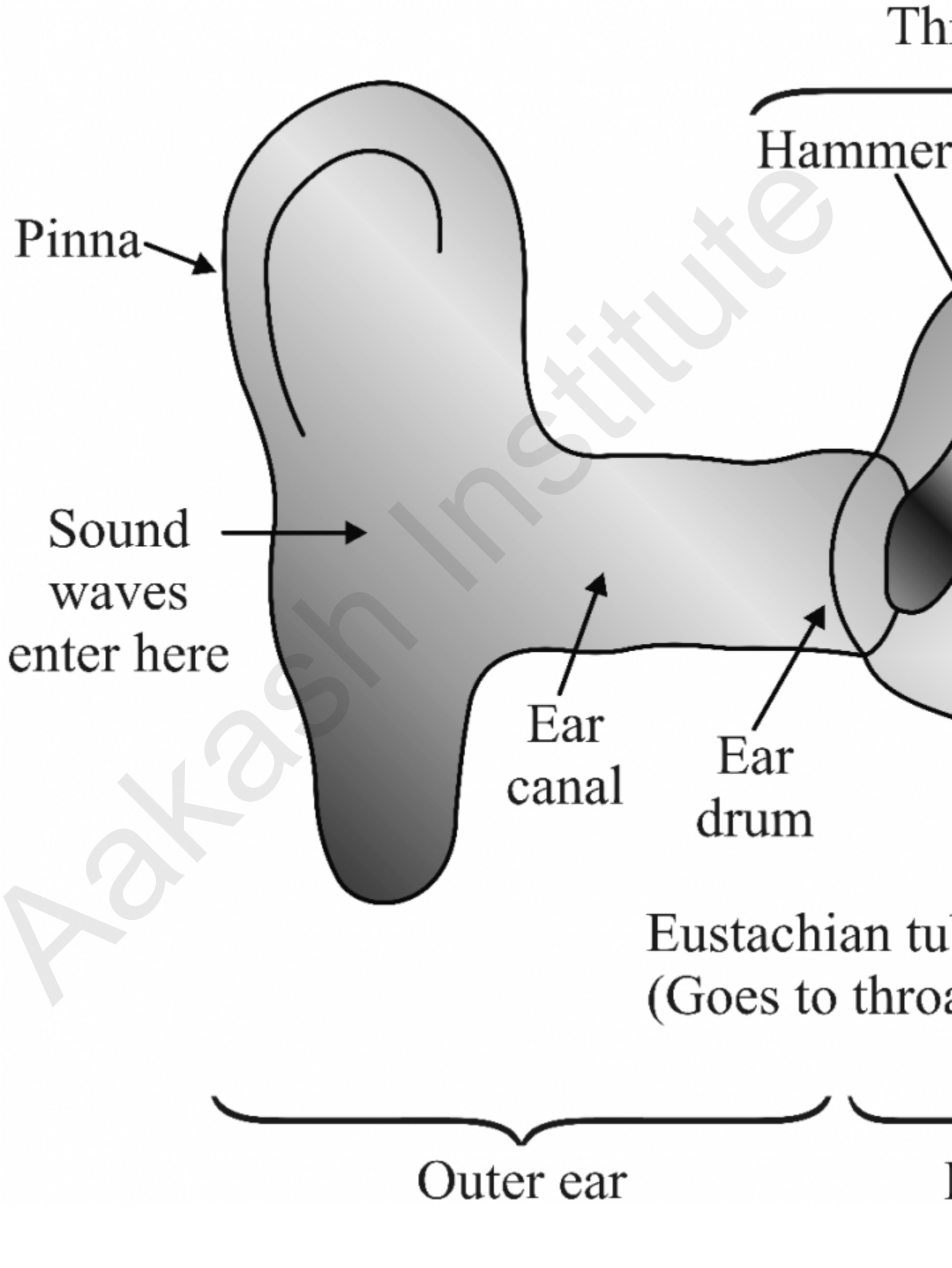
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Draw a neat and labelled diagram of the human ear. With the help of this diagram, explain the construction and working of the human ear.

ANSWER:

Construction of the human ear is as follows:
The ear consists of three compartments: outer ear, middle ear, and inner ear. The outer ear consists of broad part called pinna and about 2–3 cm long tube called ear canal. At the end of ear canal is a thin circular elastic membrane called tympanum or eardrum. The middle ear contains three small delicate bones called hammer, anvil, and stirrup. These bones are linked to one another. The one end of the hammer touches the eardrum and the free end of the stirrup is held against the membrane over the oval window of the inner ear. The lower part of middle ear has Eustachian tube going to the throat. The inner ear has a coiled structure called cochlea. The cochlea is filled with liquid containing sound-sensitive nerve cells. The cochlea is connected to the auditory nerve that goes to the brain.

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Working of the ear can be explained as follows:

The sound waves are collected by the pinna. These sound waves pass through the ear canal and fall on the eardrum. Sound waves consist of compressions and rarefactions. When the compression strikes the eardrum, the pressure on the outer surface of the eardrum increases and pushes the eardrum inward. Whereas when rarefaction strikes the eardrum, the pressure on the outer surface of eardrum decreases and pushes the eardrum outward. Thus, when sound falls on the eardrum, it vibrates back and forth rapidly. These vibrations are passed onto the three bones in the middle ear and finally to the liquid in the cochlea. Due to this phenomenon the liquid starts to vibrate, setting up electrical impulses in the nerve cells present in it. These impulses are carried to the brain by auditory nerves. The brain interprets the impulses and thus we feel the hearing sensation.

Question 69:

In SONAR we use :
(a) ultrasonic waves
(b) infrasonic waves
(c) radio waves
(d) audible sound waves

ANSWER:

SONAR uses ultrasonic sound waves.
Ans: (a) Ultrasonic waves.

Question 70:

When we change a feeble sound to a loud sound, we increase its :
(a) frequency
(b) amplitude
(c) velocity
(d) wavelength

ANSWER:

Loudness: if a sound is directly proportional to its amplitude.
Ans: (b) Amplitude.

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Question 71:

Which kind of sound is produced in an earthquake before the main shock wave begins ?
(a) ultrasound
(b) infrasound
(c) audible sound
(d) none of the above

ANSWER:

Infrasonic waves are formed before the major shock of earthquake.
Ans: (b) Infrasound.

Question 72:

Before playing the orchestra in a musical concert, a *sitarist* tries to adjust the tension and pluck the strings suitably. By doing so he is adjusting :
(a) intensity of sound only
(b) amplitude of sound only
(c) frequency of the *sitar* string with the frequency of other musical instruments
(d) loudness of sound

ANSWER:

A sitarist tries to adjust the tension in the strings as to adjust the frequency of sitar with the frequency of other musical instruments.
Ans: (c) Frequency of sitar strings with the frequency of other instruments.

Question 73:

'Note' is a sound :
(a) of a mixture of several frequencies
(b) of mixture of only two frequencies
(c) of a single frequency
(d) always unpleasant to listen to

ANSWER:

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Note is a sound of single frequency.
Ans: (c) Single frequency.

Question 74:

A key of mechanical piano is first struck gently and then struck again but much harder this time. In the second case :
(a) sound will be louder but pitch will not be different
(b) sound will be louder and the pitch will also be higher
(c) sound will be louder but pitch will be lower
(d) both loudness and pitch will remain unaffected

ANSWER:

By pressing the key gently and then again by, some force, increasing the amplitude of the wave, but the frequency remains the same.
Ans: (a) Sound will be louder, but pitch will not be different.

Question 75:

One of the following can hear infrasound. This one is :
(a) dog
(b) bat
(c) rhinoceros
(d) humans

ANSWER:

Rhinoceros can hear infrasonic sounds.
Ans: (c) Rhinoceros.

Question 76:

An echo-sounder in a trawler (fishing boat) receives an echo from a shoal of fish 0.4 s after it was sent. If the speed of sound in water is 1500 m/s, how deep is the shoal ?
(a) 150 m
(b) 300 m

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(c) 600 m
(d) 7500 m

ANSWER:

Time taken to list the sent signal is 0.4 s.
Speed of sound in water is 1,500 m/s.
So,
$=1500\times0.42=300$ m$=1500\times0.42=300$ m
Ans: (b) 300 m.

Question 77:

The speed of highly penetrating ultrasonic waves is :
(a) lower than those of audible sound waves
(b) higher than those of audible sound waves
(c) much higher than those of audible sound waves
(d) same as those of audible sound waves

ANSWER:

The speed of sound wave in air is independent of its frequency.
Ans: (d) Same as those of audible sound waves.

Question 78:

The ultrasound waves can penetrate into matter to a large extent because they have :
(a) very high speed
(b) very high frequency
(c) very high wavelength
(d) very high amplitude

ANSWER:

Ultrasound waves can enter the metal surfaces because of their high frequency.
Ans: (b) Very high frequency.

Question 79:

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The frequencies of four sound waves are given below. Which of these sound waves can be used to measure the depth of sea by the echo method ?
(a) 15,000 Hz
(b) 10 kHz
(c) 50 kHz
(d) 10,000 Hz

ANSWER:

Depth of sea can be measured using ultrasonic waves.
Ans: (c) 50 kHz.

Question 80:

Which of the following frequency of sound can be generated by a vibrating simple pendulum as well as by the vibrating vocal cords of a rhinoceros ?
(a) 5 kHz
(b) 25 Hz
(c) 10 Hz
(d) 15,000 Hz

ANSWER:

Rhinoceros can produce infrasonic sound waves.
Ans: (c) 10 Hz.

Question 81:

Which of the following device does not work on the multiple reflections of sound waves ?
(a) stethoscope
(b) hydrophone
(c) soundboard
(d) megaphone

ANSWER:

Hydrophone does not work on the principle of multiple reflections.
Ans: (b) Hydrophones.

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Question 82:

What type of waves are generated by SONAR device fixed to a fishing ship ?
(a) water waves
(b) radio waves
(c) sound waves
(d) infrared waves

ANSWER:

SONAR uses ultrasonic sound waves.
Ans: (c) Sound waves.

Question 83:

We can distinguish between the musical sounds produced by different singers on the basis of the characteristic of sound called :
(a) frequency
(b) timbre
(c) pitch
(d) loudness

ANSWER:

We can distinguish between the sounds of different singer by their pitch.
Ans: (c) Pitch.

Question 84:

At 20°C, the minimum distance of a person from a sound reflecting surface to hear an echo is :
(a) 12.2 m
(b) 17.2 m
(c) 15.2 m
(d) 34.4 m

ANSWER:

At room temperature, the minimum distance for echo is 17.2 m.
Ans: (b) 17.2 m.

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Question 85:

The drawing shows a ship 800 m from a cliff. A gun is fixed on the ship. After 5 seconds the people at the front of the ship hear the sound of the gun again.

figure

(a) What is the name of this effect ?
(b) What happens to the sound at the cliff ?
(c) How far does the sound travel in 5 seconds ?
(d) Calculate the speed of sound.

ANSWER:

(a)The name of this effect is echo.

(b) Sound gets reflected back after reflecting from the cliff.

(c) Distance covered by sound wave in 5 s can be calculated as follows:
Incident sound travels distance (d_I) = 800 m
Sound after reflection travels (d_R) = 800 m
Total distance travelled by sound
= $d_I + d_R$
= (800 + 800) m
= 1600 m

(d) We have to calculate the speed of sound.
Given: Distance of cliff d = 800 m
Time taken to listen to the echo t = 5 s
So, time taken to reach the cliff $(tI) = 52 s tI = 52s$
So, speed of sound is
$= dtI = 800 \times 25 m/s = 320\ m/s = dtI = 800 \times 25 m/s = 320$ m/s

Question 86:

Consider the following sound waves marked A, B, C and D.

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Figure

(a) Which two waves represent sounds of the same loudness but different pitch ?
(b) Which two waves represent sounds of the same frequency but different loudness ?
(c) State whether all these sound waves have been produced by the same vibrating body or different vibrating bodies ?
(d) Which vibrating body/bodies could have generated the sound waves shown here ?

ANSWER:

(a) A and D waves represent sounds of the same loudness but different pitch as both of them have same amplitude but different frequency.
(b) B and D waves represent sounds of same frequency but different loudness as both have same frequency but different amplitude.
(c) Same vibrating body can produce all the given sound waves.
(d) Tuning fork is a device that can produce sound waves of different frequencies and amplitudes. Therefore, all these sound waves can be generated by a tuning fork.

Question 87:

In an experiment, Anhad studies sound waves. He sets up a loudspeaker to produce sound as shown below :

figure

Anhad adjusts the signal to the loudspeaker to give a sound of frequency 200 Hz.
(a) What happens to the air in-between Anhad and the loudspeaker ?
(b) Explain how Anhad receives sound in both ears.

ANSWER:

(a) The air in between Anhad and speaker vibrates with the frequency of 200 Hz. Sound is a longitudinal wave, so successive compression and rarefaction is formed between Anhad and the speaker.
(b) Anhad receives sound in the right ear by the sound waves transmitted directly from the loudspeaker, and in his left ear, he receives sound from sound waves reflected from the classroom wall.

Question 88:

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Figure X shows a trace of a sound wave produced by a particular tuning fork :

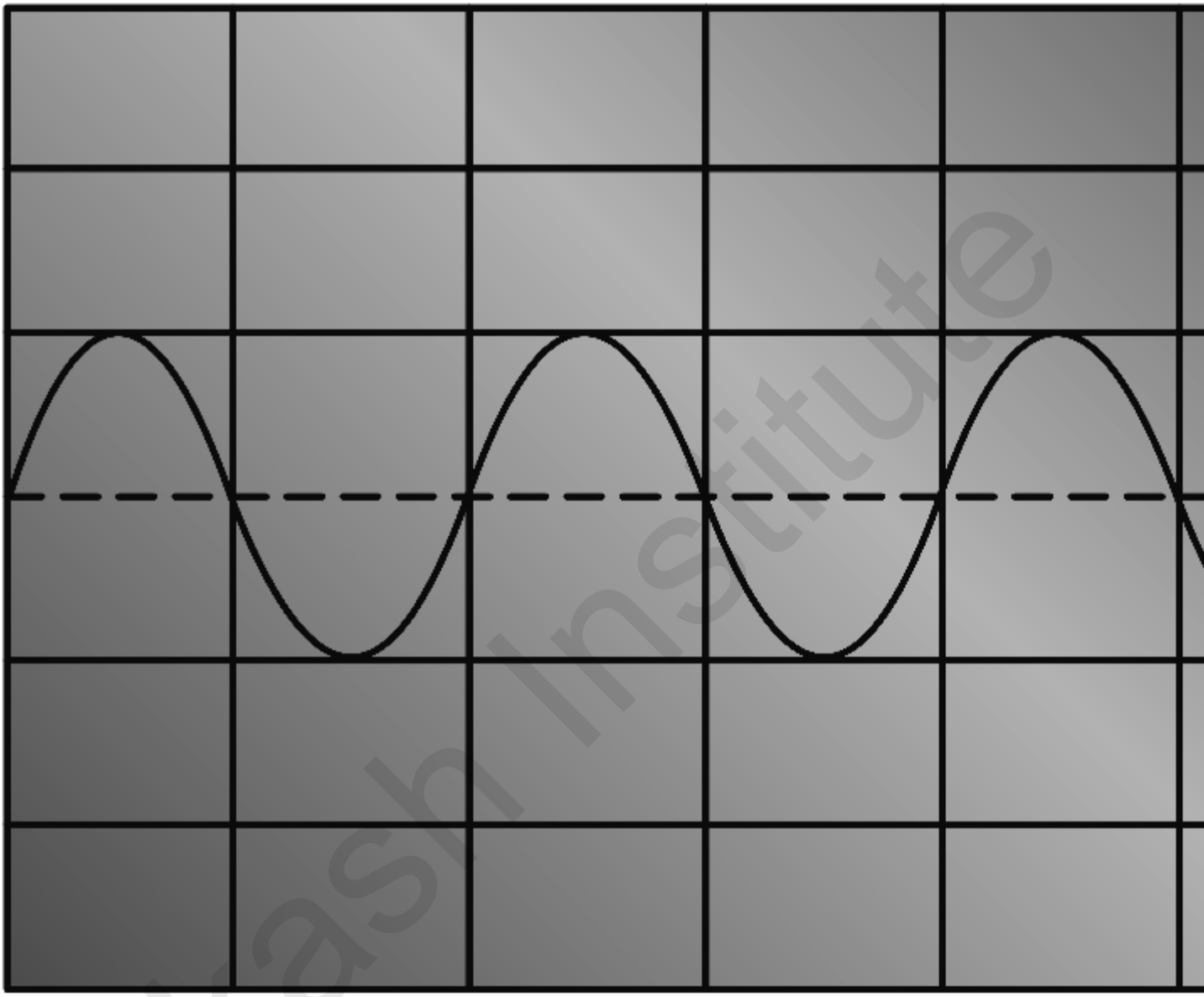
figure

(a) On the graph paper given in Figure Y, draw a trace of the sound wave which has a higher frequency than that shown in figure X.
(b) On the graph paper show in Figure Z, draw a trace of the sound wave which has a larger amplitude than that shown in Figure X.

ANSWER:

(a) Higher frequency sound wave in comparison to sound wave produced by the tuning fork in X.

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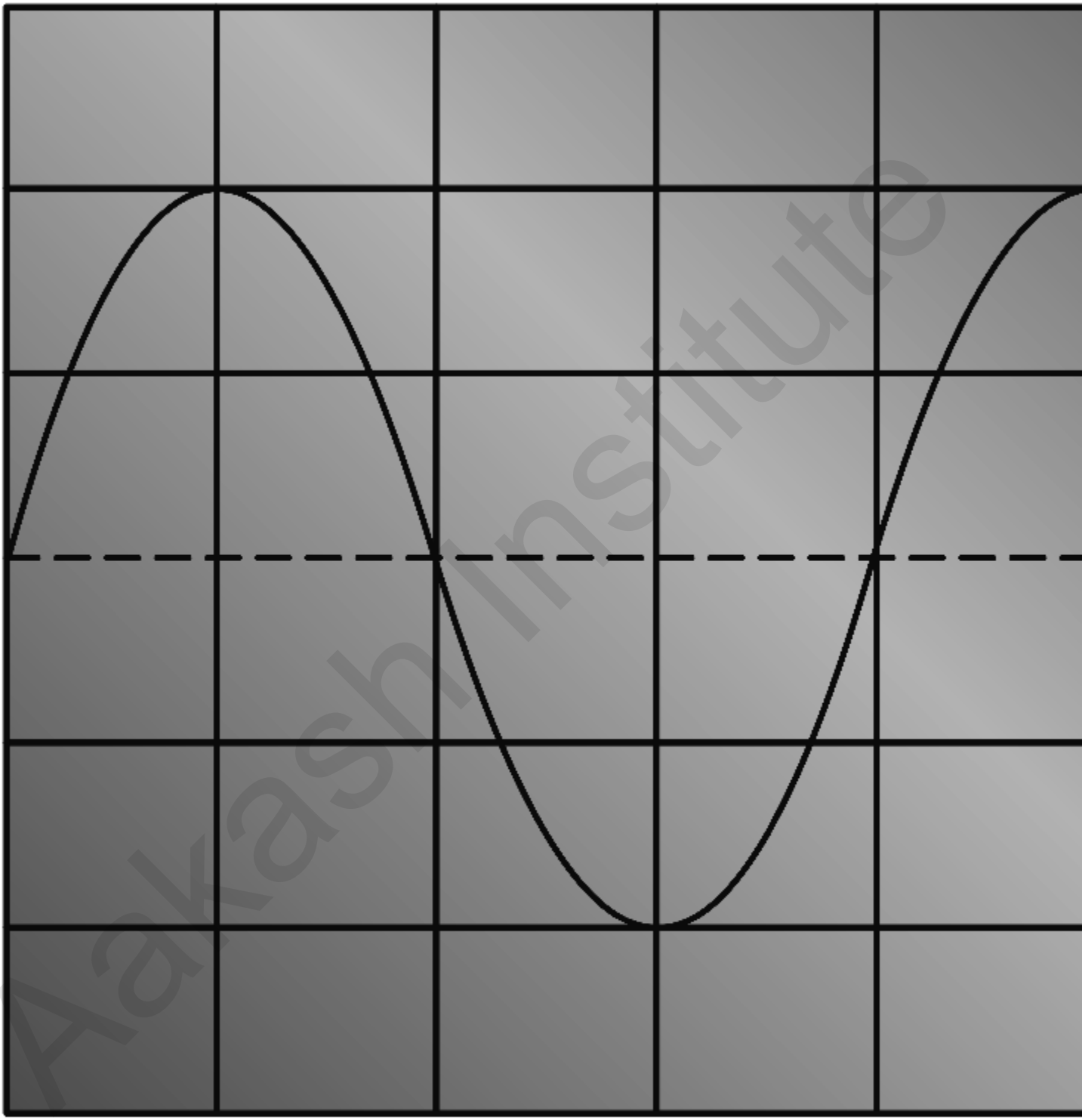


(Y)

(b) Sound wave with larger amplitude in comparison to sound wave produced by the tuning

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fork in X.



(Z)

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Question 89:

Three different vibrating objects produce three-types of sounds X, Y and Z. Sounds X and Y cannot be heard by a man having normal range of hearing but sound Z can be heard easily. The sound X is used in hospitals to break kidney stones of a patient into fine grains which then get flushed out with urine. The sound Y is similar to that which is produced during an earthquake before the main shock wave is generated.

(a) What type of sounds are (i) X (ii) Y, and (iii) Z ?
(b) Name one device which can produce sound like X.
(c) Name one device in a science laboratory which can produce sound like Y.
(d) Name one device in our homes which can produce sound like Z.
(e) What is the frequency range of sounds like Z ?

ANSWER:

(a)
(i) X is an ultrasonic sound as it is used in hospitals to break the kidney stones.
(ii) Y is an infrasonic sound as it is produced during the earthquake.
(iii) Z is an audible sound as it can be easily heard.

(b) Ultrasound machine in hospitals is used to produce ultrasonic sound waves.

(c) Simple pendulum can produce infrasonic sound waves.

(d) Loudspeaker can produce sound of audible range.

(e) Since Z is an audible sound, its frequency range is between 20 Hz and 20,000 Hz.

Question 90:

A man is kidnapped, blindfolded and imprisoned in a big room. How could the man tell if he was in :
(a) a city (b) a village (c) a bare room (d) a furnished room ?

ANSWER:

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(a) The person would hear a lot of noise in heavy city traffic. Hence, he can conclude that he was in a city.
(b) The person would hear a very little noise in village traffic. Hence, he can conclude that he was in a village.
(c) The person would hear echoes when talking in a bare room.
(d) In furnished room, echo is very less. Hence, he can conclude that he was in a furnished room.

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