Sound

Solution 1

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

Solution 2

No, sound cannot travel through vacuum.

Solution 3

Radio waves are used to communicate with one another on moon.

Solution 4

Solid – table

Liquid – water

Gas – air

Solution 5

Vacuum

Solution 6

Frequency

Solution 7

SI unit of frequency is hertz.

Solution 8

(a)Longitudinal wave

(b)Transverse wave

Solution 9

Speed of sound is more in steel (solid medium) as compared to water (liquid medium).

Solution 10

Sound travels faster in iron (being a solid medium).

Solution 11

Sound travels fastest in steel (solid medium).

Solution 12

(a)Sound travels slowest in gases.

(b)Sound travels fastest in solids.

Solution 13

(a) Speed of sound in copper = 3750m/s

(b) Speed of sound in aluminium = 5100m/s

Solution 14

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.

Solution 15

Speed of sound (at 20^{o}C) in:

(a) Air = 344 m/s

(b) Water =1498 m/s

(c) Iron =5130 m/s

Solution 16

Supersonic aircrafts

Solution 17

Supersonic Speed

Solution 18

Supersonic speed refers to the speed of an object which is greater than the speed of sound.

Solution 19

It is common observation that in the rainy season, the flash of lightning is seen first and the sound of thunder is heard a little later. That's because, speed of light is very high as compared to speed of sound in air.

Solution 20

Transverse and Longitudinal waves.

Solution 21

Transverse (water) waves.

Solution 22

Longitudinal (sound) waves.

Solution 23

(a) Longitudinal waves

(b) Transverse waves.

Solution 24

(a) Longitudinal waves

(b) Transverse waves

Solution 25

Transverse waves

Solution 26

An object should vibrate in order to produce sound.

Solution 27

Vocal cords vibrate in our voice box when we talk.

Solution 28

Tuning fork is used to produce sound in laboratory experiments.

Solution 29

The sound waves in air are longitudinal waves.

Solution 30

The conclusion from the observation is that the prongs of tuning fork are vibrating, and the vibrating prongs carry energy which gets transmitted to surrounding medium.

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Solution 31

False

Solution 32

Slowest: Sound

Fastest: light

Solution 33
Supersonic is used to denote a speed greater than the speed of sound.
Solution 34
Sound travels faster in hydrogen (speed of sound in hydrogen is 1284m/s)
Solution 35
The number 256 on tuning fork signifies the frequency of tuning fork.
Solution 36

$$\text{Frequency} = \frac{1}{\text{time period}}$$

Frequency =200Hz

$$\text{Time period} = \frac{1}{\text{frequency}}$$

$$= \frac{1}{200} = 5 \times 10^{-3} \text{ sec}$$

Solution 37

$$\text{Frequency} = \frac{1}{\text{time period}}$$

$$= \frac{1}{0.02} = 50\text{Hz}$$

Solution 38
Velocity of sound = Frequency x wavelength

Speed of sound in air is constant.

Hence, frequency x wavelength = constant

If frequency is doubled, wavelength is reduced to half.
Solution 39
The frequency in hertz is equal to the number of waves produced per second. In this case, 20 waves are produced per second, so the frequency of sound waves is 20 hertz.
Solution 40
(a) Vibrations

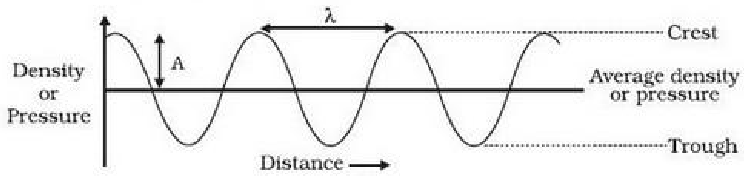
(b)Compressions; lower; rarefactions

(c)Hertz; wavelength; metres

(d) Vacuum

(e)Greater

(f) Decreases
Solution 41
Vacuum means empty space, region with no matter particles. Sound cannot travel through vacuum because vacuum has no molecules which can vibrate and carry sound waves.
Solution 42
The maximum displacement of the particles of the medium from their original undisturbed positions, when a wave passes through the medium, is called amplitude (A) of the wave.



Solution 43
(a) A wave in which the particles of the medium vibrate back and forth in the 'same direction', in which the wave is moving, is called a longitudinal wave. These
waves can be produced in all the three media: solids, liquids and gases. A wave in which the particles of the medium vibrate up and down, 'at right angles'
to the direction in which the wave is moving, is called a transverse wave. It can be produced in solids and liquids but not in gases.

(b) Sound is a longitudinal wave.

Solution 44

Due to the very high speed of light we see the ball hitting the bat first. And it is due to comparatively lower speed of sound that the sound of hitting is heard a little later.

Solution 45

Light travels much faster than sound. Due to this, the flash of lightning is seen first and the sound of thunder is heard a little later.

Solution 46

Light travels much faster than sound. Due to this, the flash of gun shot is seen first and the sound of gun shot is heard a little later.

Solution 47

Sound waves in air: Longitudinal, Compression, Rarefaction

Water waves: Transverse, Crest, Trough

Solution 48

(a) Sound can be produced by the following methods:

(i) By vibrating strings (as in a sitar),

(ii) By vibrating air (as in a flute),

(iii) By vibrating membranes (as in a drum)

(iv) By vibrating plates (as in cymbals)

(b) Speed of sound wave= frequency x wavelength

(b)Speed of sound wave= frequency x wavelength

$v = f \times \lambda$

Frequency f=2kHz= 2000Hz

Wavelength, $\lambda = 65cm$

= 0.65 m

Velocity, v= 2000 x 0.65=1300m/s

Solution 49

This is due to the fact that when the ringing bell is held tightly with our hand, it stops vibrating and the sound coming from it also stops.

Solution 50

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.

Solution 51

In most of the cases, a sound producing object vibrates so fast that we cannot see its vibrations with our eyes. The time inetrval between two successive vibration is lower than the persistence of vision. Hence we see the object in static state and not in vibration mode.

Solution 52

Fill water in a beaker up to its brim. Touch the surface of water with the prongs of a sound making tuning fork (which has been struck on a hard rubber pad). The prongs of tuning fork producing sound splash water. This shows that the prongs of a sound producing tuning fork are vibrating (moving forwards and backwards rapidly).

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

Solution 53

The sound of a gas travels through the vibrations of air layers so it reaches first, but the smell of gas reaches the person through the actual movement of the air
layers, which takes more time.

Solution 54

Frequency is number of vibrations produced per second i.e. 128 Hz.

Frequency is number of vibrations produced per second i.e. 128 Hz.
Wavelength, $\lambda = 2.7$ m
Speed of sound wave= frequency x wavelength
$v = f \times \lambda$
Velocity, v= 128 x 2.7 =345.6 m/s

Solution 55

Velocity of wave= 340m/s

Frequency= 512 Hz

Wavelength=?

Speed of sound wave=

frequency x wavelength

Velocity of wave= 340m/s
Frequency= 512 Hz
Wavelength=?
Speed of sound wave= frequency x wavelength
$v = f \times \lambda$

Hence,
$$\lambda = \frac{\text{Velocity of wave}}{\text{Frequency}}$$
$$= \frac{340}{512} = 0.66\,\text{m}$$

Solution 56

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 cycle) is called time-period of the wave.

The time taken to complete one vibration is called time-period.

Relation between time-period and frequency of a wave is:

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 cycle) is called time-period of the wave.
The time taken to complete one vibration is called time-period.
Relation between time-period and frequency of a wave is:

$$\text{Frequency} = \frac{1}{\text{time period}}$$

Solution 57

A ringing bell suspended in a vacuum chamber cannot be heard outside because sound cannot travel through vacuum as it has no molecules which can vibrate and carry
sound waves.

Solution 58

Frequency, f=1020Hz

Velocity, v=340m/s

Wavelength =?

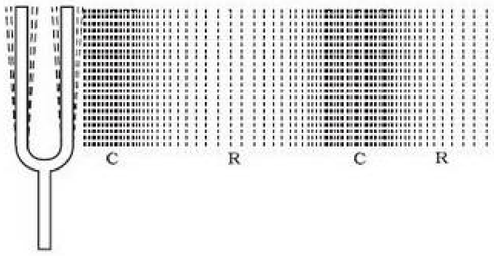
Speed of sound wave= frequency x wavelength

Frequency, f=1020Hz
Velocity, v=340m/s
Wavelength =?
Speed of sound wave= frequency x wavelength
$v = f \times \lambda$
$$\lambda = \frac{\text{Velocity of wave}}{\text{Frequency}}$$
$$= \frac{340}{1020} = 0.333\,\text{m} = 33.3\,\text{cm}$$

Solution 59

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.

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.



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Solution 60

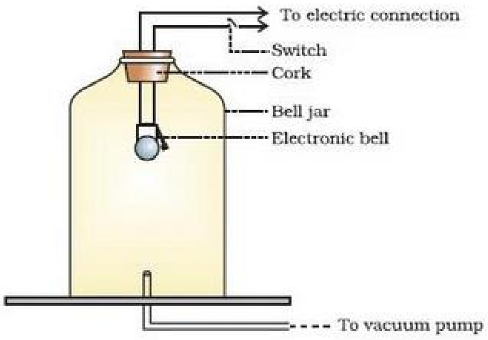
(a) Sound is that form of energy which makes us hear. Sound waves are longitudinal waves in air.

(b) Sound cannot travel through vacuum. This can be shown by the following experiment:

(i) A ringing electric bell is placed inside an air tight glass jar containing air. We can hear the sound of 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 ringing bell is placed over the plate of a vacuum pump. Air is gradually removed from the bell jar by switching on the vacuum pump. As more and more air is removed from the bell jar, the sound of ringing bell becomes fainter and fainter. And when all the air is removed from the bell jar, no sound can be heard at all. Thus, when vacuum is created in the bell jar, then the sound of ringing bell placed inside it cannot be heard.

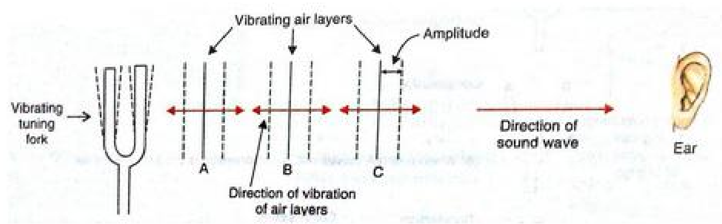
This shows that sound cannot travel through vacuum.



Solution 61

(a) Sound is produced when an object vibrates. For example, the sound of our voice is produced by the vibrations of two vocal cords in our throat caused by air coming from the lungs.

(b) When an object vibrates (and makes sound), then the air layers around it also start vibrating in exactly the same way and carry sound waves from the sound producing object to our ears. Suppose a tuning fork is vibrating and producing sound waves in air. Since the prongs of the tuning fork are vibrating, the individual layers of air are also vibrating. 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 sound wave.



Solution 62

(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.

(b) Sound cannot be heard on the surface of moon because there is no air on the moon to carry the sound waves.

Astronauts talk to one another on the surface of moon through wireless sets using radio waves. This is because radio waves can travel even through vacuum though sound waves cannot travel through vacuum.

Solution 63

(a) The number of vibrations per second is called frequency.

The minimum distance in which a sound wave repeats itself is called its wavelength.

The distance travelled by a wave in one second is called velocity of wave.

Relation between velocity, frequency and wavelength of a wave:

Velocity of wave= frequency x wavelength

Velocity of wave= frequency x wavelength

$v = f \times \lambda$

(b) Time period, T=1/256 s

Velocity, V = 350m/s

$$\text{Frequency} = \frac{1}{\text{time period}} = 256\ \text{Hz}$$

Hence,

$$\lambda = \frac{\text{Velocity of wave}}{\text{Frequency}}$$

$$= \frac{350}{256} = 1.36\ \text{m}$$

Solution 64

(a) A wave in which the particles of the medium vibrate back and forth in the 'same direction', in which the wave is moving, is called a longitudinal wave. These waves can be produced in all the three media: solids, liquids and gases.

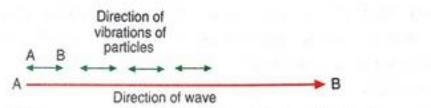


Diagram to explain the meaning of a longitudinal wave.

A wave in which the particles of the medium vibrate up and down 'at right angles' to the direction in which the wave is moving, is called a transverse wave. It can be produced in solids and liquids but not in gases.

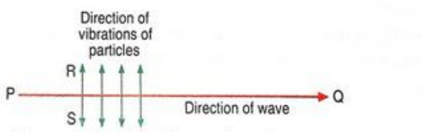


Diagram to explain the meaning of a transverse wave.

(b) Longitudinal waves:

(i) The waves which travel along a spring when it is pushed and pulled at one end.

(ii) Sound waves in air Transverse waves:

(i) The waves produced by moving one end of a long spring up and down rapidly, while other end is fixed.

(ii) The water waves or ripples formed on the surface of water in a pond.

Solution 65

(a) 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.
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. Longitudinal waves consist of compressions and rarefactions.

(b) Speed = $\frac{\text{Distance}}{\text{time}}$

Speed =330m/s

Distance =1.32km =1320 m

$$\text{Time} = \frac{\text{distance}}{\text{speed}} = \frac{1320}{330} = 4\text{sec}$$

Solution 66

(a) The 'elevation' or 'hump' in a transverse wave is called crest. It is that part of the transverse wave which is 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 which is below the line of zero disturbance of medium. A ransverse wave consists of crests and troughs.

(b) Speed of sound= 332m/s

Time =3 sec

A transverse wave consists of crests and troughs.

(b) Speed of sound= 332m/s

Time =3 sec

Speed = $\frac{\text{Distance}}{\text{time}}$

Distance = Speed x Time

= 332 x 3= 996 m

Solution 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. This is due to the fact that sound travels much more fast through the railway line made of steel than through 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 till it reaches our ear.

This will be clear from an example: If we turn on a gas tap for a few seconds, a person standing a few metres away will hear the sound of escaping gas first and the smell of gas reaches him afterwards. The sound of gas travels through the vibrations of air layers so it reaches first, but the smell of gas reaches the person through the actual movement of the air layers, which takes more time. So, it is clear that the sound is not being transmitted by the actual movement of air from the gas tap to person, otherwise he would hear and smell the gas at the same time.

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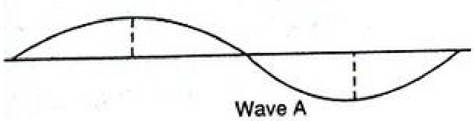
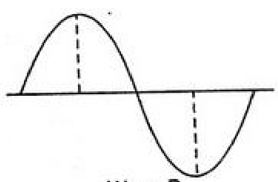
Solution 81



Wave A



Wave B

Solution 82

(a) Given that there are four complete waves.

(a) Given that there are four complete waves.

$$\text{Wavelength} = \frac{\text{total length of string}}{\text{number of waves}} = \frac{20}{4} = 5\text{cm} = 0.05\text{m}$$

(b) Frequency = vibrations per sec x number of complete waves
= 30 x 4 =120 Hz
(c) Speed = frequency x wavelength
= 120 x 0.05= 6m/s

(b) Frequency = vibrations per sec x number of complete waves

= 30 x 4 =120 Hz

(c) Speed = frequency x wavelength

= 120 x 0.05= 6m/s

Solution 83

Sound can travel through all the given materials.

Solution 84

(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.

Solution 85

(i) The distance between two consecutive compressions or rarefactions is equal to its wavelength. Hence,

wavelength is =20 cm= 0.20 m

(ii) Speed of wave =4 m/s

Wavelength=0.20 m

Speed of wave =frequency x wavelength

4 m/s = frequency x 0.20 m

Frequency

(i) The distance between two consecutive compressions or rarefactions is equal to its wavelength.
Hence, wavelength is =20 cm= 0.20 m
(ii) Speed of wave =4 m/s
Wavelength=0.20 m
Speed of wave =frequency x wavelength
4 m/s = frequency x 0.20 m

$$\text{Frequency} = \frac{4}{0.20} = 20\text{Hz}$$

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Solution 1

The reflection of sound leads to formation of echoes

Solution 2

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

Solution 3

The persistence or sound in a big hall or auditorium is called reverberation.

Solution 4

a) Megaphone and bulb horn

b) Stethoscope

c) Soundboard

Solution 5

Megaphone

Solution 6

a) Loudness

b) Pitch

c) Timbre or Quality

Solution 7

The loudness of sound is measured in decibel. Its symbol is dB.

Solution 8

Pitch helps us to distinguish between a man's voice and a woman's voice, even without seeing them.

Solution 9

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

Solution 10

(i) Loudness

(ii) Pitch

(iii) Timbre

Solution 11

Quality or timbre

Solution 12

Ears enable us to hear sounds.

Solution 13

Ear drum starts vibrating when outside sound falls on it.

Solution 14

There are three small bones in the middle ear- anvil, hammer and stirrup.

Solution 15

a) Hammer

b) Stirrup

Solution 16

The function of three tiny bones in the ear is to increase the strength of vibrations coming from the ear drum before passing them onto the inner ear.

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Solution 17

Eustachian tube

Solution 18

Auditory nerve

Solution 19

Ear canal

Solution 20

We should not put a pin or pencil or any other sharp pointed objects in our ears because they can damage the ear-drum and damaging of ear drum can make us deaf.

Solution 21

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

Solution 22

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

Solution 23

SONAR is used to find the depth of sea by using ultrasonic sound waves.

Solution 24

SO und Navigation And Ranging

Solution 25

Soundboard works on the principle of reflection of sound.

Solution 26

A megaphone is used to address a small gathering of people.

Solution 27

A stethoscope, based on the principle of reflection of sound, is used by doctors to listen to our heartbeats.

Solution 28

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

Solution 29

Curtains and carpets can make our big room less echoey.

Solution 30

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

Solution 31

Infrasonic sound

Solution 32

Ultrasonic sounds

Solution 33

Infrasonic sound waves

Solution 34

As the frequency increases the pitch of the sound also increases.

Solution 35

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

Solution 36

Ultrasonic sound waves

Solution 37

a) reflected

b) frequency

c) amplitude

d) waveform

e) reflection

Solution 38

An echo is heard sooner on a hot day because the speed of sound in air increases with temperature. So the speed of sound in air is more on a hot day, and an echo is heard sooner.

Solution 39

An echo is heard sooner in water because the speed of sound in water is higher than the speed of sound in air.

Solution 40

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 time in a big hall is too long, then the sound becomes blurred, distorted and confusing due to overlapping.

Solution 41

Reverberations in a big hall or auditorium can be reduced by the following methods :

i) Panels made of sound absorbing materials are put on the walls and ceilings of hall and auditorium.

ii) Carpets are put on the floor to absorb sound and reduce reverberations

iii) Heavy curtains are put on doors and windows to absorb sound and reduce reverberations

iv) The seats in the hall are made from materials having sound absorbing properties

Solution 42

We hear more clearly in a room with curtains than in a room without curtains because curtains are bad reflectors of sound. They absorb most of the sound falling on them, and hence do not produce echoes. On the other hand, in rooms without curtains, there is a greater reflection of sound due to which some echoes are produced.

These echoes cause a hindrance to hearing.

Solution 43

A megaphone is a large, cone-shaped (or funnel-shaped) device for amplifying and directing the voice of a person who speaks into it. A megaphone works on the principle of multiple reflections of sound.

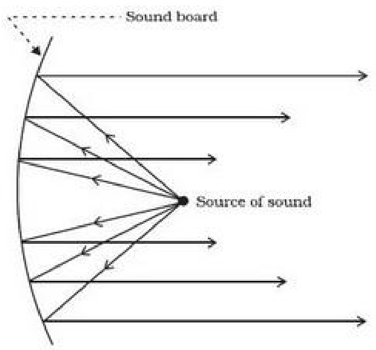
Solution 44

A bulb horn is a cone shaped wind instrument which used for signaling in bicycles, cars, buses, trucks and boats, etc. A bulb horn works on the principle of multiple reflections of sound.

Solution 45

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

Solution 46

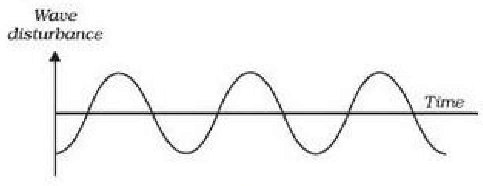


Sound board used in a big hall.

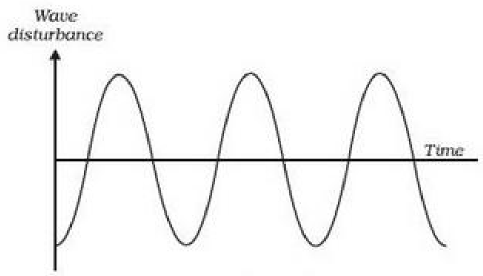
The soundboard is a concave board (curved board) which is placed behind the speaker in large halls or auditoriums so that his speech can be easily heard even by the persons sitting at a considerable distance. The sound board works as follows: the speaker is made to stand at the focus of the concave soundboard. The concave surface of the soundboard reflects the sound waves of the speaker towards 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.

Solution 47

a) The loudness of sound is a measure of the sound energy reaching the ear per second. It depends on the amplitude of the sound waves.



Soft sound

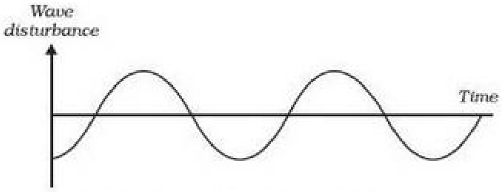


b) Louder sound

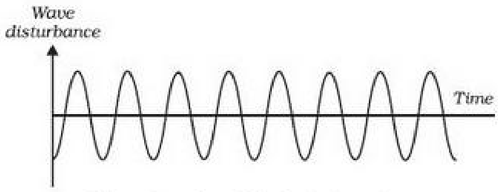
Solution 48

(a)Pitch is that characteristic of the sound by which we can distinguish between different sounds of same loudness. It depends on the frequency of the sound waves

(b)



Wave shape for a low pitched sound.



Wave shape for a high pitched sound.

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Solution 49
Quality (or timbre) is that characteristic of the sound by which we can distinguish between sounds of same pitch and loudness produced by different musical instruments (and different singers). The quality (or timbre) depends on the shape of the sound wave (or waveform) produced by it.

Solution 50
When we strike a table lightly, then due to less energy supplied, the table top vibrates with a small amplitude and hence a soft sound is produced. However if we hit the table hard, due to greater energy supplied, the table top vibrates with a large amplitude and hence a loud sound is produced.

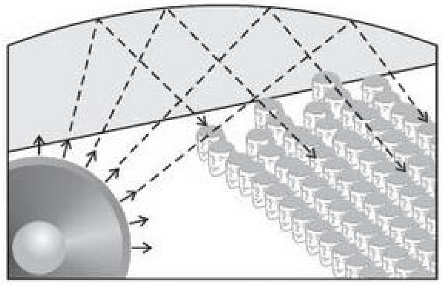
Solution 51
Ultrasound is used in industry for detecting flaws in metal blocks without damaging them. In hospitals, ultrasound is used to investigate the internal organs of the human body such as liver, kidneys, uterus, etc.

Solution 52
Bats are able to fly at night without colliding with other objects because they emit high frequency ultrasonic squeaks while flying and listen to the echoes produced by the reflection of their squeaks from the objects or obstacles in their path. From the time taken by the echo to be heard, bats can judge the distance of the object in their path and avoid it by changing the direction.

Solution 53
Bats emit high frequency 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 it.

Solution 54
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 waves.
(i) If the ultrasound waves pass uninterrupted through all parts of the metal block, then the block is flawless.
(ii) However, 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.

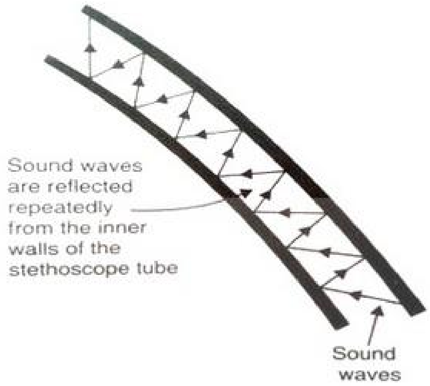
Solution 55



Curved ceiling of a conference hall.

The ceilings of concert halls are made curved so that sound, after reflection from the ceiling, reaches all part of the hall.

Solution 56



Solution 57

(a) Infrasounds include sounds of frequencies below 20 Hz.

(b) Audible sounds include sounds of frequencies between 20 Hz and 20,000 Hz

(c) Ultrasounds include sounds of frequencies above 20,000 Hz.

Solution 58

(b) Infrasonic waves: 10 Hz, 18 Hz

Ultrasonic waves: 30,000 Hz ,50,000 Hz

(a)

Infrasonic waves	Ultrasonic waves
These include sounds of frequencies below 20 Hz	These include sounds of frequencies above 20,000 Hz
These sounds are produced by objects vibrating very slowly	These sounds are produced by objects vibrating very rapidly

(b) Infrasonic waves: 10 Hz, 18 Hz

Ultrasonic waves: 30,000 Hz ,50,000 Hz

Solution 59

(a) Range of hearing in humans is 20 Hz to 20,000 Hz

(b) The sound frequencies that cannot be heard by a human ear are 10 Hz, 15 Hz and 40,000 Hz.

Solution 60

Time taken to listen the echo = 5 s

So time taken for

Time taken to listen the echo = 5 s

So time taken for sound to reach the reflecting surface, $t = \frac{5}{2}$ s

Speed of sound in air, v = 342 m/s

Distance of reflecting surface = $v \times t = 342 \times \frac{5}{2} = 855$ m

Solution 61

We can hear original sound and reflected sound separately only if there is a time interval of at least 0.1 sec between them.

So, time taken to listen to echo = 0.1 s

Time taken for sound to reach the reflecting surface,

We can hear original sound and reflected sound separately only if there is a time interval of at least 0.1 sec between them.

So, time taken to listen to echo = 0.1 s

Time taken for sound to reach the reflecting surface, $t = \frac{0.1}{2}$ s

Speed of sound in water v = 1500 m/s

Distance of reflecting surface = v x t = $1500 \times \frac{0.1}{2} = 75$ m

Solution 62

(a) The bouncing back of sound when it strikes a hard surface is called reflection of sound.Hard, solid surfaces are the best for reflecting sound waves.

(b) Metal sheet, hard wood are good reflectors of sound.

(c) The laws of reflection of sound are:

1. The incident sound wave, the reflected sound wave, and the normal at the point of incidence, all lie in the same plane.
2. The angle of reflection of sound is always equal to the angle of incidence of sound.

Solution 63

(a) The repetition of sound caused by the reflection of sound waves 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^{o}C) is 17.2 metrers

(c) Distance s = 825 m

speed of sound v = 330 m/s

Time taken for sound to reach the reflecting surface,

(a) The repetition of sound caused by the reflection of sound waves 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^{o}C) is 17.2 metrers

(c) Distance s = 825 m

speed of sound v = 330 m/s

Time taken for sound to reach the reflecting surface, $t = \frac{s}{v} = \frac{825}{330} = 2.5$ s

So, time taken to hear the echo = 2 x 2.5 = 5 s

Solution 64

(a) Ultrasounds are the sounds having very high frequency which cannot be heard by human beings.

(a) Ultrasounds are the sounds having very high frequency which cannot be heard by human beings.

Ordinary sound	Ultrasound
These include sounds of frequencies in the range of 20 Hz to 20,000 Hz	These include sounds of frequencies above 20,000 Hz
These sounds are audible to human ears	These sounds are inaudible to human ears

(b) Applications of ultrasound are:

1. Ultrasound is used in industry for detecting flaws in metal blocks without damaging them
2. In hospitals, ultrasounds are used to investigate the internal organs of the human body such as liver, kidneys, uterus, etc
3. Ultrasounds are also used to monitor the growth of fetus inside the mother's uterus.

(b)Applications of ultrasound are:

1. Ultrasound is used in industry for detecting flaws in metal blocks without damaging them
2. In hospitals, ultrasounds are used to investigate the internal organs of the human body such as liver, kidneys, uterus, etc
3. Ultrasounds are also used to monitor the growth of fetus inside the mother's uterus.

Solution 65

(a)Infrasonic waves include sounds of frequencies below 20 Hz. These sounds are produced

by objects vibrating very slowly. Whales and elephants can produce these sounds.
(b)Ultrasonic waves include sounds of frequencies above 20,000 Hz. These sounds are produced by objects vibrating very rapidly. Bats and dolphins can produce these sounds.
(c)Speed of sound v = 344 m/s
Lower frequency f_l= 20 Hz
Higher frequency f_h = 20,000Hz

(a) Infrasonic waves include sounds of frequencies below 20 Hz. These sounds are produced by objects vibrating very slowly. Whales and elephants can produce these sounds.

(b) Ultrasonic waves include sounds of frequencies above 20,000 Hz. These sounds are produced by objects vibrating very rapidly. Bats and dolphins can produce these sounds.

(c) Speed of sound v = 344 m/s

Lower frequency f_l= 20 Hz

Higher frequency f_h = 20,000Hz

$$\text{Wavelength}_{(l)} = \frac{v}{f_l} = \frac{344}{20} = 17.2\text{ m}$$

$$\text{Wavelength}_{(h)} = \frac{v}{f_h} = \frac{344}{20000} = 0.0172\text{m}$$

So, the wavelength range is 0.0172 m to 17.2 m.

Solution 66

(a)
(a) Echolocation is the method used by some animals to locate the objects by hearing the echoes of their ultrasonic squeaks.
(b) Echocardiography is the use of ultrasound waves to investigate the action of the heart.
(c) Ultrasonography is the technique of obtaining pictures of internal organs of the body by using echoes of ultrasound pulses.
(b) Bat navigates and finds its food by echolocation.
(c) Porpoise produces ultrasonic waves.

Solution 67

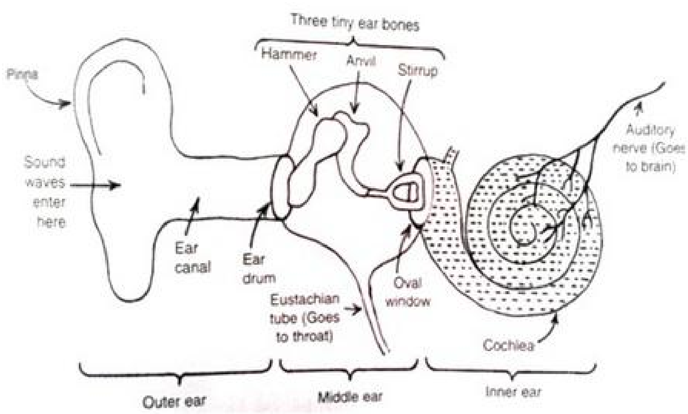
(a) SONAR stands for SOund Navigation And Ranging. A sonar is an apparatus (or device) which is used to find the depth of a sea or to locate the underwater things like shoals of fish, shipwrecks and enemy submarines.
(b) Time taken to listen to the return signal = 3 s

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

(b) Time taken to listen to the return signal = 3 s

So time taken to reach the object = $\frac{3}{2}$ = 1.5 s
Speed of sound in water = 1440 m/s
Distance of object = 1440 x 1.5 = 2160 m

Solution 68



Construction of human ear:
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 to 3 centimeters long passage called ear canal. At the end of ear canal is a thin, elastic, circular membrane called tympanum or ear-drum. The middle ear contains three small delicate bones called hammer, anvil and stirrup.

These bones are linked to one another. The one end of hammer is touching the ear drum and its other end is connected to the second bone called anvil. The other end of anvil is connected to the third bone called stirrup. And the free end of 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 other side of cochlea is connected to the auditory nerve which goes to the brain.

Working of human ear:

The sound waves are collected by the pinna. These sound waves pass through ear canal and fall on the ear-drum. Sound waves consist of compressions and rarefactions. When the compression strikes the ear drum, the pressure on the outside of ear drum increases and pushes the ear drum inwards. And when rarefaction strikes the ear drum, the pressure on the outside of ear drum decreases and it moves outwards. Thus, when sound waves fall on the ear drum, 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, liquid in the cochlea starts to vibrate, setting up electrical impulses in the nerve cells present in it. These impulses are carried to the brain by auditory nerve. The brain interprets the impulses and we get the sensation of hearing.

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Solution 85

(a) Echo

(b) Sound gets reflected back

(c) Incident sound travels distance = 800 m

Sound after reflection travels = 800 m

Total distance travelled by sound = 800 + 800 = 1600 m

(d) Distance of cliff, d = 800 m

Time taken to listen to the echo = 5 s

(a) Echo

(b) Sound gets reflected back

(c) Incident sound travels distance = 800 m

Sound after reflection travels = 800 m

Total distance travelled by sound = 800 + 800 = 1600 m

(d) Distance of cliff, d = 800 m

Time taken to listen to the echo = 5 s

So time taken by sound to reach the cliff, $t = \frac{5}{2} = 2.5$ s

Speed of sound $= \frac{d}{t} = \frac{800}{2.5} = 320$ m/s

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Solution 86

(a) A and D

(b) B and D

(c) Same vibrating body produced all the sound wvaes

(d) Tuning forks

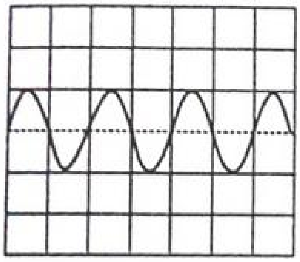
Solution 87

(a) The air in-between Anhad and the loudspeaker vibrates with the frequency of 200 Hz

(b) Anhad receives sound in the right ear by the sound waves coming directly from the loudspeaker and in his left ear he receives sound from sound waves reflected from the classroom wall.

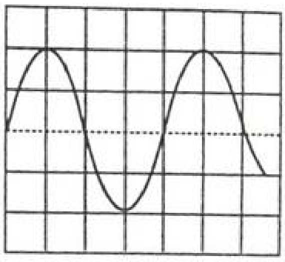
Solution 88

(a)



(Y)

(b)



(Z)

Solution 89

a)

(i) X is ultrasonic sound

(ii) Y is infrasonic sound

(iii) Z is audible sound

(b) Ultrasound machine in hospitals

(c) Simple pendulum

(d) Loudspeaker

(e) 20 Hz to 20000 Hz

Solution 90

(a) The person would hear a lot of noise of heavy traffic in a city.

(b) The person would hear very little noise of traffic in a village.

(c) The person would hear echoes of persons talking in a bare room.

(d) The person will find furnished room less echoic.