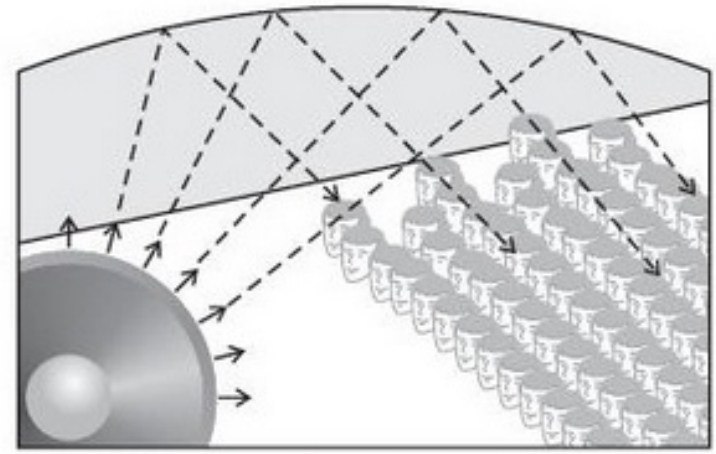
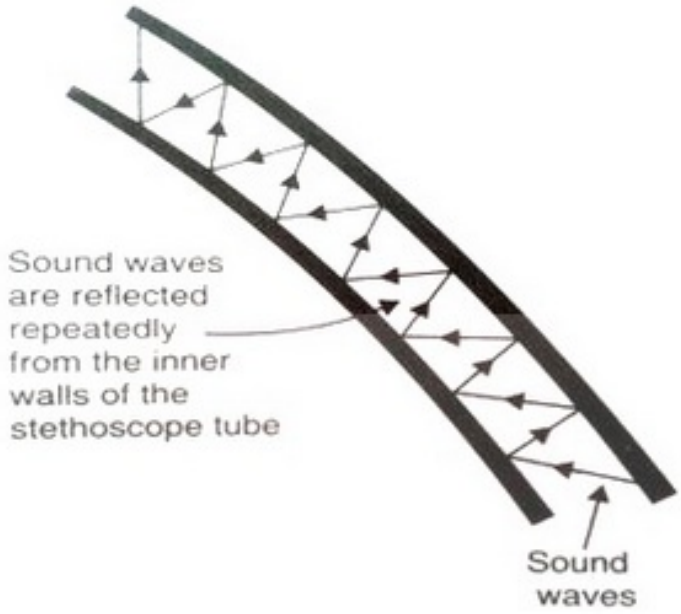
Page 208
Solution 49
Quality (or timbre) is that characteristic of the sound by which we can distinguish between sounds of same pitch and loudness produced by different musical instruments (and different singers). The quality (or timbre) depends on the shape of the sound wave (or waveform) produced by 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 x t = 342 x $\frac{5}{2}$ = 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 x $\frac{0.1}{2}$ = 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

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(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

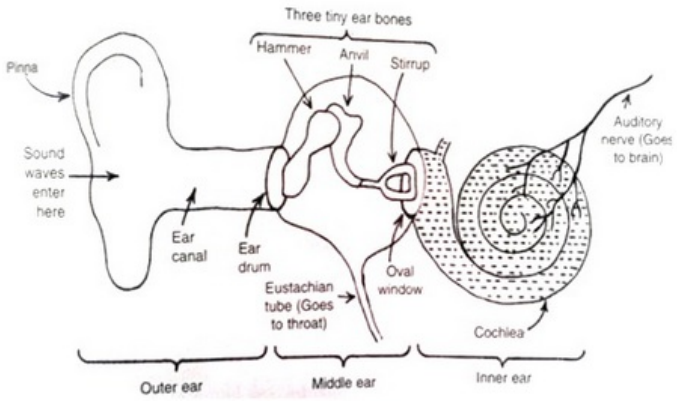
(a) SONAR stands for SOund Navigation And Ranging. A sonar is an apparatus (or device) which is used to find the depth of a sea or to locate the underwater things like shoals of fish, shipwrecks and enemy submarines.

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

$$\text{So time taken to reach the object} = \frac{3}{2} = 1.5 \text{ s}$$

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.

********** END **********