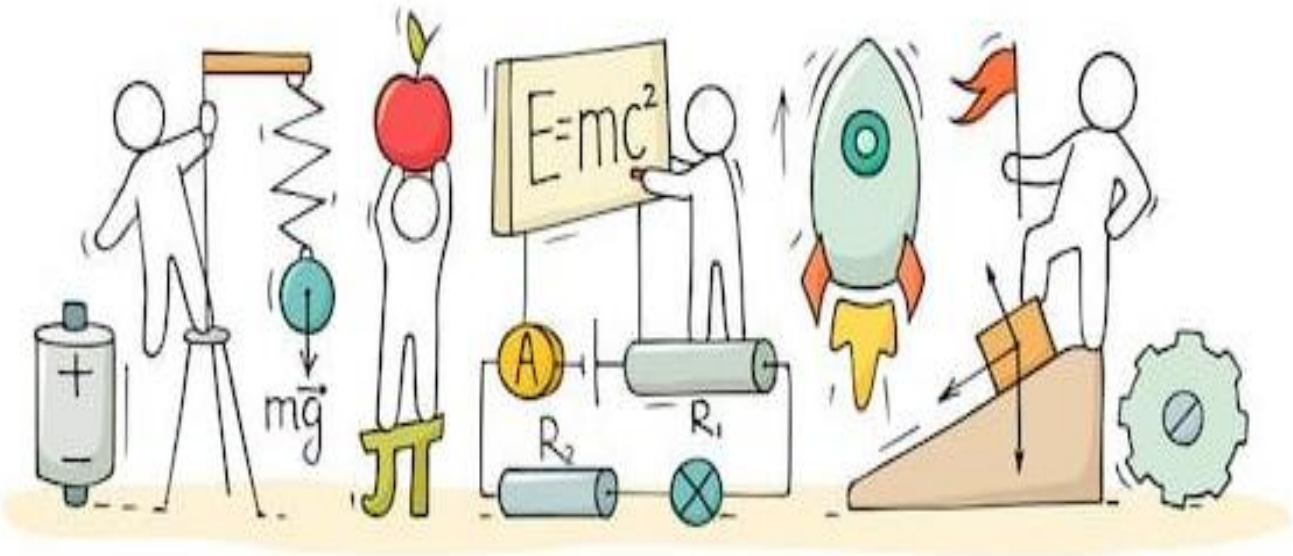
SCIENCE

Chapter 13: Sound



Sound

- Sound is a form of energy that travels in the form of vibrations through the air or any another medium.
- Vibration is defined as a rapid to and from or up and down movement about a mean position.
- Vibrations travel through a medium such as air and reach our ears where they are interpreted by the brain as sound.
- Human beings are capable of producing sound which originates from the larynx or the voice box in the neck. The sound produced is controlled by thin membranous structures known as vocal cords that stretch across the larynx.
- The vibrating body can be- a stretched animal hide (as in drums and table), stretched strings (as in guitar and sitar), or air columns (as in flute or pipes).

Simple pendulum

You can produce slower vibration in a simple pendulum. It consists simply of a weight hanging by a thread. When the ball is given a small push, it performs to and fro movements which you can easily observe. These slow vibrations are also known as oscillations.

Production of Sound

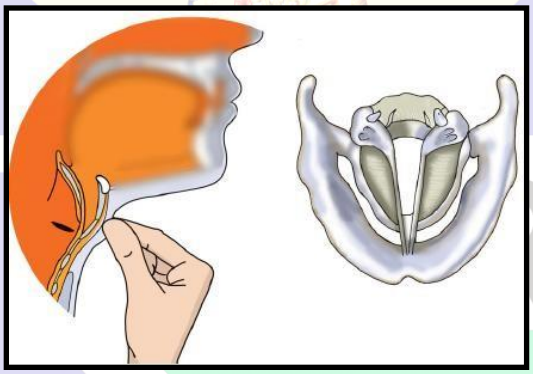
Sound Produced by a Vibrating Body

- The rapid to-and-fro or back-and-forth motion of an object is called vibration.
- A vibrating object produces sound.
- To produce pleasant sounds, several musical instruments have been developed.

- Some instruments produce sound due to the vibration of membranes, some due to the vibration of strings and some produce sound due to the vibration of an air column.

- The sitar, violin, guitar and ektara are stringed instruments. The tabla, manjira (cymbals), ghatam and kartal work on the vibration of a membrane. Instruments such as the flute and trumpet produce sound due to the vibration of an air column.

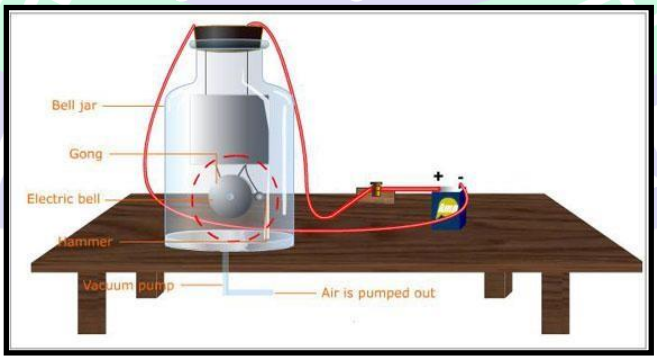
Sound Produced by Humans



- In humans, the sound is produced by the voice box or the larynx.
- The voice box is at the upper end of the windpipe.
- When we speak, the two vocal cords in the larynx vibrate and produce sound.
- These vocal cords are stretched across the voice box or larynx so that there is a narrow slit between them for the passage of air.
- The vocal cords are about 20 mm long in men, 15 mm long in women (5 mm shorter) and they are very short in children.

Propagation of Sound

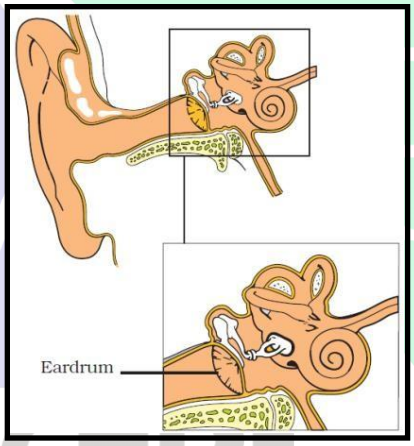
- Sound needs a material medium to travel.
- It cannot travel through vacuum. Example:
- An electric bell suspended inside an airtight glass bell jar is connected to a vacuum pump.



- As the electric bell circuit is completed, the sound is heard.
- If the air is slowly removed from the bell jar by using a vacuum pump, then the intensity of sound goes on decreasing and no sound is heard when all the air is removed.
- Sound travels through solids, liquids and gases.
- The speed of sound is the maximum in solids, less in liquids and the least in gases.

Human Ear

- We hear sound with our ears.
- The shape of the outer part of the ear is like a funnel.
- When sound enters the ear, it travels down a canal which has a thin stretched membrane at its end. It is called the eardrum.



- The ear drum sends the vibrations to the inner ear and the signals are then carried to the brain.

Characteristics of vibration

The important characteristics of vibrations are its frequency, amplitude and time period. These determine the characteristics of the sound produced.

Frequency:

- The number of vibrations made by the vibrating body in one second is known as its frequency.
- The SI unit of frequency is the hertz (Hz).

Amplitude:

The maximum extent of vibration of the vibrating body from its mean position is known as its amplitude.

Time period:

The time taken by the vibrating body for one complete vibration is known as the time period of vibration. It is denoted by T.

T=1/f and f=1/T

Time period and frequency are reciprocals of each other.

Characteristics of Sound

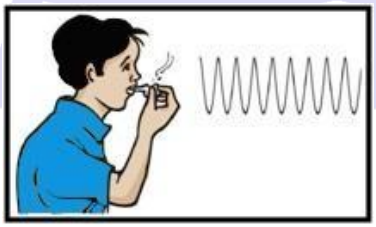
- The to-and-fro motion of a vibrating object is called oscillatory motion.
- The number of oscillations per second is called the frequency of oscillation. It is expressed in hertz (Hz).
- The time taken by the vibrating particle for one full vibration or oscillation is called the time period of oscillation.
- The properties by which sounds can be differentiated are amplitude and frequency.
- The various characteristics of sound are loudness, pitch or shrillness and quality or timbre.

Loudness

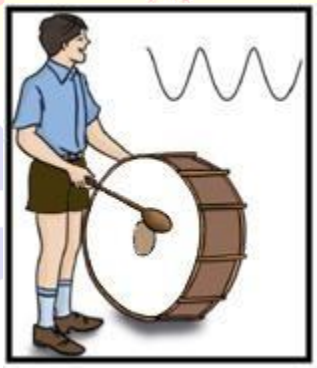
- The loudness of sound is proportional to the square of the amplitude.
- Larger the amplitude of sound, more is its loudness. Example: The roar of a lion is more than that of a person.
- The loudness of sound is measured in decibel (dB).
- If loudness exceeds 80 dB, then the sound becomes physically painful.

Pitch

- The pitch or shrillness of sound depends on its frequency.
- If the frequency is more, then the pitch or shrillness is more. Example:
  A whistle has a high frequency, so it produces a sound of a higher pitch.



- If the frequency is low, then the pitch or shrillness is less. Example:
  A drum vibrates with a low frequency, so it produces a low-pitched sound.



Audible and Inaudible Sound

- Not all sound produced by vibrating bodies is audible.
- The human ear can only recognise sounds of frequencies between 20 Hz and 20,000 Hz, and this range of frequency is called audible sound frequencies.
- Sound of frequencies outside this range is called inaudible sound.
- Some animals such as dogs and snakes can hear sounds of frequencies greater than 20,000 Hz.
- Sounds of frequencies less than 20 Hz are called infrasonic sounds, while sounds of frequencies greater than 20,000 Hz are called ultrasonic sounds.

Sound Travel

- Sound travels through a medium in the form of waves. When vibrations take place, they are transmitted through a medium and form alternate compression and rarefactions.
- Compressions are regions in the medium where the particles are closer whereas rarefactions are regions in the medium where the particles are spread out.

Speed of sound:

The speed of sound changes with the change in medium. Speed also depends on the physical state and temperature of the medium. At higher temperature, the speed of sound is higher, while at lower temperature, the speed decreases.

The speed of sound is maximum in solids (5920m/s in steel), lesser in liquids (1480m/s in

water) and minimum in gases (330m/s in air).

Noise and Music

- Any unpleasant, intolerable and irritating sound is called noise.
- Music refers to any sound which is pleasant to the ear.
- Sound produced by musical instruments is pleasing to the ear. However, if the intensity of the sound exceeds a certain limit, then it becomes intolerable and is noise.

Noise Pollution

- The presence of excessive or unwanted sounds in the environment is called noise pollution.
- Noise pollution may cause high blood pressure, panic attacks and lack of sleep in those exposed.
- Continuous exposure to loud noise may cause temporary or permanent hearing impairment.
- To reduce noise pollution, trees should be planted along roads and in residential areas. Factories should not be set up in residential areas. Vehicles should not blow horns around schools, hospitals and residential areas. TVs and music systems should not be played at a high volume.

Sources of noise pollution:

The sources of noise pollution include road traffic, jet planes, trains, construction sites, factories, uses of loudspeakers, lighting of crackers during festivals, and noise from radio and television.

Harmful effects of noise pollution:

Sudden exposure to high noise level can cause permanent deafness by rupturing the eardrum.

Noise environment causes headache and inability to concentrate on work.

High noise levels can also lead to nervous tension and increase of blood pressure.

Reflection and absorption of sound:

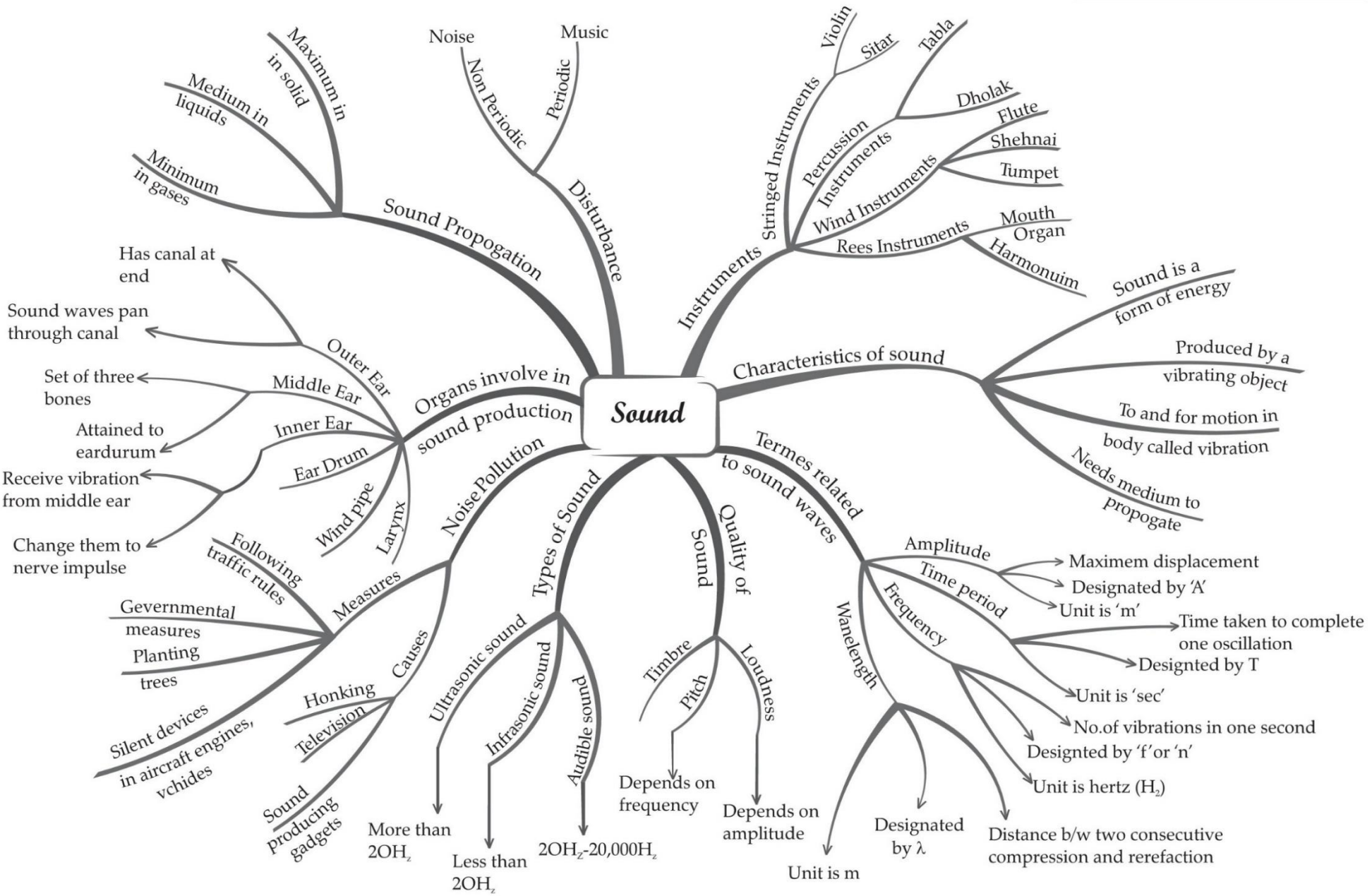
The echo:

- Sound heard after reflection from a surface is called echo.
- Just like heat or light, when sound falls on a surface, it is partly reflected and partly absorbed.
- Soft surfaces are better absorbers of sound whereas hard surfaces are better reflectors of sound.

Uses of Echo:

- Echo is used in SONAR (Sound Navigation and Ranging) to find the depth of seas or distance of submarines.
- In concert halls, echo is desirable to some extent, because it enhances the sound and produces a pleasing effect.
- Bats use the principle of echolocation to avoid hitting against obstacles in their path.

MIND MAP : LEARNING MADE SIMPLE CHAPTER-16



Important Questions

Multiple Choice questions-

Question 1. The voice box is also called as

(a) stomach

(b) heart

(c) larynx

(d) mouth

Question 2. Sound is a kind of

(a) work

(b) energy

(c) force

(d) pressure

Question 3. The hearing range of human ear is

(a) 20 Hz to 20,000 Hz

(b) less than 20 Hz

(c) more than 20,000 Hz

(d) 20 Hz to 25,000 Hz

Question 4. Pitch of sound is determined by its

(a) frequency

(b) speed

(c) amplitude

(d) loudness

Question 5. The frequency of subsonic sound is

(a) more than 20 Hz

(b) 100 Hz

(c) less than 20 Hz

(d) more than 20,000 Hz

Question 6. Cochlea is a part of

(a) hearing organ

(b) sound producing organ

(c) muscular organ

(d) air pollution

Question 7. 1 hertz is equal to

(a) 1 vibration per minute

(b) 10 vibrations per minute

(c) 60 vibrations per minute

(d) 600 vibrations per minute

Question 8. Sound cannot travel through

(a) air

(b) water

(c) air

(d) vacuum

Question 9. The sound in the audible range is called

(a) ultrasonic sound

(b) sonic sound

(c) subonic sound

(d) light sound

Question 10. Speed is

(a) $\frac{Distance travelled}{Time}$

(b) $\frac{Time}{Distance travelled}$

(c) Distance travelled × Time

(d) Time + Distance travelled

Very Short Questions :

1. What is sound?
2. How is sound produced?
3. Do all bodies can produce sound?
4. What do you feel when you touch a sound producing school bell?
5. Touch the bell when it stops producing sound. Can you feel the vibrations?
6. What do you understand by this?
7. What do you understand by vibrations?
8. In some cases we cannot see vibrations explain why is it so?
9. What is amplitude?
10. Name a musical instrument which produces sound by air column.

Short Questions :

1. Discuss the importance of sound in our life.
2. How is sound produced?
3. How does sound travel from one place to another?
4. Why some sounds are louder than others?
5. Explain with an activity that vibrating object produces sound.
6. Vibrating objects produces sound; can we see the vibrations all the time?
7. What are vibrating parts of Veena and Tabla?
8. What are vibrating parts of Flute?
9. Name some musical instrument which are simply beaten or struck to produce melodious music.
10. How sound is produced from a guitar?

Long Questions :

1. State the differences between ultrasonic sound and infrasonic sound?
2. What are the methods to control noise pollution?
3. What is the property of vibration which determines the pitch of the sound?
4. Define frequency.
5. A string musical instrument was first plucked with a force of smaller magnitude and then with a force of greater magnitude. In which case would the instrument produce a louder sound?

ANSWER

MCQ Answer:

1. Answer: (c) larynx
2. Answer: (b) energy
3. Answer: (a) 20 Hz to 20,000 Hz
4. Answer: (a) frequency
5. Answer: (c) less than 20 Hz
6. Answer: (a) hearing organ
7. Answer: (c) 60 vibrations per minute
8. Answer: (d) vacuum
9. Answer: (b) sonic sound
10. Answer: (a) $\frac{Distance travelled}{Time}$
11. Answer: (c) 0.2 sec.
12. Answer: (c) amplitude
13. Answer: (a) frequency
14. Answer: (a) amplitude
15. Answer: (b) 340 m/sec.

Very Short Answer:

1. Answer: Sound is the medium by which we communicate with one another.
2. Answer: Sound is produced by vibrating bodies.
3. Answer: No, all bodies cannot produce sound.
4. Answer: We feel the vibrations in the bell.
5. Answer: No, we cannot feel vibrations.
6. Answer: We understand that only vibrating bodies can produce sound.
7. Answer: The back and forth motion of an object is called vibration.
8. Answer: When amplitude of vibrations is very small, then we cannot see them.
9. Answer: The maximum displacement of a vibrating body on one side is called amplitude.
10. Answer: Flute.

Short Answer :

1. Answer: Sound plays an important role in our life; Sound helps us to communicate with one another. Sound is so important because animals are able to hear events all around them, no matter where their attention is focused or not.
2. Answer: Sound is produced by the vibrations of a body and is transmitted through material media in pressure waves made up of alternate condensations (forcing of the molecules of the medium together) and rarefactions (pulling of the molecules of the medium away from one another).
3. Answer: Sound travels through a medium solid, liquid and gas. It cannot travel through vacuum.
4. Answer: The loudness of sound depends upon its amplitude. , larger the amplitude of vibration the louder is the sound and vice versa.
5. Answer: Take metal dish pour water into it, strike its edge with a spoon, you will hear a sound, now again strike the edge of dish and look at the surface of water inside it, you will observe that vibrating dish producing sound along with wave in water. This shows that there is vibration in dish which is producing sound.
6. Answer: No, we cannot see the vibrations all the time as their amplitude is so small that we cannot see them rather we can feel them.
7. Answer: Vibrating part of Veena that produces sound is stretched string and Vibrating part of Tabla that produces sound is stretched membrane.
8. Answer: Vibrating part of Flute that produces sound is air column.
9. Answer: Manjira, ghatam, not and kartal are some of the instruments that which are simply beaten or struck to produce melodious music.
10. Answer: The string of the sitar is plucked it vibrate to produce sound, along with string other parts infact the whole instrument is forced to vibrate, and it is the sound of the vibration of the instrument that we hear.

Long Answer:

1. **Answer:**

Ultrasonic sound	Infrasonic sound
I. Sound of frequency higher than 20,000 Hz is called ultrasonic sound.	I. Sound of frequency lower than 20 Hz is called the infrasonic sound.

II. Animals like dog, bat, monkey, deer, etc., can hear ultrasonic sound.	II. Animals like whale, elephant, hippopotamus, giraffe, etc., can hear infrasonic sound.

2. Answer:

Following are the methods to control noise pollution:

- The noise pollution can be controlled by reducing the respective sources of noise pollution.
- The blowing of horns and speaker should be strictly avoided near schools and hospitals.
- More and more trees should be planted on the roadside because trees absorb sound.

3. Answer:

The frequency is the property which determines the shrillness or pitch of a sound. If the frequency of a sound is higher then we say that the sound has lower pitch.

4. Answer:

The number of oscillations completed by a vibrating body in one second is called frequency. The unit of frequency is hertz. It is denoted by Hz. If a vibrating body makes 20 oscillations in a second we say that its frequency is 20 Hz. The human voice can produce frequency between 60 Hz and 13,000 Hz. It is interesting that a human ear can hear sound of frequency between 20 Hz to 20,000 Hz.

A string musical instrument was first plucked with a force of smaller magnitude and then with a force of greater magnitude. In which case would the instrument produce a louder sound?

5. Answer:

The loudness of sound depends upon the amplitude of vibration. The amplitude of string is larger when it is plucked with greater force and hence the sound will be louder in that case.