Sound

1. **What is Sound?**
   Ans. Sound is a form of energy which produces a sensation of hearing in our ears.

2. **How sound energy is produced?**
   Ans. When a body vibrates, the particles of the medium also start vibrating. During vibration, the kinetic energy of particles changes into potential energy and potential energy into kinetic energy. This is why the sound energy produced.

3. **How sound energy is propagated in air?**
   Ans. When a source of sound vibrates, it creates a periodic disturbance in the medium near it. This disturbance then travels in the medium in form of waves. This is how the sound energy is propagated.

4. **What are the characteristics of Wave?**
   Ans. Sound is a longitudinal wave which consists of compression and rarefactions travelling through a medium.
   Soundwave can be described completely by five characteristics
   a. Wavelength
   b. Amplitude
   c. Time period
   d. Frequency
   e. Velocity

5. **What is Wavelength?**
   Ans. The distance travelled by the wave in one time period of the vibration of particle of medium is called the Wavelength.
   It is denoted by λ (Lambda)
   SI unit of Wavelength is Meter (m)

6. **What is Amplitude?**
   Ans. When a wave passes through a medium the maximum displacement of the particle of medium on either side of its mean position is called the amplitude of wave.
   It is denoted by the letter "a".
   SI unit is Meter (m)

7. **What is Time Period?**
   Ans. The time taken by a particle of medium to complete its one vibration is called Time Period of Wave.
   It is denoted by the letter "T".
   The SI unit of Time Period is "Sec".

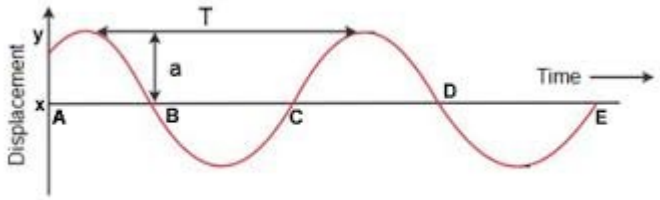
8. **What is Frequency?**
   Ans. The number of vibrations made by a particle of medium in one second is called the frequency of wave.
   i.e. It is the number of waves passing through a point in one second.
   IT is denoted by "f"
   Si unit od Frequency is sec^{-1} or Hertz.

9. **What is Wave Velocity?**
   Ans. The distance travelled by a wave in 1 second is called Wave Velocity.
   It is denoted by "v".
   SI unit is ms^{-1}.

10. What is the relation between Frequency "f" and Time Period "T"?
    Ans. The relation between Frequency "f" and Time Period "T" is

$$f = \frac{1}{T}$$

11. **Describe Displacement Time Graph of Sound.**
    Ans. The variation of displacement with time for a particle of the medium at a given position, when a wave propagates through the medium is called Displacement-Time Graph.



    In this Graph a= Amplitude and T= Time Period

12. **What are the characteristics of Wave Motion?**
    Ans. Wave motion is the transfer of energy and momentum from one point of the medium to another point of the medium without actual transport of matter between two points. Wave motion is classified into three different ways they are,
    - The medium of propagation,
    - The dimensions in which a wave propagates energy,
    - The energy transfers

13. **What is the relationship between the wavelength, wave velocity and frequency?**
    Ans. Frequency wavelength and wave velocity are related as follows:
    Wave length is the distance travelled by the wave during the time a particle of the medium completes one vibration.
    Therefore, if λ be the wavelength and T the time period then the wave travels a distance λ and time T
    Hence,
    Wave velocity =Distance/ Time
    ⇒v=λ/T
    ∴v=fλ [1/ T =frequency(f)]
    ∴ Wave velocity= Frequency × Wavelength

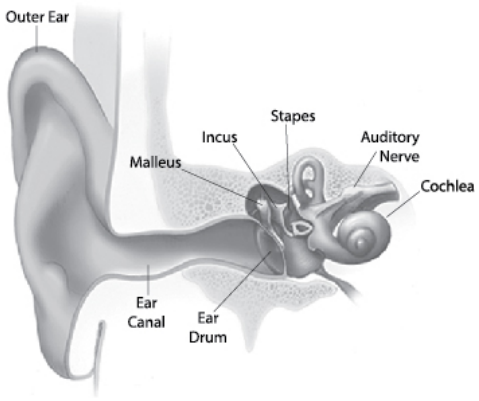
14. **What is Vibration?**
    Ans. One complete to and fro motion of the particle of medium is called Vibration.

15. **What is Wind Instrument?**
    Ans. The instrument where vibration in air columns produce sound is called Wind Instrument.
    The frequency is changed by changing the length of the vibrating air column.
    Ex: Shehnai, Flute etc.

16. **What is Stringed Instrument?**
Ans. The instrument where vibration in wires produces sound is called Stringed Instrument.
The frequency of vibration is changed by changing the length, thickness and tightness of the wires.
Ex: Guitar, Sitar etc.

17. **What are Percussion Instruments?**
Ans. These instruments have stretched skin whose vibrations produce sound.
The pitch or frequency of vibrations can be increased by stretching the skin more.
Ex: Drum, Tabla etc.

18. **How can we hear through ear?**
Ans. Hearing depends on a series of complex steps that change sound waves in the air into electrical signals. Our auditory nerve then carries these signals to the brain.
    i. Sound waves enter the outer ear and travel through a narrow passageway called the ear canal, which leads to the eardrum.
    ii. The eardrum vibrates from the incoming sound waves and sends these vibrations to three tiny bones in the middle ear. These bones are called the malleus, incus, and stapes.
    iii. The bones in the middle ear amplify, or increase, the sound vibrations and send them to the cochlea, a snail-shaped structure filled with fluid, in the inner ear. An elastic partition runs from the beginning to the end of the cochlea, splitting it into an upper and lower part. This partition is called the basilar membrane because it serves as the base, or ground floor, on which key hearing structures sit.



    iv. Once the vibrations cause the fluid inside the cochlea to ripple, a traveling wave forms along the basilar membrane. Hair cells—sensory cells sitting on top of the basilar membrane—ride the wave. Hair cells near the wide end of the snail-shaped cochlea detect higher-pitched sounds, such as an infant crying. Those closer to the centre detect lower-pitched sounds, such as a large dog barking.
    v. As the hair cells move up and down, microscopic hair-like projections (known as stereocilia) that perch on top of the hair cells bump against an overlying structure and bend. Bending causes pore-like channels, which are at the tips of the stereocilia, to open up. When that happens, chemicals rush into the cells, creating an electrical signal.
    vi. The auditory nerve carries this electrical signal to the brain, which turns it into a sound that we recognize and understand.

19. What is Loudness of Sound

Ans. This phenomenon of a sound depending on the amplitude of the sound wave. If the amplitude of the sound wave is large, then the sound is said to be loud.
It is directly proportional to the square of the amplitude of vibration. If the amplitude of the sound wave becomes double, then the loudness of the sound will be quadrupled.
It is expressed in decibel (dB).
Sounds above 80 dB becomes noise to human ears.
The table given below gives us data for various sources of sound.

20. What is Pitch of Sound?

Ans. This depends on the frequency of vibration of the waves.
If the frequency of vibration is higher, we say that the sound is shrill and has a high pitch. On the other hand, if the sound is said to have a lower pitch then it has a lower frequency of vibration.
A bird produces high-pitched sound whereas roaring of a lion is a low-pitched sound.
The Voice of a woman has a high pitch than that of a man.

21. What is the Difference between Pitch and Loudness?

Ans.

Loudness	Pitch
Loudness is defined as the property of sound which is used for differentiating between the loud and faint sound	Pitch is defined as the characteristic of sound which is used for differentiating between the shrill and flat sound
Loudness is dependent on the energy received by the ear in unit time	Pitch is independent of the energy received by the ear in unit time
Loudness is independent of the change in frequency	Pitch is dependent on the change in the frequency. As the frequency increases, the shrillness of the sound increases

22. What is Inaudible sound?

Ans. Human ear cannot detect sound frequencies less than 20 vibrations per second i.e. 20 Hz. So any sound below this frequency will be inaudible sound for humans. In the high-frequency range, the human ear cannot detect frequencies above 20000 vibrations per second (20 kHz) and the amplitude of the wave would be dependent on the loudness of the sound. So the frequencies below 20 Hz and above 20 kHz comes under the category of inaudible frequencies. The low-frequency sound which the human ear cannot detect is also known as infrasonic sound. Whereas the higher range inaudible frequency is also known as ultrasonic sound.
Some animals like dogs have the ability to hear sounds having frequencies higher than 20 kHz. The police department uses whistles with frequencies higher than 20 kHz so that only dogs can listen to it. Inaudible frequencies are helpful for many purposes. These are used in many fields like research and medicine. The ultrasound equipment used for tracking and studying many medical problems works at frequencies above 20 kHz.

23. What is Audible sound?

Ans. The human ear can easily detect frequencies between 20 Hz and 20 kHz. Hence, sound waves with frequency ranging from 20 Hz to 20 kHz is known are audible sound. The human ear is sensitive to every minute pressure difference in the air if they are in the audible frequency range. It can detect pressure difference of less than one billionth of atmospheric pressure.

As we grow older and are exposed to sound for a longer period of time, our ears get damaged and the upper limit of audible frequencies decreases. For a normal middle-aged adult person, the highest frequency which they can hear clearly is 12-14 kilohertz.

24. What are the uses of Ultrasonic Sound?

Ans. Ultrasonic Sound have higher frequency than 20,000 Hz. So, we cannot hear ultrasonic waves.

We apply them in various technologies. Some of them are given below.

a. **Cleaning:**
   In objects with parts that are difficult to reach, for example, spiral tubes and electronic components, the process of ultrasonic cleaning is used. Here, the object is dipped in a solution of suitable cleaning material and ultrasonic waves are passed into it. As a result of this, high-frequency waves are generated that cause the dirt and grease to detach from the surface.
b. **Detection of cracks:**
   Ultrasound is used to detect cracks in the metallic components that are used in the construction of high rise structures such as buildings and bridges. They generate and display an ultrasonic waveform that is interpreted by a trained operator, often with the aid of analysis software, to locate and categorize flaws in test pieces. High-frequency sound waves reflect from flaws in predictable ways, producing distinctive echo patterns that can be displayed and recorded by portable instruments. A trained operator identifies specific echo patterns corresponding to the echo response from good parts and from representative flaws. The echo pattern from a test piece may then be compared to the patterns from these calibration standards to determine its condition.
c. **Echocardiography:**
   In the process of electrocardiography, the ultrasonic waves are used to form an image of the heart using reflection and detection of these waves from various parts.
d. **Ultrasonography:**
   Medical ultrasound is a diagnostic imaging technique based on it. It is used for the imaging of internal body structures such as muscles, joints and internal organs. Ultrasonic images are known as sonograms. In this process, pulses of ultrasound are sent to the tissue using a probe. The sound echoes off the tissue, where different tissues reflect sound varying in degrees. These echoes are recorded and displayed an image.
e. **Lithotripsy:**
   Ultrasonic waves are used to break stones in the kidney. High energy sound waves are passed through the body without injuring it and break the stone into small pieces. These small pieces move through the urinary tract and out of the body more easily than a large stone.
f. **SONAR:**
   SONAR, Sound Navigation, and Ranging is a technique in which sound waves are used to navigate, detect and communicate under the surface of the water.

g. **Echolocation:**
Echolocation is the process where sound waves and echoes are used to determine objects in space. Echolocation is used by bats to navigate and find their food in the dark. Bats send out sound waves from their mouth and nose, which then hit the objects in their vicinity producing echoes, which are then received by the bats. The nature of the echo helps them determine the size, the shape and the distance of the object.

25. What is Music?
Ans. Music is a collection of coordinated sound or sounds.

26. What is Noise?
Ans. Noise is unwanted sound considered unpleasant, loud or disruptive to hearing.

27. What are the differences between Noise and Sound?
Ans.

Parameter	Sound	Noise
Definition	It is defined as the continuous vibrations that travel from one medium to another	It is defined as the unpleasant sound that causes disturbance
Effects on health	Sound has a positive effect on the health	Noise has a negative effect on health like hearing loss, hypertension
Connotation	Sound carries a positive connotation as it is audible, distinctive, relevant and definitive	Noise carries a negative connotation as it is irrelevant, incompressible

28. What is Noise Pollution?
Ans. Noise pollution, unwanted or excessive sound that can have deleterious effects on human health and environmental quality.

29. What are the harmful effects of Noise Pollution?
Ans. The presence of excessive noise in the surrounding can affect human health in a number of ways:

a. High noise pollution can cause hypertension, lack of sleep, anxiety and many more health disorders.
b. Sudden explosure to high noise level can cause permanent deafness by rupturing the ear drum.
c. High noise can cause heart attack and death.

30. How can we reduce Noise Pollution?
Ans. Some noise pollution preventive measures are provided in the points below

- Honking in public places like teaching institutes, hospital, etc. should be banned.
- In commercial, hospital, and industrial buildings adequate soundproof systems should be installed.
- Musical instruments sound should be controlled to desirable limits.
- Dense tree cover is useful in noise pollution prevention.
- Explosives should be not used in forest, mountainous, and mining areas.