Worksheet – SOUND **Solutions**

1. Define echo. Mention its two applications.

   Echo is the reflected sound which can be distinguished by human beings from the original sound.
   Applications: SONAR (Sound Navigation and Ranging) and Medical ultrasonography

2. Mention the three characteristics of sound and the corresponding physical properties of sound waves that affect these characteristics.

Characteristics	Corresponding Physical properties
Loudness	Intensity
Pitch	Frequency
Quality/Timbre	Waveform

3. Distinguish between echo and reverberation.

   Echo is a reflection of the sound which can be distinguished from the original sound. Multiple reflections of a sound which cannot be distinguished from the original sound but have the effect of prolonging the sound are called reverberations.

4. A SONAR receives a strong echo of ultrasonic signal it sent downwards into the sea 3.6 seconds after the transmission. Calculate the depth of the sea-bed if the speed of ultrasonic waves in sea-water is 1250 m/s.

   Let the depth of the sea-bed be x m.
   Distance, d = 2 x
   Time, t = 3.6 s
   Speed, v = 1250 m/s
   v = d/t 1250 = 2x / 3.6 2x = 1250*3.6 x = 4500/2 = 2250 m

5. A person standing at the finish line of a 100-m race event notices a time gap between the time he sees the clapper clap at the starting line and the moment he hears the clap. He measures this time gap 4 times. The time periods he measured are given in the table below:

Observation #	Time gap (second)
1	0.28
2	0.36
3	0.30
4	0.32

   Calculate the average time gap he measured and use that to find out the speed of sound in air.

   Distance, d = 100 m
   Average time gap, t = (0.28+0.36+0.30+0.32)/4 = 0.315 = 0.32 s (rounded off to 2 decimal places)
   Time taken for light from the clapper to reach the person is negligible.
   So, speed of sound, v = d/t = 100/0.32 = 312.5 m/s

6. Name the units used to measure
   a. Intensity of a sound wave
   b. Loudness of sound
   c. Frequency of sound

   a. W/m^2 b. decibel (dB) c. Hz

7. What are ultrasonic waves? Mention their any two applications.

   Ultrasonic waves are mechanical waves whose frequency is beyond the upper limit of human audibility range, i.e. 20 000 Hz.
   Applications: Medical ultrasonography and SONAR (Sound and Navigation Ranging)

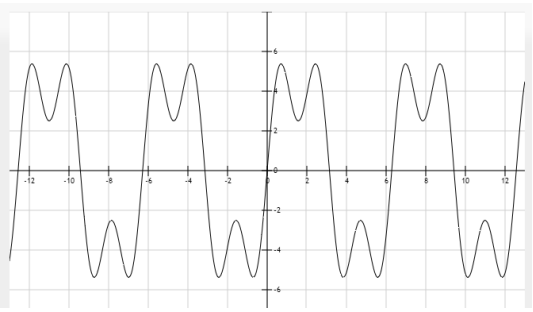
8. Mention any two factors on which the natural frequency of the vibrations of a stretched sitar string depends on.

   a. Tension in the string
   b. Length of the string

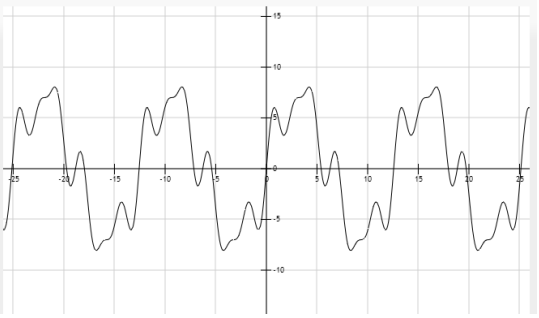
9. Describe resonance. Explain how it is employed to produce certain notes in a flute.

   If the frequency of the external periodic force influencing a vibrating object is equal to the natural frequency of the object, then the amplitude of the vibrations increase to a large value. This phenomenon is known as resonance.
   Any air column has its own natural frequency and this is dependent on its length. If the column vibrates at this frequency, resonance occurs and a loud sound of that frequency is produced. In a flute, the length of the air column is controlled by closing the holes and thus the natural frequency of the column is changed. This produces different frequencies of sound and therefore different notes.

10. Study the waveforms of sounds produced from different sources:



Sound waveform of a guitar



Sound waveform of a piano

[Ignore the marking on the axes; assume the axes of both plots have the same scale]

   a. Which of these sounds has a higher pitch?
   b. Which of these has a higher number of harmonics?

   a. Piano (because its waves have a smaller time period and therefore higher frequency)
   b. Piano (because its waveform looks more complex and therefore the wave seems to be composed of more harmonics)