Chapter: 11

Sound

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Objective

1. Sound is form of Energy OR Which form of energy sound is:

Ⓐ Electrical **Ⓑ Mechanical** Ⓒ Thermal Ⓓ Chemical

2. Two consecutive waves compression and Rarefaction is called:

Ⓐ Focal length Ⓑ Frequency **Ⓒ Wave length** Ⓓ Time Period

3. The example of longitudinal waves is:

Ⓐ Sound waves Ⓑ Water Waves Ⓒ Radio Waves Ⓓ Light waves

4. Which of the waves consist of compressions and rarefactions?

Ⓐ Television waves Ⓑ X-rays **Ⓒ Sound waves** Ⓓ Radio waves

5. The unit of intensity of sound is:

Ⓐ Wm Ⓑ Wm^{-3} Ⓒ Wm^{-1} **Ⓓ Wm^{-2}**

6. The intensity level of rustling of leaves is:

Ⓐ 10 dB Ⓑ 30 dB Ⓒ 40 dB Ⓓ 20 dB

7. The intensity level of train siren is:

Ⓐ 100 dB Ⓑ 130 dB **Ⓒ 120 dB** Ⓓ 150 dB

8. The sound level of whisper is:

Ⓐ 40 dB Ⓑ 70 dB Ⓒ 10 dB **Ⓓ 30 dB**

9. The intensity level of faintest audible sound is:

Ⓐ 40 dB Ⓑ 10 dB **Ⓒ 0 dB** Ⓓ 130 dB

10. The intensity level of vacuum cleaner is:

Ⓐ 100 dB Ⓑ 10 dB **Ⓒ 70 dB** Ⓓ 40 dB

11. The intensity level of mosquito buzzing is:

Ⓐ 40 dB Ⓑ 10 dB Ⓒ 30 dB Ⓓ 0 dB

12. Sound level in dB is:

Ⓐ $10\log\frac{I}{I_0}$ Ⓑ $10\log\frac{I_0}{I}$ Ⓒ $\log\frac{I_0}{I}(db)$ Ⓓ $\log\frac{I}{I_0}(db)$

13. The loudness of sound is most closely related to its:

Ⓐ Period **Ⓑ Amplitude** Ⓒ Wavelength Ⓓ Frequency

14. The pitch of sound mostly depends on:

Ⓐ Frequency Ⓑ Amplitude Ⓒ Period Ⓓ Wavelength

15. The frequency of silent whistle lies between:

Ⓐ 10000-20000 Hz **Ⓑ 20000-25,000 Hz** Ⓒ 15000-25000 Hz Ⓓ 20-20000 Hz

16. The intensity level of lawn mower is:

Ⓐ 70 dB Ⓑ 10 dB Ⓒ 120 dB **Ⓓ 100 dB**

17. One bell is equal to:

Ⓐ 10 dB Ⓑ 40 dB Ⓒ 20 dB Ⓓ 90 dB

18. The sensation of sound persists in our mind for about:

Ⓐ 0.2 s Ⓑ 0.02 s Ⓒ 0.01 s **Ⓓ 0.1 s**

19. To hear a clear echo, the time interval between our sound and the reflected sound must be at least:

Ⓐ 0.2 s **Ⓑ 0.1 s** Ⓒ 0.02 s Ⓓ 0.01 s

20. Speed of sound in air:

Ⓐ 2162 Km/h **Ⓑ 1246 km/h** Ⓒ 1262 Km/h Ⓓ 1264 km/h

21. In general, the speed of sound is greater in:

Ⓐ Liquids Ⓑ Gases Ⓒ None of these **Ⓓ Solids**

22. Calculate the frequency of sound wave of speed 340 m/s and wavelength 0.5 m?

Ⓐ 680 Hz Ⓑ 340 Hz Ⓒ 170 Hz Ⓓ 0.5 Hz

23. The speed of sound in air at 0^0C is:

Ⓐ 376 m/s Ⓑ 231 m/s Ⓒ 386 m/s **Ⓓ 331 m/s**

24. Formula for finding speed of sound is:

Ⓐ $f = v/\lambda$ **Ⓑ $V = f\lambda$** Ⓒ $v = f/\lambda$ Ⓓ $f = v\lambda$

25. If speed of sound is 320 m/s, the distance covered in a time of 1.5 s will be:

Ⓐ 221 m Ⓑ 480 cm Ⓒ 408 m **Ⓓ 480 m**

26. The speed of sound in air at 25^0C is:

Ⓐ 376 m/s **Ⓑ 346 m/s** Ⓒ 231 m/s Ⓓ 386 m/s

27. The speed of sound in hydrogen at 0^0C is:

Ⓐ 376 m/s Ⓑ 231 m/s Ⓒ 331 m/s **Ⓓ 1290 m/s**

28. The speed of sound in Aluminum at 25^0C is:

Ⓐ 5950 m/s **Ⓑ 6420 m/s** Ⓒ 6040 m/s Ⓓ 4700 m/s

29. The speed of sound in wood at 25^0C is:

Ⓐ 2000 m/s **Ⓑ 1531 m/s** Ⓒ 1498 m/s Ⓓ 1290 m/s

30. The speed of sound in oxygen at 0^0C is:

Ⓐ 376 m/s Ⓑ 331 m/s Ⓒ 386 m/s **Ⓓ 317 m/s**

31. The speed of sound in Distilled water at 25^0C is:

Ⓐ 3980 m/s **Ⓑ 1498 m/s** Ⓒ 331 m/s Ⓓ 972 m/s

32. The speed of sound in Helium at 0^0C is:

Ⓐ 376 m/s **Ⓑ 972 m/s** Ⓒ 1290 m/s Ⓓ 386 m/s

33. The speed of sound in Iron at 25^0C is:

Ⓐ 5950 m/s Ⓑ 3980 m/s Ⓒ 972 m/s Ⓓ 331 m/s

34. The speed of sound in steel at 25^0C is:

Ⓐ 4700 m/s **Ⓑ 5960 m/s** Ⓒ 5950 m/s Ⓓ 1290 m/s

35. The speed of sound in Nickel at 25^0C is:

Ⓐ 6420 m/s **Ⓑ 6040 m/s** Ⓒ 231 m/s Ⓓ 3980 m/s

36. The speed of sound in Brass at 25^0C is:

(A) 6040 m/s (B) 4700 m/s (C) 6420 m (D) 2000 m/s

37. The speed of sound in Flint glass at 25^0C is:

(A) 5950 m/s (B) 5960 m/s (C) 6040 m/s (D) 3980 m/s

38. The speed of sound in air was first accurately measured in:

(A) 1738 (B) 1638 (C) 1938 (D) 1838

39. The level of noise recommended in most countries over an eight hour workday is usually:

(A) 83-90 dB (B) 85-90 dB (C) 84-90 dB (D) 82-90 dB

40. A safe level of noise depends upon ..... factors:

(A) 1 (B) 4 (C) 3 (D) 2

41. The technique or method used to absorb undesirable sounds by soft and porous surfaces in called:

(A) Acoustic protection (B) Reflection of sound
(C) Diffraction of sound (D) Noise pollution

42. Sometimes when sound reflect from the walls, ceiling, and floor of the room, the reflecting surfaces are too reflective and the sound becomes grabbed. This is due to multiple reflections called:

(A) Reverberations (B) Reflection
(C) Acoustic protection (D) None of these

43. For a normal person, audible frequency range lies between:

(A) 30Hz-30kHz (B) 20 Hz-20kHz (C) 10 Hz-10 kHz (D) 25 Hz-25 kHz

44. Audibility range ..... with ages.

(A) Remains same (B) Decreases (C) Increases (D) None of these

45. Bats can hear frequency up to:

(A) 120,000 Hz (B) 25,000 Hz (C) 35,000 Hz (D) 100,000 Hz

46. Mice can hear frequency up to:

(A) 20,000 Hz (B) 100,000 Hz (C) 25,000 Hz (D) 35,000 Hz

47. Dogs can hear frequency up to:

(A) 25,000 Hz (B) 35,000 Hz (C) 120,000 Hz (D) 100,000 Hz

48. Cats can hear frequency up to:

(A) 35,00s0 Hz (B) 25,000 Hz (C) 120,000 Hz (D) 100,000 Hz

49. Humans can hear frequency up to:

(A) 25,000 Hz (B) 120,000 Hz (C) 100,000 Hz (D) 20,000 Hz

50. Sounds of frequency higher than ..... are called ultrasound.

(A) 20000 Hz (B) 30000 Hz (C) 25000 Hz (D) 20 Hz

51. Ultrasound is used to locate under water depths or is used for locating objects lying deep in the ocean floor, this technique is called:

(A) SONAR (B) Reverberation (C) Acoustics (D) None of these

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Subjective

Q1: ***What is the necessary condition for the production of sound?***

Ans: *The sensation of sound produce on our ear only when an object vibrates about its mean position. So the necessary condition for the production of sound is vibration of a body.*

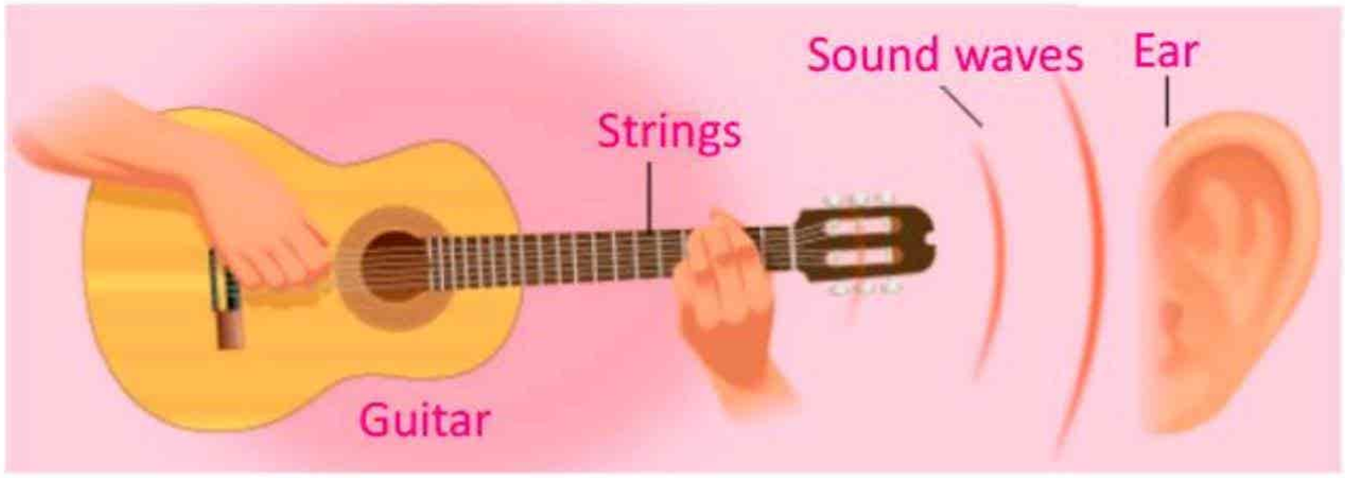

Fig. Vibrations of guitar strings produce sound waves

Q2: ***What is the effect of the medium on the speed of sound? In which medium sound travels faster: air, solid or liquid? Justify your answer.***

Ans: *Sound requires medium for its propagation so medium will affect the speed of sound. Denser medium transmit energy more quickly as compared to rare medium. So speed of sound is more in solids as compared to liquid and gases.*

Q3: ***How can you prove the mechanical nature of sound by a simple experiment?***

Ans: *Take a jar with a hole at the bottom. Attach a vacuum pump at the bottom of the jar and put a bell inside the jar. Close the jar with a cork and attach the bell with the battery. Bell will start ringing and you will hear the sound.*
Now start releasing the air through vacuum pump. The sound will become feeble as the air is removes from the jar and when all the air is removed from the jar you will hear no sound. It proves that sound waves are mechanical waves.

Q4: ***What do you understand by the longitudinal waves? Describe the longitudinal nature of sound waves.***

Ans: *Those waves in which particles of medium vibrate parallel to the motion of waves are called longitudinal waves. These waves move with the help of compressions and rarefactions. Sound waves are also longitudinal waves because sound also travels with the help of compressions and rarefactions.*

When we speak compressions and rarefactions are formed in air. Pressure also changes during compressions and rarefactions.

Q5: ***We know that waves manifest phenomenon of reflection, refraction and diffraction. Does sound also manifest these characteristics?***

Ans: *All the waves manifest Phenomenon of reflection, refraction, interference and diffraction. Sound is form of energy and it propagates in the form of waves. When another medium is placed in the path it obeys the laws of reflection, refraction and diffraction.*

Q6: ***Sound is form of wave. List at least three reasons to support the idea that sound is a wave?***

Ans: *List of least three reasons to support the idea that sound is a wave:*

- *Sound is a form of energy which obeys the laws of diffraction.*
- *Sound is a form of energy which obeys laws of refraction.*
- *Sound is a form of energy which obeys laws of reflection.*

Q7: ***What is the difference between the loudness and intensity of sound? Derive the relation between the two.***

Ans: Difference between the loudness and intensity of sound

Loudness	Intensity of Sound
❖ *Loudness is the characteristics of sound by which we can differ between loud and faint sound.* ❖ *Loudness depends on intensity of sound and physical condition of ear.*	❖ *Sound energy passing per second through a unit area held perpendicular to the direction of propagation of sound waves is called intensity of sound.* ❖ *Intensity of sound is a physical quantity and it depends on amplitude of sound.*

Relation between Loudness and Intensity:

The loudness of sound is directly proportional to the logarithm of intensity of sound.

$$L \alpha \log I \text{ or } L = k \log I$$

Q8: ***On which factors does the loudness of sound depends?***

Ans: Loudness of sound depends on the following factors:

- *Distance from the vibrating body*
- *Area of the vibrating body*
- *The amplitude of vibrating body*

Q9: ***What do you understand by the term intensity level of the sound? Name the unit of intensity level of sound.***

Ans: Difference between two loudness, is called the intensity level of sound.

Unit:

Its unit is decibel (dB).

Q10: ***Why do we use the logarithmic scale to describe range of the sound intensities we hear?***

Ans: Human ear can hear wide range of intensities. Sound intensity level on a linear scale is not convenient for us. So instead of linear scale, logarithmic scale is used for this purpose.

Intensities are scaled by a factor of ten. By using this scale, sound level can easily be calculated using this formula:

$$\text{Sound level} = 10 \log \frac{I}{I_0} \text{ dB}$$

Q11: ***What is the difference between frequency and pitch?***

Ans: The difference between frequency and pitch is:

Pitch is the characteristics of sound by which we can differ between shrill and grave sound while number of waves passing through a unit area in unit time is called frequency. Pitch depends on frequency of sound.

Q12: ***Describe the change in amplitude on loudness and change in frequency on pitch of sound.***

Ans: ***Change in amplitude on loudness of sound:***

A body vibrating with large amplitude produces loud sound.

For example:

- *The sound produced by a sitar will be loud if we pluck its wires more violently.*

Change in frequency on pitch of sound:

A sound with high pitch has higher frequency and vice versa.

For example:

- ❖ *The frequency and pitch of ladies and children is higher than that of men.*

Q13: ***If the pitch of sound is increased, what are the changes in the following?***
(i). The frequency (ii). The wavelength (iii). The wave velocity (iv). The amplitude

Ans: ***(i). The frequency:***
If the pitch of the sound is increased frequency will also increase.

(ii). The wavelength:
With the increase of pitch, wavelength of the waves decreases.

(iii). The wave velocity:
If the pitch increases then velocity of the wave also increases.

(iv). The amplitude:
Pitch is independent of amplitude of the sound waves, so amplitude of the wave does not change with the change of pitch of sound.

Q14: ***If we clap or speak in front of building while standing at a particular distance. We rehear our sound after sometime. Can you explain how does this happen?***

Ans: When we clap or speak in front of building we rehear our sound because of reflection of sound waves which is called echo. To hear echo minimum distance of obstacle and sound source should be 17m, and time interval must be at least 0.1s.

Q15: ***What is the audible frequency range for human ear? Does this age vary with age of people? Explain.***

Ans: Human ear can sense sound waves of frequency 20Hz to 20000Hz. *This range varies with the age of people. At the age of* 60 *year it becomes* 20Hz to 150000 Hz.

Conceptual Question

Q1: ***Why two tin cans with a string stretched between them could be better way to communicate than merely shouting through the air?***

Ans: String stretched between two cans is better way to communicate because string is a solid material and sound waves move faster in solid as compared to gases or air. Since sound expands in all direction in air and communication becomes difficult.

Q2: ***We can recognize persons speaking with the same loudness from their voice. How is this possible?***

Ans: We can recognize person speaking with same loudness from their voice because sound waves have different waveforms, so their quality is different and we can differ between them.

Q3: ***You can listen to your friend around a corner, but you cannot watch him. Why?***

Ans: Sound can be listened around the corner because sound waves due to its large wavelength diffract around the obstacle. So we cannot watch a person because light waves cannot bend around normal sized object due to its small wavelength.

Q4: ***Why must the volume of a stereo in a room with wall to wall carpet be tuned higher than in a room with a wooden floor?***

Ans: The volume of a stereo in a room with wall to wall carpet be tuned higher because carpet absorbs the sound waves while wooden floor reflects the sound waves so loud sound is produced.

Q5: ***student says that the two terms speed and frequency of the wave refer to the same thing. What is your response?***

Ans: ***No,*** *speed and frequency are different terms. Rate of change of distance is called speed but number of waves passing through a point in one second is called frequency. Frequency does not depend on medium but speed depends on medium.*

Q6: ***Two people are listening to the same music at the same distance. They disagree on its loudness. Explain how this could happen?***

Ans: They disagree on loudness because loudness depends on sensitivity of ear of the listener.

Q7: ***Is there any difference between echo and reflection of sound? Explain.***

Ans: ***No,*** *there is no difference between echo and reflection of sound because reflection of sound waves is called echo.*

For example:

You shout from a valley you hear an echo.

Q8: ***Will two separate 50dB sounds together constitute a 100dB sound? Explain.***

Ans: *Since dB is the unit of sound level, and its value depend upon the log of intensities, therefore 50dB sound from two bodies does not constitute 100dB sound. Each 10dB increase in sound makes the sound 10 times louder.*

Q9: ***Why ultra sound is useful in medical?***

Ans: *Ultrasound is useful in medical field because it carries more energy and highest frequency with very small wavelengths than audible sound waves.*

Additional Question

Q1: ***Write names of characteristics of sound.***

Ans: *There are five characteristics of sound:*

- *Loudness.*
- *Intensity.*
- *Pitch.*
- *Quality.*
- *Music.*

Q2: ***Define Loudness.***

Ans: ***Loudness:***

Loudness is the characteristic by which we differ between loud and faint sound.

Q3: ***What do you meant by intensity of sound? Also write its unit.***

Ans: *Sound energy flowing per second through a unit area held perpendicular to the direction of sound waves is called intensity of sound.*

Unit: *Its unit is* $W\ m^{-2}$.

Q4: ***What is difference between noise and music?***

Ans: *The sound which has pleasant effect on ears is called musical sound. The sound which has jarring effect on ears is called noise. The frequency and amplitude of musical sound change in regular manner and in noise does not change in regular manner.*

Q5: ***Define pitch and quality of sound.***

Ans: ***Pitch:***

The characteristics of sound by which a shrill and grave sound can be distinguished is called pitch.

Quality:

The characteristics of sound by which two sounds of same loudness and pitch can be distinguished from each other is called quality.

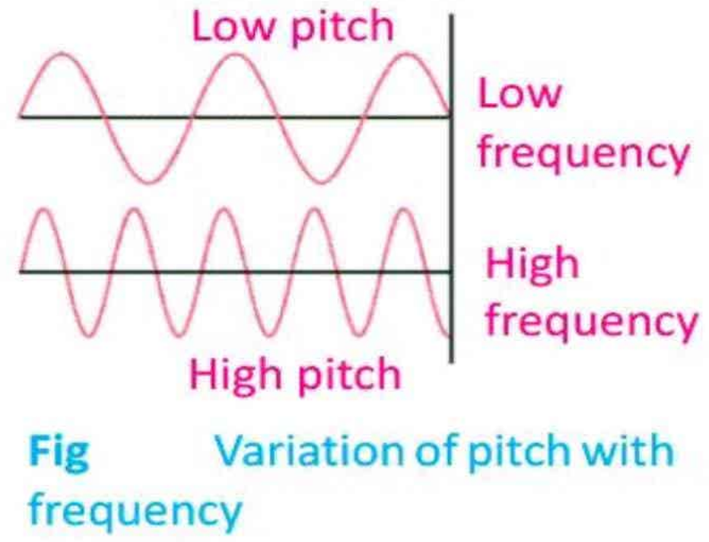

Fig Variation of pitch with frequency

Q6: ***What are factors upon which safe level of noise depends?.***

Ans: *A safe level of noise depends on two factors:*

- *The period of exposure to the noise.*
- *The volume of noise.*

Q7: ***What is meant by pitch of sound? On what factor does it depend?***

Table

Speed of sound in various media	
Medium	Speed ($m\ s^{-1}$)
Gases	
Air(0°C)	331
Air (25°C)	346
Air(100°C)	386
Hydrogen (0°C)	1290
Oxygen (0°C)	317
Helium (0°C)	972
Liquids at 25°C	
Distilled water	1498
Sea water	1531
Solids 25°C	
Wood	2000
Aluminium	6420
Brass	4700
Nickel	6040
Iron	5950
Steel	5960
Flint Glass	3980

Ans: The characteristics of sound by which a shrill and grave sound can be distinguished is called pitch. It depends on frequency. A higher pitch means higher frequency and vice versa.

Q8: ***Is speed of sound more in solids or liquids? And why?***

Ans: Speed of sound in solids is more than in liquids because the solid atoms are closely packed whereas molecules of liquids are far apart.

Q9: ***On what factors loudness of sound depends?***

Ans: Loudness of sound depends on the following factors:

- *Physical condition of ear.*
- *The distance from vibrating body.*
- *The area of vibrating body.*
- *The amplitude of vibrating body.*

Q10: ***What is difference between longitudinal and transverse waves?***

Ans: When sound is incident on the surface of a medium, it bounces back into the first medium. This phenomenon is called echo or reflection of sound.

Q11: ***What is meant by SONAR?***

Ans: The technique to locate underwater depths or is used for locating object lying deep on the ocean floor with the help of ultrasound is called SONAR or sound navigation and ranging.

Q12: ***What is meant by silent whistle?***

Ans: some people use silent whistle to call dogs whose frequency lies between 20000Hz to 25000Hz. *It is silent for human beings but not for dogs because their audible frequency range is much higher than human.*

Q13: ***What is meant by Ultrasound?***

Ans: Sound of frequency higher than 20000Hz *which are inaudible to normal human ear are called ultrasound.*

Q14: ***How can depth of sea be measured by ultrasonic?***

Ans: The technique to find depth of sea is called SONAR. The sound waves are sent from a transmitter and a receiver collects the reflected sound. The time lapse is calculated, knowing the speed of sound in water, the distance of the object from the ocean surface can be estimated.

For your information

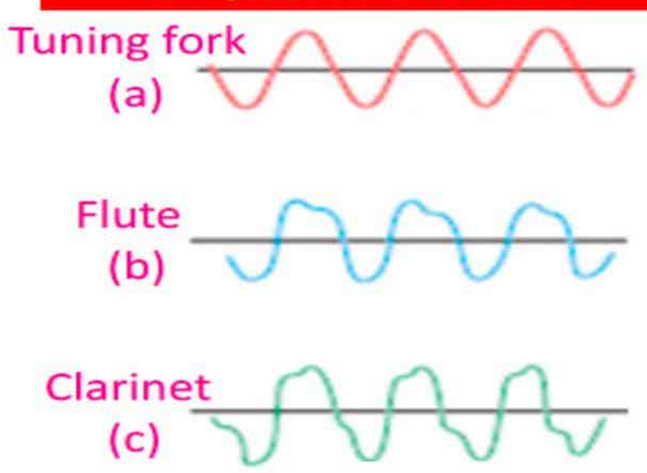

Fig Sound waveforms produced by (a) a tuning fork, (b) a flute, and (c) a clarinet, are all at approximately the same frequency. Pressure is plotted vertically, time

Fig. Doctors are taking ultrasound test of a patient with an ultrasound machine

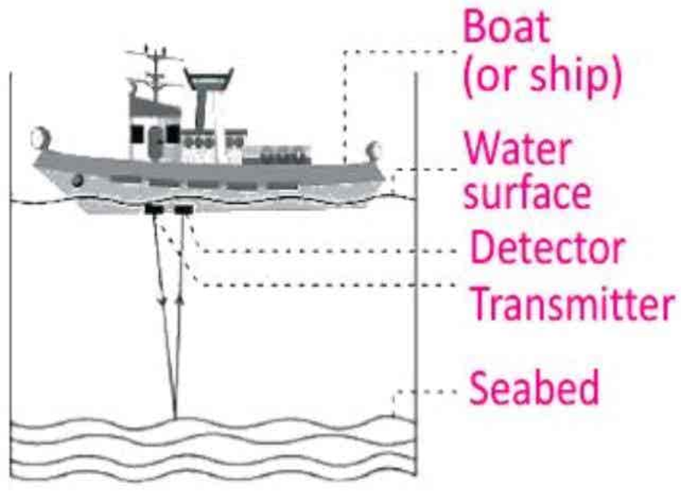

Fig. Ultrasonics are used to measure the depth of water by echo method

Imp.Long Questions

Q.1: *Explain that noise is nuisance.*

Q.2: *Describe the importance of acoustic protection.*

Q.3: *Define Ultrasonic and give their uses or applications from everyday life.*

Q.4: *What do you mean by intensity level? Derive it relation. Also name and define its unit.*

Q.5: *A normal conversation involves sound intensities of about* 3.0×10^{-6} W m^{-2}. *What is the decibel level for this intensity? What is the intensity of sound for* 100 dB?

Q.6: *If at Anarkali Bazar Lahore, intensity level of sound is 80 dB, what will be the intensity of sound there?*

Q.7: *At a particular temperature, the speed of sound in air is* 330 m/s. *If the wavelength of a note is* 5 cm.

Q.8: *calculate the frequency of the sound wave. Is this frequency in the audible range of human ear?*