



Physics 10
Unit 11 – Sound
Solved Exercise

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TEXT BOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

- i. Which is an example of a longitudinal wave? (K.B)**
(GRW-G1)-2014 / (FSD-G1), (SGD-G2), (LHR-G1)-2015 / (RWP-G2), (MTN-G1), (DGK-G1)-2016 / (DGK-G1), (RWP-G1), (MTN-G2), (SGD-G1), (SGD-G1), (SWL-G1)-2017
(a) sound wave (b) light wave
(c) radio wave (d) water wave
- ii. How does sound travel from its source to your ear? (K.B)**
(a) by changes in air pressure (b) by vibrations in wires or strings
(c) by electromagnetic wave (d) by infrared waves
- iii. Which form of energy is sound? (K.B)**
(a) electrical (b) mechanical
(c) thermal (d) chemical
- iv. Astronauts in space need to communicate with each other by radio links because: (K.B+A.B)**
(SWL-G2), (RWP-G1,G2)-2017
(a) Sound waves travel very slowly in space (b) Sound waves travel very fast in space
(c) Sound waves cannot travel in space (d) Sound waves have low frequency in space
- v. The loudness of a sound is most closely related to its: (K.B)**
(a) Frequency (b) Period
(c) Wavelength (d) Amplitude

- vi. For a normal person, audible frequency range for sound wave lies between: (K.B)
 (a) 10 Hz and 10 kHz (b) 20 Hz and 20 kHz
 (c) 25 Hz and 25 kHz (d) 30 Hz and 30 kHz
- vii. When the frequency of a sound wave is increased, which of the following will decrease? (K.B)
- i. Wavelength ii. Period iii. Amplitude
 (a) i only (b) iii only
 (c) i and ii only (d) i and iii only

ANSWER KEY

i	ii	iii	iv	v	vi	vii
a	a	b	c	d	b	c

REVIEW QUESTIONS

- 11.1 What is the necessary condition for the production of sound? (K.B)

Ans:

Production & propagation of sound waves

Production of Sound:

Like other waves sound is also produced by vibrating bodies.

Propagation of Sound:

Sound is a form of energy that travels/propagates in the form of waves from one place to another place in the presence of a medium.

Condition:

Sound require material medium for its production and propagation.

- 11.2 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. (K.B+U.B)

Ans:

Speed of sound in different medium

The speed of sound is affected by the medium it travels through because it depends on the medium's ability to transmit vibrations. Sound travels fastest in solids, slower in liquids, and slowest in gases like air. This is because particles in solids are tightly packed, allowing vibrations to pass quickly. In liquids, particles are less tightly packed than in solids but more so than in gases, leading to a moderate speed. In gases, particles are far apart, making sound travel the slowest.

- 11.3 How can you prove the mechanical nature of sound by a simple experiment?

(K.B+U.B+A.B)

Ans:

PRODUCTION & PROPAGATION OF SOUND WAVES

Production of Sound:

Like other waves sound is also produced by vibrating bodies.

Propagation of Sound:

Sound is a form of energy that travels/propagates in the form of waves from one place to another place in the presence of a medium.

Condition:

Sound require material medium for its production and propagation.

11.4 What do you understand by the longitudinal wave? Describe the longitudinal nature of sound waves. (K.B+U.B)

Ans: (Long Question: See Topic 11.1, Short Question-3)

11.5 Sound is a form of wave. List at least three reasons to support the idea that sound is a wave. (K.B)

Ans: “Sound is the form of energy that travels in the form of pressure waves from one place to another and require medium for its propagation”.

We know that waves manifest the phenomenon of reflection, refraction and diffraction. Since the sound can also be reflected, refracted and diffracted like other waves. This proves that they are waves.

11.6 We know that waves manifest phenomenon of reflection, refraction and diffraction. Does sound also manifest these characteristics? (K.B+U.B)

Ans: Yes, they do manifest phenomenon of reflection, diffraction and refraction.

11.7 What is the difference between the loudness and intensity of sound? Derive the relationship between the two. (K.B)

Ans:

Loudness of sound		Intensity of sound	
i.	Definition Difference between the loudness L of an unknown sound and a reference sound.	i.	Characteristic of sound by which loud and faint sounds can be distinguished.
ii.	Comparative measure between two sounds.	ii.	Absolute perception of sound strength
iii.	Depends on reference sound and unknown sound.	iii.	Depends on the intensity of the sound wave and human perception.

11.8 On what factors does the loudness of sound depend? (K.B)

Ans: The loudness of sound depends on several factors:

- 1. Amplitude of the vibrating body:** Loudness increases with the amplitude of vibrations.
- 2. Area of the vibrating body:** Larger vibrating areas produce louder sounds.
- 3. Distance from the vibrating body:** Loudness decreases with increasing distance.
- 4. Physical condition of the ears:** Sensitive ears perceive sound as louder compared to defective ears.

11.9 What do you mean by the term intensity level of the sound? Name and define the unit of intensity level of sound. (K.B+U.B+A.B)

Ans:

Sound intensity level

“The difference ($L - L_0$), between the loudness L of an unknown sound and the loudness L_0 is called the intensity level of the unknown sound.

Mathematical Equation:

$$\text{Intensity level} = K \log \frac{I}{I_0}$$

Where K is the constant of proportionality, I is the intensity of unknown sound and I_0 is the intensity of faintest audible sound.

Intensity level of sound:

“If the intensity of any unknown sound is **10** times greater than the intensity I_0 of the faintest audible sound i.e. $I = 10I_0$ then the intensity level of such sound is taken as unit, called Bel. The value of K becomes **1**”.

11.10 What is the units of loudness? Why do we use logarithmic scale to describe the range of the sound intensities we hear? (K.B)

Ans: **Unit of Loudness:**

Loudness is not a physical quantity, that’s why it has no unit.

Logarithmic Scale:

We use logarithmic scale to describe the sound intensities we hear because this range is so wide.

11.11 What is the difference between frequency and pitch? Describe their relationship graphically. (K.B)

Ans:

DIFFERENCE

The difference between frequency and pitch are as follows:

Frequency	Pitch
Definition	
<ul style="list-style-type: none"> Number of waves passing through a point in one second is called its frequency. 	<ul style="list-style-type: none"> Pitch is the characteristics of sound by which we can distinguish between a shell and grave sound.
Unit	
<ul style="list-style-type: none"> Its unit is Hertz (Hz). 	<ul style="list-style-type: none"> It has no unit.
Graph	

11.12 Describe the effect of change in amplitude on loudness and the effect of change in frequency on pitch of sound. (K.B)

Ans:

CHANGE IN AMPLITUDE

Loudness of sound depends upon the amplitude of vibrating body. So that, if there is an increase in the amplitude of a vibrating body there will be the increase in the loudness of sound and vice versa.

CHANGINE IN FREQUENCY:

Pitch of sound depends upon its frequency so that if there is increase in frequency there will be the increase its pitch and vise versa.

11.13 If the pitch of sound is increased, what are the changes in the following? (U.B + A.B)

a. The frequency

b. The wavelength

c. The wave velocity

d. The amplitude of the wave

Ans: According to wave equation, $v = f\lambda$, If there is an increase in the pitch of a wave then:

- frequency will increase
- wavelength will decrease
- wave velocity will increase
- amplitude of wave will remain unchanged

11.14 If we clap or speak in front of a building while standing at a particular distance, we rehear our sound after sometime. Can we explain how this happens? (K.B + A.B)

Ans: It is due to reflection of sound. When sound is incident on the surface of a medium it bounces back into the first medium. This is known as reflection of sound or echo.

11.15 What is the audible frequency range for human ear? Does this range vary with the age of people? Explain. (K.B)

Ans:

Audible frequency range

“The range of the frequencies which a human ear can hear is called the audible frequency range”.

Range:

A normal human ear can hear a sound only if its frequency lies between 20Hz and 20,000 Hz.

Explanation

Variation of Audible Range with Age

The human ear can hear sounds with frequencies between 20 Hz and 20,000 Hz. Sounds below 20 Hz or above 20,000 Hz are inaudible because the eardrum cannot vibrate that quickly. The audible range varies among individuals and changes with age. Young children can hear up to 20,000 Hz, while older people often cannot hear sounds above 15,000 Hz.

11.16 Explain that noise is a nuisance. (K.B)

Ans: (For long Question, See Topic 11.5, Long Question-1)

Noise is a nuisance because it consists of unpleasant sounds from irregular vibrations, such as those from machinery and traffic. When noise exceeds safe levels, especially in big cities, it becomes noise pollution, which is harmful to human health. It can cause

hearing loss, sleep disturbances, stress, and accidents, significantly affecting the quality of life.

11.17 Describe the importance of acoustic protection. (K.B)

Ans:

Importance of Acoustic protection

“The technique or method used to absorb undesirable sounds by soft and porous surfaces is called acoustic protection”. By using such materials in noisy places we can reduce the level of noise pollution.

11.18 What are the uses of ultrasound in medicine? (A.B)

Ans:

Use of Ultrasound in Medicine

Diagnostic Imaging

Ultrasound waves create internal organ images by reflecting off tissues and tumors, aiding in disease detection.

Blood Clot Removal

Powerful ultrasound dissolves artery blood clots, enhancing treatment effectiveness.

Thyroid Diagnosis

Ultrasound provides detailed thyroid gland images for accurate medical diagnoses.

CONCEPTUAL QUESTIONS (A.B)

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

Ans:

BETTER WAY TO COMMUNICATE

String stretched between two tin cans could be better way to communicate than merely shouting through the air because sound waves propagate much better and faster in solids than air. Sound expands in air in all directions and communication between persons become difficult. In two tin cans and wire system, sound travel in a specific direction with greater speed than in air. So, it is a better way for communication.

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

Ans:

RECOGNITION OF VOICE

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 distinguished them from each other.

11.3. You can listen to your friend round a corner, but you cannot watch him/her. Why?

Ans:

LISTENING RATHER THAN WATCHING

Voice can be listened around the corner because sound waves travel around obstacles, due to its very large wavelength it diffract around the corner of obstacle. We cannot watch a person around the corner because light wave cannot bend around normal sized

objects due to its very small wavelength. So we can listen a friend around a corner but we cannot watch him.

11.4. Why the volume of a stereo in a room with wall-to-wall carpet is be tuned higher than in a room with a wooden floor?

Ans: VOLUME OF STEREO IN A ROOM

The volume of the stereo in a room with wall to wall carpet be tuned higher than in a room with wooden floor because it does not absorbs sound waves. So the loud sound is heard as compared to the room with wall to wall carpeted.

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

Ans: SPEED VS FREQUENCY

No, speed and frequency are different. Frequency measures how many waves occur per second, while speed measures how quickly a wave travels over a distance. They both involve time but measure distinct aspects of a wave. Also, frequency is independent of the medium, whereas the speed of sound varies in different mediums.

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

Ans: DIFFERENCE OF LOUDNESS AT SAME DISTANCE

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

11.7. Is there any difference between echo and reflection of sound? Explain.

Ans: ECHO AND REFLECTION OF SOUND

The phenomenon of repetition of a sound caused by reflection of sound from a surface is called echo. For example, you shout from a valley, you hear an echo. While the reflection is the change in direction of a wave such as light or sound wave, away from a boundary.

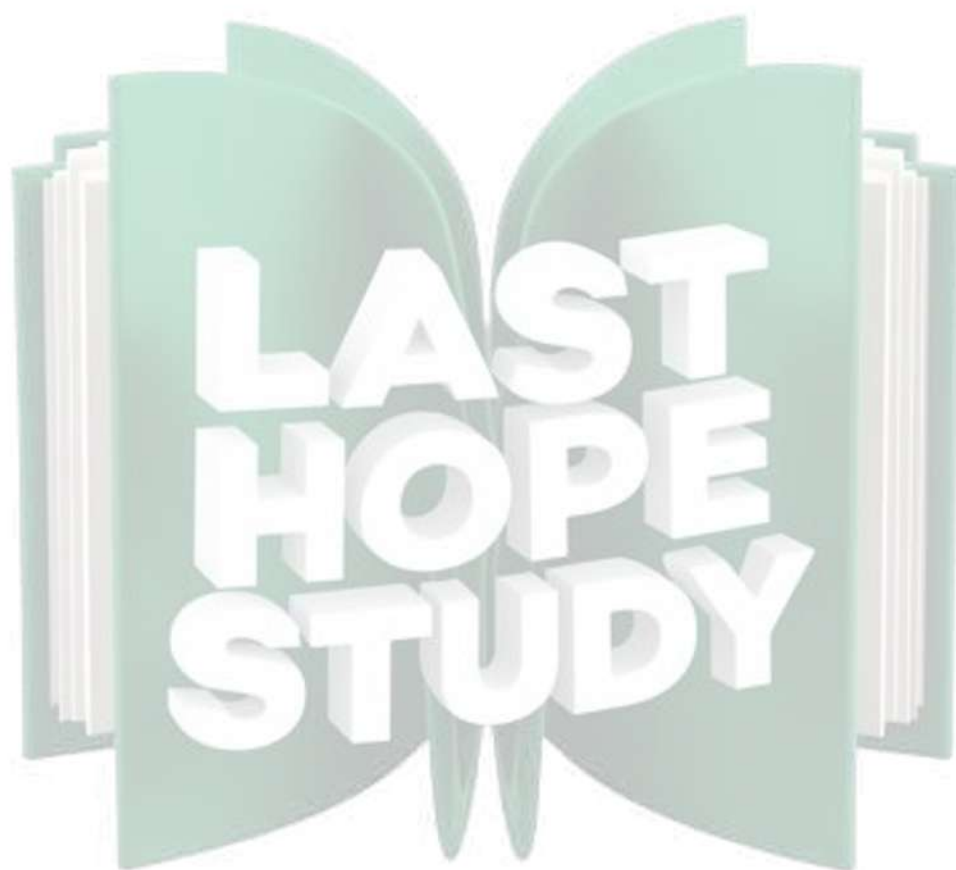
Conditions for Echo:

To hear a clear echo, the minimum distance of obstacle and source of sound must be 17m, and the time interval between our sound and the reflected sound must be at least 0.1 s.

11.8. Will two separate 50dB sounds together constitute a 100dB sound? Explain.

Ans: CONSTITUTION OF A SOUND

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



11.9. Why ultrasound is useful in medical field?

Ans: ULTRASOUND IN MEDICAL FIELD

Ultrasound is useful in medical field because it carries more energy and higher frequency, ($v = f\lambda$) with very small wavelengths than audible sound waves. Ultrasound due to its characteristics has vast applications in medical and in technical field.

