Chapter = 11

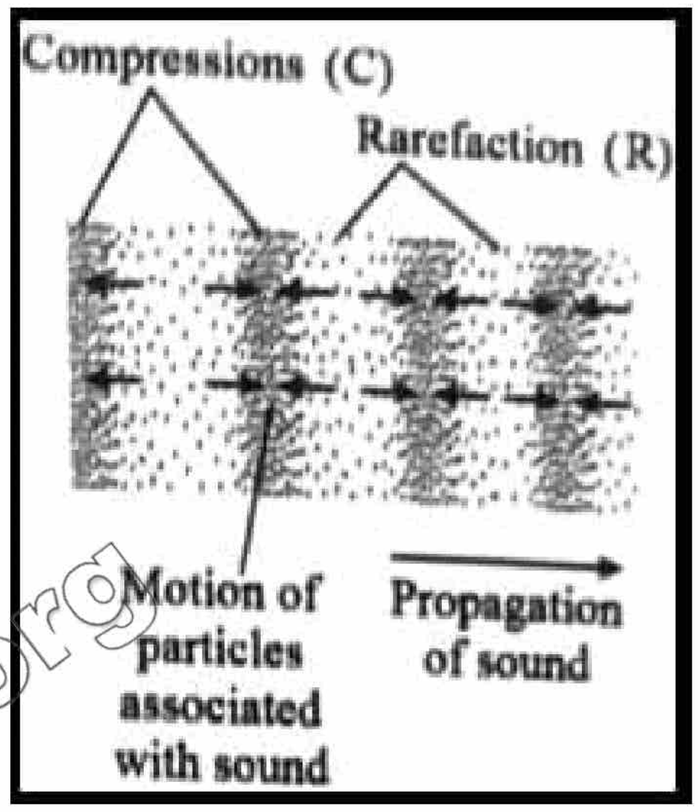
Sound

Q 1. How is the sound produced?

Ans. Sound is produced by vibrating sources placed in a medium.

Q 2. With the help of a diagram, describe how compressions and rarefactions are produced in the air near a source of the sound.

Ans. we can consider that the compressions and rarefactions of sound waves are due to a slight change in the air pressure. Compressions are regions where air pressure is slightly higher than surrounding air pressure and rarefactions are regions where air pressure is slightly lower than the surrounding air pressure. This rising and falling of air pressure take place Continuously as long as the drum produces the sound. Thus, We can illustrate the region where the sound travels through air as in figure.



Q 3. Discus the electric bell jar experiment.

Ans. **ELECTRIC BELL JAR EXPERIMENT**

Take an electric bell and an airtight glass bell jar and then suspend the electric bell inside the jar. Connect the bell jar to a vacuum pump. When you switch on the electric bell, you can hear the sound of the bell coming from inside air and glass material. Now start the vacuum pump as the air in the jar is gradually pumped out, the sound becomes fainter, although the same current is passing through the bell and hammer that strikes the gong. After a while, you will hear the faintest sound, when there is less air.

Q 4. What happens when the air is completely removed? Will you still be able to hear the sound of the bell?

The electric bell still produces the sound, but now we cannot hear it. This is because sound waves always need a medium to propagate sound energy. In the bell jar, it was a vacuum hence sound waves cannot travel. This experiment makes sure that the bell does not touch glass and that the connecting wires used are thin. This prevents the sound energy from being transmitted through the glass and wires to the outside of the jar as the hammer vibrates vigorously.

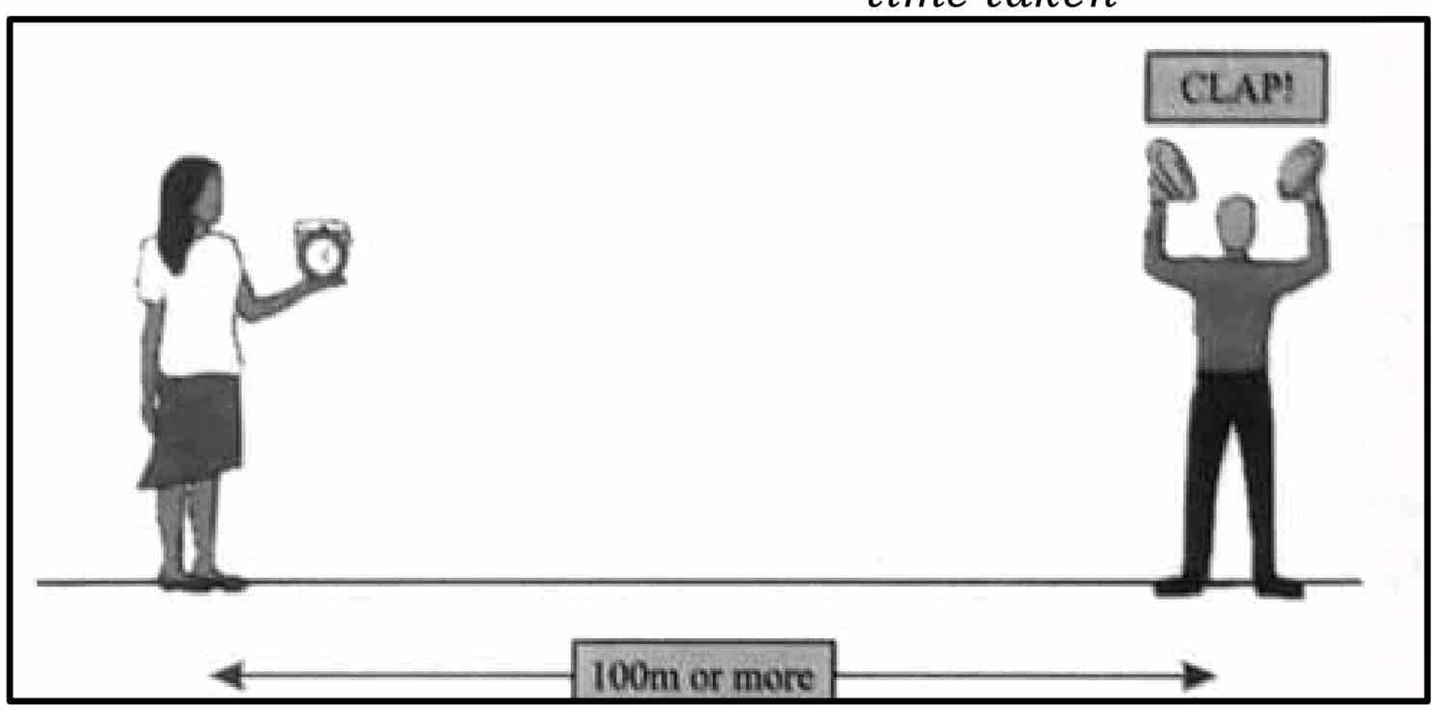
Q 5. Discus two method to determine speed of sound

Ans. **METHOD 1: MEASURING SOUND BETWEEN TWO POINTS**

MEASURING THE SPEED OF SOUND DIRECTLY BETWEEN TWO POINTS

1. Two people stand a distance of around 100 m apart
2. The distance between them is measured using a trundle wheel
3. One person has two wooden blocks, which they bang together above their head
4. A second person with a stopwatch starts watch when he hears one of the claps and ends timing after 20 Claps.
5. This is then repeated several times and an average Value is taken for the time.
6. The speed of sound can then be calculated using the equation:

$$Speed\ of\ sound = \frac{distance\ traveled\ by\ sound}{time\ taken}$$

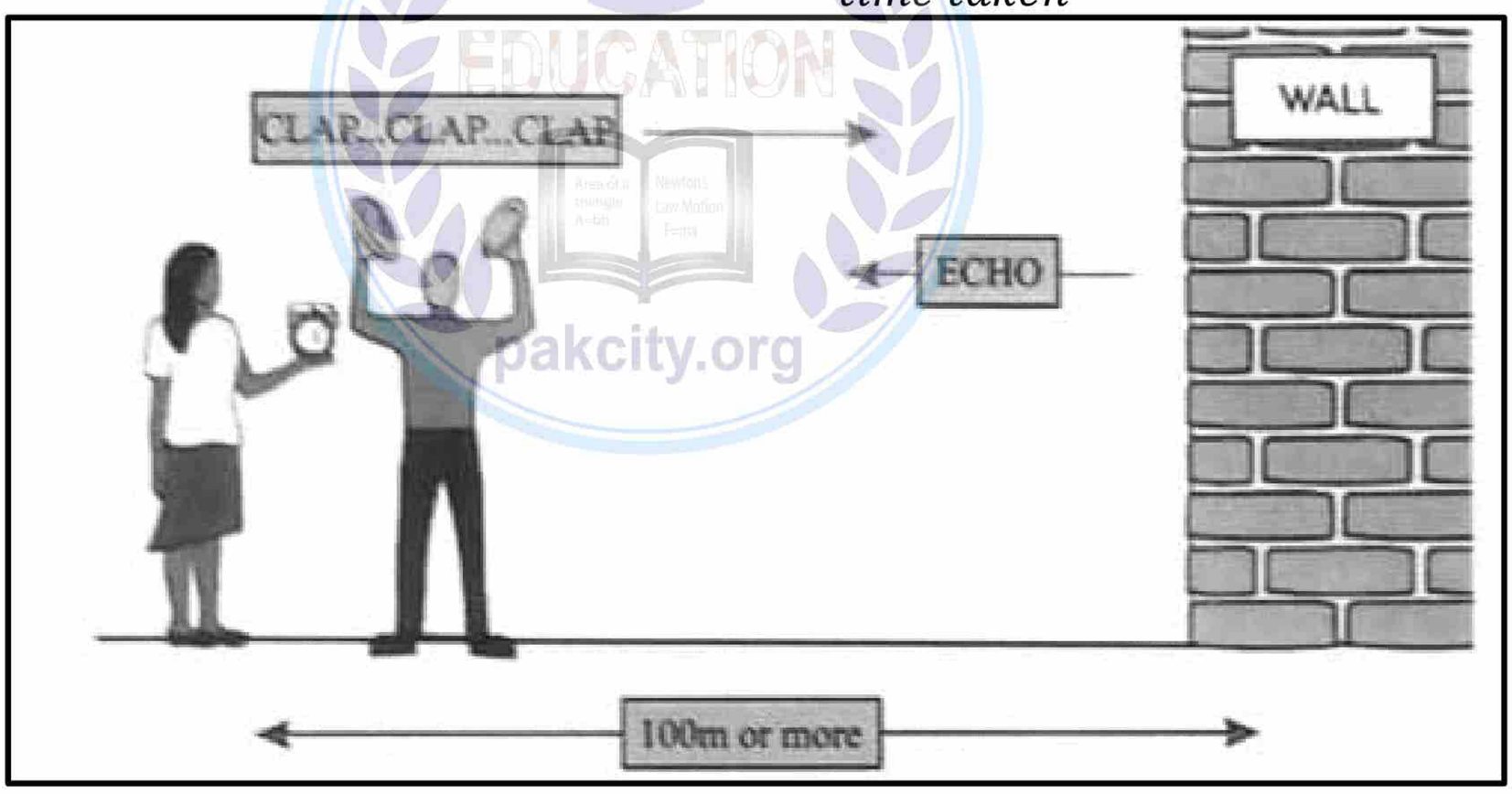


METHOD 2: USING ECHOES

MEASURING THE SPEED OF SOUND USING ECHOES

1. A person stands about 50 m away from a wall (or Cliff using a trundle wheel to measure this distance the person claps two wooden blocks together and listens for the echo
2. The person then starts to clap the blocks together repeatedly, in rhythm with the echoes
3. A second person has a stopwatch and starts timing when they hear one of the claps and stops timing 20 claps later
4. The process is then repeated and an average time calculated
5. The distance travelled by the sound between each clap and echo will be (2 x 50) m
6. The total distance travelled by sound during the 20 Claps will be (20 x 2 x 50) m
7. The speed of sound can be calculated from this distance and the time using the equation

$$Speed\ of\ sound = \frac{2 \times distance\ of\ wall}{time\ taken}$$



Q 6. Define speed of sound and derive $V=f\lambda$

SPEED OF SOUND

The speed of sound is defined as the distance which a point on a wave, such as a compression or a rarefaction, travels per unit of time.

MATHEMATICAL EXPRESSION

Since,

Velocity = $\frac{\text{Distance}}{\text{time}}$ **Distance = λ**

$V = \frac{\lambda}{T}$ **But** $\frac{\lambda}{T} = f$

$V = f \lambda$

Q 7. Define quality, loudness, pitch, acoustic intensity.

PITCH:

It is the quality of sound that distinguishes between a shrill and a flat sound.

QUALITY:

It is defined as the characteristic of sound by which we can distinguish between two sounds of the same loudness and pitch.

LOUDNESS:

It refers to the ability to distinguish between a Loud and a quiet sound.

ACOUSTIC INTENSITY OR SOUND INTENSITY:

It is defined as the power carried by sound waves per unit area in a direction perpendicular to that area.

Q 8. Write short note on speed of sound in solid, liquid and gases.

SPEED OF SOUND IN SOLIDS, LIQUIDS, AND GASES.

Sound waves are mechanical waves. Any medium that contains particles can transmit sound. The speed of sound is not the same in all mediums. Sound waves travel at different Speeds in different in mediums. Remember that the speed of sound depends on the properties such as temperature, Pressure and density of the medium through which it travels.

Sound moves faster in solid because the molecules/ particles of solid are very close to each other, as compare to liquid and Gases.

The speed at which a sound wave travels depends upon the Medium and state of the medium (steel, water, air). The rate at sound wave travel decreases when we go from solid to the gaseous state.

Q 9. Discus the factor effecting speed of sound.

EFFECT OF TEMPERATURE

Heat is a form of energy that depends upon the Kinetic energy of molecules. Molecules of the medium at Higher temperatures have more energy. Thus, they can Vibrate at a higher rate. As the molecules vibrate Faster, sound waves can travel more quickly.

The speed of Sound in air is directly proportional to the square root of the

Thus, the temperature of the Air increases, so the speed will also increase.

EFFECT OF HUMIDITY:

Humidity also affects the speed of sound in the air the effect of water vapor on the speed of sound is minimum than that of dry air. The presence of moisture in air replaces oxygen and nitrogen gases that reduce the density of air because the molecular mass of water vapors (Molecular mass=18) is less than that of oxygen (Molecular Mass = 32) and nitrogen (Molecular Mass 28) gases since the speed of sound in gases are inversely related to the square root of its density

Thus, humidity increases, the density of the air decreases and sound travels faster.

Q 10. Distinguish between noise and music.

NOISE	MUSIC
Noise is those types of sounds that appear unpleasant to hear.	Music appears pleasant to hear.
Noise is random.	Music is ordered.
Noise is a type of sound that has a continuous structure.	Music is a kind of sound that has a discrete structure.
Listening to noise for a long time can irritate and frustrate people	Even after listening to music for hours, people enjoy it.
Noise is constituted of low frequency, irregular wavelength and waveform.	Music is constituted of harmonious wavelength, waveform and frequency.
Examples of noise is the sound produced by vehicles and crackers.	Examples of music are the sounds produced by flute, piano, guitar.

Q 11. Define echo, ultrasound, audible frequency range, infrasonic.

ECHO

The repetition of the sound after reflection is known as an echo.

ULTRASOUND

Ultrasound is the sound with frequencies above the upper limit of the human Range of audibility. The range of audibility is the range of sound frequencies that a person can hear. The normal human ear, the lower limit of audible frequency is 20 Hz, and the Upper limit is 20K Hz.

INFRASONIC

having or relating to a frequency below the audibility range of the human ear

Give uses of ultrasonography

USES OF ULTRASONOGRAPHY

1. It is a technique that uses an instrument ultrasound scanner.
2. This scanner uses high-frequency sound waves to obtain Images of the internal organs of the human body and to examine the fetus during pregnancy.
3. A sonologist visualize the organs of the patient, such as the liver, gall bladder, Uterus kidney. Etc.
4. It helps the doctor to identify Abnormalities, such as stones in the gall bladder and kidney or tumours and abnormalities in different organs.

Worked Example 1 A sound wave has a frequency of 6 kHz and wave length 25cm. How long will it take to travel1.5 km?

Worked Example 2 Calculate the speed of sound in air at 30°C? Given that Speed of sound at 0°C is 331 m/s.

Worked Example3 A boy clapped his hands near a wall and heard the echo after 1.6 s. What is the distance of the wall from the boy if the speed of the sound, v is taken as 340 ms^{-1}.

BOOK NUMERICALS

1. Calculate the speed of sound in air at 50°C? Given that speed of sound at 0°C Is 331m/s. (360.0 ms^{-1})
2. A person has an audible range from 20 Hz to 20 kHz. What are the distinguishing wavelengths of sound waves in air corresponding to these two Frequencies? Take the speed of sound in air as 340 ms^{-1}
   (58.8mm and 58.82m)
3. A ship uses ultrasonic pulses to measure the depth of the submarine beneath the ship. A sound pulsing is transmitted into the sea, and the echo from the Sea-bed is received after 40 ms^{-1}. The speed of sound in seawater is 1480 m/s. Calculate the deepness of the submarine. (29.6 ≈ 30m)
4. At night, bats emit pulses of sound to detect their prey. The speed of sound in air is 340 m/s.
   (i) A bat emits a pulse of the sound of wavelength 0.0080 m. Calculate the Frequency of the sound. (42.5Hz)
   (ii) The pulse of sound hits its prey and is reflected in the bat. The bat receives The pulse 0.10 s after it is emitted. Calculate the distance traveled by the pulse of sound during this time. (17m)
   (iii) Calculate the distance of prey from the bat. (8.5m)