Date 1, 12, 18 Science Notes Page No.: 183 K.V.S.

Class:- 9th

SOUND

Sound:- Sound is a form of energy which produces a sensation of hearing in our ears.

* Sound is produces when a object vibrates.

Vibration:- To and fro motion of an object is called vibration.

Eg:- Sten, Rubber band.

Sound can produced by following methods:-

i) By vibrating string (sitar)
ii) By vibrating air (flute)
iii) By vibrating membrane (table, drum)
iv) By vibrating plates (bicycle bell)
v) By friction in objects.
vi) By scratching the object.

Medium:- The substance through which sound travels is called a medium.

Machenical waves:- Sound travels in wave is called machenical waves.

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Date 1/12/18 Page No.: 184

Compression (C):— When a body vibrates then it compressed the air surroundings it and form a area of high density called compression.

Rarefaction (R):— When vibrating body vibrates back a area of low pressure is ~~formed~~ called rarefaction.

5/12/18

Sound waves:— Sound waves are called machanical waves because it requires a material medium for its propagation.

Longitudinal waves:— Waves in which particles of medium oscillates about their mean position in the same direction of wave propagation.

Transverse waves:— waves in which particles of the medium vibrates perpendicular to the direction of wave propagation.

Wavelength (λ):— it is the distance between two consecutive compressions or rarefactions is called wavelength.

* S.I unit is metre. (λ lambda)

Frequency (V):— The number of oscillation taking places per second is called frequency

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Date 3, 12, 18 Page No.: 185

* Frequency unit is Hz.

Time period (T) :- Time taken by a object to complete one oscillation is called Time period.

$$T = \frac{1}{V} \text{ or } T = \frac{1}{\text{Frequency}}$$

Velocity of sound :- Distance travelled by a sound per unit time or wavelength per unit time.

$$V = \frac{\text{Distance}}{\text{Time}} \text{ or } \frac{\lambda}{T}$$

or $\boxed{V = \lambda \times V}$ Speed = λ × frequency.

amplitude :- The maximum displacement of vibrating particles from their mean position.

Quality or tiber of sound :- property of sound which enable us to distinguish one sound from another sound.

Tone :- Sound is single frequency.

Note :- Sound produced due to mixture of frequencies.

Intensity of sound :- The amount of sound energy passing each second through unit area.

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Date 3/12/18 Page No.: 186

Remadial Class

Q.1 What is kinetic energy of an object.
Q.2 Write an expression for the kinetic energy.
Q.3 what is power.
Q.4 A lamp Consumes 1000 J of electrical energy In 10 sec. what is its power?
Q.5 Define 1 watt power.

Ans-1 energy due to motion of body is called Kinetic energy.

Ans-2 $K.E = \frac{1}{2}MV^2$

Ans-3 Rate of doing work is called power.

Ans-4 $W = 1000\ J$ $T = 10\ Sec.$
$P = ?$
$P = \frac{W}{T} = \frac{1000}{10} = 100\ watt.$ Ans

Ans-5 $1\ watt = \frac{1\ Joule}{1\ second} = J/Sec. = 1\ watt.$

Date 15/12/18 Page No.: 187

Crest:— The 'elevation' or 'hump' in a transverse wave is called crest.

Trough:— The 'depression' or 'hollow' in a transverse wave is called trough.

V.Imp
* Loudness of sound is determined by Amplitude
* Pitch is detemined by frequency.
* by increasing the temperature of medium, speed of sound increases.

Speed of Sound in different media at 25°C

State	Substances	speed in m/s
Solid	Aluminium	6420
	Nickel	6040
	steel	5960
	Iron	5950
	Brass	4700
	Glass (Flint)	3980
Liquids	water (sea)	1531
	water (distilled)	1498
	Ethanol	1207
	Methanol	1103
Gases	Hydrogen	1284
	Helium	965
	Air	346
	Oxygen	316
	Sulphur dioxide	213

Date 5/12/18 Page No.: 188

Sonic boom:- air pressure variation associated with this type of shock waves Produces a very sharp and loud Sound Called the sonic boom.

Reflection of sound:- The bouncing back of sound waves in same medium after striking a hard surface is Called reflection of sound.

Echo:- Echo is repetion of Sound due to reflection of sound waves back towards the Source

* minimum distance for echo is 17.2m.

$$\text{speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Distance} = \text{speed} \times \text{time}.$$

Reverberation:- The multiple Reflection of Sound is Called reverberation.

Pitch:- the pitch of sound depends on the frequency of Sound (vibration).

Loudness:- The loudness depends on the amplitude of the Sound wave.

* Loudness is denoted by dB LD.

Date 5,12,18 Page No.: 189

Methods to Control reverbration in big halls or auditoriums:—

i) Panels made of felt or compressed fibre board are put on walls and ceiling to absorb Sound.
ii) Heavy curtains are put on doors and windows.
iii) Carpets are put on the floor.
iv) Seats are made of material having Sound absorbing properties.

Range of Hearing:—

i) Range of Hearing in human is 20Hz to 20000 Hz.
ii) Children younger than 5 years and dogs Can hear upto 25 KHz.

Ultrasound or ultrasonic:— The sound having to high frequency which canot be heard by human beings are Called ultrasound.

Infrasound or infrasonic:— The sound of frequencies lower than 20 Hz are Known as Infrasound.

Applications of ultrasound:—

i) it is used to detect cracks in metal blocks in industries without damaging them.

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ii) it is used to investigate the internal organs of human body such as liver, gall bladder, kidneys, uterus and heard.

iii) ultrasound is used to spliting stones in kidneys into fine grains.

Eco cardiography:- These waves are used to reflect the action of heart and its images are formed is called Echocardiography.

Ultrasonography:- The technique of obtaining pictures of internal organs of the body by using echoes of ultrasound wave is called ultrasonography.

SONAR:-

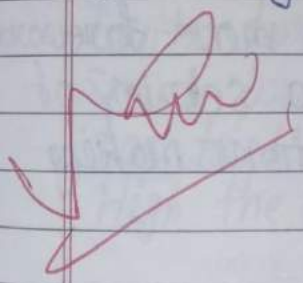
* SONAR is full name is Sound navigation And Ranging.
* Sonar is device uses for locating undersea objects like a ship wreck, Sub marine etc.
* SONAR Consist of a transmitter and a recepter or detector and installed at the bottom of a ship.
* The transmitter produces and transmits Ultrasound waves.
* $D = \text{speed} \times \text{time} \rightarrow \text{speed} = \frac{\text{Distance}}{\text{time}}$

$\text{Speed} = \frac{2d}{\text{Time}} \rightarrow d = \frac{\text{Speed} \times \text{time}}{2}$

Date 6/12/18 Page No.: 191

Structure of Human ear :-

* The ear consist of three parts :- outer ear, middle ear and inner ear.
outer ear – Pinna, ear canal.
Middle ear :- eardrum, Hammer, Anvil, stirrup.
Inner ear :- Cochlea, Circular Canal, auditory nerve.
* ~~The ears are the sense orgains which~~.
* The sound passes through the auditory canal.
* The lower part of middle ear has a narrow Eustachian tube.
* othre side of cochlea is connected to auditory nerve which goes to brain.



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Date 8 12 18 Page No.: 192

Home-work

Q.1 How does the sound produced by a vibrating object in a medium reach your ear?

Ans The sound produced by a vibrating object reaches our ear through sound waves which which travel in the medium as a series of compressions and rarefactions caused by the vibration of the particles of the medium.

Q.2 Explain how sound is produced by your school bell.

Ans when the bell continues to move foreword and backward, it creates a series of compressions and rarefactions making production of sound.

Q.3 Why are sound waves called machanical waves?

Ans Sound waves needs material medium to propagate therefore, they are called machanical waves, Sound waves propagate through a medium because of Theinteraction of the particles present in the medeum.

Q.4 Suppose you and your friend are on the moon, will you able to hear any sound

produced by your friend?

Ans: NO, because Sound waves needs a medium through which they can propagate. Since there is no material medium on the moon due to absence of atmosphere, you cannot hear any Sound on the moon.

Q.5 Which wave property determines
a) loudness, b) pitch?

Ans a) Amplitude b) frequency.

Q.6 Guess which sound has a higher pitch:- guitar or car horn?

Ans Guitar has a higher pitch than car horn because Sound produced by the strings of guitar has high frequency than that of car horn High the frequency higher is the pitch.

Q.7 How are the wavelength and frequency of a sound wave related to its speed?

Ans speed, wavelength and frequency of a sound wave are related by the following equation.

Speed(v) = Wavelength(λ) x frequency (ν)

$$v = \lambda \times \nu$$

Q8 Calculate the wavelength of a sound wave whose frequency is 220Hz and speed is 440 m/s in a given medium.

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Date 8, 12, 18 Page No.: 199

Ans Frequency = 220 Hz
Speed = 440 m/s
λ = ?
Wavelength = ~~frequency~~ / ~~Spe~~
Speed = Wavelength × frequency
Wavelength = Speed / frequency
$\lambda = \frac{440}{220}$
$\lambda = 2$ m Ans

Q.9 A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. what is the time interval between successive compressions from the source?

Ans F = 500 Hz λ = 450m
$T = \frac{1}{F}$
$= \frac{1}{500} = 0.002$ Sec.

The time interval between successive compressions from the source of sound is equal to the time period of sound waves which is 0.002 Sec.

Date 8,12,18 Page No.: 195

Q.10 In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Ans The speed of sound depends on the nature of the medium. Sound travels the fastest in Solids. it's speed decreases in liquids and it is the slowest in gases. Therefore, for a given temperature sound travels fastest in iron.

Q.11 An echo returned in 3sec. what is the distance of the reflecting surface from the source, given that the speed of sound is 342 m/s?

Ans $V = 342$ m/s $T = 3$ sec.

Distance = ~~Velo~~ Speed × Time

$= 342 \times 3$

$= 1026$ m

in a 3 sec sound has to travel twice the distance between surface from the source. Hence. The distance between surface and the source

$= \frac{1026}{2} = 513$ m Ans

Q.12 Why are the ceilings of concert halls curved?

Ans Ceilings of concert halls are curved so that sound after reflection (from the walls) spreads uniformly in all directions.

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Date 8/12/18 Page No.: 196

Q.13 What is the audible range of the average human ear?

Ans The audible range of the average Human ear lies between 20 Hz to 20000 Hz.

Q.14 What is the range of frequencies associated with

a) Infrasound?

b) Ultrasound?

Ans a) Infrasound has frequancies less than 20 Hz.

b) ultrasound has frequancies more than 20,000 Hz

Q.15 Distinguish between loudness and intensity of sound

Ans

	Loudness of Sound	Intensity of Sound.
i)	The sensation produced in the ears which enables us to distinguish between a faint sound and a loud sound is called Loudness of Sound.	i) The average energy transported by a sound wave per second per unit area is called Intensity of sound.
ii)	Loudness of sound is measured in the unit of decibal (dB)	ii) Intensity of sound is measured in the unit of watts per square metre (W/m^2).
iii)	Loudness of sound depends on the sensitivity of ears.	Intensity of sound does not depend on the sensitivity of ears.

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Date 8/12/18 Page No. 197

Q.16 A submarine sends a sonar pulse, which returns from an underwater cliff in 1.02 sec. if the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Ans $T = 1.02$ sec.

$V = 1531$ m/s

Distance = speed × time

$= 1531 \times 1.02$

$= 1561.62$ m/s

in a 1.02 sec. Sound has to travel twice the distance between Submarine to underwater Hence, the distance between submarine and underwater.

$= \frac{1561.62}{2} = 780.81$ m Ans

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Date 9/12/18 Page No.: 138

Exercise

Q.1 What is sound and how is it produced?

Ans Sound is form of energy which gives the sensation of hearing. it is produced by the vibrations caused in air by vibrating object.

Q.4 Why is sound wave called a longitudinal wave?

Ans Sound wave is called longitudinal wave because it is produced by compressions and rarefactions in the air. The air particle vibrates parallel to the direction of propagation.

Q.5 Which characteristic of the sound helps you to identify your ~~answer~~ friend by his voice while sitting with others in a dark room?

Ans The quality or timber of sound enables us to identify our friend by his voice.

Q.6 Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?

Ans The speed of sound (344 m/s) is less than the speed of light (3×10^8 m/s) sound of thunder takes more time to reach the

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earth as Compared to light. Hence, a flash is seen before we hear a thunder.

Q.7 A person has a hearing range of 20 Hz to 20 KHz. what are the typical wavelengths of Sound waves in air corresponding of these two frequencies? take the speed of sound in air as 344 m/s.

Ans In the first case:

$V = 344\ m/s$

$f = 20\ Hz$

$\lambda = ?$

$V = f \times \lambda$

$344 = 20 \times \lambda$

$\lambda = \frac{344}{20}$

$\boxed{\lambda = 17.2\ m}$ Ans

In the second case:

$V = 344\ m/s$

$f = 20000\ Hz$

$\lambda = ?$

$V = f \times \lambda$

$344 = 20000 \times \lambda$

$\lambda = \frac{344}{20000}$

$\boxed{\lambda = 0.0172\ m}$ Ans

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Date 9/12/18 Page No.: 200

Q.8 Two children are at opposite ends of an aluminium rod. one strikes the end of rod with a stone. find the ratio of times taken by sound wave in air and in aluminium to reach the sound child (Given: speed of sound in air = 346 m/s. speed of sound in aluminium = 6420 m/s)

⇒ Velocity of sound in air = 346 m/s

Velocity of sound in aluminium = 6420 m/s

~~Let~~

Time taken for sound wave in air $t_1 = \frac{1}{\text{velocity}}$

$= \frac{1}{346}$ m/s

Time taken for sound wave in Aluminium t_2

$= \frac{1}{\text{Velocity}}$ $\frac{1}{6420}$ m/s

ratio $= \frac{t_1}{t_2} = \frac{\frac{1}{346}}{\frac{1}{6420}}$

$= \frac{1}{346} \times \frac{6420}{1} = \frac{3210}{173}$

$= \frac{18.55}{1}$

$= 18.55 : 1$ Ans

Q.9 The frequency of a source of sound is 160 Hz. How many times does it vibrate in a minute.

Date 10, 12, 18 Page No.: 201

Ans Frequency = 100 Hz
This means the source of sound vibrates 100 times in one second
Therefor, number of vibrations in 1 minute or 60 sec
= 100 X 60 = 6000 times Ans

Q.10 Does sound follow the same laws of reflection as light does explain?

Ans Yes, Sound follows the same laws of reflection as that of ligh because,

i) Angle of incidence of sound is always equal to that of angle of reflection of sound waves.

ii) The direction in which sound is incident, the direction in which it is reflected and normal all lie in the same plane.

Q.11 When a sound - - - - - - - - - - - - - - day?

Ans An echo is heard when the time for the reflected sound is heard after 0.1 sec.
Time taken = $\frac{\text{Total distance}}{\text{Velocity}}$.
On a hotter day, the velocity of sound is more. if the time taken by echo is less than 0.1 sec it will not be heard.

Q.12 Give two practical applications of reflection of sound waves.

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Date 10/12/18 Page No.: 202

Any i) Reflection of sound is used to measure the distance and speed of under water object.

ii) Working of a stethoscope is also based on reflection of sound.

Q.13 A stone ---------- 340 m/s.

Any $S = 500\ m \qquad u = 0\ m/s$

$g = 10\ m/s^2$

$S = ut + \frac{1}{2}gt^2$

$500 = 0 \times t + \frac{1}{2} \times 10 \times t^2$

$t^2 = \frac{500}{5} \times 100$

$t = \sqrt{100} = 10\ sec.$

Speed of sound = 340 m/s

Time taken by sound to cover a distance of

$500\ m = \frac{500}{340} = 1.47\ sec.$

Total time = $10 + 1.47 = 11.47$ sec Any

Q.14 A sound wave travels at a speed of 339 m/s. if its wavelength is 1.5 cm. what is the frequency of the wave? will it be audible.

Any $V = 339\ m/s$

$\lambda = 1.5\ cm = 0.015\ m$

$\text{frequency} = \frac{\text{speed}}{\text{wavelength}} = \frac{339}{0.015} = 22600\ Hz$ Any

∴ it will not be audible

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Date 10/12/18 Page No.: 203

Q.15 What is reverbration? How can it be reduced.

Ans The repeated multiple reflections of sound in any big enclosed space is known as reverbration. The reverbration can be reduced by covering the celling and walls of the enclosed space with sound absorbing materials, such as fibre boards, loose, woollens etc.

Q.16 What is loudness of sound? what factors does it depends on?

Ans The effect produced in the brain by the sound of different frequencies is called loudness of sound.
Loudness depends on the amplitude of vibrations in fact, loudness is proportional to the square of the amplitude of vibrations.

Q.17 Explain how bats ~~are~~ use ultrasound to catch a prey.

Ans Bats produce high pitched ultrasonic squeaks. This high pitched squeaks are reflected by objects such as preys and returned to the bat's ear. This allows a bat to know the distance of his prey.

Q.18 How is ultrasound used for cleaning?

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Date 10/12/18 Page No.: 204

Ans Objects to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through that solution. The high frequency of these ultrasound waves detaches the dirt from the objects.

Q.20 A Sonar device on a Submarine sends out a signal & receives an echo 5sec. later. Calculate the speed of sound in water if the distance of the object from the Submarine is 3625 m.

Ans $t = 5\,sec$

$d = 3625\,m$

Total distance travelled by the sonar waves during the transmission and reception in water $= 2d$

Velocity of sound in water, $v = \frac{2d}{t}$

$= \frac{2 \times 3625}{5}$ (725)

$= 1450\,m/s$ Ans