Board – ICSE	Class- 9th	TOPIC – SOUND

1. What is Galton's whistle? To what use it can be put?

Ans. Galton's whistle is a special kind of whistle which emits ultra-sonic vibrations between 20,000 Hz to 40,000 Hz. The vibrations of this range cannot be perceived by human ears, but can be easily perceived by dogs. Thus, the dogs can be trained to perform special tasks on hearing the sound from Galton's whistle. It is very useful, if intruders enter in someone's house. On blowing the whistle the dog will attack intruder and the intruder will not be able to hear the sound.

2. (a) What do you understand by the term ultra-sonic vibrations?

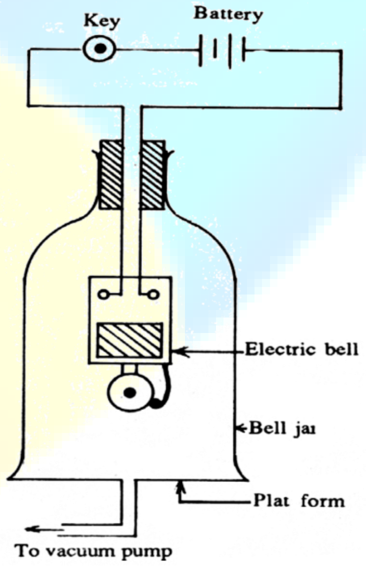
(b) Name three animals which can hear ultra-sonic vibrations. necessary for the propagation of sound.

Ans. (a) The vibrations which are not perceived by human ear and their frequency range is above 20,000 Hz are called ultra-sonic vibrations.

(b) (i) Bats (ii) Dogs (iii) Dolphins

3. Describe an experiment to prove that material medium is necessary for the propagation of sound.

Ans. An electric circuit consisting of a cell, a switch, an electric bell is arranged inside a bell jar, which is placed on the platform of an evacuated pump as shown in diagram alongside. The switch of the electric circuit is pressed in, when a clear sound of bell is heard. Air is now removed from the bell jar by evacuating the pump. It is noticed that intensity of sound gradually decreases. When the bell jar is completely evacuated, it is noticed that no sound is heard when the hammer of bell is striking the gong. Thus, experiment clearly proves that material medium (in the present case air) is necessary for the propagation of sound energy.



4. State any two characteristics of wave motion.

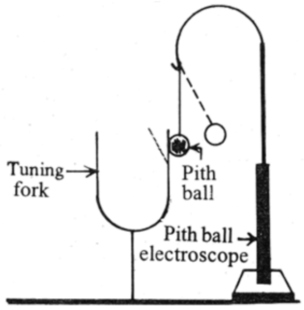
Ans. (a) A wave is caused due to periodic disturbance of particles of medium, and the wave by itself is periodic in nature.

(b) It is the disturbance which travels outward and not the particles of medium. The particles of medium, simply vibrate either to and fro or up and down about their mean positions

5. Describe briefly an experiment to prove that vibrating bodies produce sound.

Ans. Take a tuning fork and strike it against a rubber cork. Bring the tuning fork close to ear. A humming sound is heard. Again strike the tuning fork against the rubber cork and touch its prong to the stationary pith ball of pith ball electroscope. It is observed that pith ball repeatedly flies outward.

Thus, experiment proves that sound is produced by a vibrating body.



6. State four practical uses of ultra-sonic vibrations.

Ans. (i) They are used in ultrasound scanning of various organs of human body.

(ii) They are used for welding metals having high melting point.

(iii) They are used for homogenising milk.

(iv) They are used for scaring insects and rats from godowns.

7. The sound of an explosion on the surface of lake is heard by a boatman 100 m away and a diver 100 m below the point of explosion.

(i) Of the two persons mentioned (boatman and diver), who would hear the sound first?

(ii) Give reason for your answer in (i).

(iii) If the sound takes 't' seconds to reach the boatman, approximately how much time it will take to reach the diver?

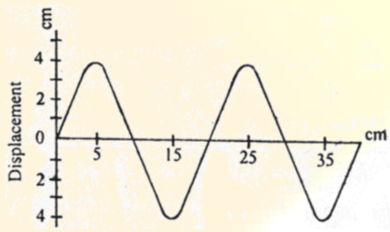
Ans (i) The diver hears the sound first.

(ii) It is because sound travels at 1450 ms–1 in water and 330 ms^{-1} in air.

(iii) The time in which sound reaches diver is $\frac{330}{1450}$ s

$= 0.227$ seconds.

8. The diagram shows a snap shot of a wave form of frequency 50 Hz in a string. The numbers in diagram represent distance in centimeters.



For this wave motion find,

(i) Wavelength (ii) Amplitude (iii) Wave velocity.

Ans. (i) Wavelength = 20 cm.

(ii) Amplitude = 4 cm.

(iii) Wave velocity = $f\lambda = 50 \times 20 = 1000\ cms^{-1} = 10\ ms^{-1}$

9. A sound wave of frequency 640 Hz travels 800 m in 2.5 s. Calculate

(a) speed of sound (b) wavelength of sound wave.

Ans. (a)Speed of sound $= \frac{\text{Distance}}{\text{Time}} = \frac{800\text{m}}{2.5\text{s}} = 320\ \text{ms}^{-1}$.

(b) Speed of sound (v) = fλ.

$\therefore 320 = 640 \times \lambda$

$\therefore \lambda = 320640 = 0.5$ m.

10. A sound wave has a frequency of 2000 Hz and wavelength 17 cm. If the wavelength increases to 51 cm, what is the frequency, the nature of material through which sound is propagating remains same.

Ans. Initial wavelength (λ_1) = 17 cm.

Initial frequency (f_1) = 2000 Hz.

Final wavelength (λ_2) = 51 cm.

Final frequency (f_2) = ?

For a given material velocity of sound is a constant quantity.

$\therefore f_2 \lambda_2 = f_1 \lambda_1$

$f_2 \times 51$ cm = 2000 Hz × 17 cm.

$$\therefore f_2 = \frac{2000 \times 17}{51}$$

= 666.67 Hz.

11. A thin metal plate is placed against the teeth of a cog wheel. If the cog wheel is rotated at a constant speed of 360 rotations per minute and has 80 teeth, calculate:

(i) frequency of note produced

(ii) speed of sound, if the wavelength is 0.7 m

(iii) what will be the effect, if the speed of cog wheel is halved?

Ans. (a) Number of rotations of cog wheel in 1 minute (60 s) = 360

∴ Number of rotations of cog wheel in 1second $= \frac{360}{60\text{s}} = 6\ \text{s}^{-1}$.

∴ Frequency of note produced = No. of rotations per second ×Teeth in cog wheel

$= 6\ \text{s}^{-1} \times 80 = 480\ \text{s}^{-1} = 480$ Hz.

(b) Speed of sound = Frequency × Wavelength

$= 480\ \text{s}^{-1} \times 0.7\ \text{m} = 336.0\ \text{ms}^{-1}$.

(c) The frequency of note produced is halved. Thus, in turn will lower the pitch of sound, i.e., a bass note is produced.

12. The distance between one crest and one trough produced on the surface of water is 0.04 m. If the waves are produced at a rate of 180 per minute. Calculate:

(a) time period

(b) wave velocity.

Ans. (a) Number of waves produced in 1 minute (60 s) = 180

∴ Number of waves produced in 1 second $= \frac{180}{60s} = 3\ s^{-1}$

∴ Frequency of waves = 3 s^{-1}.

Now, Time periond (T) = –1= 0.33 s.

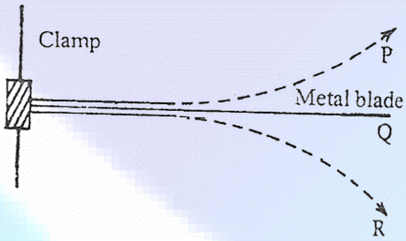
(b) Distance between one crest and one trough =λ/2

$\therefore \frac{\lambda}{2} = 0.04$ m

∴ λ = 0.04 × 2 = 0.08 m

$\therefore$ Wave velocity $= \frac{\lambda}{2} = \frac{0.08m}{1/3s} = 0.24\ ms^{-1}$.

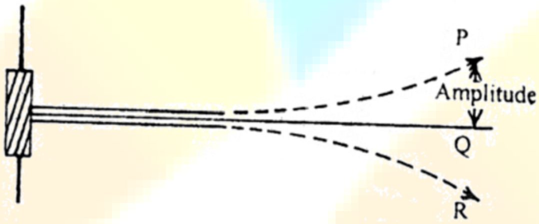
13. The diagram alongside shows a vibrating metal blade clamped at one end. P and R are the extreme positions occupied by the blade during its course of vibration, Q, being its position of rest. The vibrating blade produces a note of 480 Hz.



(i) Mark on the diagram amplitude of vibration.

(ii) If the velocity of sound in air is 320 ms^{-1}, what is the wavelength of sound produced?

Ans. (i)



(ii) f = 480 Hz.

$$\lambda = \frac{v}{f} = \frac{320}{480} = 0.66 \text{ m}$$

14. Compare the frequencies of two waves X and Y while velocity and wavelength of X are 5×10^3 m/s and 25 m respectively and for Y, 4×10^3 m/s and 20 m respectively.

Ans. $\lambda_x = 25m, V_x = 5 \times 10^3$ m/s

$\lambda = 20m, V_y = 4 \times 10^3$ m/s

$\nu_x : \nu_y = ?$

$$\frac{V_x}{V_y} = \frac{V_x \lambda y}{V_x \lambda_x} = \frac{5 \times 10^3 \times 20}{4 \times 10^3 \times 25} = \frac{1}{1}$$

$\nu_x : \nu_y = 1$

15. In 0.4 m, there are 20 waves and an observer's ear perceives 120 waves in a minute. Calculate the wavelength, the frequency and the speed of the wave.

Ans. The distance travelled by the wave in one time period of vibration is,

Wavelength $\lambda = 0.4m/20 = 0.02m$

Frequency $\nu = 120 waves/60s$

$= 2$ waves/s $= 2Hz$

Speed $V = \nu\lambda = 2Hz \times 0.02m = 0.04m/s$