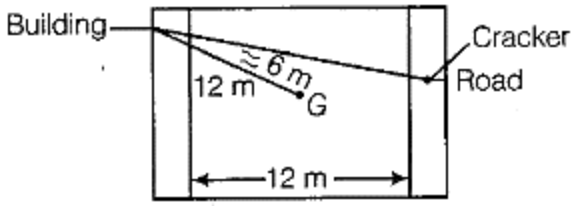
Board – CBSE	Class – 9th	Topic – Sound

Q.1 A girl is sitting in the middle of a park of dimension 12 m×12 m. On the left side of it, there is a building adjoining the park, and on the right side of the park, there is a road adjoining the park. A sound is produced on the road by a cracker. Is it possible for the girl to hear the echo of this sound? Explain your answer.

Ans: No, the girl can't hear the echo of this sound because the distance between girl and obstacle (building) is only 6 m approx. But the echo is heard only if the minimum distance between the observer at the source of sound and the obstacle is 11.3 m.



Q.2 Why do we hear the sound produced by the humming bees while the sound of pendulum vibrations is not heard?

Ans: The frequency of vibrations of the pendulum is below 20 Hz (infrasound). We cannot hear infrasound, but humming produces an audible sound which human beings can hear.

Q.3 If any explosion takes place at the bottom of a lake, what type of shock waves in water will take place?

Ans: If any explosion takes place at the bottom of a lake. Infrasound type of shock waves in water will take place.

Q.4 Sound produced by a thunderstorm is heard 10 s after the lightning is seen. Calculate the approximate distance of the thunder cloud (Given the speed of sound $= 340\ ms^{-1}$).

Ans: Given, time $ft) = 10\ s$ and speed $(v) = \frac{340\ m}{s}$

We know that, distance = speed × time

$= 340{\times}10 = 3400\ m = \frac{3400}{1000}\ km = 3.4\ km$

Q.5 For hearing the loudest ticking sound heard by the ear, find the angle x in the given figure.

Ans: We know that, in the law of reflection, the angle of incidence (x) is always equal to the angle of reflection (x)

Since AOB is a straight line.

$\angle AOB = 180^\circ 50^\circ + x + x + 50^\circ = 180^\circ$

($\therefore$ sum of all angles lies on the same side of aline

is 180°)

$2x + 100^\circ = 180^\circ$

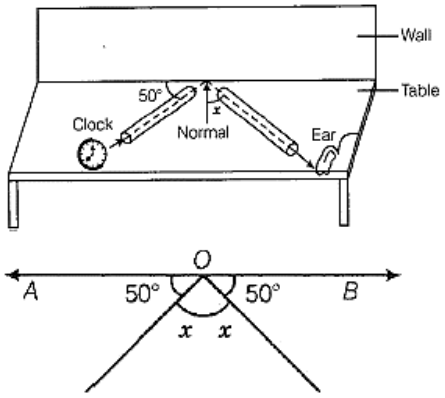
$2x = 180^\circ - 100^\circ$

$2x = 80^\circ$

$x = 80^\circ/2$

$x = 40^\circ$

Hence, the value of x is 40°.



Q.6 Why is the ceiling and wall behind the stage of good conference halls or concert halls made curved?

Ans: The ceiling of concert halls, conference halls, and cinema halls is curved. Sound after reflection reaches all corners of the hall uniformly.

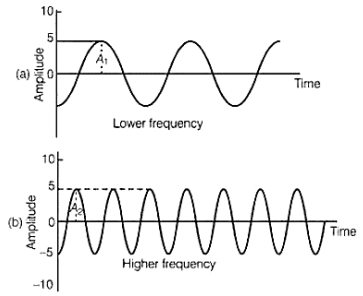
Q.7 Represent graphically by two separate diagrams in each case.

(i) Two sound waves having the same amplitude but different frequencies.

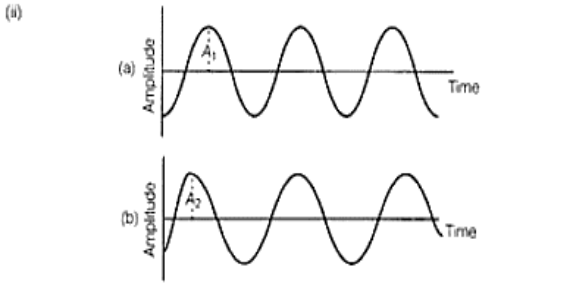
(ii) Two sound waves having the same frequency but different amplitudes.

(iii) Two sound waves having different amplitudes and also different wavelengths.

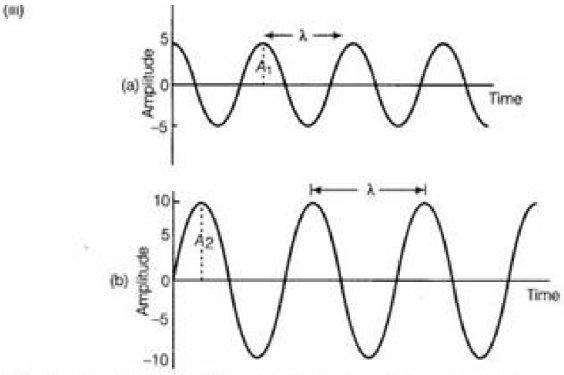
Ans:



(i) In both cases (a) and (b), same amplitude but different frequencies ($A_1 = A_2$).



In both cases (a) and (b) same frequency and different amplitudes *i.e.*, ($A_1 \neq A_2$)



In both cases (a) and (b), different amplitudes and different wavelengths *i.e.*, $A_1 \neq A_2, \lambda_1 \neq \lambda_2$.

Q.8 A human heart, on average, is found to beat 75 times a minute. Calculate its frequency.

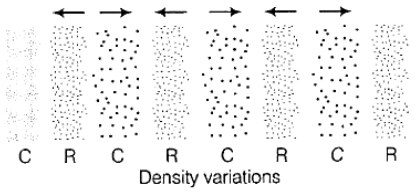
Ans: No. of beats of human heart $= 75\ min^{-1} = \frac{75}{1\ min} = \frac{75}{60\ s} = 1.25\ s - 1$

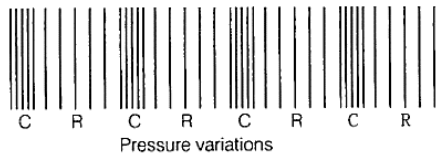
So, the Average frequency of human heart beating $= 1.25\ s^{-1}$

Q.9 Draw a curve showing density or pressure variations with respect to distance for a disturbance produced by sound. Mark the position of compression and rarefaction on this curve. Also, define wavelengths and time periods using this curve.

Ans: We have a curve showing density or pressure variations with respect to distance for a disturbance produced by sound, denoted by X.

Time taken by the waves to complete one full cycle so that its particles are in the same phase is called the time period. It is denoted by T.





Q.10 A source of wave produces 40 crests and 40 troughs in 0.4 seconds. Find the frequency of the wave.

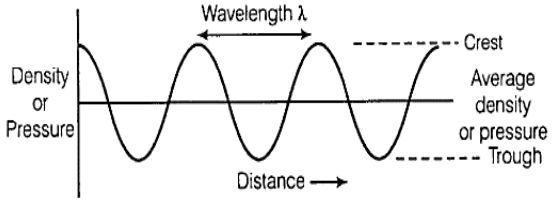
Ans: Number of crests and troughs produced by the wave $= 40$

Number of waves formed $= 40$

Time taken $= 0.4\ s$, Frequency $=?$

Number of waves produced in one second $== 100\ s^{-1}$

Frequency of the wave $= 100\ Hz$



Q.11 A person has a hearing range from $20\ Hz$ to $20kHz$. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as $344\ m\ s^{-1}$.

Ans: Hearing range $= 20\ Hz$ to $20kHz (= 20000\ Hz)$

Speed of sound in the air $= 344\ ms^{-1}$

For a wave,

Wavelength $= \frac{v}{f}$

So, for $v = 20\ Hz = 20/s$

$$\lambda = \frac{344\ m\ s^{-1}}{20\ s^{-1}}$$

$$= 17.2\ m$$

and for $v = 20000\ Hz = 20000\ s^{-1}$

$$\lambda = \frac{344\ m\ s^{-1}}{2000\ s^{-1}} = 0.0172\ m = 1.72\ cm$$

Q.12 Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Ans: Frequency, $v = 220\ Hz$

Speed of sound, $v = \frac{440\ m}{s}$

The relationship can describe the wavelength,

Wave velocity = Wavelength of the wave x Frequency of the wave

$$440\ s^{-1} = 1 \times 220\ Hz = 1 \times 220\ s^{-1}$$

So, $1 = \frac{440\ m\ s^{-1}}{220\ s^{-1}} = 2\ m$

Therefore, the wavelength of the sound wave is 2 m.

Q.13 A person is listening to a sound of 50 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 reaches him?

Ans: Frequency of the sound = 50 Hz

Distance from the source = 450 m

The time between the successive compressions is equal to the time taken by the sound to travel a distance equal to its wavelength. Thus, we have to find out the time period we know,

Time period, $T = \frac{1}{frequency}$

So $T = \frac{1}{50\ Hz} = \frac{1}{50\ s^{-1}} = 0.02\ s$

The successive compressions will reach the person after every 0.02 s.

Q.14 A boat at anchor is rocked by waves whose consecutive crests are 100 m apart. The wave velocity of the moving crests is 20 m/s. What is the frequency of rocking of the boat?

Ans: Distance between two consecutive crests $= 100\ m$

Wave velocity $v = \frac{20\ m}{s}$

The distance between two consecutive crests is equal to the wavelength of the wave. So,

$$Frequency = \frac{Wave\ velocity}{Wavelength} = \frac{20\ m/s}{100\ m} = 0.2\ s^{-1}$$

So, the frequency of rocking of the boat is $0.2\ s^{-1}$.

Q.15 A longitudinal wave is produced on a toy slinky. The wave travels at a speed of 30 cm/s, and the wave's frequency is 20 Hz. What is the minimum separation between the consecutive compressions of the slinky?

Ans: Wave speed, $v = 30\ cm/s$

Frequency of the wave, $v = 20\ Hz = 20\ s^{-1}$

The minimum separation between the consecutive compressions is equal to the wavelength. Therefore,

$$Wavelength = \frac{v}{f} = \frac{30\ cm/s}{20\ s^{-1}} = 1.5\ cm$$

Thus, the minimum separation between the consecutive compression of the slinky is $1.5\ cm$

Q.16 A bat can hear sound at frequencies up to $120kHz$. Determine the wavelength of sound in the air at this frequency. Take the speed of sound in the air as 344 m/s.

Ans: Frequency, $v = 120kHz = 120\times10^3\ Hz = 120\times10^3\ s^{-1}$

The velocity of sound in the air, $v = \frac{344\ m}{s}$

The wavelength of the sound wave, l =?

We know,

$$Wavelength,\ 1 = \frac{Wave\ velocity}{Wavelength} = \frac{344\ m/s}{120\times10^3\ s^{-1}}$$

$= 2.87 \times 10^{-3}\ m = 0.29\ cm$

Q.17 A gun is fired in the air at a distance of 660 m from a person. He hears the sound of the gun after 2 s. What is the speed of sound?

Ans: Distance travelled by sound $= 660\ m$

Time taken by the sound $= 2\ s$,

Speed of sound in air =?

So, speed of sound $= \frac{Distance\ travelled\ by\ sound}{Time\ taken\ by\ the\ sound}$

Speed of sound $= \frac{660\ m}{2\ s} = \frac{330\ m}{s}$

Thus, the speed of sound in the air is 330 m/s.

Q.18 A child hears an echo from a cliff 4 seconds after the sound from a powerful cracker is produced. How far away is the cliff from the child? The velocity of sound in air at $20^{\circ}C$ is 344 m/s

Ans: Let the distance between the child and the cliff be d. Then,

Total distance travelled by the sound $= 2\ d$

Total time taken by the sound $= 4\ s$

Then,

Velocity of sound

$344\ m/s = \frac{d}{2\ s}$

This gives, $d = \frac{344\ m}{s} \times 2\ s = 688\ m$

Thus, the cliff is at a distance of 688 m from the child.

Q.19 A ship sends on a high-frequency sound wave and receives an echo after 1 second. What is the depth of the sea? The speed of sound in water is 1500 m/s.

Ans: Let, Depth of the sea $= d$

So, Total distance travelled by the sound wave $= 2\ d$

Time taken by sound to travel both ways $= 1\ s$

As per definition,

Speed of the sound =

Then, $1500\ m\ s\ -\ 1\ = \frac{d}{2\ s}$

or $d\ = \frac{1500\ ms^{-1} \times 1\ s}{2}\ =\ 750\ m$

Thus the depth of the sea is 750 meters.

Q.20 A sonar echo takes 2. 2 s to return from a whale. How far away is the whale?

Ans: Total time taken by the signal $=\ 2.\ 2\ s$

So, time taken for the signal to reach the whale $==\ 1.\ 1\ s$

Distance of the whale $=\ d$?

From the literature, the speed of sound in seawater at $25^{\circ}C\ =\ 1533\ ms^{-1}$

So, Distance of the whale, $d\ =$ Speed of the signal x Time taken

or $d\ =\ 1533\ m\ s^{-1} \times 1.\ 1\ s\ =\ 1686.\ 3\ m$

Q.21 18. Using sonar, sound pulses are emitted at the surface of the water. These pulses, after being reflected from the water bottom, are detected. If the time interval from the emission to the detection of the sound pulses is 2 seconds, find the depth of the water.

[speed of sound in water $= \frac{1531\ m}{s}$ given].

Ans: $t\ =\ 2s$

$Speed\ = \frac{Distance}{time}$

$1531\ = \frac{2x}{2}$

$x\ =\ 1531\ m$