NCERT SOLUTIONS CLASS IX-SCIENCE

CHAPTER 12- SOUND

Que.1. When an object vibrates in a medium, it produces sound which reaches our ear. Explain how it is done.

Ans. Sound propagates through air which is a medium. When the prongs of a tuning fork vibrate, they disturb the air molecules in the surrounding. When it moves forward, the molecules in the surrounding air gets pushed which in turn creates a high pressure and high density, thus leading to compression of air. This is called compression of air. This compressed air moves forward. When the prong vibrates backward, a region of low pressure and density is formed in the air and this is called rarefaction. When the tuning fork vibrates back and forth, the surrounding air is subjected to both compression and rarefaction alternately. Thus the energy released by the tuning fork travels outward. When these energies on reaching the ear causes the eardrum to vibrate and we will be able to hear the sound.

Que.2. How does a school bell produce sound?

Ans. Sound propagates through air which is a medium. When the bell rings and vibrates, they disturb the air molecules in the surrounding. When it moves forward, the molecules in the surrounding air gets pushed which in turn creates a high pressure and high density, thus leading to compression of air. This is called compression of air. This compressed air moves forward. When the bell vibrates backward, a region of low pressure and density is formed in the air and this is called rarefaction. When the bell vibrates back and forth, the surrounding air is subjected to both compression and rarefaction alternately. Thus the energy released by the school bell travels outward. When these energies on reaching the ear causes the eardrum to vibrate and we will be able to hear the sound.

Que.3. Sound waves are sometimes called mechanical waves. Explain why.

Ans. When the object is to be vibrated, some kind of mechanical energy is needed. The sound energy due to vibration cannot be produced on its own. Vibrating object's mechanical energy uses a medium to travel and they reach our ears. Hence, sound waves are sometimes called mechanical waves.

Que.4. Would you be able to hear any sound made by your friend if both of you are on the moon?

Ans. No, as there is no atmosphere in the moon, sound waves cannot travel and reach your ears. Hence, one will not be able to hear any sounds made in the moon.

Que.5. Which property of wave do you think determines loudness and pitch?

Ans. Pitch – The frequency of the wave determines the pitch. When the frequency of wave is high, then the pitch is high and the sound is shriller.

Loudness – Loudness is determined by the amplitude of the wave. When the amplitude is high, the loudness produced is more.

Que.6.Which of the following sounds have a higher pitch, guitar or car horn?

Ans. The sound produced by the guitar has greater frequency when compared with the car horn. Frequency is directly proportional to the pitch if the sound. Hence, pitch of the guitar is higher than the pitch of the car horn.

Que.7. Explain the terms wavelength, time period, frequency and amplitude of a sound wave.

Ans. Wavelength – It is defined as the period between two consecutive compression or rarefaction. Meter (m) is the Si unit.

Frequency – In a period of one second, the number of oscillations that are produced by the vibrating body is known as the frequency of the sound wave. Hertz (Hz) is the Si unit.

Amplitude – It is the measure of maximum displacement of a vibrating particle about its mean position.

Que.8. Explain how the frequency and wavelength of a sound are related to its speed.

Ans. The product of frequency and wavelength is the speed of the sound wave.

Speed = Wavelength x Frequency = $\nu\lambda$

Que.9. A sound wave has a frequency of 200 Hz and speed of 400 m s^{-1} in a medium. Find the wavelength of the sound wave.

Ans. Given:

Frequency of sound wave = 200 Hz

Speed of sound wave = 400m s^{-1}

By formulae,

Speed of sound = Frequency x wavelength

= 200 x wavelength

Wavelength = $\frac{400}{200}$

= 2m

Therefore, the wavelength of sound wave is 2m

Que.10. A person who is sitting at a distance of 400 m from a source of sound is listening to a sound of 600 Hz. Find the time period between successive compressions from the source.

Ans. Given:

Frequency = 600 HZ

Frequency = $\frac{1}{Time\ period}$

Time period (T) = $\frac{1}{Frequency}$

= $\frac{1}{600}$

= 0.0016 s

Hence, the time period between two successive compressions is 0.0016 s.

Que.11.What is the difference between loudness and intensity of sound?

Ans. The intensity of sound depends on the energy per unit area of the wave whereas, the loudness depends on the response of the ear as well.

Que.12. In which of the following three media, does the sound travel faster at a particular temperature (i) air (ii) water (iii) iron.?

Ans. For the sound to travel it needs a medium and the sound travels fast in solids as compared to liquids and gases. So, sound travels fast in iron as compared to water and iron.

Que.13. Explain why the ceilings of the concert halls are curved.

Ans. The sounds after reflection has to travel in all the directions uniformly and reach all the corners of the hall and should be audible to everyone in the hall, so that is why the ceilings of the concert halls are curved.

Que.14. For an average human ear, what will be the audible range?

Ans. Frequencies in the range of 20 Hz to 20,000 Hz are the audible range for an average human ear.

Que.15. For infra sound and ultrasound, what is the range of frequencies?

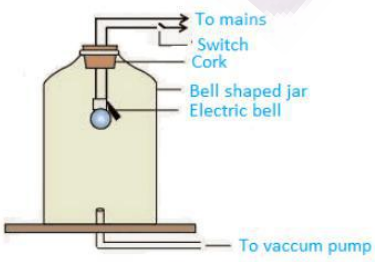
Ans. (i) Infra sound: The range of frequencies are from 1 Hz to 20 Hz.

(ii) Ultrasound: Frequencies which are in the range of above 20,000 Hz comes under ultrasound.

Que.16.What is sound and how it is created?

Ans. A sensation of hearing is produced by the sound which is in the form of mechanical energy. Sound is produced when an object starts to vibrate.

Experimental setup to show sound needs a medium to travel



Que.17. Explain with an experiment which shows that sound needs a medium to travel

Que.17. Explain with an experiment which shows that sound needs a medium to travel.

Ans. Construct a circuit consist of an air tight bell jar and electric bell which is connected to a vacuum pump. Place the bell inside the jar and using the vacuum pump, clear the air out of the jar. The bell sound faints and it is not heard after some time. This happens because there is no air in the jar as the air is pumped out. This proves that the sound needs a medium for it to propagate.

Que.18. Explain why sound waves are sometimes called longitudinal waves.

Ans. The air particles in the medium vibrate the same direction as that of the wave of propagation and this is why sound waves are sometimes called longitudinal waves.

Que.19. When your friend is sitting in a dark room along with others, which characteristic of sound helps you to identify him?

Ans. Quality and tone of the sound are the characteristics that help to identify my friend.

Que.20. Flash and thunder occurs at the same time but flash is seen first followed by thunder with a delay of few seconds. Why is that?

Ans. Speed of light (3 x 10^8) is greater than the speed of sound (344 m/s). The thunder sound takes more time to reach as compared to light and hence, flash is seen first followed by lightning.

Que.21. A hearing range of a person is from 20 Hz to 20 KHz. Corresponding to these two frequencies, find the wavelength of sound waves in air. Assume that the speed of sound is 434 ms^{-1}.

Ans. Given:

Frequency = 20 Hz

Speed of sound = 434 m/s

Wavelength λ = ?

Speed = Wavelength x Frequency

Wavelength = $\frac{Speed}{Frequency}$ = $\frac{434}{20}$

= 21.7 m

When frequency = 20 KHz

Wavelength = $\frac{Speed}{Frequency}$

= $\frac{434}{20,000}$

= 0.0217 m

Hence, 21.7 m and 0.0217 m are the wavelength of sound corresponding to frequencies 30 Hz and 30 KHz.

Que.22. Do sound and light follow the same laws of reflection? Explain your answer.

Ans. Yes, both light and sound follow the same laws of reflection because

(a) The angle of incident is equal to the angle of reflection.

(b) The incident sound wave, the reflected sound wave and the normal all lie in the same plane.

Que.23. An echo is produced when a sound is reflected from a distant object. The distance between the source and the reflecting surface remains same. Does one hear echo on a warm day?

Ans. Time = $\frac{Distance}{Speed}$

Time is directly proportional to distance and inversely proportional to speed. The velocity of sound is more in a warm day and the echo is not heard if the time taken by the echo is less than 0.1 s.

Que.24. Provide any two practical applications of reflection of sound wave.

Ans. (a) Sonar is used to detect underwater objects which uses the reflection of sound.

(b) Stethoscope is used to hear the patient's heartbeat.

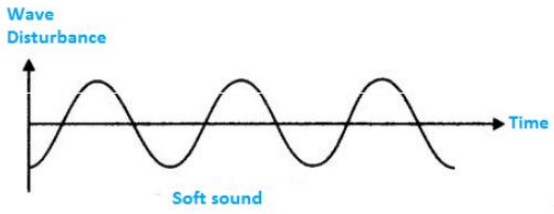
Que.25. What is reverberation? What can be done to reduce it?

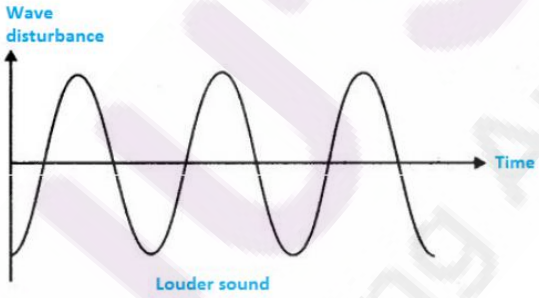
Ans. The persistence of sound due to the multiple reflection of sound in an auditorium is called as reverberation.

It can be reduced by wall proofing and roof proofing the auditorium with sound absorbent materials like compressed fiberboard. The seat should have sound absorbing properties.

Que.26. Explain the loudness of sound . On what factors do they depend on?

Ans. Amplitude determines the loudness of sound. Depending upon the force which is used to vibrate the object, the amplitude of sound is determined. As loud sounds are associated with higher energy, it travels a large distance. As the sound comes out the source, it spreads out and its amplitude as well as loudness decreases.





Que.27. Explain how bats catch their pray using ultrasound.

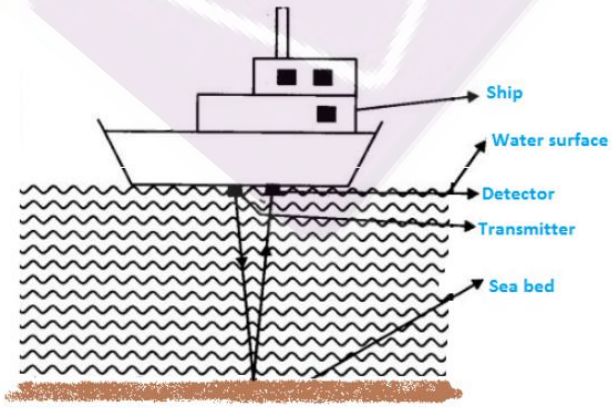
Ans. When the bat hunts for its pray, it produces high-pitched ultrasonic squeaks. These ultrasonic waves gets reflected on hitting the prey and they are received back by the bat. Based on the nature of reflection, the bat finds it's prey.

Que.28. Explain how cleaning is done using ultrasound.

Ans. The parts which are difficult to be cleaned are placed in an cleaning solution and they are subjected to ultrasonic waves. The dust and dirt are removed due to the high frequency ultrasonic waves. Thus, ultrasound is used for cleaning.

Que.29. Explain how sonar works and mention its applications.

Ans. SONAR is Sound Navigation and Ranging. It is installed in a ship and it has a transmitter and a detector. Ultrasonic waves are produced and are transmitted by a transmitter. These waves on transmission, gets reflected back after striking the sea bed or an object and are received by the detector. The ultrasonic waves are converted into electrical signals by the detector and are interpreted accordingly. The object distance can be calculated by knowing the speed of sound in water and the time taken between transmission and reception.



Let the sound in water be v

Let the depth be d

Total time taken be t

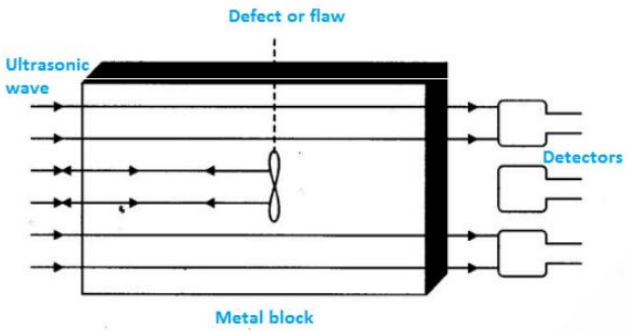
∴ Time taken to travel the distance d = $\frac{t}{2}$

∴ sea depth = $\frac{t}{2} \times \nu$

(Since, distance = speed x time)

Que.30. Using ultrasound, how can we detect defects in a metal block?

Ans. Ultrasonic waves are made to pass through the metal block and a detector is placed on the other side to receive them. When there are cracks and holes in the metal block, the transmitted waves gets reflected back and are not received by the detector. Thus, using ultrasonic waves, the defects are detected in the metal block.



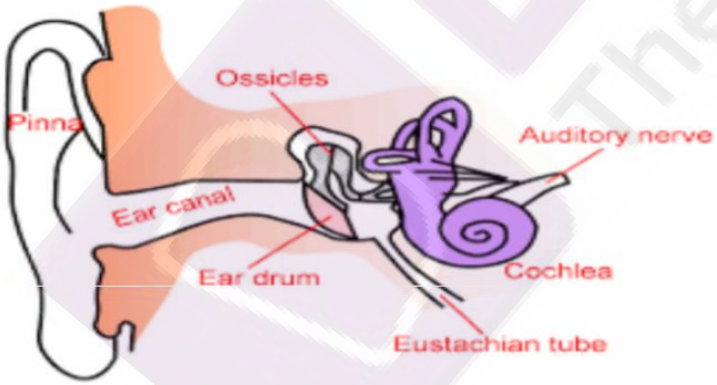
Que.31. Explain the working of human ear.

Ans. The human ear consist of three parts, they are:

(a) Outer ear – Its other name is 'pinna'. The sound from the surrounding is collected and it is directed into the auditory canal.

(b) Middle ear – Eardrum is a thin membrane which is present at the end of the auditory canal. When sound waves reach the eardrum, it sets the membrane into vibration. Amplification of these vibrations are caused by three small bones which are namely hammer, stirrup and anvil.

(c) Inner ear – The cochlea which is present in the inner ear, converts the amplified vibrations into electrical signal. The auditory nerve sends these electrical signals to the brain and these signals are interpreted as sound.



Que.32. An object is at an distance 4500 m from a submarine. The sonar in the submarine sends a signal and receives it at a delay of 10 s. What is the speed of sound in water?

Ans. The total time interval between transmission and reception = 10 s

The object distance from the submarine = 4500 m

Speed of sound in water = $\frac{Distance\ Travelled}{Time\ taken}$

= $\frac{4500}{10}$

= 450 m/sec

Que.33. The speed of the sound wave is 450 ms^{-1}. Find the frequency of the wave, if the wavelength is 0.5 cm. Will it be audible?

Que.33. The speed of the sound wave is 450 m s^{-1}. Find the frequency of the wave, if the wavelength is 2.5 cm. Will it be audible?

Ans. The speed of sound = 450 m/sec

Wavelength of sound = 0.025 m

Frequency of the wave = $\frac{Speed\ of\ Sound}{Wavelength}$

= 18000 Hz

It is audible as it lies between the audible range of 20 Hz to 20000 KHz.

Que.34. From a tower whose height 600 m, a stone is dropped into a pond which is at the base of the tower. When will the person at the top of building hear the splash of water? The gravity is 20 ms^{-2} and the speed of sound is 400 ms^{-1}.

Ans. The total distance = 600 m.

Acceleration due to gravity = 20 ms^{-2}

Initial velocity = 0 ms^{-1}

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

600 = 0 x t + $\frac{1}{2}$ x 20 x t^2

60 = t^2

t = 7.75 sec.

The time taken by the stone to reach the pond is 8 sec.

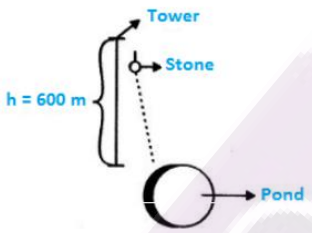
The speed of sound is 400 m/s

The time taken to cover the distance = $\frac{600}{400}$ = 1.5 s.

The total time taken = 7.75s + 1.5s

= 9.25s

The splash is heard at the top of the building after 9.25 sec.



Que.35. If the frequency of sound is 200 Hz, then how many times does it vibrate in a minute?

Ans. The frequency of sound = 200 Hz

Total time taken = 60 s

By formulae, Frequency = $\frac{Number\ of\ oscillations}{Time\ Taken}$

∴ Total number of vibrations in a minute = v x t

= 200 x 60

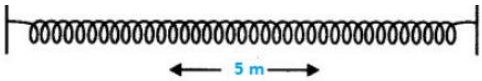
= 12000 times

Que.36. Choose the correct answer:

(i) A slinky spring stretches and comes back in 5 sec whose length is 5 m. What is the velocity of the wave?

(a) 10 m/s (b) 5 m/s (c) 2m/s (d) 25 m/s

Ans. (c) 2 m/s



(ii) Sounds which are loud can travel large distance, due to

(a) higher energy (b) high speed (c) high amplitude (d) high frequency

Ans. (d) high frequency

(iii) The characteristic which distinguishes the sound having same pitch and loudness is (a) tone (b) timber (c) pitch (d) note

Ans. (d) note

(iv) Speed of sound is based on

(a) pressure of medium (b) temperature of medium (c) medium temperature and pressure (d) temperature of source

Ans. (c) medium temperature and pressure

(v) The sound frequency, wavelength and speed are related by

(a) u = s x v (b) u = s/v (c) s = u x v (d) v = s x u

Ans. (a) u = s x v

(vi) What must be the time period between the original sound and the reflected sound for an echo to be heard distinctly?

(a) 0.2 s (b) 1 s (c) 0.1 s (d) 2 s

Ans. (c) 0.1 s

(vii) The sound reverberation is used in

(a) trumpets (b) stethoscope (c) megaphone (d) all the above

Ans. (d) all the above

(viii) Children till the age of 5 can hear upto:

(a) 20 KHz (b) 25 Hz (c) 20 Hz (d) 25 KHz

Ans. (c) 20 Hz

(ix) Dolphins, bats and porpoise uses

(a) infrasound (b) ultrasound (c) both a & b (d) none of these

Ans. (b) ultrasound

(x) The conversion of electrical signals from sound vibrations is done by which part of the human ear?

(a) Stirrup (b) Hammer (c) Cochlea (d) Tympanic membrane

Ans. (C) cochlea

Que.37. What is the nature of sound waves?

Ans. Sound waves are longitudinal in nature.

Que.38. Give the relation between frequency and time period of a sound wave.

Ans. The relation is that time period is inversely proportional to sound.

v = 1/T

Where, v = frequency

T = Time period

Que.39. Sound travels faster in which of the following medium: air, water or steel?

Ans. Sound travels faster in solids as compared to liquids and gases. Hence, sound travels faster in steel.

Que.40. Among the following which has the higher pitch – the sound of a drum or that of a whistle?

Ans. The sound of the whistle has higher pitch as the frequency of the sound from whistle is higher as compared with that of a drum.

Que.41. Explain pitch.

Ans. Pitch is described as how high or low the sound is. Pitch is directly proportional to frequency.

Que.42. What is one Hz?

Ans. Hertz (Hz) is the unit of frequency. It is equal to one cycle per second.

Que.43. What is speed of sound?

Ans. It is the distance travelled by the sound per unit time due to compression and rarefaction.

Que.44. What is note of sound?

Ans. The sound produced due to the combinations of different frequencies is called as note. The sound which is produced is pleasant to hear.

Que.45. For an time period of 0.005 seconds, what is the frequency of wave?

Ans. Given: Time period = 0.005

Frequency = $\frac{1}{Time\ Period}$

= $\frac{1}{0.005}$

= 200 Hz

Que.46. For a sound wave, what is its time period?

Ans. The time interval between two consecutive compressions or rarefaction of the sound wave is known as its time period.

Que.47. For an echo to be heard, what should be the minimum distance?

Ans. For an echo to be heard, the minimum time period between the source of sound and the reflected one should be 0.1 sec.

Que.48. Explain reverberation.

Ans. The persistence of sound due to the repeated reflection of sound is known as reverberation.

Que.49. What is SONAR?

Ans. SONAR – Sound Navigation and Ranging. It is a device which is used to detect the underwater objects and to measure the distance, speed and direction using ultrasonic waves.

ultrasonic waves.

Que.50. Explain ultrasonic and infrasonic sound waves.

Ans. Ultrasonic waves are sound waves whose frequencies are greater than 20000 Hz and are above the audible range of humans.

Infrasonic waves are sound waves whose frequencies are less than 20 Hz and are below the audible range of humans.

Que.51. Explain medium and give any two examples.

Ans. Sound can be transmitted through a substance or material and this material through which the sound is transmitted is known as medium. It can be solid, liquid or gas. Examples are metal, water and air.

Que.52. Define wave-motion

Ans. The particles in the medium sets the neighboring particles into motion, when a wave of disturbance travels through the medium. The particles in the medium does not gets displaced but only the disturbance is carried forward.

Que.53. Define sonic boom.

Ans. Shock waves are produced in air, when an object attains a supersonic speed. There is large change in air pressure due to this and this is called sonic boom.

Que.54. When the distance increases, the sound faints. Why is that?

Ans. Sound is a kind of energy and as it moves away from source, its amplitude decreases, so does its loudness. In the medium, the energy gets transformed into vibration of particles.

Que.55. Sound waves are sometimes called longitudinal. Why is that?

Ans. It is so, because when the sound propagate through the medium, then the particles are vibrating in the direction which is parallel to the direction of propagation.

Que.56. Distinguish between a longitudinal and a transverse wave.

Ans. Longitudinal wave – They need a medium for propagation and the particles in the medium travel in the direction which is parallel to the direction of propagation of the disturbances.

Transverse wave – It either uses a medium for propagation or it does not require a medium. The particles of the medium travel in the direction which is perpendicular to the direction of propagation of disturbance.

Que.57. Describe crest and trough.

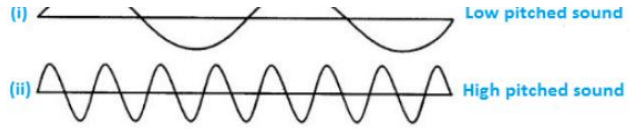
Ans. When a sound wave travels in a particular direction, the peak is called as crest and the valley is called as the trough of a wave.

Que.58. Define the velocity of sound and explain why sound travels faster in summer than in winter.

Ans. Velocity of sound is defines as the speed of sound in a given medium, at a given temperature. When the temperature is increased, the speed of sound also increases and therefore sound travels faster in summer than in winter.

Que.59. Using graphical representation, draw low pitched sound and high pitched sound.

Ans.



Que.60. Give any two applications of echo of sound.

Ans.

(i) SONAR which is used to detect the objects which are under water.

(ii) The walls and ceilings of a concert hall are curved so that the reflection of sound reaches all corner of the hall.

Que.61. In a time period of 3 minutes, a sound wave causes the density of air to oscillate 1400 times. What is the frequency and time period of the wave?

Ans. Frequency = $\frac{1400}{3\times60}$

= 7.7 Hz

We know that time period is inversely proportional to frequency

T = $\frac{1}{Frequency}$

= $\frac{1}{7.7}$

= 0.129 s

Que.62. What are the uses of ultrasound?

Ans. Uses of ultrasound:

(a) The cracks and flaws in metal blocks are detected using ultrasound.

(b) It is used to image the internal organs and also detects abnormalities in the organ. It is known as ultrasonography.

(c) It is used in SONAR in ships which is used to detect the objects under water.

Que.63. What is the distance of the seabed from the ship if the speed of ultrasound in water 1634 m/s and the time interval is 4.32 s.

Ans. Ultrasonic speed in water = 1634 m/s

Time interval = 4.32 s

Distance travelled by the ultrasound = 2 x depth of sea = 2d

2d = Speed of sound x time

= 1634 x 4.32

= 7058 m

d = $\frac{7058}{2}$

= 3529 m

The distance of the ship from the sea board is 3529 m.

Que.64. What is tone, note and noise?

Ans. Tone: A single frequency of sound is called tone.

Note: The sound which is produced due to combination of different frequencies is called a note

Noise: The sound which is very unpleasant to hear or listen is known as noise.

Que.65. Give the relation between wavelength, speed and frequency of sound.

Ans. Speed is defined as the distance travelled by a wave per unit time.

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

$v = \frac{\lambda}{T}$

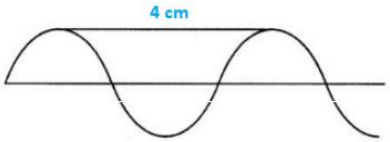
Frequency is inversely proportional to time period.

$Frequency = \frac{1}{Time\ Period}$ $v = \lambda \times \nu$

Speed = Wavelength x Frequency

Que.66. In 5 seconds, a sound produces 15 crests and 20 troughs. The time interval between the two crest is 4 cm. Calculate the frequency, the wavelength and the wave speed.

Ans.



(a) Wavelength is the distance between two consecutive crests or troughs which is 4 cm.

(b) Frequency = $\frac{Number\ of\ troughs}{Time}$

= $\frac{20}{5}$

= 4 Hz

(c) Wave speed = $\frac{Distance}{Time}$

Distance travelled by the wave = 20 x 4 = 80 cm

Time = 5 s

∴ Wave speed = $\frac{80}{5}$

= 16 cm/s

Que.67. A sound travels in air at a speed of 430 m/s. what is the wavelength of the sound in air which is produced by a source of 30 KHz? When the same source is put in a water tank, find the wavelength of the sound waves in water. Given that the speed of sound in water is 1640 m/s.

Ans. Speed of sound in air = 430 m/s

Frequency = 30 KHz = 30 x 10^3

Wavelength = ?

Speed = Wavelength x Frequency

$v = \lambda \times \nu$ $\lambda = \frac{v}{\nu}$

= $\frac{430}{30 \times 10^3}$

= 0.014 m

Speed of sound in water =1640 m/s

Frequency = 30 x 10^3

Speed = Wavelength x frequency

Wavelength = $\frac{Speed}{Frequency}$

= $\frac{1640}{30 \times 10^3}$

= 0.054 m

Que.68. A person who is watching Dussehra celebrations sees the effigy of Ravana burst into flames and the explosion is heard at a delay of 5 sec. calculate how far he was from the effigy if the speed of sound was 435 m/s.

Ans. Speed of sound = 435 m/s

The delay in time period = 5 sec

Distance of the source = ?

By formulae, Speed = $\frac{Distance}{Time}$

Distance = Speed x Time

= 435 m/s x 5 s

= 2175 m

The effigy was burnt at a distance 2175 m away from the person.

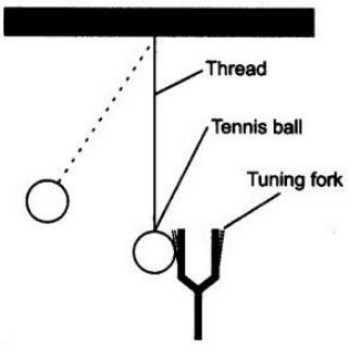
Que.69. Take a tuning fork and by striking it on the rubber pad, set the tuning fork into vibration. Bring it near your ear.

Do you hear any sound?

Now, suspend a small plastic ball by a thread from a support. Touch the ball gently with the prong of a vibrating tuning fork.

Observe what happens.

Ans.



Yes, the sound is heard.

The ball gets displaced from its initial position and starts to move.