

Answer the following questions:

PART ONE: CIRCLE

1. Velocity
2. $V = 2d/t$
3. Sonometer
4. Ultrasonic waves
5. Frequency
6. Infrasound
7. Dog
8. 300 m
9. All of them



PART TWO

Fill in the blank space with a suitable term.



1. Longitudinal
2. Sound waves
3. Medium
4. Slower, Fastest
5. Vacuum
6. Reflection
7. Echo
8. Hearing aid, Stethoscope
9. Frequency
10. Timber or Quality
11. 20Hz to 20kHz
12. Low/ High
13. Resonance
14. Standing Waves

PART THREE:DIRECT QUESTIONS

Question 1

Name the three characteristics of sound,

Answer:

1. Loudness
2. Pitch
3. Quality or Timber



Question 2

Name the characteristic which helps us distinguish between a man's voice and a woman's voice, even without seeing them

Answer:

Pitch helps us to distinguish between man and woman voice even without seeing them.



Question 3

How does pitch of a sound depend on frequency?

Answer:

This depends on the frequency of vibration of the waves. If the frequency of vibration is higher, we say that the sound is shrill and has a high pitch. On the other hand, if the sound is said to have a lower pitch then it has a lower frequency of vibration.



Question 4

Name the act of sound which depends on

- a) Amplitude
- b) Frequency
- c) Waveform



Answer:

- (a) The characteristic of sound which depends on amplitude is loudness.
- (b) The characteristic of sound which depends on frequency is pitch.
- (c) The characteristic of sound which depends on waveform is timber.

Question 5

Which property of sound leads to the formation of echoes?

Answer:

The property which leads to the formation of echoes is reflection of sound. When a sound is repeatedly reflected and if minimum distance between sound sources and reflecting surface is more than 17m, then we hear echoes.



Question 6

State two conditions necessary for the formation of echo.

Answer:

1. The minimum distance between the source of sound and the reflecting body should be 17 meters.
2. The intensity of sound should be sufficient so that it can be heard after reflection.



Question 7

Name that part of ear which vibrates when outside sound falls on it.

Answer:

Ear-drums of ear vibrate when outside sound falls on it.



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Question 8

Name three tiny bones present in the middle part of ear.

Answer:

The middle ear contains three tiny bones known as the ossicles: malleus, incus, and stapes.



Question 9

What name is given to the repetition of sound caused by the reflection of sound waves?

Answer:

The repetition of sound caused by reflection of sound waves is called echo.



Question 10

Why is the voice of children, men and women different?

Answer:

The voices of men, women and children differ from each other due to the following factors:

- (i) The pitch is one of the most essential factors to determine the voice of the individual. For example, men have lower-pitched voices while women have higher-pitched voices.
- (ii) Second factor which brings in the difference in the voices is the length and the thickness of vocal cords.

Shorter the vocal cord, more is the frequency and hence more shrill is the voice.



Question 11

What is the name of the device used to find the depth of sea (or ocean) by using ultrasonic sound waves!

Answer:

Sonar is a device used to find the depth of a sea through ultrasonic sound waves.



Question 12

What name is given to the sound waves of frequency too low for humans to hear?

Answer:

Infrasound, sometimes referred to as low-frequency sound, describes sound waves with a frequency below the lower limit of audibility (generally 20 Hz).



Question 13

What name is given to the sound waves of frequency too high for humans to hear?

Answer:

Ultrasound, sometimes referred to as high-frequency sound, describes sound waves with a frequency above the Upper limit of audibility (generally 20 kHz).



Question 14

An echo is heard by a radar in 0.08sec . If velocity of radio waves is $3 \times 10^8 \frac{m}{s}$. How far is the enemy plane?



Solution:

Time = $t = 0.08$ sec

Velocity of radio waves = $v = 3 \times 10^8 \frac{m}{s}$

Distance = $d = ?$

$$2d = v \times t$$

$$d = \frac{v \times t}{2} = \frac{3 \times 10^8 \times 0.08}{2} = 1.2 \times 10^7 \text{ m}$$

Question 15

What do you understand by the term pitch of sound?

Answer:

Pitch of sound depends on its frequency that is the number of vibrations produced per second by the body.



Question 16

What is ultrasound? What is the difference between ordinary sound and ultrasound?

Answer:

The sound wave with the frequency above 20,000 Hz is called ultrasound.

The ordinary sound wave has the frequency from 20 Hz to 20,000 Hz, Whereas the ultrasound wave has the frequency above 20,000 Hz.



Question 17

Write any three applications (or uses) of ultrasound.

Answer:

1. Ultrasounds can be used to detect cracks and flaws in metal blocks.
2. Ultrasound is used to see the growth of the fetus inside the mother's uterus.
3. Ultrasound is used to detect the problems of liver and kidney.



Question 18

What are infrasonic waves? Name two animals which produce infrasonic waves?

Answer:

Infrasonic are vibration of frequency less than 20 Hz. Whales and elephants produced infrasonic.



Question 19

What are ultrasonic waves? Name two animals which can produce ultrasonic waves?

Answer:

Sound waves of frequencies greater than 20,000 Hz are called ultrasonic waves. Porpoises and bats produce ultrasonic waves.



Question 20

How is the pitch of sound related to the frequency of a vibrating body?

Answer:

The pitch of the sound we hear depends on the frequency of the sound wave. A high frequency sound wave has a high pitch, and a low frequency sound has a low pitch



Question 21

What do you understand by the term loudness of sound?

Answer:

The sensation produced in the ears which enables us to distinguish between a faint sound (feeble sound) and a loud sound 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.



Question 22

A radar sends to an aero plane at a distance 45km away with a speed of $3 \times 10^8 \frac{m}{s}$.

After how long is the signal received back from the aero plane?

Solution:

Distance = $d = 45 \text{ km} = 45000 \text{ m}$

Speed = $v = 3 \times 10^8 \frac{m}{s}$.

$$2d = v \times t$$

$$t = \frac{2d}{v} = \frac{2 \times 45000}{3 \times 10^8 \frac{m}{s}} = 3 \times 10^{-4} \text{ seconds}$$



Question 23

When can an echo be heard faster? On a hot or a cold day? Give reasons for your answer

Answer:

During a hot day an echo is heard sooner. The speed of sound is high when the temperature is high, so on a hot day an echo is heard faster.



Question 24

A man stands in between two parallel cliffs and explodes a cracker. He hears the first echo after 0.6s and second echo after 2.4s. Calculate the distance between the cliffs. Take speed of sound to be 336m/s.



Solution:

Let A and B be two cliffs at distance d_1 and d_2 metre from a man.



$$d_1 = \frac{v \times t}{2} = \frac{336 \times 0.6}{2} = 100.8 \text{ m}$$

$$d_2 = \frac{v \times t}{2} = \frac{336 \times 2.4}{2} = 403.2 \text{ m}$$

Total distance = 100.8 + 403.2 = 504 m

Question 25

An enemy plane is at a distance of 300km from a radar. In how much time will the radar be able to detect the plane? Take velocity of radio waves as ?



Solution:

Distance = $d = 300\text{km} = 300000 \text{ m}$

Velocity of the radio wave = $v = 3 \times 10^8 \text{ m/s}$

Time = $t = ?$

$$t = \frac{2d}{v} = \frac{2 \times 300,000}{3 \times 10^8} = 2 \times 10^{-3} \text{ sec}$$

Question 26

A drummer hits a cymbal and 10s later hears the echo of the sound from a distant mountain. How far away was the mountain?

Solution:

Time = $t = 10$ sec

Speed of sound = $v = 340$ m/s

Distance = $d = ?$

$$d = \frac{v \times t}{2} = \frac{340 \times 10}{2} = 1700 \text{ m}$$



Question 27

A fishing boat uses a sonar to detect a shoal of fish. A short pulse of sound waves is emitted from the boat and the echo from the shoal is detected 0.1 s later. The waves travel through sea water at 1500 m/s. How far below the boat is the shoal of fish?



Solution:

Time = $t = 0.1$ sec

Speed = $v = 1500$ m/s

$$d = \frac{v \times t}{2} = \frac{1500 \times 0.1}{2} = 75 \text{ m}$$

Question 28

The echo of a sound is heard after 5 seconds. If the speed of sound in air is 342 m/s calculate the distance of the reflecting surface.

Solution:

Time = $t = 5$ sec

Speed = $v = 342$ m/s

$$d = \frac{v \times t}{2} = \frac{342 \times 5}{2} = 855 \text{ m}$$



Question 29

What is meant by reflection of sound?

Answer:

When after hitting a hard surface sound bounce back, this is known as reflection of sound.



Question 30

State the laws of reflection of sound.

Answer:

The laws of reflection of sound are:-

1. The normal, incident wave and the reflected wave all lie on the same plane at the point of incidence.
2. The angle of incidence of sound is always equal to the angle of reflection.



Question 31

How will you verify laws of reflection experimentally?

Answer:

It is given in the book.



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Question 32

Name any two objects which are good reflectors of sound.

Answer:

Metal sheet and hard wood are good reflector of sound.



Question 33

What is an echo? How is echo formed ?

Answer:

The repetition of sound wave caused by the reflection of sound wave is called echo. For an echo to happen it requires a hard surface like a tall brick wall or cliff to bounce the sound back.



Question 34

What is reverberation? Give two examples of reverberation.

Answer:

The repeated reflection of sound that causes its persistence until it is reduced to an inaudible value is called reverberation.

1. Sound bouncing around in a large speaker.
2. The impact of a no trespassing law at a shopping center on students at a nearby high school.



Question 35

What is sonar? State its principle. How is it used to find the depth of sea?



Answer:

SONAR stands for Sound Navigation And Ranging. It is a device used to measure the distance, direction and speed of underwater. **Sonar** works on the **principle** of echoes.

Working: SONAR is an acronym for Sound Navigation and Ranging. A beam of ultrasonic sound is produced and transmitted by the transducer (it is a device that produces ultrasonic sound) of the SONAR, which travels through sea water. The echo produced by the reflection of this ultrasonic sound is detected and recorded by the detector, which is converted into electrical signals. The distance (d) of the under-water object is calculated from the time (t) taken by the echo to return with speed (v) is given by $2d = v \times t$. This method of measuring distance is also known as 'echo-ranging'.

Question 36

A man standing 825 meters away from a cliff (steep rock) fires gun. After how long will he hear its echo? Speed of sound in air is 330 m/s.

Solution:

Time = t = ?

Distance = d = 825 m

Speed = v = 330 m/s

$$t = \frac{2d}{v} = \frac{2 \times 825}{330} = 5 \text{ sec}$$



Question 37

What is reverberation? What will happen if the reverberation time in a big hall is too long?

Answer:

Due to the repeated reflection from the walls, and ceiling a persistence sound is produced which is known as reverberation. When the reverberation time is too long in a big hall, the sound becomes confusing due to overlapping of sounds.



Question 38

How can reverberations in a big hall or auditorium be reduced?

Answer:

Following are some of the methods to reduce the reverberation in a big hall or auditorium:-

- 1) Sound absorbing materials should be used to make panels for the walls of the hall.
- 2) To absorb sound and reduce the reverberation carpets are used on the floor.
- 3) To absorb sound heavy curtains should be used on the doors and windows.
- 4) Materials with sound absorbing properties should be used for making seats.



Question 39

Why do we hear more clearly in a room with curtains than in a room without curtains?

Answer:

Curtains are poor reflector of sound and hence they absorb most of the sound falling on them. Due to this it do not let echo to occur. On the other hand echo occurs in the room without curtains. So we hear more clearly in a room with curtains then a room without curtains.



Question 40

What is the frequency range of hearing in humans?

Answer:

The frequency range of hearing in humans is from 20Hz to 20,000 Hz.



Question 41

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



Solution:

For a sound wave,

$$v = f \times \lambda$$

(i) For $f = 20\text{Hz}$

$$v = f \times \lambda$$

$$\lambda = \frac{v}{f} = \frac{344}{20} = 17.2 \text{ m}$$

(ii) For $f = 20,000 \text{ Hz}$

$$\lambda = \frac{v}{f} = \frac{344}{20,000} = 0.0172 \text{ m}$$

Hence, for humans, the wavelength range for hearing is 0.0172 m to 17.2 m.

Question 42

Which of the following sound frequencies cannot be heard by a human ear?

- (i) 10 Hz
- (ii) 100 Hz
- (iii) 10,000 Hz
- (iv) 15 Hz
- (v) 40,000 Hz

Answer:

- (i) 10 Hz (cannot hear)
- (ii) 100 Hz (can hear)
- (iii) 10,000 Hz (can hear)
- (iv) 15 Hz (cannot hear)
- (v) 40,000 Hz (cannot hear)



Question 43

If 5 seconds elapse between a lightning flash and the clap of thunder, how far away is the storm? (Speed of sound = 330 m/s)

Solution:

Time = $t = 5$ sec

Distance = $d = ?$

Speed = $v = 330$ m/s

$$d = v \times t = 330 \times 5 = 1650 \text{ m}$$



Question 44

Find the intensity level of sound at:

a) $10^{-10} \frac{W}{m^2}$

Solution:

$$I = 1 \times 10^{-10} \frac{W}{m^2}$$

$$dB = 10 \log_{10} \left(\frac{I}{I_0} \right)$$

where $I_0 = 1 \times 10^{-12} W/m^2$ is the threshold intensity of hearing.

$$dB = 10 \log_{10} \left(\frac{1 \times 10^{-10}}{1 \times 10^{-12}} \right) = 100 \text{ dB}$$

b) $7 \times 10^{-7} \frac{W}{m^2}$

Solution:

$$I = 7 \times 10^{-7} \frac{W}{m^2}$$

$$dB = 10 \log_{10} \left(\frac{I}{I_0} \right)$$

where $I_0 = 1 \times 10^{-12} W/m^2$ is the threshold intensity of hearing.

$$dB = 10 \log_{10} \left(\frac{7 \times 10^{-7}}{1 \times 10^{-12}} \right) = 7 \times 10^5 \text{ dB}$$



Question 45

What is the intensity of sound with intensity level of

a) 30dB

Solution:

$$\text{dB} = 10 \log_{10} \left(\frac{I}{I_0} \right)$$

$$30 = 10 \log_{10} \left(\frac{I}{1 \times 10^{-12}} \right)$$

$$\frac{30}{10} = \log_{10}(I) - \log_{10}(1 \times 10^{-12})$$

$$3 = \log_{10}(I) + 12$$

$$\log_{10}(I) = 3 - 12 = -9$$

$$I = 10^{-9} = 1 \times 10^9 \text{ W/m}^2$$

b) 75 dB

Solution:

$$\text{dB} = 10 \log_{10} \left(\frac{I}{I_0} \right)$$

$$75 = 10 \log_{10} \left(\frac{I}{1 \times 10^{-12}} \right)$$

$$\frac{75}{10} = \log_{10}(I) - \log_{10}(1 \times 10^{-12})$$

$$7.5 = \log_{10}(I) + 12$$

$$\log_{10}(I) = 7.5 - 12 = -4.5$$

$$I = 10^{-4.5} = 3.16 \times 10^{-5} \text{ W/m}^2$$



Question 46

An open pipe is suddenly closed with the result that the second overtone at the closed pipe is found to be higher in frequency by 100Hz than the first overtone of the original pipe. What is the fundamental frequency of the open pipe? $V=340\text{m/sec}$



Solution:

Let L be the length of pipe.

frequency of first overtone, when the pipe is open, $f_1 = \frac{v}{L}$

frequency of second overtone, when the pipe is closed,

$$f_3 = \frac{5v}{4L}$$

given, $f_1 + 100 = f_3$,

$$\text{or } \frac{v}{L} + 100 = \frac{5v}{4L}$$

$$\text{or } \frac{v}{4L} = 100$$

$$\text{or } L = \frac{v}{400}$$

therefore fundamental frequency of open pipe will be,

$$f = \frac{v}{2L} = \frac{v}{2\left(\frac{v}{400}\right)} = 200 \text{ Hz}$$

Question 47

The fundamental frequency of a closed pipe is 300Hz. What are the first three overtones?

Solution:

Given $f = 300\text{Hz}$

$$f_n = \frac{nv}{4L} \text{ OR } f_n = nf$$

For 1st overtone $n = 3$

$$f_3 = nf = 3 \times 300 = 900\text{Hz}$$

For 2nd overtone $n = 5$

$$f_5 = nf = 5 \times 300 = 1500\text{Hz}$$

For 3rd overtone $n = 7$

$$f_7 = nf = 7 \times 300 = 2100\text{Hz}$$



Question 48

A band has produced an intensity level 110 dB. What is the sound intensity?

Solution:

$$\text{dB} = 10 \log_{10} \left(\frac{I}{I_0} \right)$$

$$110 = 10 \log_{10} \left(\frac{I}{1 \times 10^{-12}} \right)$$

$$\frac{110}{10} = \log_{10}(I) - \log_{10}(1 \times 10^{-12})$$

$$11 = \log_{10}(I) + 12$$

$$\log_{10}(I) = 11 - 12 = -1$$

$$I = 10^{-1} = 0.1 \text{ W/m}^2$$





Question 49

If the speed of sound is 340 m/s what is then wavelength of a note of frequency:

- (i) 340 Hz,

Solution:

$$\lambda = \frac{v}{f} = \frac{340}{340} = 1m$$

- (ii) 170 Hz

Solution:

$$\lambda = \frac{v}{f} = \frac{340}{170} = 2m$$

Question 50

Suppose a train that has a 150-Hz horn is moving at 35.0 m/s in still air on a day when the speed of sound is 340 m/s.



- (a) What frequencies are observed by a stationary person at the side of the tracks as the train approaches and after it passes?
- (b) What frequency is observed by the train's engineer traveling on the train?

Solution:

For this Question , we will define some parameters

V_L = Velocity of listner
 V_S = Velocity of source
 V = Velocity of sound
 f = Actual frequency
 f' = Apparent frequency

(a) When train approaches

$$f' = \frac{V - V_L}{V - V_S} \times f$$

CHAPTER EXERCISE

SOUND WAVES CHAPTER 3

$$f' = \frac{340-0}{340-35} \times 150 = 167.2 \text{ Hz}$$

When train passes

$$f' = \frac{340 - 0}{340 + 35} \times 150 = 136 \text{ Hz}$$



- (b) When Engineer is on the train, so velocity of listener and source are same.

i.e. $V_L = V_S$

$$f' = \frac{V - V_L}{V - V_L} \times f$$

$$f' = \frac{V - V_L}{V - V_S} \times 150 = 1 \times 150 = 150 \text{ Hz}$$

Question 51

A company operates a quarry near local housing. People living near this quarry complained about the noise levels. The company then built an earth barrier to reduce the noise levels that reached the houses

This is shown in the diagram below



- (a) (i) State what is meant by noise.

The Unwanted sound that is unpleasant to ear is called noise.

Why is it important to reduce noise?

Noise pollution can negatively impact the body in significant ways, including elevated blood pressure, impaired cognitive functioning, and other effects of chronic stress. The following are effective strategies you can use to limit the negative impact of noise pollution and safeguard your health and happiness

- (iii) Describe how the barrier reduced noise levels at the houses.

A noise barrier (also called a soundwall, noise wall, sound berm, sound barrier, or acoustical barrier) is an exterior structure designed to protect inhabitants of sensitive land use areas from noise pollution.

Question 52

A microphone is setup to record and display the sound of two single notes made by a loudspeaker, the sound are displayed on an oscilloscope which shows the sound as transverse waves.



Describe and explain the difference between two sounds made. Use the two oscilloscope traces to help you.

Answer:

1. Wavelength of wave 2 is shorter than wave 1.
2. Amplitude of wave 2 is greater than wave 1.
3. Frequency of wave 2 is greater than wave 1.

Question 53



- (a) What is the relationship between the frequency of a sound wave and the pitch of the sound?
- (b) The foghorn emits sound waves with a frequency of 160Hz. The speed of sound is 340 m/s.
- (i) State the equation linking wave speed, frequency and wavelength.

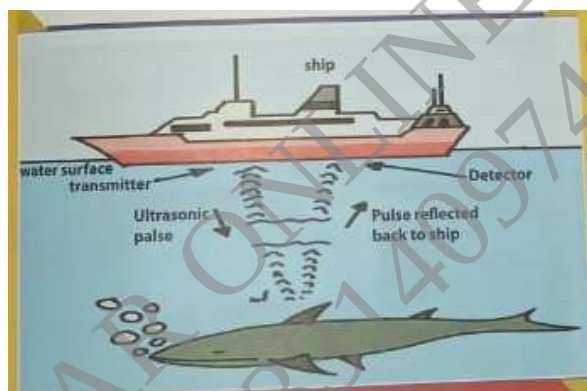
$$v = f \times \lambda$$

- (ii) Calculate the wavelength of these sound waves.

$$\lambda = \frac{v}{f} = \frac{340}{160} = 2.125 \text{ m}$$

Question 54

The diagram shows a ship using an echo locator (SONAR) to find a shoal of fish. The pulsed waves is transmitted from the ship, which is then reflected off the top of the shoal and is then picked up by the receiver.



The time taken to receive the echo is 0.2 s after transmission. Calculate the deep ship has to lower its fishing nets to catch the top of the shoal.

Solution:

Time = $t = 0.2$ sec

Distance = $d = ?$

Velocity = $v = 340$ m/s

$$d = \frac{v \times t}{2} = \frac{340 \times 0.2}{2} = 34 \text{ m}$$