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S3 New Curriculum Physics

Theme: waves

Chapter 5 – Sound waves



Sound waves

Sound is a form of energy produced by vibrating objects.

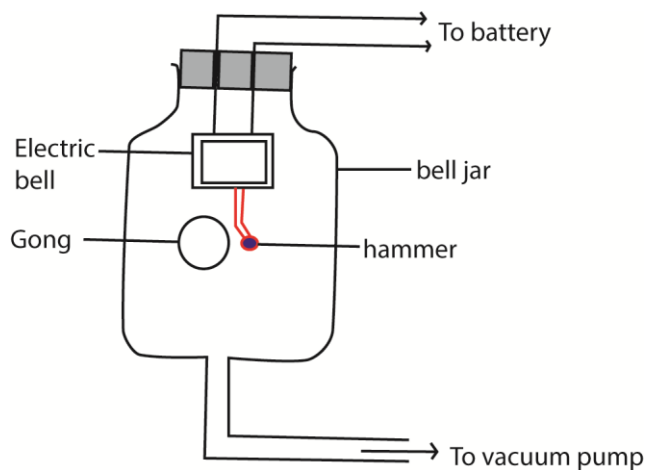
Production

Sound is produced by vibrating objects. Vibrating objects cause nearby surrounding air molecules to vibrate. When these vibrating air molecules reach our ear, sensation of sound is produced. A sound wave is a longitudinal wave

Propagation of sound

Sound waves need a material medium for transmission so that the vibrating objects cause the nearby molecules of the medium to vibrate. Sound travels at a speed of 343ms^{-1} .

Experiment to show that sound needs a material medium for the transmission



1. **Switch on the electric bell:** Switching on the electric bell, a loud sound is heard
2. **Removal of air gradually:** On gradually removing the air by a vacuum pump, the loudness of sound gradually dies away.
3. No sound is heard when all the air has been completely removed though the hammer is seen hitting the gong.

This shows sound waves need material medium like air, liquid or solid for transmission.

The speed of sound waves depends on:-

- (i) Temperature.
- (ii) Density and elasticity of the medium.
- (iii) Wind in the case of air.

How each factor affects the speed of sound waves?

Density: The speed of sound waves is higher in denser medium than in less denser medium; thus, the speed of sound is higher in solids than in liquids and gases because solids are generally more denser. In a steel rod the speed of sound is about 5000ms^{-1} yet in water the speed of sound is 1500ms^{-1} because steel is denser than water.

In daily life, an approaching train can easily be detected by human ears positioned close to the rails than in air. This is explained from the fact that sound waves travel faster through solids than through air as solids are generally denser than air. So sound waves from an approaching train travel faster and over longer distances before dying away in solid like rails than air.

Temperature: Increasing the temperature, increases the speed of sound in air greatly because the speed of vibrating air molecules increases with temperature. However in solids and liquids, increasing the temperature, decreases the speed of sound waves because solids and liquids become less dense.

Wind in the case of air: The speed of sound waves increases if the direction of sound wave travel is the same as that of the wind. If the direction of sound waves travel is opposite that of wind, the speed decreases.

Note: Pressure change in air (gases) does not affect the speed of sound wave because density of air is not affected by change in pressure,

- a) Experiment to measure the speed of sound (echo method)
Two people one claps and the other records the time, while standing at a known distance from a high wall. The time taken for the sound wave to travel to and from the wall is recorded.

The exercise is repeated many times so that the average time is obtained.

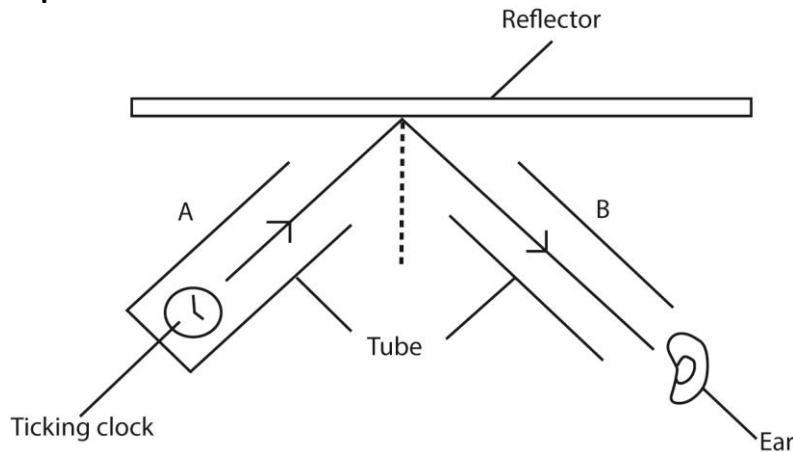
$$\text{Speed of sound} = \frac{2 \times \text{distance}}{\text{Average time}}$$

Reflection of sound

Laws of reflection of sound waves state:-

- i) Incident sound wave, reflected sound wave and the normal at the point of incidence all lie in the same plane,
- ii) The angle of incidence of sound waves is equal to angle of reflection of sound waves.

Experiment to show reflection of sound waves



- (a) Producing sound waves: Sound waves produced by the clock at the end of tube A are reflected at the hard surface reflector.
- (b) Moving tube B: The ear is put at the end of the tube B and the tube B is moved until the ticks of the clock are loudest. This is the direction of reflected sound wave.

Note: Hard surfaces reflect sound waves while soft surfaces absorb sound waves.

ECHOES

An echo is reflected sound waves

Echoes are produced by the reflection of sound from a hard surface. Echoes are often heard in the neighbourhoods of large houses, high walls, cliffs etc.

Echoes are often heard in the big churches, halls etc. They are not heard in a small room or class-room because the reflected sound waves return very quickly and mix up with the original sound wave.

Echoes are troublesome in lecture halls, cinema etc. To reduce echoes in such places, the walls are covered with soft thick porous materials.

Furniture and people in halls also reduce echoes. So many echoes are produced in empty halls compared to one filled with people because bodies of people are soft so they absorb some of the sound.

Reverberation

If the reflecting surface is nearer, the echo joins the original sound which then seems to become prolonged. This is called reverberation.

To some degree, reverberation is desirable in concert halls to stop the hall sounding dead so that hearing in such places is improved.

However, too much reverberation causes confusion.

The time taken by

of particular intensity of sound to die away is the reverberation time.

For echo

$$\text{Velocity} = \frac{2 \times \text{distance}}{\text{time taken}}$$

Example 1

A man stands at a distance of 990m away from a tall building and makes a loud sound. He hears the echo after 6 seconds. Calculate the speed of sound.

$$\text{For echo: Speed} = \frac{2 \times \text{distance}}{\text{time taken}} = \frac{2 \times 990}{6} = 330 \text{ms}^{-1}$$

Example 2

A man stands between two walls, but nearer one of them and makes a loud sound. If he hears the third echo after 6 seconds, calculate the distance between the two walls, (speed of sound in air is 330ms^{-1}).

$$V = 330 \text{ms}^{-1} \quad d = ? \quad t = 6 \text{ seconds}$$

$$\text{Velocity} = \frac{2d}{t}$$

$$330 = \frac{2 \times d}{6}$$

$$d = 330 \times 3 = 990 \text{m}$$

Example 3

A sound of frequency 150Hz is produced 45m away from a cliff. Calculate the

(i). wavelength

From $V = \lambda f$

$$\lambda = \frac{v}{f} = \frac{330}{150} = 2.3 \text{m}$$

(ii). Time it takes the sound wave to travel to and from the cliff (speed of sound in air = 300ms^{-1}).

$$\text{Time} = \frac{\text{distance to and fro}}{\text{speed}} = \frac{45 \times 2}{300} = 0.27 \text{s}$$

Example 4

A man stands between two cliffs and makes a loud sound. If he hears the first echo after 1.5s and second echo after 2s, find the distance between the two cliffs. Speed of sound in air is 300ms^{-1} .

Diagram to be drawn

$$\text{Using Velocity} = \frac{2 \times \text{distance}}{\text{time taken}}$$

First echo

$$t = 1.5\text{s}$$

$$V = 300\text{ms}^{-1}$$

$$X = ?$$

$$V = \frac{2X}{t}$$

$$300 = \frac{2X}{1.5} \quad 300 = \frac{2Y}{2}$$

$$X = \frac{300 \times 1.5}{2} = 225\text{m}$$

Second echo

$$t = 2\text{s}$$

$$V = 300\text{ms}^{-1}$$

$$Y = ?$$

$$V = \frac{2Y}{t}$$

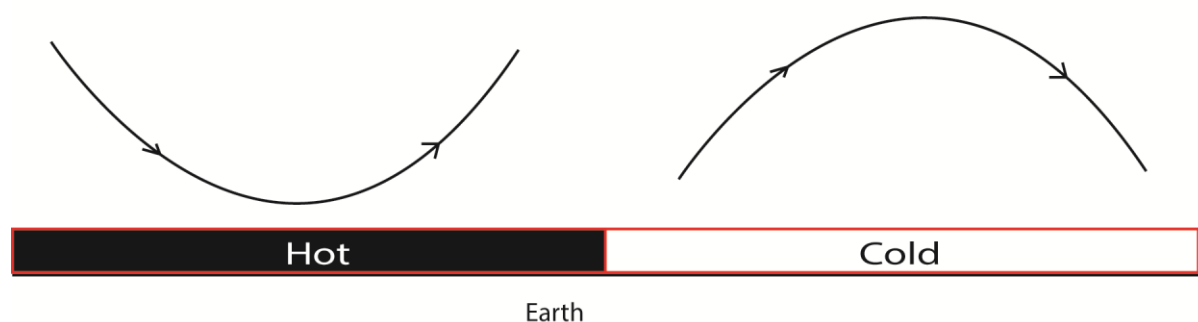
$$Y = \frac{300 \times 2}{2} = 300\text{m}$$

Distance between the two cliffs = $225 + 300 = 525\text{m}$

Refraction of sound waves

Refraction of sound waves occurs when the speed of the wave changes as it moves from one medium to another of different density. The speed of sound waves in air is affected by the air temperature. When sound waves pass through layers of air at different temperature they are refracted i.e. turned into another direction. On a hot day sound waves are bent upwards away from the earth where they otherwise travel faster.

During day sound waves bend away from hot earth At night sound waves bend toward colder earth



In the evening when the air near the ground becomes cool, refraction of sound is towards the earth, making it easier to hear distant sound as the range of sound is more.

Radios are clearer at night than during day because at night the sound waves are bent down towards the cool earth making the range of sound more.

Ultrasonic

Sound waves with frequencies above 20 kHz are called ultrasonic waves. They are emitted by bats. Sound of high frequency that human ear cannot detect is described as ultrasonic.

Applications of ultrasonic sound

- (i) Ultrasonic enable bats to judge the distance of an object from the time taken by the reflected wave to return.

- (ii) Ultrasonic are used in spectacles for blind to judge distances of an object from the time taken by reflected waves to return. Such spectacles contain ultrasonic sender and receiver.
- (iii) In sonar (echo-sounding system) of ships use ultrasonic wave to measure the depth of sea and to detect shoals of fish.
- (iv) In industry, ultrasonic waves are used to reveal flaws in welded joints and also holes are cut in glass and steel by ultrasonic drills.

Note:

In an echo sounder (sonar, ultrasonic waves are used because they:-

- (i) Cannot be confused with engine sound and other sound made ship,
- (ii) Can penetrate sea water to a large distance without undue loss of energy.
- (iii) They are not much detracted.

Frequency and audio frequency range.

The human ear has a range of sound frequencies which it can hear. The lowest limit of audibility is about 30Hz and the upper limit audibility for most people is between 20 kHz and 30 kHz.

In daily life, a dog is more able than a human being to detect the presence of a thief tiptoeing at night. A thief tiptoeing at night produces sound of low frequency that can only be detected by dog ears not human being ears because the dog has wider ears than human being ears.

Musical notes

Musical notes are regular vibrations of sound waves.

Properties of musical notes

Musical notes have three properties namely:
Pitch, loudness and quality

Pitch

A pitch is the sharpness or mildness of the soft musical note. A pitch is directly proportional to the frequency in that high frequency gives high pitch (sharper note).

A high pitched note has high frequency and short wavelength.

A pitch Produced by a string instrument depends on the nature of the string, length and tension acting of the string.

Shorter strings and high tension produce sound of higher frequency than long strings of low tension

Loudness and intensity

The intensity or loudness of sound depends on the amplitude of the vibration in that a loud note has a large amplitude while a quiet note has a small amplitude.

A mother and child may both shout a note of the same frequency but the note from a mother is louder because the amplitude of the sound wave made by the mother is larger so a greater mass of air is set into vibration.

In general, the greater the mass of air which can be set into vibration the louder will be the sound. The prongs of a vibrating tuning fork, make a small mass of air vibrate. So the sound is soft. However if the end of the fork is placed on a table the sound is much louder because a large mass of air in contact with surface of the table is set into vibration.

A violin string directly produces soft sound because very little air is set into vibration as the violin has small surface area.

When the same violin string is attached to a sounding box a much louder sound is produced because the large surface area of the sounding box results in large mass of air to vibrate as the box vibrates,

The sound from a telephone earpiece is heard distinctly only when the ear is placed close to the earpiece because the vibrating circular metal plate inside has a small area so only a small mass of air is set into vibration.

A loud sound may be heard from a small transistor set or a television set because the loud speaker has a vibrating cone with relatively large surface area so a large mass of air in contact is set into vibration.

Intensity of sound

The intensity of sound is the rate of flow of energy per unit area perpendicular to the direction of sound. Intensity is proportional to;

- i) The square of the amplitude,
- ii) The square of the frequency
- iii) The density of the medium

Loudness of sound

Loudness depends on;-

- i) The varying pressure exerted on the eardrum by the sound,
- ii) The sensitivity of the ear to the different frequencies,
- iii) The sound intensity.

Loudness of sound is the sensation of a note in the mind of an individual.

Quality or tone (timbre) of a musical note

The same note on different instruments sounds different, the notes are said to differ in quality or timbre. The difference arises because no instruments except a tuning fork and single generator can emit a pure note i.e. of one frequency but they produced notes consisting of main or fundamental frequency mixed with overtones.

Overtone have frequencies that are exact multiples of the fundamental. The number and strength of overtones determines the quality of a note.

A violin has more and stronger higher overtones than a piano.

Waves in strings and pipes

Factors on which the frequency of a wave in a vibrating string depend

- Length of the string.
- Tension in the string.
- Mass per unit length of the string.

A stationary wave can be set up in a string which has both ends fixed.

Resonance

Resonance occurs when a body or system is set into vibrations with its own natural frequency by a nearby body or system vibrating with the same frequency.

The vibrations combine to produce a larger vibration with larger amplitude.

Thus, resonance occurs when a body is set into vibration with its own natural frequency by another nearby body which vibrates with the same frequency.

Exercise

1. Which of the following statement is true?
 - A. Light wave, radio waves and sound waves will all travel through a vacuum.
 - B. Light waves and radio waves will travel through vacuum, sound waves will not.
 - C. Light waves and sound waves will travel through vacuum, radio waves will not
 - D. Sound waves and radio waves will travel through vacuum, light waves will not
2. Sound waves
 - A. Do not pass through vacuum
 - B. Travel through solids at lower speed than in air
 - C. Do not travel through liquids
 - D. Travel in at the highest speed in air
3. Which one of the following does not change when waves travel from deep to shallow water?
 - A. Frequency
 - B. Amplitude
 - C. Velocity
 - D. Wavelength
4. Which of the following statements is true about the wave travelling from one medium to another
 - (i) Its frequency and wavelength change
 - (ii) Its frequency and velocity change

- (iii) Its velocity and wavelength change
 (iv) Only its frequency remain unchanged
 A. (i) only B. (i) and (ii)only C. (i), (ii), (iii) only **D. (iii) and (iv) only**
5. Which of the following statements is true about sound waves?
 (i) They are longitudinal
 (ii) They are transverse
 (iii) They are produced by vibration
 (iv) They can travel in empty space
 A. (ii) and (iv) only **B. (i) and (iii) only** C. (i), (ii) and (iii) only D. (iv) only
6. Which of the following are not electromagnetic wave?
 A. X-ray
 B. Radar waves
 C. Microwaves
D. Sound waves
7. Which of the following are transverse waves only?
 A. Radio waves, sound waves, ultraviolet
B. Ultra violet, x-ray, water
 C. Infrared, sound and gamma
 D. Sound waves, ultraviolet, x-ray
8. A boy standing 150m from a vertical cliff claps his hand and hears an echo 0.85 seconds later. Find the speed of sound in air.
 A. 128ms^{-1} B. 176ms^{-1} C. 255ms^{-1} **D. 353ms^{-1}**

$$v = \frac{D}{t} = \frac{150 \times 2}{0.85} = 353\text{ms}^{-1}$$
9. In sound waves the particles of the medium
 A. Are stationary
 B. Move along with the wave
C. Vibrate in the same direction as the wave
 D. Vibrate at right angle to the direction of a wave
10. What would occur when a body is made to vibrate with its natural frequency due to external vibration?
 A. Echo
B. Resonance
 C. Refraction
 D. reverberation
11. A man standing 85m from tall wall fires a gun and hears and echo from the wall after 0.5s. calculate the speed of sound in the air
 A. **340ms^{-1}** B. 170ms^{-1} C. 85ms^{-1} D. 43ms^{-1}

$$V = \frac{D}{t} = \frac{85 \times 2}{0.5}$$

12. A source produces waves which travel a distance of 140cm in 0.08s, if the distance between successive crests is 20cm, find the frequency of the source.

- A. 0.875Hz B. 8.750Hz **C. 87.500Hz** D. 8750Hz

$$V = \frac{D}{t} = \frac{1.4}{0.08} = 17.5ms^{-1}$$

$$f = \frac{v}{\lambda} = \frac{17.5}{0.2} = 87.5Hz$$

13. A man sees the flash from a gun fired 1020m away and then later hears a bang. How long does the bang take to reach him? (Take the speed of sound as 340ms⁻¹)

- A. $\frac{1020s}{340 \times 10}$ B. $\frac{340s}{1020}$ **C. $\frac{1020s}{340}$** D. (340 x 1020)s

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

14. The velocity of sound in air at constant pressure

- A. increases with loudness
B. Decreases with loudness
C. Increases with temperature
D. Decreases with temperature

15. sound is produced by a source vibrator at a frequency of 50Hz. Given that the speed is 330ms⁻¹ in air, its wavelength is

- A. 0.15m B. 6.6m C. 380m D. 16500m

$$\lambda = \frac{v}{f} = \frac{330}{50} = 6.6m$$

16. In force vibration, resonance occurs

- A. Frequency is equal to the natural velocity
B. Velocity is equal to natural velocity
C. Frequency is equal to natural frequency
D. Frequency exceeds natural frequency

17. A man standing in front of a tall wall makes a loud sound and hears the echo after 1 ½ s. how far is he from the wall if the velocity of sound in air is 330ms⁻¹.

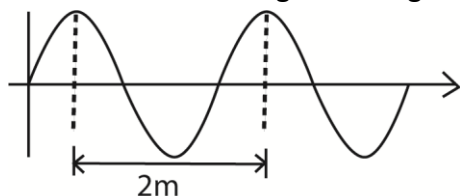
- A. 110m **B. 247.5m** C. 440m D 990m

$$\text{Distance} = (\text{velocity} \times \text{time})/2 = (330 \times 1 \frac{1}{2})/2$$

18. The number of vibrations a wave makes per second is the

- A. frequency** B. wavelength C. period D. amplitude

19. The figure shows a wave produced in a string. If the frequency is 2Hz, at what speed do waves travel along the string



- A. 0.5ms⁻¹ B. 1.0ms⁻¹ C. 2.0ms⁻¹ D. 4.0ms⁻¹

$$\text{Velocity } v = f\lambda = 2 \times 2 = 4.0\text{ms}^{-1}$$

20. A vibrator produces a sound that travels 900m in 3 seconds. If the wavelength of the wave is 10m, find the frequency of vibrator.

- A. 30Hz B. 270Hz C. 300Hz D. 3000Hz

$$\text{Velocity} = \frac{\text{distance}}{\text{time}} = \frac{900}{3} = 300\text{ms}^{-1}$$

$$\text{Frequency, } f = \frac{\text{velocity}}{\text{wavelength}} = \frac{300}{10} = 30\text{Hz}$$

21. A longitudinal wave is one in which the

- A. Direction of propagation is parallel to that of vibration producing it
B. Particles of a medium through which it travels move in opposite direction to the direction of propagation
C. Direction of propagation is perpendicular to that of vibration producing it.
D. Particles of the medium through which it travels move together with it.

22. The basic difference between transverse and longitudinal waves is in

- A. Amplitude
B. Wavelength
C. Direction of vibration
D. Medium through which the waves travel

23. The sound waves produced by a vibrating tuning fork is longitudinal because the air vibrates

- A. The same direction as that in which the prongs vibrate
B. A direction opposite to that in which the wave is travelling
C. The same direction as that in which the wave is travelling
D. The opposite direction to that in which the prongs vibrate
A

24. An echo sounder in a boat emits a pulse of sound which returns 0.2s later after reflection from the sea bed. If sound travels at 1500ms^{-1} in sea water, how deep is water?

- A. 7500m B. 600m C. 300m D. 150m

$$\text{Depth} = \frac{\text{Speed} \times \text{time}}{2} = \frac{1500 \times 0.2}{2} = 150\text{m}$$

25. All electromagnetic waves

- A. Highly penetrate matter
B. Produce ionization in gases
C. Cause heating effect when absorbed by matter
D. Do not require any material medium for transmission.

26. Which of the following affects the frequency of vibrating string

- A. Tension and length
B. Length and mass of the string
C. Mass per length of string and temperature
D. Tension and velocity of sound

27. Sound waves travel a distance of 48cm in 8s. If the separation between successive compressions is 3.0cm, find the frequency of the waves.

- A. 0.5Hz **B. 2.0Hz** C. 18.0Hz D. 128.0Hz

$$\text{Velocity} = \frac{\text{Distance}}{\text{time}} = \frac{48}{8} = 6.0 \text{ cm s}^{-1}$$

$$\text{Wavelength} = 3.0 \text{ cm}$$

$$\lambda = \frac{\text{velocity}}{\text{wavelength}} = \frac{6}{3} = 2 \text{ Hz}$$

28. Describe a simple echo method of determining the speed of sound in air.

- ✓ Clap at such a rate that each clap coincides with the echo from a tall wall a distance D from the experimenter.
- ✓ Using a stop clock, measure the time, t, for a given number of claps, n.
- ✓ Average time for one clap = $\frac{t}{n}$ is the time taken for the wave to travel from experimenter to the wall and back
- ✓ The velocity of sound in air = $\frac{2D}{t/n} = \frac{2nD}{t}$

29. (a) What is an echo?

Echo is reflected sound

(a) (i) Describe an experiment to measure the speed of sound in air.

- Measure a distance X in meters from a point of experiment to a tall wall more than 17.5m
- Make a sharp clapping sound by bringing two blocks of wood together at such an interval that each clap coincides with its echo.
- Using a stop clock determine time, t, for 20 claps
- Velocity of light $v = \frac{2x}{\frac{t}{20}} = \frac{40x}{t} \text{ ms}^{-1}$
-

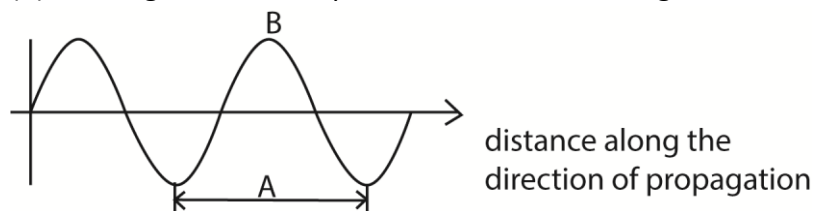
(i) State the probable source of error in this experiment.

- From timing
- Variation of speed of sound with change in temperature, humidity and wind

30. (a) What is meant by a transverse wave?

Is one in which particles in a medium vibrate perpendicular to the direction of travel of the wave.

(b) the diagram below represents a wave travelling in water



- (i) Name part labelled B
crest

- (ii) If distance represented by λ is 20cm and the speed of the wave is 8.0ms^{-1} .
What is the speed of a wave?

$$f = \frac{v}{\lambda} = \frac{8}{0.2} = 40\text{Hz}$$

31. (a) state three differences between sound and light waves

Sound wave	Light waves
<ul style="list-style-type: none"> - Need material medium for propagation - Propagate at relatively low speed - Have longer wavelength - Particles vibrate in direction is same direction as that of a wave 	<ul style="list-style-type: none"> - Can propagate in vacuum - Propagate as very high speed - Shorter wavelength - Particles vibrate perpendicular to the direction of travel of the wave.

(b) (i) explain how stationary wave is formed

When two waves of the same frequency, equal wavelength and equal amplitude are propagating in the same medium in opposite direction they meet and superpose; the resultant displacement of particles in medium at any point is the sum of displacements due to each of the waves at that point.

(ii) State three main characteristics of a wave

- Amplitude of a wave varies from place to place along the profile.
- Wave energy is not transmitted along the profile.
- At certain points called nodes, the particles are permanently at rest
- Has nodes and antinodes.

(c) (i) Define the terms frequency and wavelength as applied to sound.

(ii) Describe an experiment to demonstrate resonance in sound.

(d) The velocity and frequency of sound in air at a certain time were 320ms^{-1} and 200Hz respectively. At later time, the air temperature changed and velocity of sound in air was found to be 340ms^{-1} . Determine the change in wavelength of sound.

32. (a) What is meant by sound?

Sound is a form of energy that travels in form of longitudinal waves from one point to another than enable us to hear.

(b) Describe an experiment to show that sound waves require a material medium for transmission.

Electric bell hung from rubber bands inside a bell jar is used.

- A loud sound is heard when the bell is switched on
- When air is removed, the sound disappear

(c) Explain the following

(i) A dog is more able than human beings to detect the presence of a thief tiptoeing at night

A tip toeing thief produced low frequency (ultrasonic) sound which cannot be detected by human but can be detected by dog's ears

- (ii) An approaching train can easily be detected by human ears placed close to the rail.

Because sound travels faster in solids than in air.

- (d) A sound of frequency 250Hz is produced 120m away from a high wall.

Calculate

- (i) Wavelength
(ii) Time it takes sound wave to travel to and from the wall (speed of sound in air = 320ms^{-1})

33. (a) What is reverberation?

Reverberation is when echo joins up with original sound which seems a prolonged sound and occurs when the reflecting surface is less than 15m from the source.

- (a) State two factors which affect frequency of a vibrating string

Length of string

Tension of string

- (b) A sound wave of frequency 440Hz has a velocity 330Hz. Calculate its wavelength.

$$\lambda = \frac{v}{f} = \frac{330}{440} = 0.75\text{m}$$

34. (a) (i) Define an echo?

An echo is reflected sound

- (ii) State one application of echoes

- Measurement of velocity of sound in air
- In medicine field to give an image of internal structure of the body
- In speaking tubes to send messages from one point to another
- In Radar aerials to send out radio waves into space

- (iii) State the conditions required for a standing wave to be formed.

The two waves should have the same frequency and nearly equal amplitude moving in opposite direction

- (a) List the factors on which the frequency of vibrating string depends

- Tension in string
- Length of string

- (b) A child stands between two cliffs and makes loud sound. If he hears the first echo after 1.5s and the second echo after 2.0s. find the distance between the two cliffs (speed of sound in air = 320ms^{-1})

$$\text{Distance} = (\text{velocity} \times \text{time})/2 = (320 \times 1.5 + 320 \times 2)/2 = 560\text{m}$$

35. (a) What is an echo?

Echo is reflected sound.

(b) An echo sounder on a boat send down a pulse through the water and receives its echo 0.9s later. Calculate the water depth. (speed of sound in water = 1450ms^{-1})

$$\text{Depth} = \frac{1}{2}vt = \frac{1}{2} \times 1450 \times 0.9 = 652.5\text{m}$$

(c) State two factors which determine the frequency of a note produced when a guitar string vibrates. (1mark)

- Tension in string
- Length of the string

36. (a) State any two difference between sound and light waves.

Sound waves	Light waves
Are longitudinal	Are transverse
Slow	Fast
Do not travel n vacuum	Travel in vacuum

(b)(i) Describe a simple experiment to determine the velocity of sound in air.

- A long glass tube is filled with water.
- A tuning fork of frequency f is sounded and held close to the open end of the tube.
- Water in the tube is slowly drained until a loud sound is heard.
- Length, L , of the air column is measured
- The velocity of sound $v = 4Lf$.

(ii) Explain why the speed of sound is higher in solids than air.

The molecules of solids are closely packed, hence vibrations are easily transmitted from one atom to another, than in air.

(c) Two people X and Y, stand in a line at a distances of 330m, and 660m respectively from high wall. Find the time interval taken for X to hear the first and second sounds when y makes a loud sound. (speed of sound in air = 330ms^{-1})

$$\text{Time taken to hear first sound} = \frac{\text{distance}}{\text{velocity}} = \frac{330}{300} = 1\text{s}$$

The second sound is an echo is heard when travel 660m or 330 to and fro

$$\text{Time} = \frac{\text{distance}}{\text{velocity}} = \frac{660}{300} = 2\text{s}$$

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Thanks

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