UNIT 11

SOUND

After studying this unit, the students will be able to:

- Recognize the physical properties of sound and the ear's physical and psychological responses to it (hearing/listening).
- Recognize the acoustic/audio values of sound waves (pitch, volume, and quality/timbre).
- Define the term pitch, volume and quality of sound.
- Recognize the sound waves (frequency, pitch, loudness and the effect of overlapping frequencies and pitch).
- Recognize the sound waves (pitch and quality).
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- Sketch their notes, in a notebook.
- Recognize the sound waves (pitch and quality).
- Describe the characteristics of acoustic perfection.
- Recognize the sound waves (pitch and quality) and respond to the unit.

1) What are sound waves? What is the necessary condition for the production of sound?

Answer

We often use the word to describe something audible. But it is identical to the word sound. Sound is a mechanical wave that requires a medium to propagate. Sound waves are created by the movement of a solid, a liquid or a gas. Sound waves can be described by three properties:

Our ears hear sounds in the range of 20 Hz - 20 kHz.

Fig 1.1 Frequency Range of Human Hearing

Amplitude

Amplitude of an sound wave, human heart beats and deviations of other organs are all mechanical phenomena. Sound waves are mechanical waves. Amplitude is the

Amplitude is the distance from a point on the wave to the equilibrium position.

Frequency

A sound wave consists of a series of compressions and rarefactions. Frequency is the number of compressions per second. The unit of frequency is Hertz (Hz). Frequency is the number of compressions per second. The unit of frequency is Hertz (Hz).

Speed

Sound waves are created by the movement of a solid, a liquid or a gas. Sound waves are created by the movement of a solid, a liquid or a gas. The speed of sound is dependent on the medium in which it is produced. The speed of sound is dependent on the medium in which it is produced.

2) Why does sound travel faster in solids than in air?

Answer

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4) What is the difference between pitch and quality?

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MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the following choices:

i) Which of the following is an example of simple harmonic motion?

a) Motion of a simple pendulum **b)** The motion of ceiling fan

c) The spinning of the Earth on its axis **d)** A bouncing ball on a floor

ii) If the mass of the bob of a pendulum is increased by a factor of 3, the period of the pendulum's motion will:

a) be increased by a factor of 2 **b)** remain the same

c) be decreased by a factor of 2 **d)** be decreased by a factor of 4

iii) Which of the following devices can be used to produce both a transverse and longitudinal wave?

a) a string **b)** a ripple tank

c) a helical spring (slinky) **d)** a tuning fork

iv) Waves transfer:

a) Energy **b)** frequency

c) wavelength **d)** velocity

v) Which of the following is a method of energy transfer?

a) Conduction **b)** Radiation

c) Wave motion **d)** All of these

vi) In a vacuum all electromagnetic waves have the same:

a) Speed **b)** frequency

c) amplitude **d)** wavelength

vii) A large ripple tank with a vibrator working at a frequency of 30 Hz produces 25 complete waves in a distance of 50cm. The velocity of the wave is:

a) 53 cms^{-1} **b)** 60 cms^{-1}

c) 750 cms^{-1} **d)** 1500 cms^{-1}

viii) Which of the following characteristics of a wave is independent of the others:

a) speed **b)** frequency

c) amplitude **d)** wavelength

ix) The relation between v, f and λ of a wave is:

a) $vf = \lambda$ **b)** $f\lambda = v$

c) $v\lambda = f$ **d)** $v = \frac{\lambda}{f}$

Answers

(i) a **(ii)** b **(iii)** c **(iv)** a **(v)** d **(vi)** a

(vii) b **(viii)** a **(ix)** b

Conceptual Questions

10. 1 If the length of a simple pendulum is doubled what will be the change in its time period?

Answer

Let the initial length of simple pendulum is ' l ', and after making it double, it becomes

' l ', i.e. $l' = 2l$.

Time period of simple pendulum is given by,

$$T = 2\pi\sqrt{\frac{l}{g}} \quad \text{.....(1)}$$

And $$T' = 2\pi\sqrt{\frac{l'}{g}}$$

Or $$T' = 2\pi\sqrt{\frac{2l}{g}}$$

$$T' = \sqrt{2}\left[2\pi\sqrt{\frac{l}{g}}\right]$$

Where, $$2\pi\sqrt{\frac{l}{g}} = T$$

So, $$T' = \sqrt{2}T$$

$$T' = 1.41T$$

It shows that the time period of simple pendulum will increase by 1.41 times by making the length double.

10. 2 A ball is dropped from a certain height onto the floor and keeps bouncing. Is the motion or the ball simple harmonic? Explain.

Answer

No, in case of a bouncing ball, when it hits the floor then there will be no restoring force or acceleration opposite to the downward displacement. So, it does not fulfil the condition of simple harmonic motion. Secondly, in case of bouncing ball, the acceleration due to gravity remains the same, while for SHM the acceleration should vary at different points during the motion of the body.

10. 3 A student performed two experiments with a simple pendulum. He/She used two bobs of different masses by keeping other parameters constant. To his/her astonishment the time period of the pendulum did not change! Why?

Answer

Time period of simple pendulum only depends upon the length of simple pendulum as given in its formula, i.e.

$$T = 2\pi\sqrt{\frac{l}{g}}$$

The value of 'g' will remain constant up to a certain height. So, by changing mass of the bob or amplitude, there will be no effect on the time period, of simple pendulum.

10. 4 What type at waves do not require any material medium for their propagation?

Answer

Mechanical waves: like sound waves, water waves, waves produced in strings or springs etc.

10. 5 Plane waves in the ripple tank undergo refraction when they move from deep to shallow water. What change occurs in the speed of the waves?

Answer

In case of plane waves in the ripple tank when refraction takes place while moving from deep to shallow water. The speed of the wave is decreased due to decrease in wave length while frequency remains the same, as given by wave equation below.

$$v = f\lambda$$

Review Questions

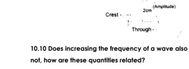
10. 2 Think of several examples in our daily life of motion that are simple harmonic?

Answer

1. Pendulum used in a clock.
2. A boy swinging on a swing.
3. See-saw: when his moved up & down.
4. Human ear drum oscillating back & forth.

10. 6 Draw a transverse wave with an amplitude of 2cm and a wavelength of 4cm. Label a crest and trough on the wave.

Answer



10.10 Does increasing the frequency of a wave also increase its wave length? If not, how are these quantities related?

Answer

No, by increasing frequency, the wave length decreases as given by the following relation,

$$v = f\lambda$$

Or $$f = \frac{v}{\lambda}$$

Or $$f \propto \frac{1}{\lambda} \quad \text{(for constant value of velocity)}$$

[Note: The answer of the remaining questions is given in the topics.]

OBJECTIVE TYPE QUESTIONS & ANSWERS

Q. What are thermocouples

Is the sound a produced?

Answer

Sound is form of energy, which is presented by a vibrating body.

Whenever a sound is produced, the vibrations of the sounding body cause an disturbance in air.

Q. What is tuning fork?

Answer

Tuning fork is used for the purpose for producing a pure note of a particular frequency.

A tuning fork has U-shaped prongs with a stem at the bottom when one strike a tuning fork it vibrates and produce 512 hertz pure note of the tuning fork is produced.

Q. What is the nature of sound?

Answer

Sound is a longitudinal pressure wave. During rarefaction, molecules are spaced out and during compression they are pushed together and produce compressed wave.

The accounting, Fitness compensational wrote one called sound waves. Power source found that it is produced by a vibrating.

Q. In sound waves sound isolated is that propagation?

Answer

Sound waves are longitudinal waves in the form of compressions, sound waves can travel through solids, liquids and gases and unlike, it means that is isolated is transmitted in the atmosphere of sound waves.

Q. 1 K HZ EQUAL 2 YEARS AGO IS SAID TRUE WHY

Answer

A sound depends on the frequency of a sound wave. It is a sound wave with greater frequency than another. Hence 1 K HZ sound is said to be 2 years old.

Q. What is the main function of speakers?

Answer

The speakers are used to convert the sound waves into electrical signals. Speakers are used in the telephone, radio, television and other sound reproducing. The speakers are the opposite of microphones.

Q. Does hardness of a sound depend on the physical condition of the ear?

Answer

No, hardness of a sound does depend on the physical condition of the ear of the listener.

A sound depends in the density of a medium with which it travels. Sound is a wave with different frequency.

Q. Differentiate between loudness and intensity of sound.

The intensity depends on sound energy and the amplitude of the sound wave. It is the rate of flow of sound energy.	Sound intensity depends on the amplitude of the sound wave. It is the rate of sound energy flow per unit area.
It is not a physical quantity.	It is a physical quantity.
It cannot be measured directly. It is measured indirectly.	It can be measured accurately.
It depends on the condition of the listener.	It does not depend on the condition of the listener.
It depends on the frequency of the sound.	It does not depend upon the frequency of the sound.

Q. Find the velocity sound of helium at normal condition?

Answer

$$V = \sqrt{\gamma P/\rho} = \sqrt{\gamma RT/M} = \sqrt{\gamma RT/M}$$

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Q. Find the velocity sound of isotopic sulphur?

Answer

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Q. What is sound?

Answer

Sound is a disturbance of a medium which is a kind of wave. Sound is a form of energy that is produced by a vibrating body.

Example: The vibration of tuning fork is a form of sound.

Q. What is a wave of sound?

Answer

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Q. What is a wave of sound?

Answer

The mechanical disturbance of a medium which travel in form of waves is called the sound.

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The position of the same wave crossing of the position of the medium is measured in a called compression.

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Q. Do sou a sustainer vibrating but is sound is from, TRUE

Answer

Sound waves are produced by a vibrating body but are not heard but their vibrations are felt. Therefore, the sounds are produced by a vibrating substance are called.

Q. How does the change in temperature affect the velocity of sound?

Answer

Velocity of sound increases by 0.61 m/s for every 1°C rise in temperature.

Q. On what factor the quality 'C' depends?

Answer

The quality of a sound depends on the following factor.

- Number of harmonics and
- Their relative intensities (accompany present in sound)

Q. Differentiate between audible and inaudible sounds.

Answer

Audible sounds are those which can be heard by our ears, are called audible sounds.

Sound waves having frequency range 20 to 20,000 Hz.

Inaudible sounds

These sounds, which cannot be heard by ears are called inaudible sounds.

Sound waves having frequency range less than 20 Hz and more than 20,000 Hz.

Q. What is decibel sound?

Answer

Decibel (dB) is used for measuring the intensity level of sound is known as decibel (dB).

Q. What is the sum of all other?

Answer

Some speakers can BEY HARD TO LIKE which frequency lies between 20 HZ to 20 kHz is called the audible sound and the range sound that is audible frequency range is known as the 20,000 Hz.

Q. Do a sound wave, a mass sound waves, Why?

Answer

Sound waves, like water waves are positive in nature. Sound waves will generally be found in the gases. That is why, in a fluid, sound is faster as it is more dense.

Q. How do we hear a sound?

Answer

Sound waves are a mass vibrations the surroundings. These vibrations are carried out by the air molecules and sound waves from air molecules are transmitted to our ears. Sound waves hitting our eardrum to the inner ear through the passage of the. Hence, the ear drum vibrates and the vibrations are transmitted through the passage of the. Hence, the ear drum vibrates. The vibrations are then converted into electrical impulses and sent to the brain by the auditory nerve.

Q. Formula for finding their deflection/sensitivity of a source.

Answer

The formula for determine the sensitivity of sound wave

- Sound wave of the source
- Sound wave of the receiving source
- Sound wave of the receiving source
- Distance of sound
- Sound wave of the source
- Sound wave of the receiving source

Q. Differentiate between intensity and loudness of a sound.

Answer

Intensity	Loudness
It is the amount of sound energy that passes through a unit area in a unit time. It is the rate of flow of sound energy.	It is the sensation of the listener. It depends upon the condition of the listener.
It is a physical quantity.	It is not a physical quantity.
It can be measured.	It cannot be measured.
It depends upon the frequency of the sound.	It does not depend upon the frequency of the sound.

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Q. Differentiate between pitch and quality of a sound.

Answer

Pitch of a sound depends upon the frequency of the sound.	Quality of a sound depends upon the fundamental frequency and the number of harmonics present.
The number of harmonics and their relative intensities do not affect the pitch of a sound.	The number of harmonics and their relative intensities do affect the quality of a sound.
It is a physical quantity.	It is not a physical quantity.
It can be measured.	It cannot be measured.

Q. What is the relation of a sound with its frequency?

Answer

Velocity of sound depends on the frequency of the sound. It is independent of the frequency. Hence, the pitch of sound is proportional to the frequency.

Q. Give the classification of vibrations.

Answer

Vibrations are classified into two categories, on the basis of the number of times a body vibrates per second, which is called the frequency of the body.

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OBJECTIVE TYPE QUESTIONS & ANSWERS

Q1. Each question is followed by four options encircle the correct option.

1) Sound waves cannot passes through:
a. metals b. air
c. vacuum d. water

2) Sound waves travel faster in:
a wood b. air
c. water d. copper

3) Ultrasonic was having frequency greater than:
a. 20 kHz b. 0.2 kHz
c. 10 kHz d. 5 kHz

4) Sound is a form of energy and it is produced by:
a. air b. vibrating body
c. heating d. water

5) Loudness of sound decreases by increasing
a. no of Vibrations b. amplitude
c. distance from sounding object d. none of these

6) By increasing temperature, the speed of sound:
a. increases b. decreases
c. remains constant d. becomes double

7) The speed of sound at 0°C in air is:
a. 3 x 108 m/s b. 1000 m/s
c. 500 m/s d. 332 m/s

8) Sound energy per unit area per second is called:
a. loudness b. intensity
c. pitch d. frequency

9) The magnitude of the sensation produced on the ear by a sound is known as:
a. intensity b. pitch
c. loudness d. quality

10) Weber Fechner Law is:
a. $I \propto \log I$, b. $L \propto \log I$ c. $L \propto I$ d. $L \propto \frac{1}{\log I}$

11) The unit of intensity level is:
a. watts b. watt m^{-2}
c. Joule d. bel

12) Intensity 1 bel is given by:
a. $K.\log\frac{I}{I_0}$ b. $10\log\frac{I}{I_0}db$ c. $K.\log\frac{I}{I_0}$ d. $K.\log\frac{I^2}{I_0^2}$

13) Decibel is the smaller unit intensity level. 1db is equal to:
a. 0.1 bel b. 10 bel
c. 100 bel d. 0.01 bel

14) The characteristic of sound which depends upon frequency is called:
a. loudness b. pitch
c. quality d. intensity

15) The nitch of women voice as compared with men voice is:
a. equal b. low
c. High d. double

16) Human ear can hear the sound of maximum frequency:
a. 200 Hz b. 2000
c. 20,000 Hz d. 20 Hz

17) Sound level for whisper is equal to:
a. 30 dB b. 20 dB
c. 10 dB d. 0 dB

18) Product of frequency and time period is:
a. 1 b. 0
c. A d. π

19) Frequency of waves having length 2m and velocity 340 m/s is:
a. 1020 Hz b. 680 Hz
c. 340 Hz d. 170 Hz

20) Speed of sound in air at normal temperature and pressure (NTP) is:
a. 330 ms^{-1} b. 672 ms^{-1}
c. 712 ms^{-1} d. 785 ms^{-1}

21) Sound level for ordinary conversion is:
a. 120 dB b. 60 dB
c. 20 dB d. 10 dB

22) The faintest audible sound of intensity is I_0 and its value is:
a. 10^{-8} wm^{-2} b. 10^{-10} wm^{-2}
c. 10^{-12} wm^{-2} d. 1 wm^{-2}

23) The unit 01' relative intensity of sound is:
a. Wm^{-2} b. decibel
c. Joule s^{-1} d. no unit

24) The characteristic of sound by which two sounds of same loudness and pitch are distinguished from each other is called:
a. pitch b. quality
c. loudness d. frequency

25) The sound which has a jarring effect on ear is called:
a. pitcf b. quality
c. noise d. loudness

26) If the frequency and amplitude of the sound changes in regular manner, the sound will be:
a. noise b. musical
c. loudness d. pitch

27) Which of the following waves are produced in resonance tube?
a. transverse waves b. progressive waves
c. stationary waves d. none of these

28) The distance between a node and antinode is:
a. λ
b. λ /2
c. λ/4
d. 3/4 λ

29) Which of the following relation is true between wavelengths of stationary wave find the length of air column in first resonance position?
a. λ =4L b. λ =2L

c. λ =L d. λ =1/2L

30) Headache and hearing loss is caused by sounds having sound level more than:
a. 60 dB b. 120 dB
c. 10 dB d. 80 dB

31) Audible frequency range is:
a. 10 to 1000 Hz. b. 20 to 20,000 Hz
c. above 20 kHz d. below 20 kHz

32) The depth of an ocean is measured by using:
a. stationary waves b. light waves
c. ultrasonic d. lasers

33) What will be the wavelength of sound of frequency 512 Hz, if speed of sound is 340ms^{-1}.
a. 66 cm b. 1.5 m
c. 174080 m^{-1} d. none of these

34) Kidney stones can be crushed and removed out through urine without any surgery by using waves which are called:
a. electromagnetic 1. transverse
c. magnetic 3. ultrasonic

35) The instrument used for producing I sound of particular frequency is:
a. tuning fork A b. fork
c. hammer d. drum

36) Sound waves are _____ in nature.
a. functional b. compression
c. dangerous d. always ultrasonic

37) Which is not a part of ear?
a. outer ear b. inner ear
c. middle ear d. optic nerve

38) Cochlea is present in:
a. outer ear b. inner ear
c. middle ear d. ear drum

39) Loudness of sound depends on:
a. amplitude of vibrating body b. area of vibrating body
c. distance from vibrating body d. all of above

40) Sound energy flowing per second through a unit area held perpendicular to the direction 01' sound waves is called:
a. intensity b. loudness
c. frequency d. pitch

41) The intensity of sound of train is:
a. 1 wm^{-2} b. 10^{-7} wm^{-2}
c. 3 wm^{-2} d. 10^{-4} wm^{-2}

42) If the intensity 01' a sound is 10^{-4} wm^{-2}, then equivalent sound level will be:
a. 70 dB b. 80 dB
c. 90 dB d. 100 dB

43) The characteristic of sound by which a shrill sound can be distinguished from a grave one is called:
a. pitch b. frequency
c. note d. node

44) Select the false statement:
a. flute and pianos are musical instruments
b. a pleasant sound is called noise
C. the change in frequency and amplitude of noise is sudden & irregular
d. sound produced by hammering is noisy

45) Which statement is not true?
a. Dogs can hear between 20,000 hertz to 25,000 hertz
b. young children can hear sounds of 20,000 hertz
c. old people cannot hear sound above. 15,000 hertz
d. human ear can hear less than 20 hertz

46) Which is not the use of ultrasonic?
a. in finding sex of the body b. in removing blood clot from arteries
c. in crushing stones in kidney d. in ciinematography

47) When the sound waves reach near the ear drum it starts:
a. vibrating b. losing
c. sounding d. resonating

48) If I= 1 wm^{-2}, then its corresponding intensity level is:
a. 1 dB b. 0 dB
c. 120 dB d. 60 dB

49) Ultrasounds are used for:
a. scaling of teeth b. crushing kidney stones
c. measuing depth of oceans d. all are true

50) Loudness of sound depends upon:
a. amplitude b. area of vibrating surface
c. direction of wind d. all are true

ANSWERS

No.	Ans.	No.	Ans.	No.	Ans.	No.	Ans.
1	c	2	d	3	a	4	b
5	c	6	a	7	d	8	b
9	c	10	b	11	d	12	c
13	a	14	b	15	c	16	c
17	b	18	a	19	d	20	a
21	b	22	c	23	d	24	b
25	c	26	b	27	d	28	c
29	a	30	b	31	b	32	c