EXERCISE. 7 (A)

Question 1:
Define following terms in relation to a wave:
(a) amplitude (b) frequency (c) wavelength and (d) wave velocity

Solution 1:
(a) **Amplitude:** The maximum displacement of the particle of medium on either side of its mean position is called the amplitude of wave. Its S.I. unit is metre (m).

(b) **Frequency:** The number of vibrations made by a particle of the medium in one second is called the frequency of the waves.
It is also defined as the number of waves passing through a point in one second. Its S.I. unit is hertz (Hz).

(c) **Wavelength:** The distance travelled by the wave in one time period of vibration of particle of medium is called its wavelength. Its S.I. unit is metre (m).

(d) **Wave velocity:** The distance travelled by a wave in one second is called its wave velocity. Its S.I. unit is metre per second (ms^{-1}).

Question 2:
A wave passes from one medium to another medium. Mention the property of the wave
(i) which changes, (ii) which does not change.

Solution 2:
(i) Wavelength (or speed) of the wave changes, when it passes from one medium to another medium.
(ii) Frequency of a wave does not change when it passes from one medium to another medium.

Question 3:
State two factors on which the speed of a wave travelling in a medium depends.

Solution 3:
Two factors on which the speed of a wave travelling in a medium depends are:
(i) Density: The speed of sound is inversely proportional to the square root of density of the gas.
(ii) Temperature: The speed of sound increases with the increase in temperature.

Question 4:
State two differences between the light and sound waves.

Solution 4:
(i) The light waves can travel in vacuum while sound waves need a material medium for propagation.
(ii) The light waves are electromagnetic waves while sound waves are the mechanical waves.

Question 5:
What is meant by an echo? What is the condition necessary for an echo to be heard distinctly?

Solution 5:
If a person stands at some distance from a wall or a hillside and produces a sharp sound, he hears two distinct sounds: one is original sound heard almost instantaneously and the other one is heard after reflection from the wall or hillside, which is called echo.

The condition for the echo: An echo is heard only if the distance between the person producing the sound and the rigid obstacle is long enough to allow the reflected sound to reach the person at least 0.1 second after the original sound is heard.

Question 6:
A man is standing at a distance of 12 m from a cliff. Will he be able to hear a clear echo? Give a reason for your answer.

Solution 6:
$t = 2d/V = 2 \times 12/340 = 24/340 < 0.1$ seconds so the man will not be able to hear the echo. This is because the sensation of sound persists in our ears for about 0.1 second after the exciting stimulus ceases to act.

Question 7:
State two applications of echo.

Solution 7:
The applications of echo:
(i) Dolphins detect their enemy and obstacles by emitting the ultrasonic waves and hearing their echo.
(ii) In medical science, the echo method of ultrasonic waves is used for imaging the human organs such as the liver, gall bladder, uterus, womb etc. This is called ultrasonography.

Question 8:
Explain how the speed of sound can be determined by the method of echo.

Solution 8:
Sound is produced from a place at a known distance say, d at least 50 m from the reflecting surface. The time interval t in which the echo reaches the place from where the sound was produced, is noted by a stop watch having the least count 0.01 s. then the speed of sound is calculated by using the following relation

V = total distance travelled / time interval = $\frac{2d}{t}$ m/s

Question 9:
State the use of echo by a bat, dolphin and fisherman.

Solution 9:
Bats, dolphin and fisherman detect their enemies or obstacles or position of fish by emitting/sending the ultrasonic waves and hearing/detecting the echo.

Question 10:
How do bats avoid obstacles in their way, when in flight?

Solution 10:
Bats can produce and detect the sound of very high frequency up to about 1000kHz. The sounds produced by flying bats get reflected back from any obstacle in front of it. By hearing the echoes, bats come to know even in the dark where the obstacles are. So they can fly safely without colliding with the obstacles.

Question 11:
What is meant by sound ranging? Give one use of sound ranging.

Solution 11:
The process of detecting obstacles with the help of echo is called sound ranging. It's used by the animals like bats, dolphin to detect their enemies.

Question 12:
Name the waves used for sound ranging. Why are the waves mentioned by you audible to us?
Solution 12:
The ultrasonic waves are used for the sound ranging. Ultrasonic waves have a frequency more than 20,000 Hz but the range of audibility of human ear is 20Hz to 20,000 Hz

Question 13:
What is sonar? State the principle on which it is based.
Solution 13:
Sonar is sound navigation and ranging. Ultrasonic waves are sent in all directions from the ship and they are received on their return after reflection from the obstacles. They use the method of echo.

Question 14:
Name the waves which are used in sonar to find the depth of a sea. Give one reason for their use.
Solution 14:
Ultrasonic waves are used in the sonar to find the depth of sea because of these waves travel undeviated through long distances.

Question 15:
State the use of echo in medical science.
Solution 15:
In medical science, echo method of ultrasonic waves is used for the imaging of human organs such as liver, gall bladder, uterus, womb; which is called ultrasonography.

MUTIPLE CHOICE TYPE:

Question 1:
The minimum distance between the source and the reflector in air. So that an echo is heard is approximately equal to:

(a) 10 m (b) 17 m (c) 34 m (d) 50 m

Solution 1:

17 m

Explanation: An echo is heard distinctly if it reaches the ear at least 0.1 s after the original sound. If d is the distance between the observer and the obstacle and V is the speed of sound, then the total distance travelled by the sound to reach the obstacle and then to come back is 2d and the time taken is,

t = Total distance travelled/Speed of sound = 2d/V

or, d = V t/2

Putting t = 0.1 s and V = 340 m/s in air at ordinary temperature, we get:

d = (340 x 0.1)/2 = 17 m

Thus, to hear an echo distinctly, the minimum distance between the source and the reflector in air is 17 m.

Question 2:

To detect the obstacles in their path, bats produce:

(a) infrasonic waves (b) ultrasonic waves

(c) electromagnetic waves (d) radio waves

Solution 2:

Ultrasonic waves

NUMERICALS:

Question 1:

The wavelength of waves produces on the surface of water is 20 cm. If the wave velocity is 24 m s^{-1}, calculate: (i) the number of waves produces in one second , and (ii) the time in which one wave is produced.

Solution 1:

(i)Frequency or the number of waves produced per second

= Velocity/Wavelength

= 24 / 20 × 10^{-2}

=120

(ii)Time = 1/ frequency = 1/ 120= 8.3 × 10^{-3} seconds

Question 2:

Calculate the minimum distance in air required between the source of sound and the obstacle to hear an echo. Take speed of sound in air = 350 m s^{-1}

Solution 2:

Velocity = 2D/Time

350 = 2 × D/ 0.1

D = 350 × 0.1 / 2 = 17.5 m

Question 3:

What should be the minimum distance between source and reflector in water so that echo is heard distinctly?

(The speed of sound in water = 1400 m s^{-1})

Solution 3:

Velocity = 2D/Time

1400 = 2 × D/ 0.1

D = 1400 × 0.1/ 2 = 70 m

Question 4:

A man standing 25 m away from a wall produces a sound and receives the reflected sound. (a) Calculate the time after which he receives the reflected sound if the speed of the sound in air is 350 m s^{-1}. (b) will the man be able to hear a distinct echo? Explain the answer.

Solution 4:

(a) Velocity = 2D/Time
Time = 2 × 25 / 350 = 0.143 seconds

(b) Yes, because the reflected sound reaches the man 0.1 second after the original sound is heard and the original sound persists only for 0.1 second.

Question 5:

A radar sends a signal to an aeroplane at a distance 45 km away with a speed of 3×10^8 m s^{-1}. After how much time is the signal received back from the aeroplane?

Solution 5:

Velocity = 2D/Time

3×10^8 = 2 x 45 x 1000/ Time

Time = 90000/ $3 \times 10^8 = 3 \times 10^{-4}$ second

Question 6:

A man standing 48 m away from a wall fires a gun calculate the time after which an echo is heard. (The speed of sound in air is 320 m s^{-1}).

Solution 6:

Velocity = 2 × D/Time

Time after which an echo is heard = 2 D/Velocity = 2 × 48 / 320 = 0.3 seconds

Question 7:

A ship on the surface of water sends a signal and receives it back froma a submarine inside water after 4 s. Calculate the distance of the submarine from the ship. (The speed of sound in water is 1450 m s^{-1})

Solution 7:

2 D = velocity × time

D = (velocity × time) / 2 = 1450 × 4 / 2 = 2900 m = 2.9 km

Question 8:

A pendulum has a frequency of 5 vibrations per second. An observer starts the pendulum and fires a gun simultaneously. He hears echo from the cliff after 8 vibrations of the pendulum. If the velocity of sound in air is 340 m s^{-1}, find the distance between the cliff and the observer.

Solution 8:

5 vibrations by pendulum in 1 sec

So 8 vibrations in 8/5 seconds = 1.6 sec

Velocity = 2 × D/ time

340 = 2 × D/ 1.6

D = 340 × 1.6 / 2 = 272 m

Question 9:

A person standing between the two vertical cliffs produces a sound. Two successive echoes are heard at 4 s and 6 s. Calculate the distance between the cliffs.

(speed of sound in air = 320 m s^{-1})

Solution 9:

The distance of first cliff from the person, 2 × D1 = velocity x time

D1 = 320 × 4 / 2 = 640 m

Distance of the second cliff from the person, D2 = 320 × 6 / 2 = 960 m

Distance between cliffs = D1 + D2 = 640 + 960 = 1600 m

Question 10:
A man fires a gun and hears its echo after 5 s. The man then moves 310 m towards the hill and fires his gun again. This time he hears the echo after 3 s. calculate the speed of sound.

Solution 10:
Distance of hill from the man

D1 = velocity x time/ 2 = v × 5 / 2----------------- (equation 1)

Now, D1 − 310 = v × 3 / 2--------------------------- (equation 2)

By subtracting equation 2 form equation 1 ,we get310 = v x (5/2 − 3/2)

So, v = 310m/s

Question 11:
On sending an ultrasonic wave from a ship towards the bottom of a sea, the time interval between sending the wave and receiving it back is found to be 1.5 s. If the velocity of wave in sea water is 1400 m s^{-1}, find the depth of the sea.

Solution 11:
Depth of the sea = velocity × time/2 = 1400 × 1.5 / 2 = 1050 m

EXERCISE. 7(B)

Question 1:
What do you understand by free vibrations of a body? Give one example.

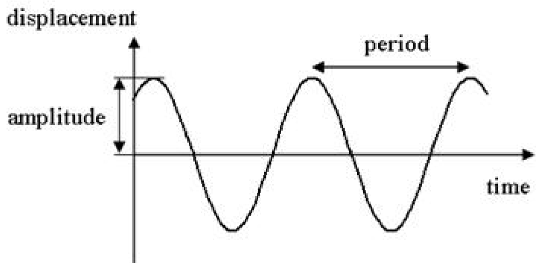
Solution 1:
The vibrations of a body in the absence of any external force on it are called the free vibrations. Eg.: When we strike the keys of a piano, various strings are set into vibration at their natural frequencies.

Question 2:
What is meant by the natural frequency of vibration of a body? On What factors does it depend?

Solution 2:
When each body capable of vibrating is set to vibrate freely and it vibrates with a frequency f. It is the natural frequency of vibration of the body.

The natural frequency of vibration of a body depends on the shape and size of the body.

Question 3:
Draw a graph between displacement from mean position and time for a body executing free vibrations in vacuum.

Solution 3:


Displacement-time graph for the free vibrations

Question 4:
State one condition for a body to execute free vibrations.

Solution 4:
The free vibrations of a body occur only in vacuum because the presence of medium offer some resistance due to which the amplitude of the vibration does not remain constant, but it continuously decreases.

Question 5:
Name one factors on which the frequency of sound emitted due to vibrations in an air column depends.

Solution 5:
The frequency of sound emitted due to vibration in an air column depends on the length of the air column.

Question 6:
State one way of increasing the frequency of a note produced by an air column.

Solution 6:
The frequency of the note produced in the air column can be increased by decreasing the length of the air column.

Question 7:
State two ways of increasing the frequency of vibrations of a stretched string.

Solution 7:
The frequency of vibration of the stretched string can be increased by increasing the tension in the string, by decreasing the length of the string.

Question 8:
What adjustments would you make for tuning a stringed instrument for it to emit a note of a desired frequency?

Solution 8:
A stringed instrument is provided with the provision for adjusting the tension of the string. By varying the tension, we can get desired frequency.

Question 9:
The diagram below in Fig. 7.11 shoes three ways in which the string of an instrument can vibrate.

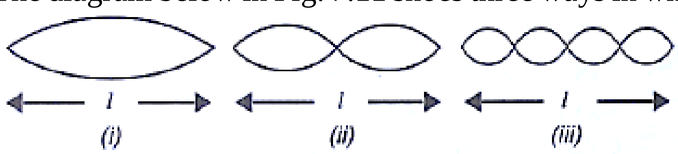


Fig. 7.11

(a) which of the diagram shows the principal note?
(b) which has the frequency four times that of the first?
(c) what is the ratio of the frequency of the vibration in (i) and (ii)?

Solution 9:
(a) (i) Diagram is showing the principal note.
(b) (iii)Diagram has frequency four times that of the first.
(c) Ratio is 1:2

Question 10:
Explain why strings of different thicknesses are provided on a stringed instrument.
[Hint : Natural frequency of vibration of a stretched string is inversely proportional to the radius (or thickness) of string so notes of different frequencies can be produces by vibrating different strings.]

Solution 10:
Strings of different thickness are provided on a stringed instrument to produce different frequency sound waves because the natural frequency of vibration of a stretched string is inversely proportional to the radius (thickness) of the string.

Question 11:
A blade, fixed at one end, is made to vibrate by pressing its other end and then releasing it. State one way in which the frequency of vibrations of the blade can be lowered.

Solution 11:
The frequency of vibrations of the blade can be lowered by increasing the length of the blade or by sticking a small weight on the blade at its free end.

Question 12:
How does the medium affect the amplitude of free vibrations of a body?

Solution 12:
The presence of the medium offers some resistance to motion, so the vibrating body continuously loses energy due to which the amplitude of the vibration continuously decreases.

Question 13:
What are damped vibrations? How do they differ from free vibrations? Give one example of each.

Solution 13:
The periodic vibrations of a body of decreasing amplitude in the presence of resistive force are called the damped vibrations.
The amplitude of the free vibrations remains constant and vibrations continue forever. But, the amplitude of damped vibrations decreases with time and ultimately the vibrations ceases.
For eg, When a slim branch of a tree is pulled and then released, it makes damped vibrations.
A tuning fork vibrating in air excute damped vibrations.

Question 14:
The diagram in Fig. 7.12 shows the displacement – time graph of vibrating body.

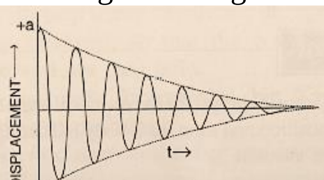


Fig. 7.12

(i) name the kind of vibrations
(ii) Give one example of such vibrations
(iii) why is the amplitude of vibrations gradually decreasing?
(iv) what happens to the vibrations of the body after some time?

Solution 14:

(i) Damped vibrations
(ii) Example: When a slim branch of a tree is pulled and then released, it makes damped vibrations.
(iii) The amplitude of vibrations gradually decreases due to the frictional (or resistive) force which the surrounding medium exerts on the body vibrating in it. As a result, the vibrating body continuously loses energy in doing work against the force of friction causing a decrease in its amplitude.
(iv) After sometime, the vibrating body loses all of its energy and stops vibrating.

Question 15:

A tuning fork is set into vibration in air. Name the kind of vibrations it executes.

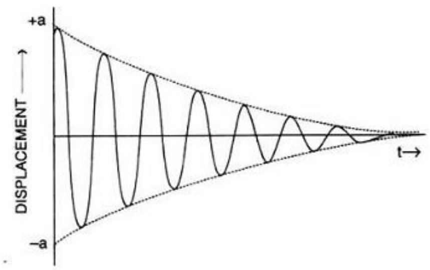
Solution 15:

The tuning fork vibrates with the damped oscillations.

Question 16:

Draw a sketch showing the displacement of a body executing damped vibrations against time.

Solution 16:



Displacement time graph of damped vibrations.

Question 17:

What are forced vibrations? Give one example to illustrate your answer.

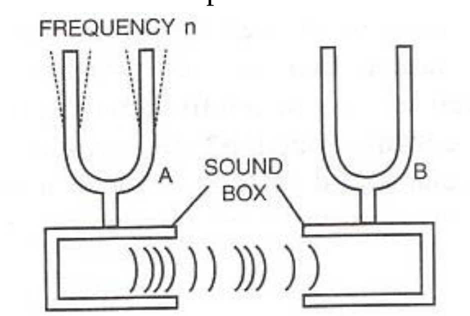
Solution 17:

The vibrations of a body which take place under the influence of an external periodic force acting on it, are called the forced vibrations. For example: when guitar is played, the artist forces the strings of the guitar to execute forced vibrations.

Question 18:
Distinguish between the free (or natural) and forced vibrations.
Solution 18:
(i) The vibrations of a body in the absence of any resistive force are called the free vibrations. The vibrations of a body in the presence of an external force are called forced vibrations.
(ii) In free vibrations, the frequency of vibration depends on the shape and size of the body. In forced vibrations, the frequency is equal to the frequency of the force applied.

Question 19:
What is meant by resonance? Describe a simple experiment to illustrate the phenomenon of resonance and explain it.
Solution 19:
Resonance is a special case of forced vibrations. When the frequency of an externally applied periodic force on a body is equal to its natural frequency, the body rapidly begins to vibrate with an increased amplitude. This phenomenon is known as resonance.

Mount two identical tuning forks A and B of same frequency upon two separate sound boxes such that their open ends face each other as shown.



If the prong A is struck on a rubber pad, it starts vibrating. On putting A on its sound box, tuning fork B also starts vibrating and a loud sound is heard. The vibrations produced in B are due to resonance.

Question 20:
State the condition for the occurrence of resonance.
Solution 20:
Condition for resonance:
Resonance occurs when the frequency of the applied force is exactly equal to the natural frequency of the vibrating body.

Question 21:
Complete the following sentence:
Resonance is a special case of …………….. vibrations, when frequency of the driving force is ……… natural frequency of the body.

Solution 21:
Resonance is a special case of **forced** vibrations, when frequency of the driving force is **equal to the** natural frequency of the body.

Question 22:
Differentiate between the forced and resonant vibrations.

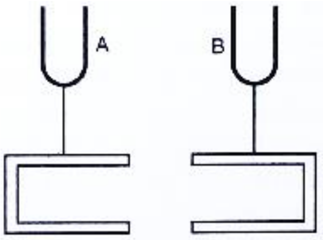
Solution 22:

Forced Vibrations	**Resonant vibrations**
These are vibrations of a body under an external periodic force of frequency different than the natural frequency of the body.	These are vibrations of a body under an external periodic force of frequency exactly equal to the natural frequency of the body.
The amplitude of the vibration is usually small.	The amplitude of vibration is very large.

Question 23:
Why is a loud sound heard at resonance?

Solution 23:
At resonance, the body vibrates with large amplitude thus conveying more energy to the ears so a loud sound is heard.

Question 24:
Fig 7.13 shows two tuning forks A and B of the same frequency mounted on separate sound boxes with their open ends facing each other. The fork A is set into vibration. (a) Describe your observation. (b) state the principle illustrated by this experiment.



Solution 24:

(a) The vibrating tuning fork A produces the forced vibrations in the air column of its sound box. These vibrations are of large amplitude because of the large surface area of air in the sound box. They are communicated to the sound box of the fork B. The air column of B starts vibrating with the frequency of the fork A. Since the frequency of these vibrations is same as the natural frequency of the fork B, the fork B picks up these vibrations and starts vibrating due to resonance.

(b) On putting the tuning fork A to vibrate, the other tuning fork B will also start vibrating. The vibrations produced in the second tuning fork B are due to resonance.

Question 25:

In fig . 7.14 A, B, C and D are four pendulums suspended from the same elastic string XY. Lengths of pendulum A and D are equal, while the length of pendulum B is smaller and the pendulum C is longer. The pendulum A is set into vibration.

(a) what is your observation? (b) Give reason for your observation.

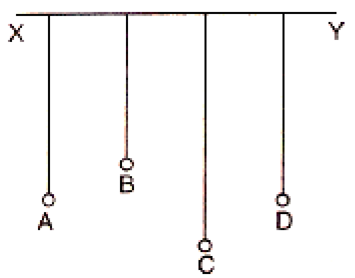


Fig. 7.14

Solution 25:

(a) Set the pendulum A into vibration by displacing it to one side, normal to its length. It is observed that pendulum D also starts vibrating initially with a small amplitude and ultimately it acquires the same amplitude as the pendulum A initially had. When the amplitude of the pendulum D becomes maximum, the amplitude of the pendulum A becomes minimum since the total energy is constant. After some time the amplitude of the pendulum D will decreases and amplitude of A increases. The exchange of energy takes place only between the pendulums A and D because their natural frequencies are same. The pendulums B and C also vibrate, but with very small amplitudes.

(b) The vibrations produced in pendulum A are communicated as forced vibrations to the other pendulums B, C and D through XY. The pendulums B and C remain in the state of forced vibrations, while the pendulum D comes in the state of resonance.

Question 26:

A vibrating tuning fork held over an air column of a given length with its one end closed, produces a loud audible sound. Name the phenomenon responsible for it and explain the observation.

Solution 26:

The phenomenon responsible for producing a loud audible sound is named resonance. The vibrating tuning fork causes the forced vibrations in the air column. For a certain length of air column, a loud sound is heard. This happens when the frequency of the air column becomes equal to the frequency of the tuning fork.

Question 27:

In Fig. 7.15, A, B , C and D represent test tube each of height 20 cm which are filled with water up to heights of 12 cm, 14 cm, 16cm and 18cm respectively. If a vibrating tuning fork is placed over the mouth if test tube D, a loud sound is heard.

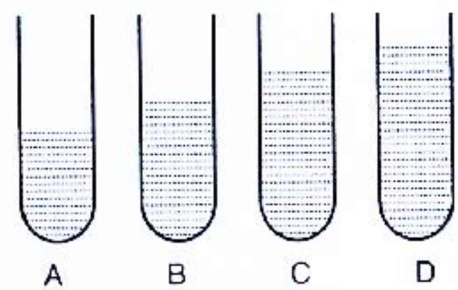


Fig. 7.15

(a) Describe the observations with the tubes A, B and C when the vibrating tuning fork is placed over the mouth of these tubes.

(b) Give the reason for your observation in each case.

(c) State the principle illustrated by the above experiment.

Solution 27:

(a) No loud sound is heard with the tubes A and C, but a loud sound is heard with the tube B.

(b) Resonance occurs with the air column in tube B whereas no resonance occurs in the air column of tubes A and C. The frequency of vibrations of air column in tube B is same as the frequency of vibrations of air column in tube D because the length of the air column in tube D is 20-18 = 2cm and that in tube B is 20-14 = 6 cm (3 times). On the other hand, the frequency of vibrations of air column in tubes A and C is not equal to the frequency vibrations of air column in tube B.

(c) When the frequency of vibrations of air column is equal to the frequency of the vibrating tuning fork, resonance occurs.

Question 28:

When a troop crosses a suspension bridge the soldiers are asked to break steps. Explain the reason.

Solution 28:

When a troop crosses a suspension bridge, the soldiers are asked to break steps. The reason is that when soldiers march in steps, all the separate periodic forces exerted by them are in same phase and therefore forced vibrations of a particular frequency are produced in the bridge. Now, if the natural frequency of the bridge happens to be equal to the frequency of the steps, the bridge will vibrate with large amplitude due to resonance and suspension bridge could crumble.

Question 29:

Why are the stringed instruments like guitar provided with a hollow sound box?

Solution 29:

The sound box is constructed such that the column of the air inside it, has a natural frequency which is the same as that of the strings stretched on it, so that when the strings are made to vibrate, the air column inside the box is set into forced vibrations. Since the sound box has a large area, it sets a large volume of air into vibration, the frequency of which is same as that of the string. So, due to resonance a loud sound is produced.

Question 30:

How do you tune your radio set to a particular station? Name the phenomenon involved in doing so and define it.

Solution 30:

When we tune a radio receiver, we merely adjust the values of the electronic components to produce vibrations of frequency equal to that of the radio waves which we want to receive. When the two frequencies match, due to resonance the energy of the signal of that particular frequency is received from the incoming waves. The signal received is then amplified in the receiver set.

The phenomenon involved is resonance. It is a special case of forced vibrations. When the frequency of an externally applied periodic force on a body is equal to its natural frequency, the body rapidly begins to vibrate with an increased amplitude. This phenomenon is known as resonance.

MUTIPLE CHOICE TYPE:

Question 1:

A wire stretched between two fixed supports, is plucked exactly in the middle and then released. It executes (neglect the resistance of the medium):

(a) resonant vibrations (b) free vibrations
(c) damped vibrations (d) forced vibrations

Solution 1:

It executes free vibrations.

Hint: The periodic vibrations of a body of constant amplitude in the absence of any external force on it are called free vibrations.

Question 2:

When a body vibrates under a periodic force, the vibrations of the body are:

(a) free vibrations (b) damped vibrations
(c) forced vibration (d) resonant vibrations

Solution 2:

Forced vibrations

Hint: The vibrations of a body which take place under the influence of external periodic force acting on it are called the forced vibrations.

Question 3:

A tuning fork of frequency 256 Hz will resonate with another tuning fork of frequency:

(a) 128 Hz (b) 256 Hz
(c) 384 Hz (d) 512 Hz

Solution 3:

A tuning fork of frequency 256 Hz will resonate with another tuning fork of frequency 256 Hz.

Hint: Resonance occurs when the frequency of an externally applied periodic force on the body is equal to its natural frequency.

EXERCISE. 7 (C)

Question 1:
Name three characteristics of a musical sound.

Solution 1:
The following three characteristics of sound are:
(i) Loudness
(ii) Pitch or shrillness
(iii)Quality or timber.

Question 2:
(a) Which of the following quality determines the loudness of a sound wave?
(i) wavelength (ii) frequency and (iii) amplitude
(b) How is loudness related to the quantity mentioned above in part(a)?

Solution 2:
(a) Amplitude - The louder sound corresponds to the wave of large amplitude.
(b) Loudness is directly proportional to the square of amplitude.

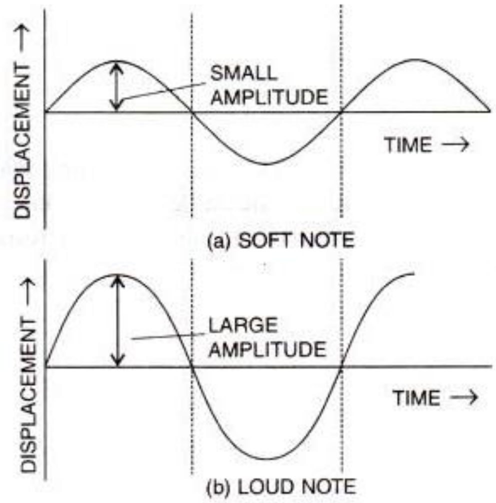
Question 3:
If the amplitude of a wave is doubled, what will be the effect on its loudness?

Solution 3:
Loudness will be four times because loudness is directly proportional to the square of amplitude.

Question 4:
Two waves of the same pitch have amplitudes in the ratio 1:3. What will be the ratio of their (i) loudness (ii) frequencies?

Solution 4:
(a) Ratio of loudness will be 1:9
(b) The ratio of frequency will be 1:1

Question 5:
How does the wave pattern of a loud note differ from a soft note? Draw a diagram.

Solution 5:


Question 6:
Name the unit in which loudness of sound is measured.

Solution 6:
The unit of loudness is phon.

Question 7:
Why is the loudness of the sound heard by a plucked wire increased when it is mounted on a sound board?

Solution 7:
Because the board provides comparatively a large area and forces a large volume of air to vibrate and thereby increases the sound energy reaching our ears.

Question 8:
Define the term intensity of a sound wave. State the unit in which it is measured.

Solution 8:

The intensity at any point of the medium is the amount of sound energy passing per second normally through unit area at that point. Its unit is microwatt per metre^2.

Question 9:

How is loudness of sound related to the intensity of wave producing it?

Solution 9:

Relationship between loudness L and intensity I is given as:
L = K log I, where K is a constant of proportionality.

Question 10:

Comment on the statement 'loudness of sound is a subjective quantity, while intensity is an objective quantity.

Solution 10:

The intensity at any point of the medium is the amount of sound energy passing per second normally through unit area at that point.
The loudness of a sound depends on the energy conveyed by the sound wave near the eardrum of the listener. Loudness, being a sensation, also depends on the sensitivity of the ears of the listener. Thus the loudness of sound of a given intensity may differ from listener to listener. Further, two sounds of the same intensity but of different frequencies may differ in loudness even to the same listener because of the sensitivity of ears is different for different frequencies. So, loudness is a subjective quantity while intensity being a measurable quantity is an objective quantity for the sound wave.

Question 11:

State three factors on which loundess of sound heard by a listener depends.

Solution 11:

The loudness of the sound heard depends on:
(i) Loudness is proportional to the square of the amplitude.
(ii) Loudness is inversely proportional to the square of distance.
(iii)Loudness depends on the surface area of the vibrating body.

Question 12:
Name the unit used to measure the sound level.
Solution 12:
Decibel is the unit used to measure the sound level

Question 13:
What is the safe limit of sound level in dB for our ears?
Solution 13:
Upto 120 dB

Question 14:
What is meant by noise pollution? Name one source of sound causing noise pollution.
Solution 14:
The disturbance produced in the environment due to undesirable loud and harsh sound of level above 120 dB from the various sources such as loudspeaker, moving vehicles etc. is called noise pollution.

Question 15:
What determines the pitch of a sound?
Solution 15:
Pitch of sound is determined by its wavelength or the frequency. Two notes of the same amplitude and sounded on the same instrument will differ in pitch when their vibrations are of different wavelengths or frequencies.

Question 16:
Name the subjective property of sound related to its frequency.
Solution 16:
Pitch

Question 17:

Name and define the characteristic which enables one to distinguish two sounds of same loudness, but of different frequencies, given by the same instrument.

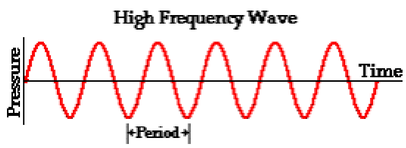
Solution 17:

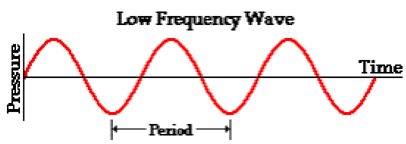
Pitch is the characteristic of sound which enables us to distinguish different frequencies sound. Pitch is the characteristic of sound by which an acute note can be distinguished from a grave or flat note.

Question 18:

Draw a diagram to show the wave pattern of high pitch note and a low pitch note, but of the same loudness.

Solution 18:





The first diagram is high pitch note and second one is low pitch note.

Question 19:

How is it possible to detect the filling of a bottle under a water tap by hearing the sound at a distance?

Solution 19:

As the water level in a bottle kept under a water tap rises, the length of air column decreases, so the frequency of sound produced increases i.e., sound becomes shriller and shriller. Thus by hearing sound from a distance, one can get the idea of water level in the bottle.

Question 20:

The frequencies of notes given by flute, guitar and 500 Hz. Which one of these has the highest pitch?

Solution 20:

Trumpet. Because its frequency is highest.

Question 21:
Complete the following sentences:
(a) The pitch of sound increases if its frequency ………….
(b) If the amplitude of a sound is halved, its loudness becomes ………………

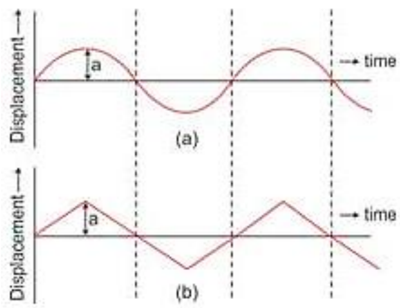
Solution 21:
(a) increases
(b) one-fourth

Question 23:
Name the characteristic which enables one to distinguish the sound of two musical instruments even if they are of the same pitch and same loudness.

Solution 23:
Quality or timber of sound.

Question 24:
How does the two sounds of same loudness and same pitch produced by different instruments differ? Draw diagrams to illustrate your answer.

Solution 24:
The two sounds of same loudness and same pitch produced by different instruments differ due to their different waveforms.
The waveforms depend on the number of the subsidiary notes and their relative amplitude along with the principal note.
Diagram below shows the wave patterns of two sounds of same loudness and same pitch but emitted by two different instruments. They produce different sensation to ears because they differ in waveforms: one is a sine wave, while the other is a triangular wave.



Question 25:
Two identical guitars are played by two persons to give notes of the same pitch. Will they differ in quality? Give a reason for your answer.
Solution 25:
Since the guitars are identical, they will have a similar waveform and so the similar quality.

Question 26:
Two musical notes of the same pitch and same loudness are played on two different instruments. Their wave patterns are as shown in Fig. 7.24

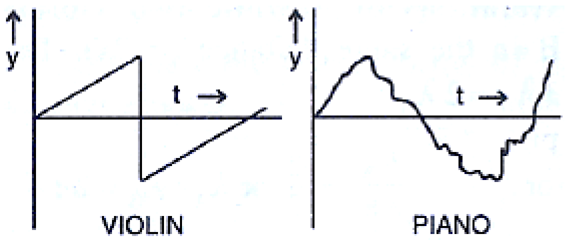


Fig. 7.24

Explain why the wave patterns are different.
Solution 26:
Different instruments emit different subsidiary notes. A note played on one instrument has a large number of subsidiary notes while the same note when played on other instrument contains only few subsidiary notes. So they have different waveforms.

Question 27:
How is it possible to recognize a person by his voice without seeing him?
Solution 27:
It is because the vibrations produced by the vocal chord of each person have a characteristic waveform which is different for different persons.

Question 28:
State the factors that determine.
(i) the pitch of a note,
(ii) the loudness of the sound heard,
(iii) the quality of the note.

Solution 28:

(i) Frequency
(ii) Amplitude
(iii) Waveform

Question 29:

Name the characteristic of the sound affected due to a change in its (i) amplitude (ii) wave form (iii) frequency.

Solution 29:

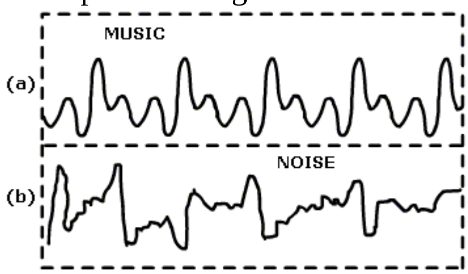
(i) Loudness
(ii) Quality or timbre
(iii) Pitch

Question 30:

In what respect does the wave pattern of a noise and a music differ? Draw diagram to explain your answer.

Solution 30:

Wave pattern is regular in music while it is quite irregular in noise.



Question 31:

The sketches I to IV in Fig. 7.25 show sound waves, all formed in the same time interval.

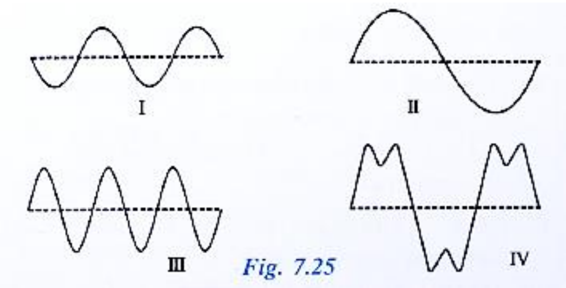


Fig. 7.25

Which diagram shows
(i) a note from a musical instrument
(ii) a soft (not loud) note,
(iii) a bass (low frequency) note.

Solution 31:

(i)IV
(ii)I
(iii)II

Question 32:

A microphone is connected to the Y-input of a C.R.O Three different sounds are made in turn in front of the microphone. Their traces (a), (b) and (c) produces on the screen are shown in Fig . 7.26

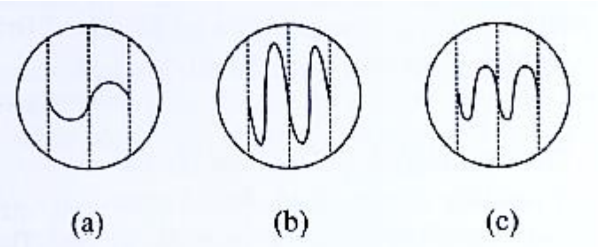


Fig. 7.26

(i) which trace is due to the loudest sound? Give reason for your answer.
(ii) Which trace is due for the sound with the lowest pitch? Explain your answer.

Solution 32:

(i)b, since amplitude is largest
(ii)a, since frequency is lowest

Question 33:

State one difference between a musical note and a noise.

Solution 33:

Musical note is pleasant, smooth and agreeable to the ear while noise is harsh, discordant and displeasing to the ear.
In musical note, waveform is regular while in noise waveform is irregular.

MULTIPLE CHOICE TYPE:

Question 1:

By reducing the amplitude of a sound wave, its:

(a) pitch increases (b) loudness decreases

(c) loudness increases (d) pitch decreases

Solution 1:

By reducing the amplitude of the sound wave, its loudness decreases.

Hint: Loudness of sound is proportional to the square of the amplitude.

Question 2:

Two sounds of same loudness and same pitch produced by two different instruments differ in their:

(a) amplitudes (b) frequencies

(c) wave forms (d) all the above

Solution 2:

Waveforms

Explanation: The waveform of a sound depends on the number of the subsidiary notes and their relative amplitude along with the principal note. The resultant vibration obtained by the superposition of all these vibrations gives the waveform of sound.

Question 3:

Two sounds A and B are of same amplitude, same wave forms but of frequencies f and 2f respectively.

Then:

(a) B differ in quality from A

(b) B is grave, A is shrill

(c) B is shrill, A is grave

(d) B is louder than A.

Solution 3:

B is shrill, A is grave

Explanation: Shrillness or pitch of a sound is directly proportional to the frequency of the sound wave. Greater the frequency, shriller will be the note.