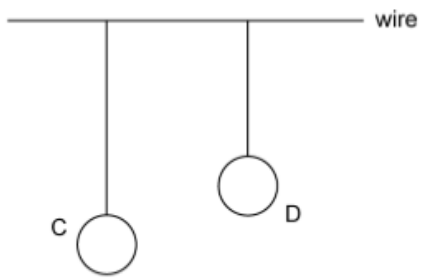
1. Two pendulums C and D are suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating.



(i) Name the type of oscillation, C will execute.

(ii) Name the type of oscillation, D will execute.

(iii) If the length of D is made equal to C then what difference will you notice in the oscillations of D?

(iv) What is the name of the phenomenon when the length of D is made equal to C?

Ans

i. Natural or free oscillation

ii. Forced oscillation

iii. The natural frequency of D becomes equal to C, and therefore, there is exchange of energy between C and D. Pendulum D starts oscillating slowly with small amplitude, and it ultimately acquires the same amplitude which pendulum C initially had.

iv. Resonance

2. (i) What is an echo [3]

(ii) State two conditions for an echo to take place.

Ans

(i) The sound heard after reflection from a distant obstacle after the original sound has ceased is called an echo.

(ii) The conditions for an echo to take place are

1. The minimum distance between the source of sound and the reflector in air must be 17 m.

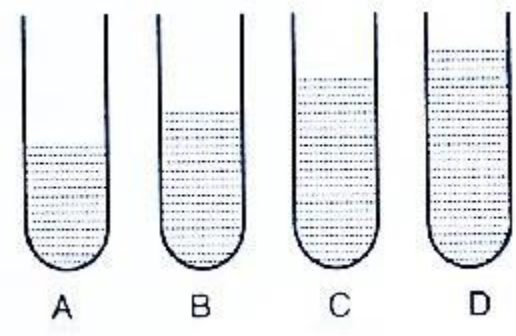
2. The size of the reflector must be large enough as compared to the wavelength of sound wave.

3. (i) Name the waves used for echo depth sounding.
(ii) Give one reason for their use for the above purpose.
(iii) Why are the waves mentioned by you not audible to us?

Ans

(i) The waves used for echo depth sounding are ultrasonic waves.
(ii) Ultrasonic waves are used for echo depth ranging because they can travel undeviated through a long distance.
(iii) Ultrasonic waves have frequency larger than 20000 Hz. Hence, these waves are not audible to us as the audible range for the human ear is 20 Hz to 20000 Hz.

4. In Fig., 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.



(i) Describe the observations with the tubes A, B and C when the vibrating tuning fork is placed over the mouth of these tubes.
(ii) Give the reason for your observation in each case.
(iii) State the principle illustrated by the above experiment.

Ans:

(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.

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

Ans:

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

6. (i) What are damped vibrations?
(ii) Give one example of damped vibrations.
(iii) Name the phenomenon that causes a loud sound when the stem of a vibrating tuning fork is kept pressed on the surface of a table.

Ans

(i) Periodic vibrations of a body of decreasing amplitude in the presence of a resistive force are called damped vibrations.

(ii) When a slim branch of a tree is pulled and then released, it makes damped vibrations.

(iii) When the stem of a vibrating fork is pressed against the table top, the tuning fork forces the table top to vibrate with its own frequency. These forced vibrations send forth a greater energy and produce large sound. Now, if the natural frequency of the table is equal to that of the vibrating fork, resonance occurs and a louder sound is heard.

7. 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.

Ans:

Distance of hill from the man

$$D_1 = \text{velocity} \times \frac{\text{time}}{2} = v \times \frac{5}{2} \quad \ldots\ldots (i)$$

$$\text{Now, } D_1 - 310 = v \times \frac{3}{2} \quad \ldots\ldots (ii)$$

By subtracting equation (ii)form equation (i), we get

$$310 = v \times \left(\frac{5}{2} - \frac{3}{2}\right)$$

So, v = 310m/s

8. An observer stands at a distance of 850m from a cliff and fires a gun. After what time gap will he hear the echo, if speed of sound in air is 350m/s?

Ans

Here, c = 350 ms^{-1}, d = 850 m, t = ?

This is a case of an echo, so, $2d = c \times t$

$$\Rightarrow t = \frac{2d}{c}$$

$$= \frac{2 \times 850}{350} = 4.86 \text{ s.}$$

9. 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.

Ans:

5 vibrations by pendulum in 1 sec

So 8 vibrations in 8/5 seconds = 1.6 sec

$$\text{Velocity} = \frac{2 \times D}{\text{time}}$$

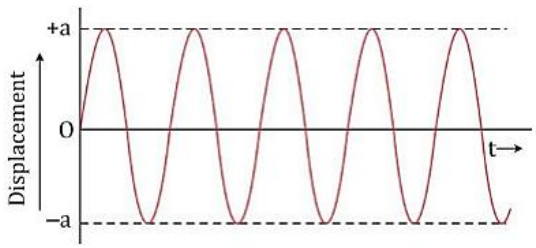
$$340 = \frac{2 \times D}{1.6}$$

$$D = \frac{340 \times 1.6}{2} = 272 \text{ m}$$

10. (i) Draw a graph between displacement and the time for a body executing free vibrations.
(ii) Where can a body execute free vibrations?

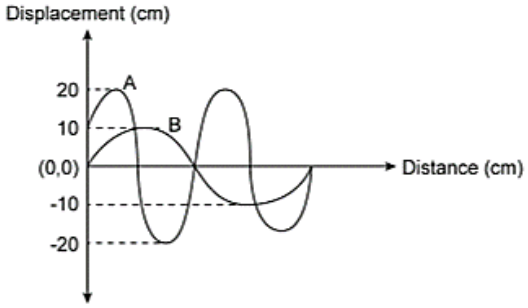
Ans

(i) The displacement–time graph for a body executing free vibrations is given below:



(ii) The free vibrations of a body actually occur only in vacuum because the presence of a medium offers some resistance due to which the amplitude of vibration does not remain constant and decreases continuously. Thus, we define free vibrations as the periodic vibrations of a body of constant amplitude in the absence of any external force on it.

11. Displacement distance graph of two sound waves A and B, travelling in a medium, are as shown in the diagram below.



Study the two sound waves and compare their: (i) Amplitudes (ii) Wavelengths

Ans

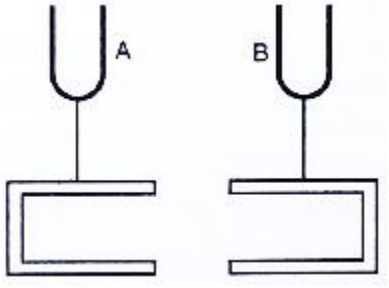
(i) Amplitude of Wave A is 20 cm. Amplitude of Wave B is 10 cm.

(ii) Wavelength of B is twice the wavelength of A.

12. Fig 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.

(i) Describe your observation.

(ii) state the principle illustrated by this experiment.



Ans:

(i) 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.

(ii) 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

13. Differentiate between the forced and resonant vibrations.

Ans:

Forced Vibrations	Resonant vibrations
1. These are vibrations of a body under an external periodic force of frequency different than the natural frequency of the body.	2. These are vibrations of a body under an external periodic force of frequency exactly equal to the natural frequency of the body.
2. The amplitude of the vibration is usually small.	3. The amplitude of vibration is very large.

14. State the condition for the occurrence of resonance.

Ans:

Condition for resonance:

Resonance occurs when the frequency of the applied force is exactly equal to the natural frequency of the vibrating body.

15. The ratio of amplitude of two waves is 3:4. What is the ratio of their: [2]

(i) loudness? (ii) Frequencies?

Ans

(i) Let a_1 and a_2 be the amplitudes and I_1 and I_2 be the intensities of the two waves.

$$\therefore \frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} = \frac{3^2}{4^2}$$

$$\therefore \frac{I_1}{I_2} = \frac{9}{16}$$

(ii) Frequency is the number of waves formed per second. It only depends on time period. Thus, the ratio of their frequencies is 1:1.