EXERCISE

Select the correct answer from the following choices.

1. Turning of a radio set is an example of

a. Mechanical resonance

b. Musical resonance

c. Electrical resonance

d. Free vibrations

2. The heating and cooking of food evenly by microwave oven is an example of

a. S.H.M

b. Resonance

c. Damped Oscillation

d. Free oscillation

3. The time period of the same pendulum at Karachi and Murree are related as:

a. $T_k = T_M$

b. $T_k > T_M$

c. $T_k < T_M$

d. $2T_k = 3T_M$

4. In an isolate system the total energy of vibrating mass and spring is:

a. Variable   b. Low   c. High   d. Constant

5. While deriving the equation of time period for simple pendulum which quantity should be kept small?

a. Length of simple pendulum

b. Amplitude

c. Mass of simple pendulum

d. Gravitational acceleration $\bar{g}$

6. If the period of oscillation of mass (m) suspended from a spring is 2s, then the period of mass 4m will be

a. 1s   b. 2s   c. 3s   d. 4s

7. The time period of a simple pendulum is 2 seconds. If its length is increased by 4 times, then its period becomes

a. 16 s   b. 12 s   c. 8 s   d. 4 s

8. To make the frequency double of a spring oscillation, we have to:

a. Reduce the mass to one fourth   b. Quadruple the mass

c. Double the mass   d. Half the mass

9. The restoring force of SHM is maximum when particle:

a. Displacement is maximum   b. Half way between them

c. Crossing mean position   d. At rest

10. Two springs of spring constants k_1 and k_2 are joined in series. The effective spring constant of the combination is given by

a. $(k_1 + k_2)/2$ b. $k_1 + k_2$

c. $k_1k_2/(k_1 + k_2)$ d. $\sqrt{k_1k_2}$

11. In a garden, a boy is swinging in the standing position. How will the time period of the swing be affected if the boy sits down on the swing?

a. Time period will not change

b. Time period will increase

c. Time period will decrease

d. Time period will depend on the weight of the boy

12. A pendulum suspended from the ceiling of a train has a period T when the train is at rest. When the train is accelerating with a uniform acceleration, the period of oscillation will

a. Increase   b. Decrease

c. Remain unaffected   d. Become infinite

Answers:

1.	(a)	2.	(b)	3.	(c)	4.	(d)	5.	(b)
6.	(b)	7.	(d)	8.	(a)	9.	(a)	10.	(c)
11.	(a)	12.	(b)	-	-	-	-	-	-

Write the short answers of the following questions:

Q.1 Give two applications in which resonance plays on important role?

Answer

Turning a radio (Electrical resonance)

- Turning of radio is a good example of electrical resonance. To tune a radio,
- We turn the knob of a radio.
- It changes the natural frequency of electrical circuit of receiver until it becomes equal to the frequency of transmitter.
- Now the resonance is produced and energy absorption is maximum.
- Hence a station is tuned.

Cooking by microwave oven

- Resonance plays an important role in heating and cooking food by microwave oven.
- The microwaves produce by oven are absorbed due to resonance by water and fats molecules in the food.
- This increases the internal energy of the molecules.
- They get heat up and so food is cooked.

Q.2 What happens to the period of simple pendulum if its length is doubled?

Answer

Since time period of simple pendulum is given as

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

Let $\qquad T_1 = 2\pi\sqrt{\frac{l_1}{g}} \qquad \qquad .....(1)$

Is the initial time period of simple pendulum. If length of the pendulum is doubled i.e. $L_2 = 2L_1$. The new time period becomes

$$T_2 = 2\pi\sqrt{\frac{l_2}{g}} \qquad \qquad .....(2)$$

Putting $L_2 = 2L_1$ in equation (2) we get,

$$T_2 = 2\pi \sqrt{\frac{l_1}{g}}$$

$$T_2 = \sqrt{2} \left(2\pi \sqrt{\frac{2l_1}{g}} \right)$$

$$T_2 = \sqrt{2}\, T_1 \qquad\qquad ....(3)$$

From equation (3), it is clear that if length of simple pendulum is doubled, its time period becomes $\sqrt{2}$ times of initial time period.

Q.3 What will be the frequency of a simple pendulum, if its length is 1m.

Answer

Since frequency of simple pendulum is given as

$$f = \frac{1}{2\pi} \sqrt{\frac{g}{l}}$$

Put $\pi = 3.14$, $g = 9.8 \, m/s^2$ & $l = 1m$, we get

$$F = \frac{1}{2 \times 3.14} \sqrt{\frac{9.8 m/s^2}{1m}}$$

$$F = 0.498H$$

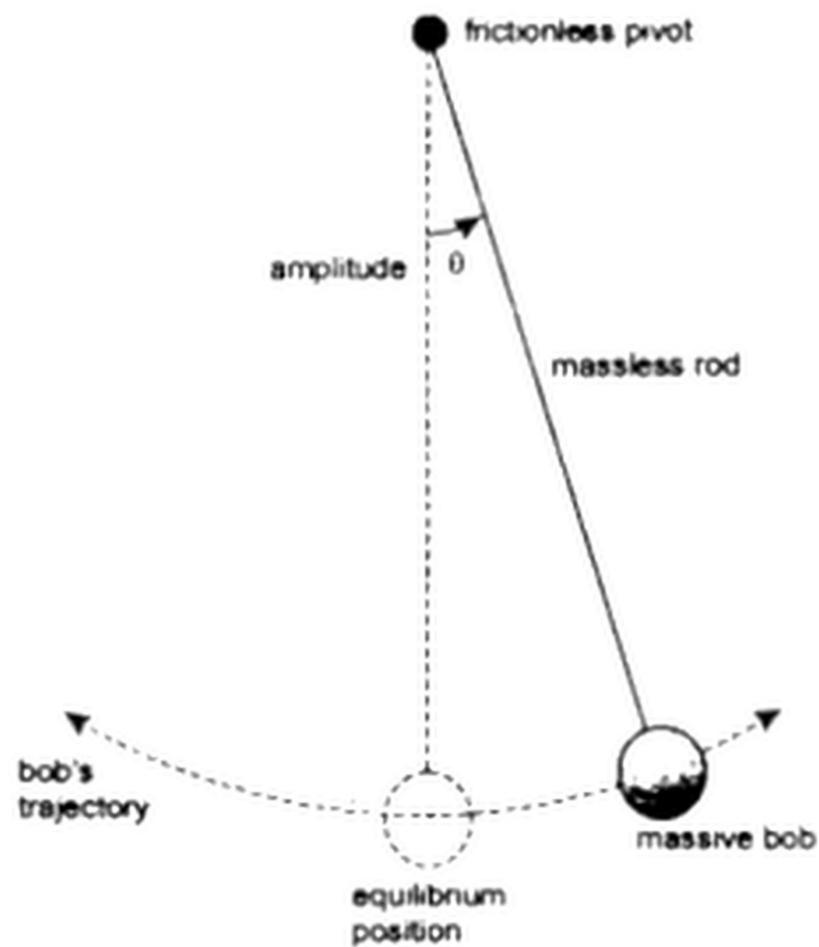## Q.4 Give one practical example each of free and forced oscillation?

Answer

Free Oscillations

A body is said to be executing free vibrations if it oscillated with its natural frequency without the interference of an external force.
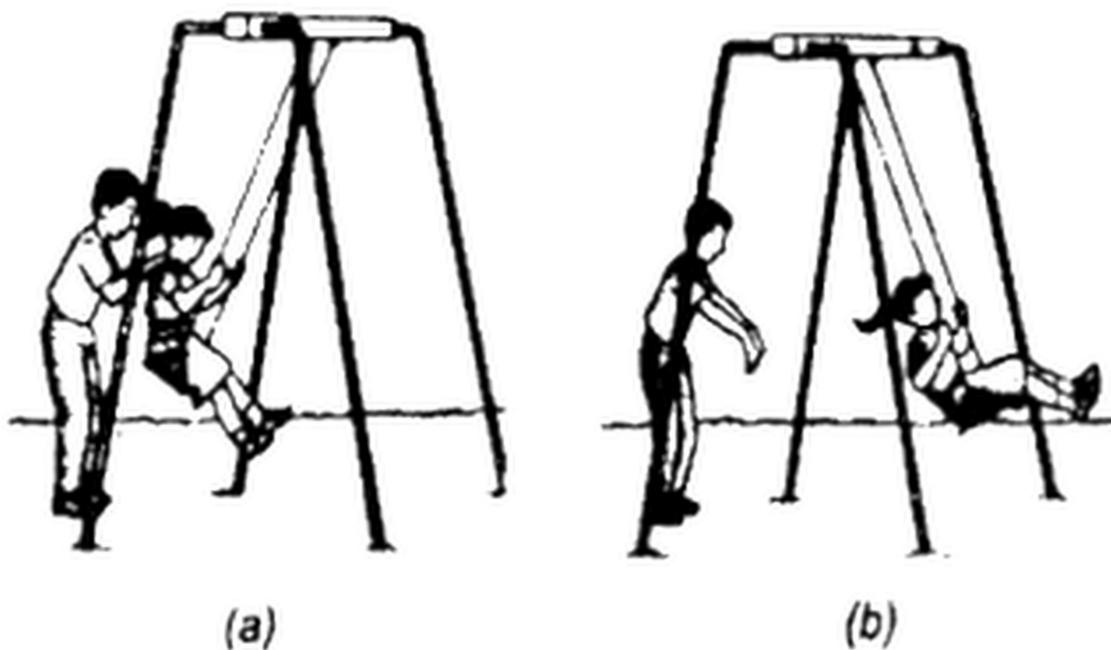
For example

A simple pendulum vibrates freely with its natural frequency that depends only upon the length of the pendulum.

Forced oscillations

A body is said to be executing forced vibrations if it oscillates with the interference of an external force.

(a)   (b)

For example

- If the mass of vibrating pendulum is struck repeatedly, then forced vibrations are produced.
- The vibration of factory floor caused by the running of heavy machinery is another example.

Driven harmonic oscillator

The physical system undergoing forced vibrations is known as driven harmonic oscillator.

Q.5 A simple pendulum set into vibrations and left untouched, eventually stops why?

Answer

When a simple pendulum set into vibrations and left untouched, it eventually stops because the amplitude of vibrations becomes smaller & smaller due to friction air resistance & some other forces. Thus, the mechanical energy of simple pendulum is converted into heat & sound energies.

Q.6 Explain why in S.H.M. accelerations is zero when the velocity is greatest.

Answer:

In S.H.M. mathematical expression for velocity & acceleration are given as

$$v = x_0 \sqrt{\frac{k}{m}\left(1 - \frac{x^2}{x_0^2}\right)} \qquad \cdots\cdots\cdots (1)$$

$$a = -\omega^2 x \qquad \cdots\cdots\cdots (2)$$

Velocity will be maximum if x=0 i.e. if the vibrating body is at mean position, so

Equation (1) $\Rightarrow$ $v = v_0 = x_0 \sqrt{\dfrac{k}{m}}$ .... (3)

& Equation (2) $\Rightarrow$ $a = 0$ .... (4)

Equation (3) and (4) show that when velocity is greatest or maximum, acceleration is zero. Also, at mean position restoring fore is zero so velocity will be maximum & acceleration will be zero.

Q.7 Is there a connection between F & x in mass spring system? Explain?

Answer:

According to Hook's Law

$$F = kx \qquad .... (1)$$

Where F is restoring force, 'x' is displacement & k is spring constant.

Equation (1) $\Rightarrow$

$$K = \dfrac{F}{x} \qquad .... (2)$$

From equation (2) it is clear that displacement in mass spring system is directly proportional to restoring force 'F' i.e. large force is required to compress or stretch a mass spring system within the elastic limit.

Q.8 What happens to the frequency of simple pendulum as it oscillation die down from large amplitude to small?

Answer

Since frequency of simple pendulum is given as

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

From the above equation it is clear that the frequency 'f' of simple pendulum does not depend on amplitude. So, if its oscillation dies down from large amplitude to small amplitude, frequency remains constant.

Q.9 A singer, holding a note of right frequency, can shatter a glass. Explain.

Answer

A singer can shatter a glass, holding a note of right frequency, because when frequency of note becomes equal to the frequency of glass molecules resonance occurs & glass molecules then vibrate with larger amplitude. If the amplitude is excessively large, glass can be shatter down.