# Simple Harmonic motion and waves

**Q1: Define vibratory motion**.

Ans: To and fro motion of a body about a point is called vibratory motion. i.e., motion of swing.

**Q2: Define SHM**

Ans: Simple Harmonic motion occurs when the net force is directly proportional to the displacement from the mean position and is always directed towards the mean position.

**Q3: Write down the features of body executing SHM.**

i) A body executing SHM always vibrates about a fixed position.
ii) Its acceleration is always directed towards the mean position.
iii) The magnitude of acceleration is directly proportional to its displacement from the mean position.
iv) Acceleration is zero at mean position and maximum at extreme position.
v) Its velocity is maximum at the mean position and zero at extreme positions.

**Q4: State Hook's law.**

Ans: Within the elastic limit of the body the displacement is directly proportional to the displacement.

Mathematically $F \propto x$

$F=kx$ (Here k is spring constant)

**Q5: What is meant by spring constant?**

Ans: According to Hook's law

$$F=kx$$

$$K=F/x$$

From above formula we state Spring constant as

" The ratio of force (F) acting on the spring to the displacement(x) from mean position".

Value of k is measurement of stiffness of the spring. Its SI unit is $Nm^{-1}$

**Q6: Define restoring force.**

Ans: A force which always pulls or push back a body to its original position is called restoring force.

Example: let a mass m attached to a spring is pulled through a displacement x and released. The mass will move back to mean position due to restoring force.

**Q7: What is simple pendulum?**

Ans: A simple pendulum is consist of a small bob of mass 'm' suspended from a light string of length 'l' .

Time period equation: $T=2\pi\sqrt{\frac{l}{g}}$

**Q8: Differentiate between vibration and Amplitude.**

| **Vibration** | **Amplitude** |
|---|---|
| One complete round trip of a vibrating body about its mean position is called one vibration. | The maximum displacement of a vibrating body on either side from its mean position is called its amplitude.<br>Unit: Meter (m) |

**Q9: Define Time period. Write its formula for simple pendulum.**

Ans: The time taken by a vibrating body to complete one vibration is called time period. It is denoted by "T"

For simple pendulum Time period is T=$2\pi\sqrt{\frac{l}{g}}$

**Q10: Define frequency and write its unit.**

Ans: The number of vibrations of a body executing SHM in one second is called frequency.

Unit: Hertz (Hz)

**Q11: If the length of a simple pendulum is doubled. What will be the change in its time period?**

Ans: Let Length of simple pendulum= l

Time Period of Simple pendulum= T=$2\pi\sqrt{\frac{l}{g}}$

According to given condition l=2l

Putting l=2l in above equation T=$2\pi\sqrt{\frac{2l}{g}}$

= $\sqrt{2}\ x\ 2\pi\ (\sqrt{\frac{l}{g}})$

=$\sqrt{2}$ T so time period will increase $\sqrt{2}\ times$.

**Q12: If the time period of a simple pendulum is 1.99 seconds, find its frequency.**

Ans: **Give data**

T= 1.99 s

f=?

f=1/T

f=1/1.99

f=0.5 Hz

**Q13: Define damped oscillations. Give example.**

Ans: The oscillations of system in the presence of some resistive force are damped oscillations.

Example: Shock absorbers in automobiles are one practical application of damped oscillations.

The motion of swing.

**Q14: Define wave motion.**

Ans: A wave is disturbance in the medium which causes the particles of the medium to undergo vibratory motion about their mean position in equal intervals of time. The motion of wave is called wave motion.

**Q15: Define Crest and Trough.**

Ans: In Transverse wave the crests are the highest point of the particles of the medium from the mean position.

Trough: In Transverse wave the trough are the lowest points of the particle of the medium from the mean position.

**Q16: What is meant by compression and rarefaction?**

**Ans:** When a slinky attached to a support and we hold it one end and move hand back fourth then the region where loop of the spring is close together are called compression. The region where loop of slinky are far from each other are rarefaction.

**Q17: What are mechanical waves? Give example .**

**Ans:** The waves which require any medium for their propagation are called mechanical waves.

Examples: Waves produced on water surface

ii) sound waves

Types of Mechanical waves: Longitudinal wave Transverse waves

**Q18: Define Longitudinal waves.**

**Ans:** In longitudinal wave the particle of the medium move back and forth(parallel) along the direction of propagation of wave. i.e., sound waves

**Q19: Define Transverse waves give example.**

**Ans:** In Transverse waves the vibratory motion of particles of the medium is perpendicular to the direction of propagation. E.g., waves on the surface of water.

**Q20: Define electromagnetic waves. Also give an example.**

**Ans:** Waves which do not require any medium for their propagation are called electromagnetic waves.

Example: radio waves , light waves, heat waves

**Q21:What is the difference between Mechanical waves and Electromagnetic waves?**

| Mechanical waves | Electromagnetic waves |
|---|---|
| The waves which require any medium for their propagation are called mechanical waves.<br>Examples: Waves produced on water surface<br>ii) sound waves<br>Types of Mechanical waves:<br>Longitudinal wave Transverse waves | Waves which do not require any medium for their propagation are called electromagnetic waves.<br>Example: radio waves , light waves, heat waves |

**Q22: What is the difference between longitudinal and transverse waves?**

**Ans:**

| Longitudinal waves | Transverse waves |
|---|---|
| The longitudinal waves the particles of the medium move back and forth along the direction of propagation of waves.<br>Example: Sound waves | In case of transverse waves, the vibratory motion of particles of the medium is perpendicular to the direction of propagation of waves.<br>Example: waves on the surface of water |

**Q23: Define wave equation and write its formula.**

**Ans:** Wave equation shows relationship between wavelength ($\lambda$) , frequency (f) and velocity of waves(v) is called wave equation.

v=f $\lambda$

**Q24: Derive wave equation. Or show that** v=f $\lambda$

**Ans:** We know that

Velocity= distance/time

v=d/t

If time taken by wave in moving from one point to another is equal to its time period T , then the distance covered by the wave will be equal to one wavelength $\lambda$ hence

v= $\lambda/T$

But time period T, is reciprocal of the frequency f

T=1/f

v= $\frac{\lambda}{\frac{1}{f}}$

V=f $\lambda$

**Q25: What is the function of Ripple Tank?**

**Ans:** Ripple tank is a device used to produce water waves to study their characteristics( reflection, refraction , diffraction)

**Q26: Define refraction of waves.**

**Ans:** When a wave from one medium enters into the second medium at some angle, its direction of travel changes. It is called refraction of waves.

**Q27: Define diffraction of waves.**

**Ans:** The bending or spreading of waves around the sharp edges of corners of obstacles or slits is called diffraction.

**Q28: Define reflection of waves.**

**Ans:** When waves moving in one medium fall on the surface of another medium, they bound back into the first medium such that the angle of incidence is equal to the angle of reflection. This process is called reflection of waves.

**Q29: Write down the structure of ripple tank.**

**Ans:** Ripple tank consist of glass tray half meter above the surface of table. It consists of a motor which acts as vibrator to produce water waves. A light blub is hung over the tray. The waves are shown as light and dark pattern on screen put beneath the tray.