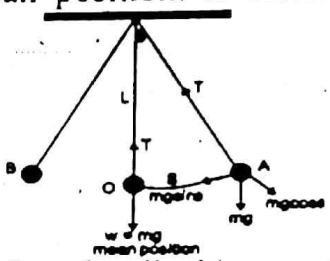
SHORT QUESTIONS

10. 1 Simple Harmonic Motion (SHM)

(1) What is meant by oscillation?

Ans: When a body moves back and forth or to and fro about its mean position. is called vibration or oscillation.



Example:

Motion of the Simple Pendulum.

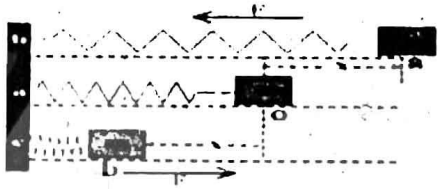
(2) Define Simple Harmonic Motion.

Ans: Simple Harmonic Motion

"The acceleration of a body executing SHM is directly proportional to the displacement of the body from the mean position and is always directed towards the mean position".

Mathematically

$a \propto -x$



Where a is acceleration. It is always directed towards the mean position and x is displacement from mean position.

(3) Define Hooke's Law. Give its expression.

Ans: According to Hooke's law the exerted force is directly proportional to change in length.

$$F \propto x$$

(4) How does stiffness of the spring affect the value of k?

Ans: The value of k is a measure of the stiffness of the spring.
Stiff springs have large k values, and soft springs have small k values.

(5) What is the function of restoring force during oscillatory motion?

Ans: A restoring force always pushes or pulls the object performing oscillatory motion towards the mean position.

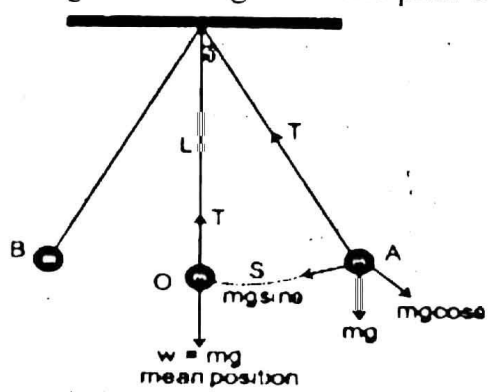
$$F_r = - kx$$

(6) Which type of forces are acting on a displaced pendulum?

OR

Which component of force act as restoring force during the oscillation of simple pendulum.

Ans: The restoring force that causes the pendulum to undergo simple harmonic motion is the component of gravitational force mg $\sin\theta$ tangent to the path of motion.



(7) **Define Time Period and Write down formulas of Time Period for mass attached to a spring and for simple Pendulum**

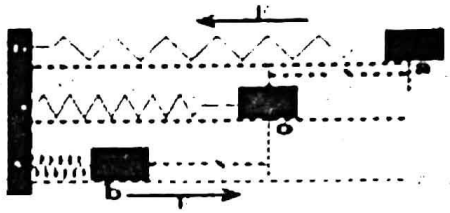
Ans:

Time Period (T):

"Time required to complete one vibration is called time period. It is denoted by T."

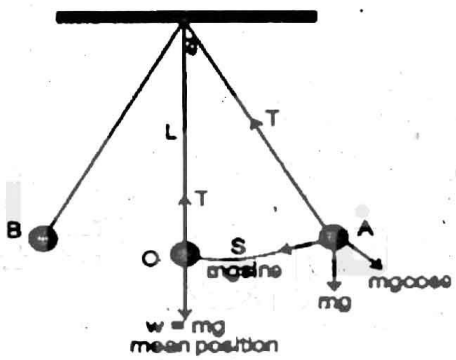
- **The time period T of the simple harmonic motion of a mass m attached to a spring is given by the following equation:**

$$T = 2\pi\sqrt{\frac{m}{k}} \ldots\ldots\ldots$$



- **Formula for the time period of simple pendulum**

$$T = 2\pi\sqrt{\frac{L}{g}} \ldots\ldots\ldots (10.2)$$



(8) **Define following terms which characterize simple harmonic motion.**

(i) Vibration **(ii) Time period**

(iii) Frequency **(iv) Amplitude** **(v) Displacement**

Ans:

(i) **Vibration:**

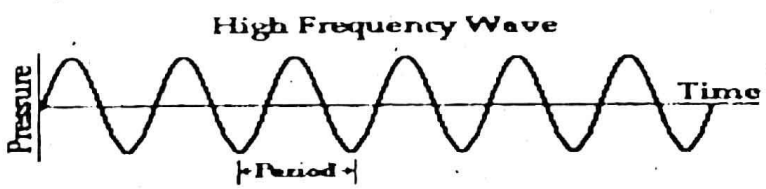
One complete round trip of a vibrating body about its mean position is called one vibration.

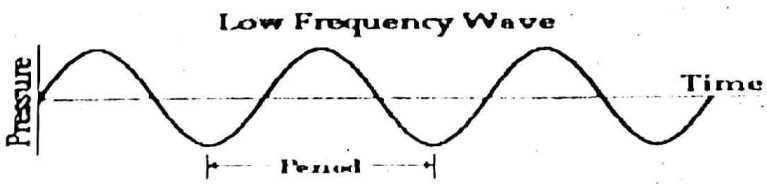
(ii) **Time period (T):**

The time taken by a vibrating body to complete one vibration is called time period

(iii) **Frequency (f):**

The number of vibrations per cycle of a vibrating body in one second is called its frequency. It is reciprocal of time period i.e f = 1/T



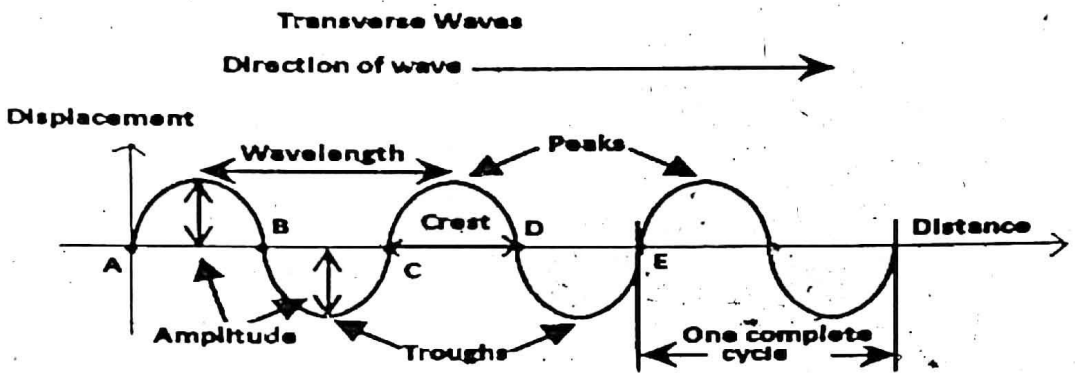


(iv) **Amplitude (A):**

The displacement of a vibrating body on either side from its mean position to extreme position is called its amplitude.

(v) **Displacement (D)**

Distance covered by the vibrating body at any instant during the vibration from mean position.



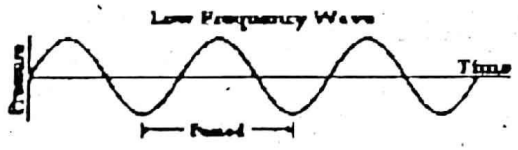
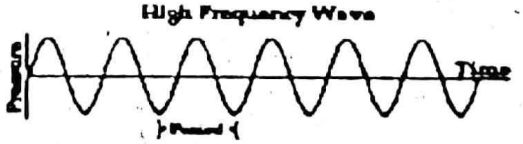
(9) Write down important features of Simple Harmonic Motion

Ans: Important features of SHM are summarized as:

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 always directly proportional to its displacement from the mean position i.e. acceleration will be zero at the mean position while it will be maximum at the extreme positions.
iv. Its velocity is maximum at the mean position and zero on the extreme positions.

(10) Define time period and frequency in case of vibratory motion.

Ans:

	Time Period	**Frequency**
Vibratory Motion	The time required to complete one vibration is known as time period.	The number of vibrations completed in one second is known as frequency
Waves	The time required to pass one wave from a certain point is called time period $T = \frac{1}{f}$ 	The number of waves passing through a certain point in one second is known as frequency. $f = \frac{1}{T}$ 

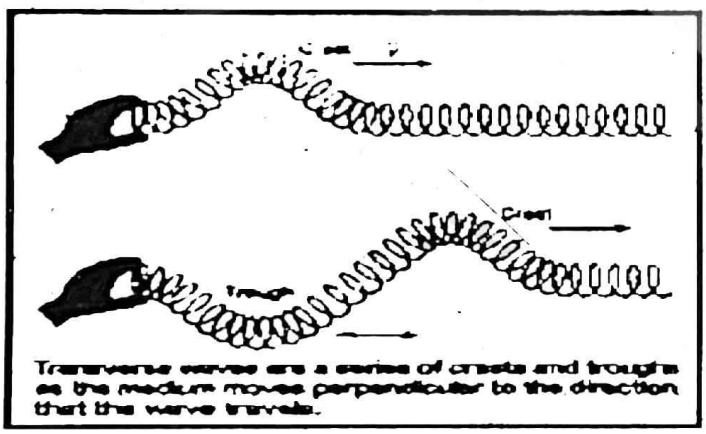
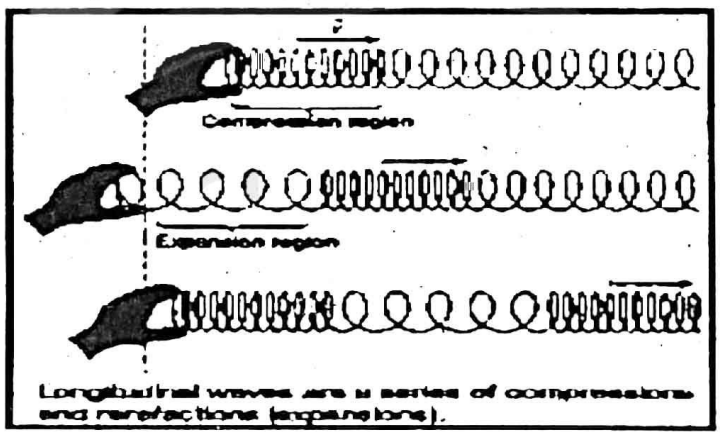
(11) Differentiate between mechanical waves and electromagnetic waves.

Ans:

Mechanical Waves	Electromagnetic Waves
The waves which require a material medium for their propagation are known as mechanical waves. **Examples** • Sound waves • Waves produced on a rope • Water waves	The waves which can propagate with or without material medium are known as electromagnetic waves. **Examples** • X-rays • Radio waves • Heat and light waves

(12) Differentiate between transverse waves and compressional or longitudinal waves.

Ans:

Transverse Waves	Compressional or Longitudinal Waves
The waves in which the direction of vibratory motion of particles of medium is perpendicular to the direction of propagation of waves are called transverse waves. **Examples** • Waves produced in a rope • Water waves	The waves in which the direction of vibratory motion of particles of medium is parallel to the direction of propagation of waves are called compressional or longitudinal waves. **Example** • Sound waves
	

(13) Write down the relationship between frequency and time period

Ans: Frequency is a reciprocal of time period (They have inverse relationship)

$$f = \frac{1}{T}$$

(14) If we double the length of the pendulum then what will be the time period?

Ans: As we know that

$$T = 2\pi\sqrt{\frac{\ell}{g}} \text{ -------(i)}$$

Now ℓ becomes 2ℓ

So

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

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

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

Hence Time period is $\sqrt{2}$ times of time period

(15) Find the time period and frequency of a simple pendulum 1.0 m long at a location where g = 10.ms^{-2}

Ans:

Given Data

L=1.0m,

g =10.0ms^{-2}.

Required

Time period of simple pendulum T = ?

Frequency of Simple pendulum f =?

Formula

Time Period of Simple Pendulum

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

By putting the values

$$T = 2\pi\sqrt{\frac{1.0m}{10.0ms^{-2}}}$$

T=1.99s.

Frequency of simple pendulum

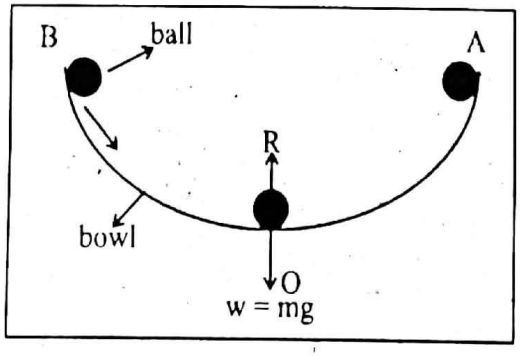
$$f = \frac{1}{T}$$

$$f = \frac{1}{1.99}$$

$$f = 0.5Hz$$

(16) When the ball is at the center of the bowl what will be the net force?

Ans: When the ball is at the center of the bowl the net force acting on the ball is zero because at this position weight of the ball acts downward and is equal to the upward normal force of the surface of the bowl.



(17) What is the displacement of an object in a simple harmonic motion when kinetic and potential energy are equal?

Ans: Kinetic energy and potential energy are equal when the body is at the middle of mean and extreme position.

(18) If we replace iron bob of simple pendulum with the wooden bob what will be the affect of time period of simple pendulum?

Ans: The time period of simple pendulum would remain same because period of a pendulum is independent of mass and amplitude.

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

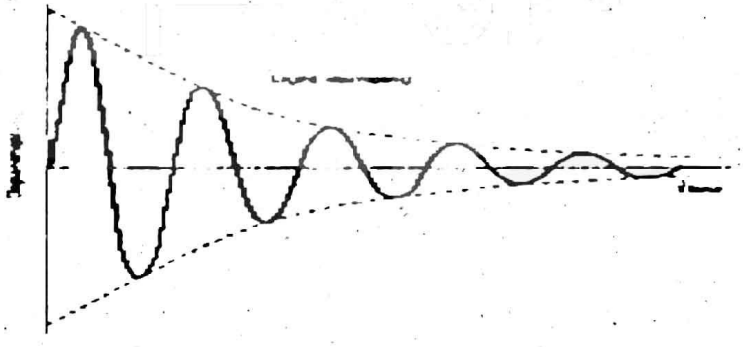
10. 2 & 10.3 Damped Oscillations and Wave Motion

(19) What is meant by damped oscillation?

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

(20) How does the mechanical energy of system reduce?

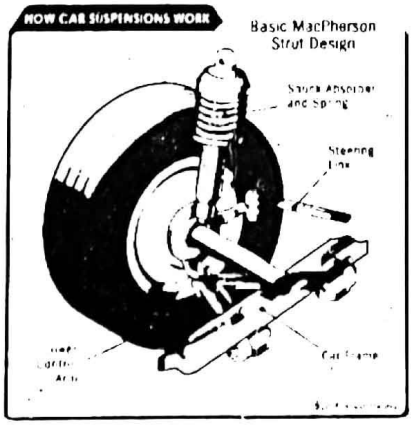
Ans: The friction reduces the mechanical energy of the system as time passes, and the motion is said to be damped, this damping progressively reduces the amplitude of the motion.

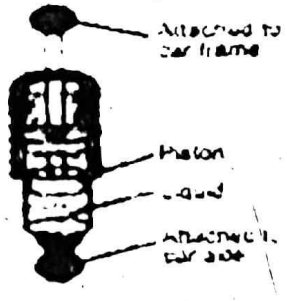


(21) Explain function of the shock absorber (application of the damped oscillation)

Ans: Shock absorbers

Shock absorbers are one practical application of damped motion. A shock absorber consists of a piston moving through a liquid such as oil. The upper part of the shock absorber is firmly attached to the body of the car. When the car travels over a bump on the road, the car may vibrate violently. The shock absorbers damp these vibrations and convert their energy into heat energy of the oil.





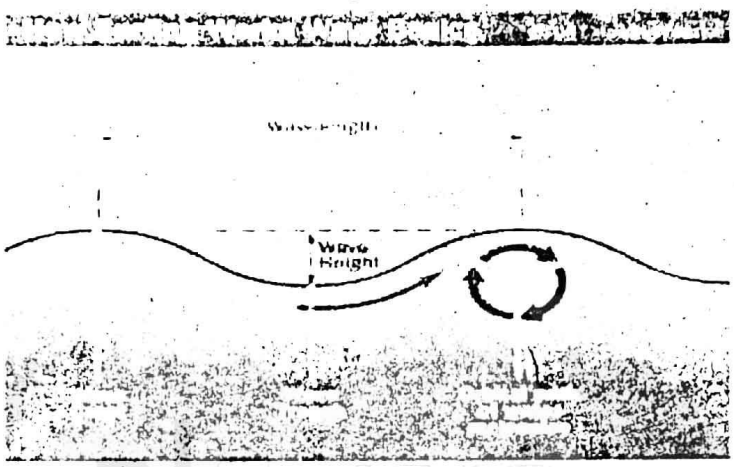
(22) How a wave can be defined? In which categories are these divided?

Ans: Wave

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

There are two categories of waves.

(i) Mechanical waves (ii) Electromagnetic Waves



(23) Define electromagnetic waves and give its examples.

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

Examples:

- Radio waves
- Heat waves
- X-rays etc

(24) Define mechanical waves. Give examples.

Ans: Waves which require any medium for their propagation are called mechanical waves Examples:

- Water waves
- Sound waves etc

(25) Do the mechanical waves pass through a space?

Ans: No, mechanical waves do not pass through the space because they require medium for their propagation.

10. 4 Types of Mechanical Wave

(26) Define longitudinal or compressional waves?

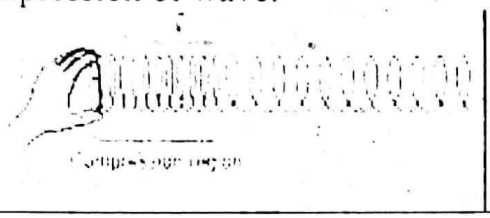
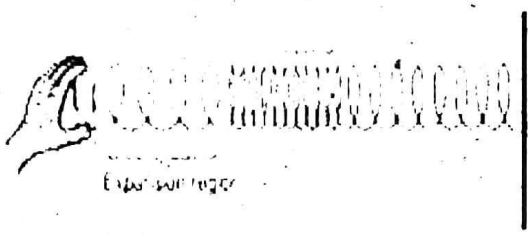
Ans: The waves in which the particles of medium move back and forth along the direction of the propagation of wave are called longitudinal or compressional waves.

Example:

- Sound waves

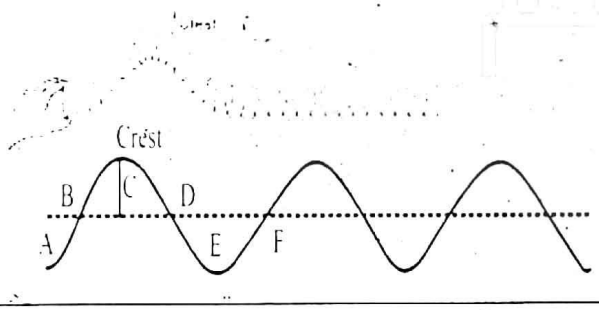
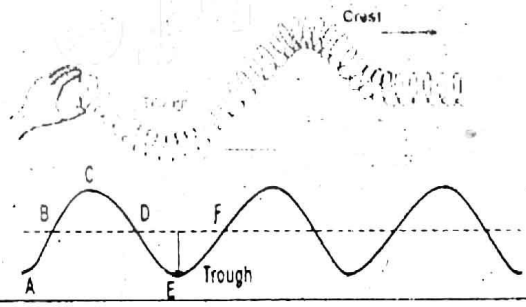
(27) Differentiate between compression and rarefaction?

Ans:

Compression	Rarefaction
The region of a wave where loops of spring are close together is called compression **OR** The region of a wave where particles of medium are closed to each other is called compression of wave. 	The region of a wave where the loops of spring are space apart is called rarefaction. **OR** Region of a wave where the particles of medium are spaced apart is called rarefaction. 

(28) Differentiate between crest and trough?

Ans:

Crest	Trough
The highest point on the wave is called crest. 	The lowest point on the wave is called trough. 

(29) Define transverse waves?

Ans: **Transverse waves**

The wave in which the particle of medium moves perpendicular to the direction of propagation of wave.

Example:

- Water waves
- Light waves
- Waves produced on a string and spring

(30) What is wave equation?

Ans: The relation between the velocity, frequency and wavelength of the wave is known as wave equation $v = f\lambda$ (wave equation)

(31) How energy can be transferred from one place to other?

Ans: Energy can be transferred from one place to another through waves.

(32) A wave moves on a slinky with frequency of 4 h z and wavelength of 0.4 m. what is the speed of the wave?

Solution:

Given that:

$f = 4Hz, \qquad \lambda = 0.4m$

Required:

Wave speed $v = ?$

Formula:

Wave speed $v = f\lambda$

$= (4Hz)\ (0.4m)$

$v = 1.6\ ms^{-1}$

(33) Describe Types of Mechanical Waves.

Longitudinal Waves or Compressional Waves

In longitudinal waves the particles of the medium move back and forth along the direction of propagation of wave.

Example:

- Sound Waves

Transverse Waves:

"The waves in which motion of particles of the medium is perpendicular to the motion of wave."

Examples:

- Waves on the surface of water and light waves are also transverse waves.

10.5 Ripple tank.

(34) Why bright lines are seen on the screen of the ripple tank?

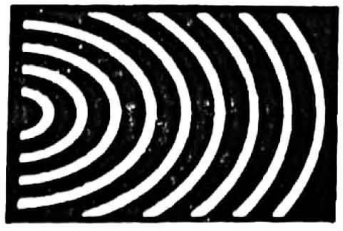
Ans: The crests of the waves appear as bright lines on the paper because they behave like a convex lens and converge the rays of light falling on them. So, bright lines are seen on the screen of the ripple tank.

(35) Why dark lines are seen on the screen of the ripple tank?

Ans: The troughs of the waves appear as dark lines on the paper because they behave like a concave lens and diverge the rays of light falling on them. So, dark lines are seen on the screen of ripple tank.

(36) How can we generate circular waves in a ripple tank?

Ans: We can generate circular waves in a ripple tank by attaching a knob on the lower side of vibrating bar. Now it is lowered in such a way that knob touches the water surface. When vibrator is set on, circular waves are produced on the water surface.

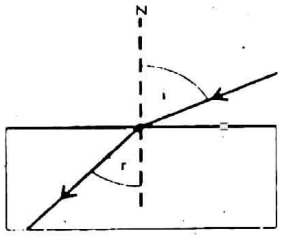


(37) In relation $v = f\lambda$ which two quantities depend upon the properties of the medium and why does third one not?

Ans: In relation $v = f\lambda$, V and λ depend on the properties of the medium while f does not depend on the properties of the medium because f depends upon the frequency of the vibrator.

(38) Why does wavelength decrease in shallow part of water?

Ans: As wavelength changes with the depth of water so there will be a decrease in wavelength of the waves in shallow part of water due to decrease in the speed of the waves.



(39) On what factor refraction of water depends?

Ans: Refraction of water waves depends upon the depth of water waves because speed of water waves depends upon the depth of water. Its speed is reduced when it enters in shallow water. So when water waves enter from deep water to shallow water their wavelength changes but frequency remains the same and refraction of water waves takes place.

(40) What is the effect of diffraction on water waves?

Ans: If we place two obstacles in a line of straight water waves in such a way that separation between them is equal to wavelength of water waves. After passing through the slits between two obstacles, straight water waves are changed into circular waves. But diffraction of waves can only be observed clearly if the size of the slit is nearly equal to wavelength of the wave.

(41) How diffraction is useful in daily life?

Ans: Due to diffraction of radio waves, transmission can be heard in such areas where the waves cannot reach directly.

(42) How do ocean waves cause destruction?

Ans: Sometime, the ocean waves cause the destruction of ships and coastal areas because in case of any disturbance in the ocean, energy is carried by the waves and they travel towards coastal area and causes destruction.