Chapter = 10

General Wave properties

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Q 1. Define the following

1. Wave:

A method transport energy from one point to another point without transfer of matter is called wave.

2. Crest:

Crest is a point on a surface wave where the displacement of the medium is at a maximum.

3. Trough:

Trough is a point on a surface wave where the displacement of the medium is at a minimum.

4. Amplitude:

Amplitude is the maximum displacement moved by a point on a vibrating body from the rest or mean position.

5. Compression:

compression Rarefaction Compression, in the longitudinal waves this is a region where turns of the coil or particles are closer together than average.

6. Time period:

Time Period is the time taken for any one point on the wave to complete one oscillation.

7. Frequency:

Frequency is the number of complete waves produced by a source per unit of time.

8. Wave front:

The Wavefront is an imaginary line on a wave that joins all points that are in the same phase.

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Q 2. **What do you know about Rarefaction of wave, Reflection of wave,** Diffraction of wave?

1. Reflection of wave:

Bouncing back of waves into same medium by striking other medium surface is called reflection.

2. Refraction of wave:

When a wave enters from a region of deep water to a region of shallow water at an angle, the wave will change its direction, this phenomenon is known as refraction of the wave.

3. Diffraction of wave:

The spreading of the waves near an obstacle is called diffraction.

Q 3. Differentiate between Transverse wave and Longitudinal Wave

Longitude Wave	Transverse wave
Particles in the medium vibrate parallel to the direction of propagation of the wave,	Particles in the medium vibrate perpendicular to the direction of propagation of the wave,
The wave travel in the form of condensation and rarefactions	The wave travel in the form of crest and troughs

One condensation and a rarefaction constitute one wave	One crest and one trough constitute wave
This cannot be polarized	This wave can be polarized

Q 4. Differentiate between mechanical and electromagnetic wave

Mechanical waves	Electromagnetic waves
Mechanical waves are such waves that need a medium for propagation.	Electromagnetic waves are such waves that do not need a medium for propagation.
Mechanical waves are produced by vibratory motion in the respective medium	Electromagnetic waves are produced by a changing of electric and magnetic fields
Sound waves, water waves, and seismic waves are examples of mechanical waves.	Radio waves, microwaves, some light waves, U.V waves and infrared waves are Some examples of electromagnetic
Mechanical waves consist of transverse as well as Longitudinal waves.	Electromagnetic waves are only comprised of a transverse waves wave in nature
Mechanical waves cannot travel through the vacuum.	Electromagnetic waves travel through the vacuum speed of 3×10^8 m/s.
All mechanical waves travel through their media at different speeds depending upon the physical properties of the respective medium.	All electromagnetic waves can travel through transparent media at different speeds depending upon the refractive index of the respective medium.

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Q 5. What is damped system? What is damped oscillation?

Damped System:

An oscillating system in which friction has an effect is a damped system.

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Damped oscillation

The oscillations of a system in the presence of some resistive forces are damped oscillations.

Q 6. Define Wave length, Wave speed. Derive V = fλ

Wave length:

Wavelength (λ) is the linear distance between two successive crests or troughs in a transverse wave and two Successive compressions and rarefactions in a longitudinal wave. Its SI unit is meter (m).

Wave speed:

It is defined as the distance travelled by a given point on the wave, such as a crest in a given interval of time.

Mathematical

Let us consider a wave,

Distance travelled = λ

Time take = T

Then

$$V = \frac{s}{t}$$

Hence S = λ

t =T

$$V = \frac{\lambda}{T} \qquad \text{But } f = \frac{1}{T}$$

V = fλ

Q 7. What is periodic motion.

Periodic Motion

A motion repeating itself in an equal time interval is referred to as periodic or oscillatory motion.

Q 8. Waves are the means of energy transfer without matter. Justify this statement with the help of everyday life examples.

Waves are means of energy transfer without transfer of matter

"The wave is a disturbance in a medium that transfers energy from one place to another" Waves transfer energy over a distance. Can waves move matter the entire distance? For example, a tide can Fig: 10.10 Longitudinal travel many kilometres. The water moves up and down- a disturbance that travels in a wave, transferring energy, not matter.

Q 9. What is a ripple tank, and explain its working?

Ripple Tank

A ripple tank is a shallow glass tank of water used to demonstrate the basic properties of waves.

Working:

A ripple tank is a shallow glass tank of water used to demonstrate the basic properties of waves. It is a particular type of wave tank. The ripple tank is usually illuminated from above so that the light shines through the water to visualize the wave being produced.

In the laboratory, we can produce water waves with the ripple tank. In the ripple tank, a small vibrator moves up and down the water surface, resulting in the water particles at the surface that are in contact with the dipper being made to move up and down. This up and down motion soon spread to other parts of the water surface in the tank in the form of ripples; fig. Here the water is the medium through which the ripples travel or propagate.

Q 10. What are the necessary conditions for a body to execute simple harmonic motion?

CHARACTERISTICS OF SIMPLE HARMONIC MOTION

I. A restoring force must act on the body.

II. Body must have acceleration in a direction opposite to the displacement and the acceleration must be directly proportional to displacement.

III. The system must have inertia (mass).

IV. SHM is a type of oscillatory motion.

V. It is a particular case of periodic motion

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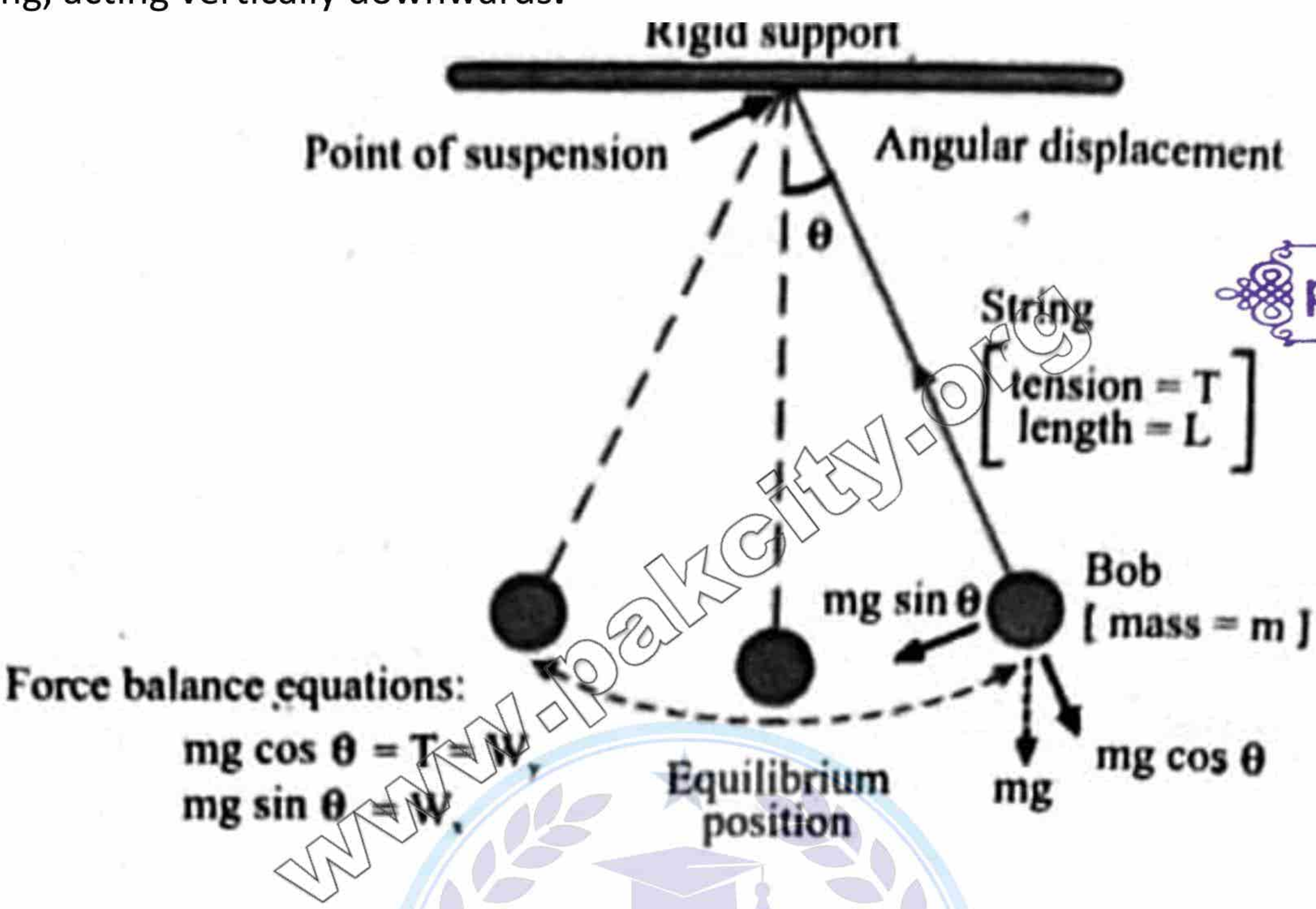
Q 11. What are the forces acting on simple pendulum? With the help of a diagram, explain SHM in the pendulum.

Forces acting on a displaced pendulum

When the bob of the pendulum is displaced at a small angle "θ" to an extreme position. The forces that act upon it are as given underneath:

Tension "T" along the direction of the string.

Weight W= mg, acting vertically downwards.



The weight is further resolved into its components The restoring force is a force which acts to bring mg sinθ and mg cosθ.

A simple pendulum consists of a small metallic bob of mass 'm' suspended from a light inextensible string of length "l" fixed at its upper end.

At the mean position 0, a pendulum is in its equilibrium position. If no external force were applied, the bob of a pendulum would naturally settle

The curve path s is the distance the bob of a pendulum travels. The weight mg consists of the component's mg cosθ along the string and mg sinθ perpendicular to the arc. For each given string, the component mg cos perpendicular to the string is exactly cancelled by the tension in the string. The resulting net force, which is directed back toward the equilibrium point, is tangential to the are and equals mg sinθ.

Q 12. What will be the effect of the period if there is an increase in its length and mass?

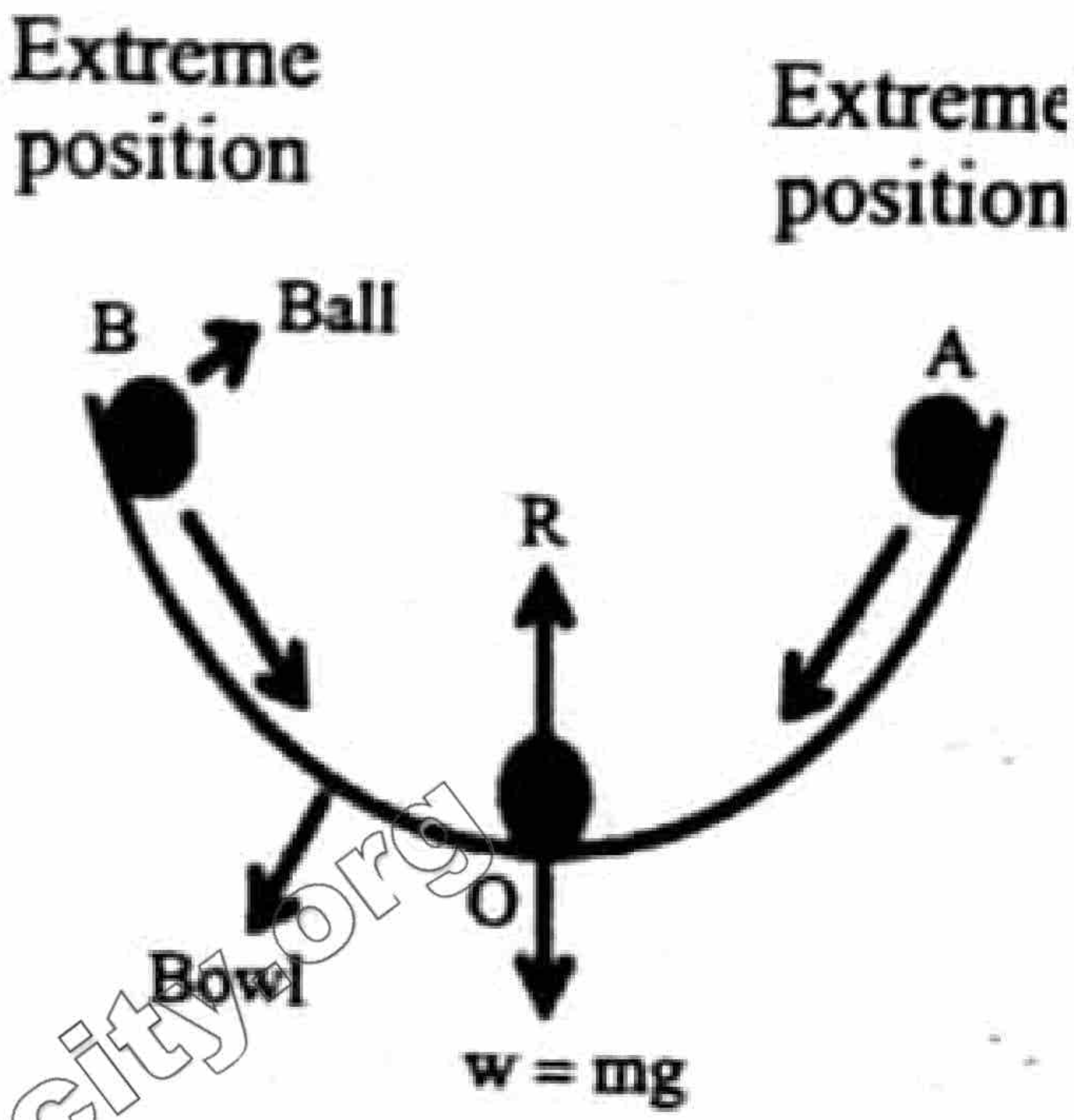
Effect of length

Simple pendulum period is affected by length and gravity acceleration.

Effect of mass

The period is independent of mass and amplitude.

Q 13. With the help of a diagram, explain SHM in the ball and bowl system.



The motion of a ball in the bowl executing Simple Harmonic Motion

Ball and bowl system and SHM

Let us examine that the motion of a ball placed in a bowl executes simple harmonic motion. When the ball is placed at the mean position "0' as shown in figure, that is, at the centre of the bowl. In this position, the net force acting on the ball is zero. Hence there is no motion.

Now, what if we displace the ball to an extreme position "A' and then release it? The ball starts moving towards the mean position O' due to the restoring force caused by its weight component. At position 0' the ball gets maximum speed and due to inertia, it moves towards opposite extreme position 'B' with the restoring force that acts towards the mean position, the speed of the ball starts to decrease. The ball stops for a while at "B' and then again moves towards the mean position 'O'. This ball's to and fro motion continues about the mean position 0'. This result shows that the acceleration of the ball is directed towards O. Hence, the ball's to and fro motion about a mean position placed in a bowl is also an example of simple harmonic motion.

Chapter = 10

Numerical

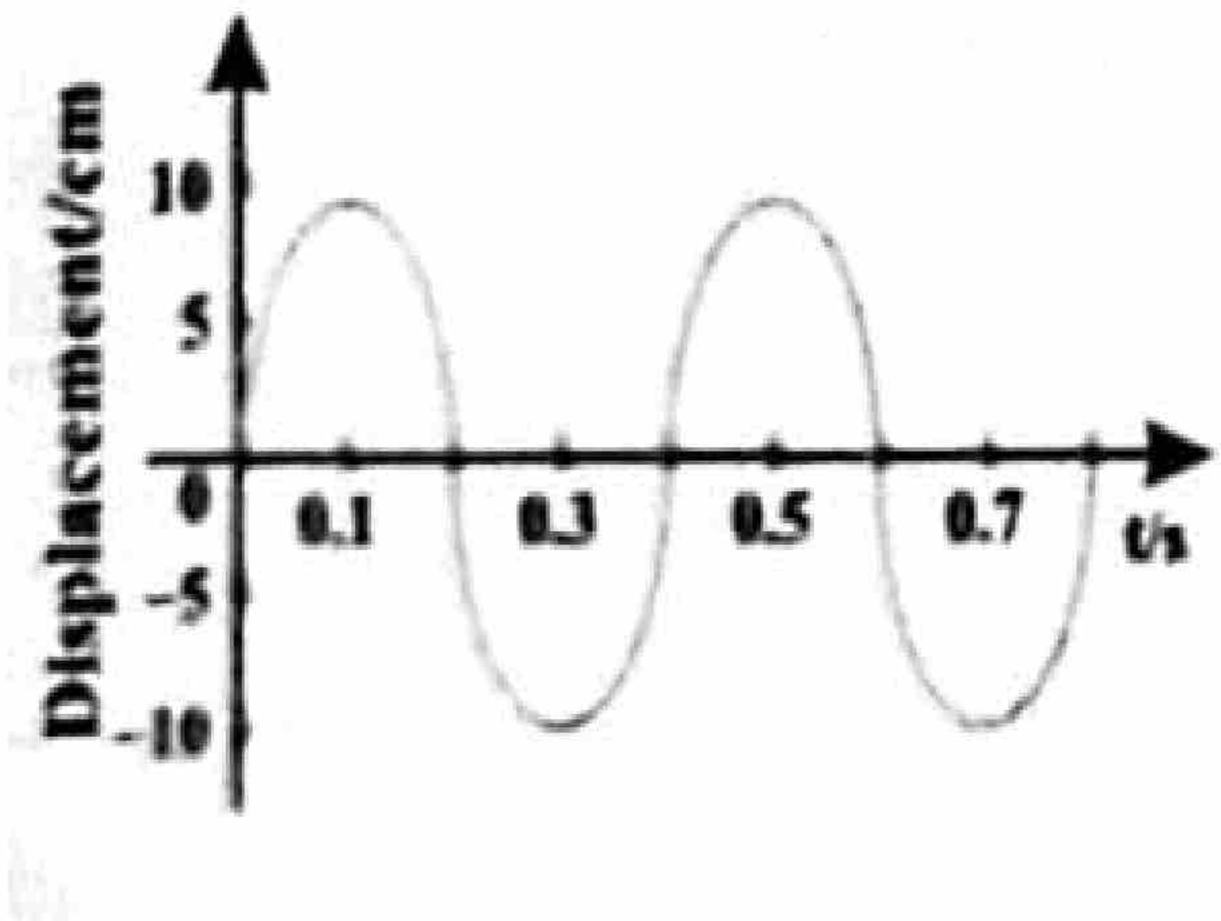
Book Work Examples

1. The given figure shows the displacement vs the time of a wave traveling to the right with a speed of 4 m/s.

(a) What is the time Period and frequency of the wave?

(b) Calculate the wavelength of the wave?

(**Ans:** 1.6m)



2. A fisherman notices that his boat is moving up and down regularly due to waves on the surface of the water. It takes 4.0s for the boat to travel from the highest to the lowest point, a total distance of 3.0 m. The fisherman sees that the wave crests are spaced 8.0 m apart.

(a) What is the period, frequency, amplitude, and wavelength of the waves?

(b) How fast are the waves moving?

(**Ans:** 8s, 0.125Hz, 1.5m and 8m)

3. Find the period and frequency of a simple pendulum 1.0 m Simple Harmonic long at a location where $g=9.8\ ms^{-2}$.

(**Ans:** 2.01s, 0.50Hz)

4. Pendulum clocks with a pendulum measuring out the passing of a second. How long of a pendulum is required to have a period of 1 second? $g = 9.8\ m/s^2$. (**Ans:** 0.25m)

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Book Numerical

1. What is the wavelength of a radio wave broadcasted by a radio station with a frequency of 1300 kHz? Where $1K=10^3$, and the speed of the radio-wave is $3x\ 10^8\ m/s^2$.

(**Ans:** 230.76m)

2. The waves moving in the pond have a wavelength of 1.6 m, and a frequency of 0.80 Hz. Calculate the speed of these water waves.

(**Ans:** 1.28m/s)

3. If 50 waves pass through a point in the rope in 10 seconds, what are the frequency and the period of the wave? If its wavelength is 8 cm, calculate the wave speed. Explain the type of wave produced.

(**Ans:** 5Hz, 0.2s, 0.4m/s)

4. A slinky has produced a longitudinal wave. The wave travels at a speed of 40 cm/s and the frequency of the wave is 20 Hz. What is the minimum separation between the consecutive compressions?

(**Ans:** 0.002m)

5. Suppose a student is generating waves in a slinky. The student's hand makes one complete forth and back oscillation in 0.40 s. The wavelength in the slinky is 0.60m. For this wave, determine a. Period and frequency b. Wave speed

(**Ans:** 0.40s, 2.5Hz, 1.5ms)

6. If 80 compressions pass through a point in spring in 20 seconds. Calculate the frequency and the period? If two consecutive compressions are 8 cm apart, calculate the wave speed.

(**Ans:** 4Hz, 0.25s, 0.32m/s)

7. Waves on a swimming pool propagate at 0.9-0 m/s. If you splash the water at one end of the pool, observe the wave go to the opposite end, reflect, and return in 30.0 s. How far away is the other end of the pool?

(**Ans:** 0.033Hz,27m)

8. A simple oscillating pendulum has a length of 80.0 cm. Calculate its a. Period b. Frequency When g 9.8 m/s^2

(**Ans:** 1.794s, 0.557Hz)

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