

Class 10 Physics - Chapter 10 Notes

Simple Harmonic Motion and Waves | Definitions, formulas, solved points | Punjab Boards (PCTB)

Simple Harmonic Motion (SHM)

- SHM is the to-and-fro motion of a body about its mean position in which acceleration is directly proportional to displacement and directed towards the mean position.
- Examples: mass-spring system, simple pendulum, vibrating tuning fork.
- Time period T = time for one complete oscillation; frequency $f = 1/T$, unit hertz (Hz).
- For a simple pendulum: $T = 2(\pi) \times \sqrt{l/g}$ - period depends on length, not on mass or amplitude (for small angles).
- For mass-spring: $T = 2(\pi) \times \sqrt{m/k}$, where k is the spring constant.

Important Terms

- Amplitude: maximum displacement from the mean position.
- Displacement: distance from the mean position at any instant.
- Damping: gradual decrease of amplitude due to friction/air resistance; oscillations die out with time.
- A wave is a disturbance that transfers energy without transferring matter.

Types of Waves

- Mechanical waves need a material medium (sound, water waves). Electromagnetic waves do not need a medium (light, radio).
- Transverse waves: particles vibrate perpendicular to wave direction (light, water surface) - they form crests and troughs.
- Longitudinal waves: particles vibrate parallel to wave direction (sound) - they form compressions and rarefactions.
- Wave speed formula: $v = f \times \lambda$ (speed = frequency $\times$ wavelength). Ripple tank is used in the lab to study water waves.

Wave Behaviour

- Reflection: waves bounce off a barrier; angle of incidence = angle of reflection.
- Refraction: speed (and wavelength) changes when waves enter a different depth/medium; frequency stays constant.
- Diffraction: spreading of waves when they pass through a slit/gap of size near their wavelength.

Exam Tips

- Numericals come from $T = 2(\pi)\sqrt{l/g}$ and $v = f(\lambda)$. Practise unit conversion (cm to m).
- In refraction questions, remember: frequency never changes, speed and wavelength do.
- Draw neat labelled diagrams of transverse and longitudinal waves.

Quick Revision Table

Quantity	Formula / Unit
Frequency	$f = 1/T$, unit hertz (Hz)

Quantity	Formula / Unit
Wave speed	$v = f \times \lambda$
Pendulum period	$T = 2(\pi) \sqrt{l/g}$
Spring-mass period	$T = 2(\pi) \sqrt{m/k}$
Wavelength symbol	λ , unit metre

Practice MCQs (answers at the end)

Q1. The unit of frequency is:

A. Second **B.** Hertz **C.** Metre **D.** Newton

Q2. In SHM, acceleration is maximum at:

A. Mean position **B.** Extreme position **C.** Mid point **D.** Nowhere

Q3. Sound waves are:

A. Transverse **B.** Longitudinal **C.** Electromagnetic **D.** Stationary

Q4. If $f = 10$ Hz and wavelength = 2 m, wave speed is:

A. 5 m/s **B.** 20 m/s **C.** 0.2 m/s **D.** 12 m/s

Q5. Which does NOT need a medium?

A. Sound **B.** Water waves **C.** Light **D.** Seismic waves