

Class 9 Science – Chapter 8: Motion

Written in a simple and natural way so they are easy to understand and revise.

1. Introduction

Everything around us is either at rest or in motion. A bus moving on the road, a bird flying, the Earth rotating — all are examples of motion.

What is Motion?

An object is said to be in motion if its **position changes with time** with respect to a fixed point.

If position does not change → object is at **rest**.

2. Reference Point

Motion is always described with respect to a reference point.

Example:

A person sitting in a moving train appears at rest to another passenger but moving with respect to trees outside.

3. Types of Motion

(a) Rectilinear Motion

Motion in a straight line.

Example: Car on straight road.

(b) Circular Motion

Motion along a circular path.

Example: Stone tied to string.

(c) Periodic Motion

Motion that repeats at equal intervals.

Example: Pendulum.

4. Distance and Displacement

Distance

- Total path covered
- Scalar quantity
- Always positive

Displacement

- Shortest straight-line distance
- Vector quantity
- Can be zero

Example:

A person walks 10 m forward and comes back →

Distance = 20 m

Displacement = 0

5. Speed

Speed tells how fast an object moves.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

SI unit = **m/s**

Types of Speed:

- Uniform speed → equal distances in equal intervals
- Non-uniform speed → unequal distances in equal intervals

6. Velocity

Velocity = Speed in a given direction.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

It is a vector quantity.

7. Acceleration

Acceleration is the **rate of change of velocity**.

$$a = \frac{v - u}{t}$$

Where

u = initial velocity

v = final velocity

t = time

SI unit = **m/s²**

If velocity decreases → **retardation** (negative acceleration)

8. Equations of Motion

For uniformly accelerated motion:

1. $v = u + at$
2. $s = ut + \frac{1}{2}at^2$
3. $v^2 - u^2 = 2as$

Where

u = initial velocity

v = final velocity

a = acceleration

t = time

s = displacement

9. Graphical Representation of Motion

Distance-Time Graph

- Straight line \rightarrow uniform speed
- Curved line \rightarrow non-uniform speed

Velocity-Time Graph

- Straight line \rightarrow uniform acceleration
- Area under graph = displacement

10. Uniform Circular Motion

Motion in circular path with constant speed.

Even though speed is constant, direction changes \rightarrow velocity changes \rightarrow acceleration present (centripetal).

11. Important Points

- ✓ Motion depends on reference point
- ✓ Distance \geq displacement
- ✓ Speed has no direction
- ✓ Velocity has direction
- ✓ Acceleration is change in velocity
- ✓ Graphs help understand motion

12. Quick Revision Formula List

$$\begin{aligned}\text{Speed} &= \frac{d}{t} \\ v &= u + at \\ s &= ut + \frac{1}{2}at^2 \\ v^2 - u^2 &= 2as\end{aligned}$$