

ICSE Class 9 Physics – Chapter 2: Motion in One Dimension

2.1 Introduction to Motion

Motion is the change in position of a body with respect to time and a reference point.

Types of Motion

- **Translatory motion:** Linear movement (straight line or curve)
- **Rotational motion:** About a fixed axis
- **Vibratory motion:** To and fro about a mean position

In this chapter, we focus on **linear motion** (motion in a straight line), also called **motion in one dimension**.

2.2 Important Terms

Quantity	Description	SI Unit
Distance	Total path length travelled	Metre (m)
Displacement	Shortest distance from initial to final point	Metre (m)

Speed	Rate of change of distance	m/s or km/h
Velocity	Rate of change of displacement	m/s or km/h
Acceleration	Rate of change of velocity	m/s ²

2.3 Distance vs. Displacement

Feature	Distance	Displacement
Scalar/Vector	Scalar	Vector
Value	Always positive	Can be positive, negative, or zero
Path	Actual path	Shortest path

2.4 Speed and Velocity

Speed

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

Velocity

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

- **Uniform speed/velocity:** Same magnitude at all times
 - **Variable speed/velocity:** Changes with time
 - **Average speed/velocity:**
Average Speed = $\frac{\text{Total distance}}{\text{Total time}}$
Average Velocity = $\frac{\text{Total displacement}}{\text{Total time}}$
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2.5 Acceleration

Acceleration (a) = $\frac{\text{Change in velocity}}{\text{Time taken}} = \frac{v - u}{t}$

Where:

- u = initial velocity
 - v = final velocity
 - t = time taken
 - Positive acceleration → speeding up
 - Negative acceleration (deceleration) → slowing down
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2.6 Graphical Representation of Motion

1. Distance-Time Graph

- **Uniform motion:** Straight line with constant slope

- **Non-uniform motion:** Curved line

2. Velocity-Time Graph

- **Uniform acceleration:** Straight sloping line
- **Area under graph** = distance travelled
- **Slope** = acceleration

2.7 Equations of Uniformly Accelerated Motion

When motion is along a straight line with constant acceleration:

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

Where:

- s = displacement
- u = initial velocity
- v = final velocity
- a = acceleration
- t = time taken

2.8 Free Fall and Acceleration due to Gravity

- **Free fall:** Motion of an object under gravity alone.
- **Acceleration due to gravity (g):**
 $g \approx 9.8 \text{ m/s}^2$
- In free fall:
 $a = g, u = 0$
- Equations used:
 $v = gt, s = \frac{1}{2}gt^2, v^2 = 2gs$