

Chapter 2: Motion in One Dimension

1. Physical Quantities

- **Scalar Quantities:** Have only magnitude.
Examples: Mass, time, speed, energy, distance.
 - **Vector Quantities:** Have both magnitude and direction.
Examples: Velocity, displacement, acceleration, force.
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2. Rest and Motion

- **Rest:** No change in position w.r.t. surroundings.
 - **Motion:** Change in position w.r.t. surroundings.
 - **One-Dimensional Motion:** Movement in a straight line (rectilinear motion).
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3. Distance vs. Displacement

Distance	Displacement
Total path covered	Shortest straight path between initial and final positions
Scalar	Vector
Depends on path	Path-independent
Always $\geq$ displacement	Can be $<$ or $=$ distance

4. Speed

- **Definition:** Distance per unit time.
$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$
 - **Types:**
 - **Uniform Speed:** Equal distance in equal time.
 - **Non-uniform Speed:** Unequal distances in equal time.
 - **Instantaneous Speed:** Speed at a particular instant.
 - **Average Speed:** Total distance / Total time.
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5. Velocity

- **Definition:** Displacement per unit time.
$$\text{Velocity} = \text{Displacement} / \text{Time}$$
 - **Vector quantity**
 - **Types:**
 - **Uniform Velocity:** Equal displacement in equal time & constant direction.
 - **Non-uniform Velocity:** Displacement or direction changes.
 - **Instantaneous Velocity:** Velocity at a specific moment.
 - **Average Velocity:** Total displacement / Total time.
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6. Speed vs. Velocity

Speed	Velocity
Scalar	Vector
Based on distance	Based on displacement
Always positive	Can be positive/negative/zero

7. Acceleration

- **Definition:** Rate of change of velocity.
$$a = (v - u) / t$$
 - **Unit:** m/s^2
 - **Vector quantity**
 - **Types:**
 - **Uniform Acceleration:** Equal change in velocity per time interval.
 - **Non-uniform Acceleration:** Unequal change in velocity.
 - **Retardation (Negative Acceleration):** Velocity decreases with time.
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8. Motion Under Gravity

- Constant acceleration due to gravity:
$$g = 9.8 \text{ m/s}^2$$
 - **Falling Body:** Acceleration = $+g$
 - **Rising Body:** Retardation = $-g$
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9. Graphical Representation

- **Displacement–Time Graph:**
Slope = Velocity
 - **Velocity–Time Graph:**
 - Slope = Acceleration
 - Area under curve = Displacement
 - **Acceleration–Time Graph:**
 - Area under curve = Change in velocity
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10. Equations of Motion (for uniform acceleration)

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
 - s : displacement
 - t : time
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