

CBSE Class 9 Science — Chapter 4: Describing Motion Around Us

Ultimate Premium Handwritten Notebook Notes (Session 2026–27)

Board: CBSE

Subject: Physics

Level: School Exams + Olympiad Basics

1. Chapter Overview

- **Introduction:** Motion is a change in position of an object with time. Everything in the universe is in motion relative to something else because the Earth itself is moving.
- **Real-life Connection:** Walking to school, trains moving on tracks, the Earth orbiting the Sun, and blood flowing through veins.
- **Learning Outcomes:** Understand how to describe position, distinguish between scalar and vector quantities, interpret motion graphs, and solve kinematic equations.
- **Importance:** Forms the fundamental bedrock of classical mechanics and higher-level physics in Class 11 and competitive exams (JEE/NEET/Olympiads).

2. Complete Theory

Basic Concepts

- **Rest:** An object is at rest if its position does not change with respect to its surroundings with time.
- **Motion:** An object is in motion if its position changes continuously with respect to its surroundings with time.
- **Reference Point (Origin):** A fixed point used to locate the position of an object.
- **Position:** The specific location of an object relative to a reference point.

Distance and Displacement

- **Distance:** The total path length covered by an object between two points. It is a scalar quantity.
- **Displacement:** The shortest straight-line distance from the initial position to the final position. It is a vector quantity.

Speed, Velocity and Acceleration

- **Speed (v):** Distance traveled per unit time. Formula: $Speed = Distance / Time$. SI Unit: m/s.
- **Average Speed:** Total distance traveled divided by total time taken.
- **Velocity (v):** Speed in a given direction, or rate of change of displacement. SI Unit: m/s.
- **Acceleration (a):** Rate of change of velocity with respect to time. Formula: $a = (v - u) / t$. SI Unit: m/s².

Equations of Motion (For Uniform Acceleration)

1. Velocity-Time Relation: $v = u + at$
2. Position-Time Relation: $s = ut + \frac{1}{2}at^2$
3. Position-Velocity Relation: $v^2 = u^2 + 2as$

3. Formula Master Sheet

Formula	Meaning	Variables	SI Unit	Shortcut / Notes
$v = s / t$	Speed / Velocity	s = distance, t = time	m/s	km/h to m/s: multiply by $5/18$
$v_{\{avg\}} = s_{\{tot\}} / t_{\{tot\}}$	Average Speed	Total distance & time	m/s	Harmonic mean for equal distances
$a = (v - u) / t$	Acceleration	u, v, t	m/s ²	If stopping, $v = 0$
$v = u + at$	1st Equation	u, v, a, t	Various	Slope of v-t graph
$s = ut + \frac{1}{2}at^2$	2nd Equation	s, u, t, a	m	Area under v-t graph
$v^2 = u^2 + 2as$	3rd Equation	v, u, a, s	Various	Independent of time t

4. Concept Boxes

★ Remember This

Displacement can be zero even if distance is positive (e.g., complete round trip on a circular track). However, distance can never be zero or negative for a moving object.

⚠ Common Mistake

Students often forget to convert units (e.g., mixing km/h with seconds or meters with hours). Always convert everything to SI units before calculation.

💡 Exam Tip

In graphical questions, clearly state what the slope and the area represent before writing any mathematical steps to secure full marks.

9. Frequently Asked Viva Questions (Excerpt)

- **Q:** What does the slope of a distance-time graph represent?
A: Speed.
- **Q:** What does the area under a velocity-time graph represent?
A: Displacement.
- **Q:** Is uniform circular motion accelerated motion?
A: Yes, because the direction changes continuously.
- **Q:** Can speed be negative?
A: No, speed is always positive or zero.

10. Chapter Mind Map

DESCRIPTIONS OF MOTION

- └ Concepts: Rest & Motion, Reference Point, Position
- └ Quantities: Scalar (Distance, Speed) & Vector (Displacement, Velocity, Acceleration)
- └ Motion Types: Uniform, Non-Uniform, Uniform Circular Motion
- └ Graphs: Position-Time & Velocity-Time Graphs
- └ Kinematic Equations: $v = u + at$, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

11. Final 10-Minute Revision Checklist

[] Can I define distance and displacement with differences?

[] Do I remember all three kinematic equations?

[] Do I know what slope and area mean on x-t and v-t graphs?

[] Can I convert km/h into m/s smoothly?