Class 9 Science Chapter 4: Describing Motion Around Us - Notes, Important Questions and MCQs (2026-27)

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These Class 9 Science Chapter 4 notes cover “Describing Motion Around Us” from the new NCERT textbook Exploration (2026-27): position, distance and displacement, average speed and velocity, acceleration, position-time and velocity-time graphs, the kinematic equations and uniform circular motion – with solved numericals, 10 MCQs and a free PDF.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Comparison Tables
- Solved Numericals
- Key Formulas at a Glance
- Important Definitions and Terms
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

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Chapter Overview

Everything in nature is in motion. To describe motion we need a reference point, and we use quantities such as position, distance, displacement, speed, velocity and acceleration. Motion in a straight line is the simplest kind of motion.

Graphs give a visual picture of motion: the slope of a position-time graph is velocity, the slope of a velocity-time graph is acceleration, and the area under a velocity-time graph is displacement. For constant acceleration, three kinematic equations connect u, v, a, s and t. The chapter ends with motion in a plane and uniform circular motion.

Important Topics and Concepts

Position, Distance and Displacement

- Position is described by distance and direction from a fixed reference point at an instant.
- Distance travelled: total length of the path (scalar, always positive).
- Displacement: change in position – shortest straight-line distance from initial to final position, with direction (vector).
- Displacement can be zero even when distance is not (e.g. a round trip).

Average Speed, Velocity and Acceleration

- Average speed = total distance travelled / time interval.
- Average velocity = displacement / time interval.
- Average acceleration = change in velocity / time interval = $(v - u)/t$; SI unit m s^{-2}.
- Acceleration can change the speed or the direction (or both); negative acceleration (slowing down) is called retardation.
- A constant speedometer reading does not mean zero acceleration – the direction may change, as on a curved road.

Graphical Representation of Motion

- Position-time graph: straight line → uniform velocity; slope = velocity; a curve → changing velocity.
- Velocity-time graph: horizontal line → constant velocity; straight sloping line → constant acceleration; slope = acceleration.
- Area under a velocity-time graph = displacement.
- Plot time on the x-axis and choose a suitable scale on graph paper.

Kinematic Equations (Constant Acceleration)

- $v = u + at$.
- $s = ut + \frac{1}{2}at^2$.
- $v^2 - u^2 = 2as$.
- u = initial velocity, v = final velocity, a = acceleration, t = time, s = displacement.
- These are derived from the velocity-time graph (slope and area).

Motion in a Plane and Uniform Circular Motion

- Motion in two dimensions: overtaking vehicles, a kicked ball, a satellite.
- In one revolution, distance = $2\pi R$ but displacement = 0.
- Average speed in circular motion $v = 2\pi R/T$, where T is the time for one revolution.
- In uniform circular motion speed is constant but direction changes continuously, so the motion is accelerated.

Comparison Tables

Common difference questions.

Distance / Speed	Displacement / Velocity
Scalar (magnitude only)	Vector (magnitude and direction)

Distance / Speed	Displacement / Velocity
Depends on path	Depends only on initial and final positions
Always positive	Can be positive, negative or zero
Average speed = distance/time	Average velocity = displacement/time

Solved Numericals

Board-style problems from the chapter pattern.

- A man walks 250 m to a shop, returns home, goes to the shop again and comes back. Distance = 4 × 250 = 1000 m; displacement = 0.
- A student climbs from ground floor to the 4th floor and comes down to the 2nd floor (3 m per floor). Distance = 12 + 6 = 18 m; displacement = 6 m upwards.
- A car starts from rest and reaches 24 m/s in 6 s. a = 24/6 = 4 m/s²; s = ½ × 4 × 36 = 72 m.
- A motorbike at 28 m/s stops after 98 m with constant acceleration. 0 = 784 + 2a(98) → a = −4 m/s²; t = (0 − 28)/(−4) = 7 s.

Key Formulas at a Glance

Quantity	Formula	SI unit
Average speed	total distance / time	m s^{-1}
Average velocity	displacement / time	m s^{-1}
Acceleration	(v − u)/t	m s^{-2}
First equation	v = u + at	—
Second equation	$s = ut + \frac{1}{2}at^2$	—
Third equation	$v^2 - u^2 = 2as$	—
Circular motion speed	2πR/T	m s^{-1}

Important Definitions and Terms

Term	Meaning
Reference point	Fixed point from which position is measured
Distance	Total path length travelled
Displacement	Shortest distance between initial and final positions, with direction
Velocity	Displacement per unit time
Acceleration	Rate of change of velocity
Uniform motion	Equal distances in equal intervals of time
Uniform circular motion	Motion in a circle at constant speed
Retardation	Negative acceleration (slowing down)

Short Answer Questions

Q1. Can displacement be zero when distance is not? Give an example.

Yes. If a runner completes one round of a circular track, the distance is the circumference but the displacement is zero.

Q2. Can a scooter with a constant speedometer reading be accelerating?

Yes, if it is turning – the direction of velocity changes, so there is acceleration.

Q3. What does the slope of a position-time graph represent?

Velocity.

Q4. What does the area under a velocity-time graph give?

Displacement.

Q5. A car accelerates uniformly from 18 km/h to 36 km/h in 5 s. Find the acceleration.

u = 5 m/s, v = 10 m/s; a = (10 − 5)/5 = 1 m/s².

Q6. Define uniform circular motion. Why is it accelerated?

Motion in a circular path at constant speed. It is accelerated because the direction of velocity changes continuously.

Q7. A child goes round a circular path of radius 7 m in 22 s. Find the average speed.

v = 2πR/T = 2 × (22/7) × 7 / 22 = 2 m/s.

Q8. What kind of motion is shown by a straight line parallel to the time axis on a velocity-time graph?

Motion with constant velocity (zero acceleration).

Long Answer Questions

Q1. Derive v = u + at and s = ut + ½at² from the velocity-time graph.

For constant acceleration the v-t graph is a straight line from u (at t = 0) to v (at time t).

Slope = acceleration: a = (v − u)/t, so v = u + at.

Displacement = area under the graph = rectangle (u × t) + triangle (½ × t × (v − u)).

Substituting v − u = at gives s = ut + ½at².

Eliminating t between these gives v² − u² = 2as.

Q2. Distinguish between speed and velocity, and between distance and displacement, with examples.

Distance is total path length; displacement is the straight-line change in position with direction.

Speed = distance/time (scalar); velocity = displacement/time (vector).

A round trip home → shop → home: distance 500 m, displacement 0.

Average velocity for a round trip is zero even though average speed is not.

In circular motion, speed may be constant while velocity keeps changing.

u = 0, v = 72 km/h = 20 m/s, t = 300 s.

a = (v − u)/t = 20/300 = 1/15 m/s² ≈ 0.067 m/s².

s = ut + ½at² = ½ × (1/15) × 300² = 3000 m.

Distance = 3 km.

Check using v² = 2as: 400 = 2 × (1/15) × 3000 ✓.

MCQs with Answers

1. The SI unit of acceleration is(a) m s^{-1} (b) m s^{-2} (c) m s (d) km h^{-1}Answer: (b) m s^{-2}

2. Displacement in one complete revolution of a circle is(a) 2πR (b) πR (c) zero (d) RAnswer: (c) zero

3. Slope of a velocity-time graph gives(a) displacement (b) acceleration (c) speed (d) distanceAnswer: (b) acceleration

4. Which equation does not contain time?(a) v = u + at (b) s = ut + ½at² (c) $v^2 - u^2 = 2as$ (d) a = (v − u)/tAnswer: (c) $v^2 - u^2 = 2as$

5. A body starting from rest with a = 2 m/s² for 5 s covers(a) 10 m (b) 25 m (c) 50 m (d) 5 mAnswer: (b) 25 m – ½ × 2 × 25

6. Uniform circular motion is(a) unaccelerated (b) accelerated (c) at rest (d) non-periodicAnswer: (b) accelerated

7. A straight-line position-time graph through the origin indicates(a) uniform velocity (b) uniform acceleration (c) rest (d) retardationAnswer: (a) uniform velocity

8. Average velocity for a round trip is(a) maximum (b) zero (c) equal to speed (d) negative alwaysAnswer: (b) zero

9. Area under a v-t graph gives(a) acceleration (b) displacement (c) force (d) velocityAnswer: (b) displacement

10. Speed in circular motion of radius R and period T is(a) πR/T (b) 2πR/T (c) R/T (d) 2R/TAnswer: (b) 2πR/T

Quick Revision Points

- Distance (scalar) vs displacement (vector).
- Speed = distance/time; velocity = displacement/time.
- a = (v − u)/t; unit m s^{-2}.
- Slope of x-t = velocity; slope of v-t = acceleration; area under v-t = displacement.
- v = u + at; s = ut + ½at²; $v^2 - u^2 = 2as$.
- Circular motion: v = 2πR/T; direction changes → accelerated.

Chapter Summary

Motion is described using a reference point and quantities such as distance, displacement, speed, velocity and acceleration. Graphs make motion visual: slopes and areas of position-time

For constant acceleration, the equations $v = u + at$, $s = ut + \frac{1}{2}at^2$ and $v^2 - u^2 = 2as$ solve most problems. In uniform circular motion, speed stays constant but direction changes, so the motion is accelerated with average speed $2\pi R/T$.

Exam Tips and PYQ Pattern

- Numericals on kinematic equations are certain – list u, v, a, s, t first.
- Convert km/h to m/s (× 5/18) before calculating.
- Practise reading slopes and areas from graphs.
- Distance vs displacement round-trip questions are common 2-markers.
- Learn the derivations from the v-t graph.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the new NCERT Class 9 Science textbook “Exploration” (first edition 2026), prescribed for the 2026-27 session.

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Yes. Use the free PDF link at the top of this page – no signup needed.

What are the three equations of motion?

$v = u + at$, $s = ut + \frac{1}{2}at^2$ and $v^2 - u^2 = 2as$, valid for constant acceleration.

Why is uniform circular motion accelerated?

Because the direction of velocity changes continuously even though speed is constant.

Conclusion

Describing Motion Around Us is the base for all of physics. Learn the formula table, practise the solved numericals and graphs here, and save the free PDF for revision.

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Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE science educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 9 Science textbook, Exploration (First Edition 2026, NCF-SE 2023), and the CBSE syllabus for the 2026-27 session. Last checked on 17 November 2026.