

CLASS 11 | PHYSICS (042) | CBSE-STYLE CHAPTER TEST

MOTION IN A STRAIGHT LINE

Maximum Marks: 70 Writing Time: 3 hours Reading Time: 15 minutes

Name: _____ Batch: _____ Date: _____

Instructions: All 33 questions are compulsory. Internal choices are given; attempt only one alternative where offered. Sections A/B/C/D/E carry 1/2/3/4/5 marks per question respectively. Show working and SI units. No calculators. Take $g = 10 \text{ m s}^{-2}$; neglect air resistance. This original Class 11 chapter test adapts the CBSE senior-secondary question format.

SECTION A - OBJECTIVE QUESTIONS [16 x 1 = 16]

- Which quantity can be negative in one-dimensional motion?
(a) distance (b) speed (c) displacement (d) elapsed time
 - A student walks 30 m east and then 20 m west. The distance and displacement are:
(a) 50 m, 10 m east (b) 10 m, 50 m east (c) 50 m, 10 m west (d) 10 m, 10 m west
 - The slope of a position-time graph gives:
(a) acceleration (b) velocity (c) distance (d) force
 - The signed area under a velocity-time graph gives:
(a) speed (b) acceleration (c) displacement (d) average velocity
 - A body moves with constant non-zero velocity. Its acceleration is:
(a) positive (b) negative (c) zero (d) increasing
 - A car's velocity rises uniformly from 4 to 16 m s^{-1} in 6 s. Its acceleration is:
(a) 1 m s^{-2} (b) 2 m s^{-2} (c) 3 m s^{-2} (d) 4 m s^{-2}
 - A particle starts from rest with acceleration 2 m s^{-2} . Its displacement in 3 s is:
(a) 3 m (b) 6 m (c) 9 m (d) 18 m
 - At the highest point of a ball thrown vertically upward, its velocity and acceleration are:
(a) both zero (b) 0, 10 m s^{-2} downward
(c) 10 m s^{-1} , 0 (d) 0, 10 m s^{-2} upward
 - A body covers equal distances at 4 and 12 m s^{-1} . Its average speed is:
(a) 6 m s^{-1} (b) 8 m s^{-1} (c) 10 m s^{-1} (d) 16 m s^{-1}
 - For $x(t) = 2t^2 + 3t + 1$ (x in m, t in s), the velocity at $t = 2 \text{ s}$ is:
(a) 7 m s^{-1} (b) 9 m s^{-1} (c) 11 m s^{-1} (d) 15 m s^{-1}
 - If velocity is negative and acceleration is positive, the particle initially:
(a) speeds up (b) slows down (c) has zero speed (d) must be at the origin
 - A particle has $v = 6 - 2t$ (SI units). Over 0 to 5 s, its total distance is:
(a) 5 m (b) 9 m (c) 13 m (d) 25 m
- For Questions 13-16, use: (a) Both A and R are true and R explains A. (b) Both A and R are true but R does not explain A. (c) A is true but R is false. (d) A is false but R is true.
- Assertion (A): Distance is always greater than or equal to displacement magnitude. Reason (R): Displacement magnitude is the shortest distance between the initial and final positions.
 - A: A body can have zero velocity and non-zero acceleration at an instant. R: A vertically thrown ball has zero velocity at its highest point but still accelerates downward.
 - A: For motion that reverses direction, the magnitude of average velocity must equal average speed. R: Average velocity uses displacement, while average speed uses total distance.
 - A: The equation $v^2 = u^2 + 2as$ applies to every accelerated motion. R: This equation is derived by assuming constant acceleration.

SECTION B - SHORT ANSWERS [5 x 2 = 10]

- Distinguish between average velocity and instantaneous velocity. Write the mathematical expression for each. [2]
 - A cyclist travels 120 m in 20 s and then returns 40 m in 10 s along the same line. Find average speed and average velocity for the whole journey, taking the initial direction as positive. [2]
 - A car moving at 20 m s^{-1} stops uniformly in 5 s. Calculate its acceleration and stopping distance. [2]
 - Sketch position-time graphs for (a) a stationary particle and (b) a particle moving with constant negative velocity. Label the axes. [2]
- OR: Sketch velocity-time graphs for (a) constant positive velocity and (b) constant positive acceleration from rest. [2]
- For $x(t) = 3t^2 - 2t + 4$ (SI units), determine the instantaneous velocity at $t = 1 \text{ s}$ and the acceleration. [2]

SECTION C - SHORT ANSWERS [7 x 3 = 21]

22. Using a velocity-time graph for uniform acceleration, derive $s = ut + \frac{1}{2}at^2$. Explain the areas used in your derivation. [3]

23. A train moving at 10 m s^{-1} accelerates uniformly at 0.5 m s^{-2} for 20 s. Find its final velocity, distance travelled and average velocity. [3]

24. A ball is thrown vertically upward at 20 m s^{-1} . Find the time to reach its highest point, maximum height and total time to return to its launch level. [3]

25. A particle has $v(t) = 4t - 2$ (SI units) for $0 \leq t \leq 2$ s. Find the reversal time, net displacement and total distance travelled. [3]

26. A body's velocity is 4 m s^{-1} from 0-2 s and then decreases uniformly to -4 m s^{-1} at 6 s. Sketch its velocity-time graph; find displacement and distance over 0-6 s. [3]

27. A car covers the first half of a 120 km trip at 30 km h^{-1} and the second half at 60 km h^{-1} . Calculate its average speed and explain why the arithmetic mean is incorrect. [3]

OR: A car travels for equal times at 30 and 60 km h^{-1} . Derive and calculate its average speed. Explain why this differs from the equal-distance result. [3]

28. A particle moves along x according to $x = t^3 - 6t^2 + 9t$ (SI units). Obtain $v(t)$ and $a(t)$. At what positive times is it momentarily at rest? [3]

SECTION D - CASE-BASED QUESTIONS [2 x 4 = 8]

29. Motion sensor record: A trolley starts at $x = 0$. The table describes its continuous, straight-line motion. Velocity changes uniformly in the first and last intervals. [4]

Time interval	0-4 s	4-8 s	8-12 s
Velocity (m s^{-1})	Rises from 0 to +8	Constant at +8	Falls from +8 to -8

Answer each part [1]: (i) Find acceleration in 0-4 s. (ii) Find displacement in 4-8 s. (iii) At what time does the trolley reverse direction? (iv) Find total distance travelled in 8-12 s.

OR for (iv): Find the trolley's position at $t = 12$ s. [1]

30. Reaction and braking: A driver moving at 20 m s^{-1} sees an obstacle 50 m ahead. The reaction time is 0.5 s, during which speed stays constant. Braking then produces uniform acceleration -5 m s^{-2} . [4]

Answer each part [1]: (i) Find reaction distance. (ii) Find braking time. (iii) Find braking distance. (iv) Does the car stop before, at, or beyond the obstacle?

OR for (iv): With a reaction time of 1 s and the same braking, how far beyond the obstacle would the car's calculated stopping position be? [1]

SECTION E - LONG ANSWERS [3 x 5 = 15]

31. (a) Derive $v = u + at$ and $v^2 = u^2 + 2as$ for constant acceleration. [3] (b) A car accelerates from 5 to 15 m s^{-1} over 50 m. Find acceleration and time taken. [2]

OR: (a) By integrating constant acceleration, derive $v = u + at$ and $s = ut + \frac{1}{2}at^2$. State initial conditions. [3] (b) A body starts from rest at 3 m s^{-2} . Find its displacement during the fourth second. [2]

32. A stone is thrown upward at 10 m s^{-1} from the top of a 40 m tower. Choose upward as positive and the launch point as $x = 0$. (a) Write $x(t)$ and $v(t)$. [2] (b) Find time to reach the ground and impact velocity. [2] (c) Find total distance travelled before impact. [1]

OR: A ball is dropped from rest from 80 m. After 1 s, a second ball is thrown downward from the same point at 20 m s^{-1} . (a) Write their positions using time measured from the first release. [2] (b) Find when and where they meet. [2] (c) Show that the meeting occurs before either reaches the ground. [1]

33. A particle has $v(t) = 12 - 4t$ (SI units) for $0 \leq t \leq 5$ s and starts at $x = 0$. (a) Sketch the velocity-time graph and mark the reversal time. [2] (b) Find displacement and distance travelled. [2] (c) Find average velocity for the interval. [1]

OR: A particle starts at $x = 0$ with $v = -6 \text{ m s}^{-1}$ and constant $a = 2 \text{ m s}^{-2}$. (a) Write $x(t)$ and find the reversal time. [2] (b) Find displacement and distance over 0-6 s. [2] (c) Find its average speed for this interval. [1]