Motion in a Straight Line

Class 11 Physics · 24 NEET MCQs with answers & explanations

Motion in a Straight Line covers kinematics — displacement, velocity, acceleration, equations of motion, free fall and motion graphs. NEET tests numerical problems using $v = u + at$, $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$, and graph interpretation (v-t, s-t, a-t). Speed and accuracy in applying equations is essential.

Key Kinematics Equations

Equation	Key Fact
$v = u + at$	Final velocity; use when displacement is not given
$s = ut + \frac{1}{2}at^2$	Displacement; use when final velocity is not given
$v^2 = u^2 + 2as$	Velocity-displacement; use when time is not given
Free fall	$a = g = 9.8$ m/s² (downward); $u = 0$ if dropped
Relative velocity	$v_{AB} = v_A - v_B$ (same direction); $v_A + v_B$ (opposite)
v-t graph	Slope = acceleration; area under curve = displacement

Questions

Q1. A particle moves 30 m east and then 40 m west along a straight line. Its displacement and distance travelled are respectively:

(A) 70 m east, 70 m
(B) 10 m east, 70 m
(C) 10 m west, 70 m
(D) 40 m west, 40 m

Q2. A car accelerates uniformly from rest at 2 m/s². The distance covered in the first 5 s is:

(A) 20 m
(B) 25 m
(C) 30 m
(D) 50 m

Q3. A car moving at 20 m/s applies brakes and decelerates uniformly at 4 m/s². How long does it take to come to rest?

(A) 3 s
(B) 4 s
(C) 5 s
(D) 6 s

Q4. Which kinematic equation directly relates final velocity, initial velocity, acceleration and time, without involving displacement?

(A) $v = u + at$
(B) $s = ut + \frac{1}{2}at^2$
(C) $v^2 = u^2 + 2as$
(D) $s = (u + v)t/2$

Q5. The relative velocity of particle A with respect to particle B is given by:

(A) $v_A + v_B$
(B) $v_A - v_B$
(C) $v_B - v_A$
(D) $|v_A| + |v_B|$

Q6. Two cars move in the same direction with speeds of 20 m/s and 12 m/s. The speed of the faster car relative to the slower car is:

(A) 4 m/s
(B) 6 m/s
(C) 8 m/s
(D) 32 m/s

Q7. Acceleration is defined as the:

(A) Rate of change of displacement
(B) Rate of change of speed
(C) Rate of change of velocity with time
(D) Distance travelled per unit time

Q8. The SI unit of acceleration is:

(A) m/s
(B) m/s^2
(C) km/h^2
(D) cm/s^2

Q9. A reference point from which the position of a particle is measured is called:

(A) Displacement
(B) Distance
(C) Origin
(D) Path length

Q10. Which of the following is true for distance but NOT for displacement?

(A) It is measured in metres
(B) It can be zero
(C) It depends on the path taken
(D) It depends on initial and final positions

Q11. The slope of a velocity-time graph represents:

(A) Displacement
(B) Speed
(C) Acceleration
(D) Distance

Q12. The area under a velocity-time graph represents:

(A) Acceleration
(B) Displacement
(C) Speed
(D) Time

Q13. A car travels 120 km in 2 hours. What is its average speed?

(A) 40 km/h
(B) 50 km/h
(C) 60 km/h
(D) 80 km/h

Q14. A particle moves 30 m east in 5 s and then 20 m east in 5 s. Its average velocity is:

(A) 5 m/s east
(B) 10 m/s east
(C) 2.5 m/s east
(D) 6 m/s east

Q15. A car starts from rest and accelerates uniformly at 4 m/s². What is the distance covered in the 5th second of its motion?

(A) 18 m
(B) 20 m
(C) 16 m
(D) 10 m

Q16. Which of the following is NOT a characteristic of uniform motion in a straight line?

(A) Velocity is constant throughout
(B) Acceleration is constant and non-zero
(C) Displacement equals distance
(D) Speed remains unchanged

Q17. Instantaneous velocity of a particle is defined as the:

(A) Total displacement divided by total time
(B) Limiting value of average velocity as the time interval approaches zero
(C) Distance travelled in unit time
(D) Average velocity during the first second

Q18. A particle moves along a straight line. At a particular instant its instantaneous velocity is −6 m/s, taking rightward as positive. Which of the following is correct?

(A) The particle is at rest
(B) The particle is moving rightward at 6 m/s
(C) The particle is moving leftward at 6 m/s
(D) The instantaneous speed is −6 m/s

Q19. A horizontal position-time graph indicates that the particle is:

(A) Moving with constant acceleration
(B) At rest
(C) Moving with constant velocity
(D) Moving with variable velocity

Q20. The slope of a position-time graph represents:

(A) Velocity
(B) Acceleration
(C) Displacement
(D) Speed

Q21. A body is dropped from rest from a height. Which physical quantity remains constant throughout its fall (neglect air resistance)?

(A) Velocity
(B) Speed
(C) Acceleration
(D) Displacement

Q22. A stone is dropped from rest. Taking g = 10 m/s², its speed after 3 s is:

(A) 20 m/s
(B) 30 m/s
(C) 40 m/s
(D) 50 m/s

Q23. A body completes one full circle and returns to its starting point. Which of the following is correct?

(A) Distance is non-zero; displacement is zero
(B) Both distance and displacement are zero
(C) Distance is zero; displacement is non-zero
(D) Both distance and displacement are non-zero and equal

Q24. Which of the following statements are correct? I. Position depends on the choice of origin. II. Position is a vector quantity. III. Distance can be negative. IV. Displacement may be zero after motion.

(A) I and II only
(B) I, II and III only
(C) II, III and IV only
(D) I, II and IV only

Answer key

1-C	**2-B**	**3-C**	**4-A**	**5-B**	**6-C**	**7-C**	**8-B**
9-C	**10-C**	**11-C**	**12-B**	**13-C**	**14-A**	**15-A**	**16-B**
17-B	**18-C**	**19-B**	**20-A**	**21-C**	**22-B**	**23-A**	**24-D**

Answers with explanations

Q1 — Answer: (C) 10 m west, 70 m
Distance = total path = 30 + 40 = 70 m. Displacement = 30 − 40 = −10 m, i.e., 10 m west (east positive). Option B fails: direction of displacement is west, not east.

Q2 — Answer: (B) 25 m
Using $s = \frac{1}{2}at^2$ with u = 0: $s = \frac{1}{2} \times 2 \times 25 = 25$ m. Option A (20 m) arises from using $s = at^2$ without the ½ factor — a common error.

Q3 — Answer: (C) 5 s
v = u + at: 0 = 20 + (−4)t → t = 5 s. Option B (4 s) traps students who divide 20 by 5 instead of 4. Option D (6 s) has no valid computational source from this data set.

Q4 — Answer: (A) v = u + at
v = u + at contains only v, u, a, t — no displacement term. Option C eliminates time instead. Option B contains all variables. Option D contains displacement implicitly via average velocity.

Q5 — Answer: (B) $v_A - v_B$
By definition, $v_{AB} = v_A - v_B$. Option C is v_{BA}, equal in magnitude but opposite in sign. Option A and D ignore vector subtraction entirely.

Q6 — Answer: (C) 8 m/s
Same direction: relative speed = 20 − 12 = 8 m/s. Option D (32) traps students who add speeds. Option A (4) has no physical basis here.

Q7 — Answer: (C) Rate of change of velocity with time
Acceleration = dv/dt. It is a vector quantity directed along the change in velocity, not necessarily along velocity itself. Option A defines velocity (ds/dt), Option B omits direction.

Q8 — Answer: (B) m/s²
Acceleration = $\Delta v/\Delta t$ = (m/s)/s = m/s². Option A is the unit of velocity. Option D (cm/s²) is the CGS unit, not SI. Option C is a valid unit but not the standard SI unit.

Q9 — Answer: (C) Origin
Origin is the fixed reference point; position is the coordinate of the particle measured from the origin along the chosen axis. Displacement and path length are derived quantities, not reference points.

Q10 — Answer: (C) It depends on the path taken
Distance depends on the actual path followed; displacement depends only on initial and final positions. Both are in metres and both can be zero, so options A and B cannot distinguish them.

Q11 — Answer: (C) Acceleration
Slope of v-t graph = dv/dt = acceleration by definition. Students must not confuse: slope of x-t gives velocity, while slope of v-t gives acceleration — a high-frequency NEET answer-swap trap.

Q12 — Answer: (B) Displacement
Area under v-t graph = $\int v\,dt$ = displacement. If the graph dips below the time axis, that area is negative displacement. Students who ignore sign below the axis compute distance, not displacement.

Q13 — Answer: (C) 60 km/h
Average speed = total distance / total time = 120 / 2 = 60 km/h. It is always a non-negative scalar; displacement is not involved.

Q14 — Answer: (A) 5 m/s east
Both legs are in the same direction so total displacement = 50 m east. Average velocity = 50 / 10 = 5 m/s east. Option C (2.5) wrongly halves the displacement before dividing.

Q15 — Answer: (A) 18 m
Using $s_n = u + a(2n-1)/2$: $s_5 = 0 + 4\times(9)/2 = 18$ m. Option B (20 m) arises from using $s=\frac{1}{2}at^2$ for n=5 (total distance, not nth second). The nth second formula gives displacement in that specific second only.

Q16 — Answer: (B) Acceleration is constant and non-zero
In uniform motion, acceleration is zero, not constant and non-zero. Option A, C, D are all true for uniform motion. Non-zero constant acceleration defines uniformly accelerated motion, not uniform motion.

Q17 — Answer: (B) Limiting value of average velocity as the time interval approaches zero
Instantaneous velocity = $\lim(\Delta t\to 0)\ \Delta x/\Delta t$. As the time interval shrinks to zero, average velocity converges to velocity at that instant. Option A defines average velocity, not instantaneous velocity.

Q18 — Answer: (C) The particle is moving leftward at 6 m/s
Negative velocity means motion opposite to the positive direction, i.e., leftward. Instantaneous speed = |−6| = 6 m/s, which is always non-negative. Option D is wrong because speed can never be negative.

Q19 — Answer: (B) At rest
A horizontal line means position does not change with time, so the particle is stationary. Students often confuse a horizontal x-t line with a horizontal v-t line, which would indicate constant velocity.

Q20 — Answer: (A) Velocity
Slope of x-t graph = dx/dt, which is instantaneous velocity by definition. Slope gives velocity (with sign), not speed; students who choose speed ignore the directional information carried by the sign.

Q21 — Answer: (C) Acceleration
In free fall, $g \approx 9.8$ m/s² acts constantly downward throughout the entire fall. Velocity and speed increase uniformly with time; displacement increases as t^2. Only acceleration remains unchanged.

Q22 — Answer: (B) 30 m/s
$v = u + gt = 0 + 10 \times 3 = 30$ m/s. Option A (20) traps students who use t = 2 s or forget to multiply correctly. Speed equals magnitude of velocity here since motion is in one direction.

Q23 — Answer: (A) Distance is non-zero; displacement is zero
Final position equals initial position, so displacement = 0. The body has traversed the full circumference, so distance = $2\pi r$, which is non-zero. Confusing path length with displacement is the classic trap.

Q24 — Answer: (D) I, II and IV only
Statements I, II and IV are correct per NCERT. Distance is always non-negative (total path length), so Statement III is false. Displacement can be zero when a body returns to its starting point.

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