Motion in a Straight Line

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. How long does a body take to go from 3 m/s to 33 m/s with acceleration 3 m/s^2?
(a) 20 s **(b)** 11 s **(c)** 9 s **(d)** 10 s

2. A car starts at 15 m/s and accelerates uniformly at 10 m/s^2 for 9 s. The distance covered is:
(a) 405 m **(b)** 135 m **(c)** 540 m **(d)** 945 m

3. A car moving at 8 m/s brakes with a deceleration of 4 m/s^2. Its stopping distance is:
(a) 2 m **(b)** 4 m **(c)** 16 m **(d)** 8 m

4. A car covers the first half of a distance at 80 km/h and the second half at 60 km/h. Its average speed is:
(a) 10 km/h **(b)** 70 km/h **(c)** 68.57 km/h **(d)** 140 km/h

5. The slope of a position–time graph gives the:
(a) velocity **(b)** distance **(c)** acceleration **(d)** displacement

6. A stone is dropped from a height of 245 m. It hits the ground with a speed of: (Take g = 10 m/s^2.)
(a) 140 m/s **(b)** 35 m/s **(c)** 245 m/s **(d)** 70 m/s

7. Two trains 60 m and 135 m long move on parallel tracks in opposite directions at 22 m/s and 14 m/s. How long do they take to cross each other?
(a) 5.42 s **(b)** 10.83 s **(c)** 3.75 s **(d)** 24.38 s

8. Assertion (A): A body speeds up uniformly from rest to 2 m/s in 7 s and then moves at 2 m/s for 7 s. It covers 28 m.
Reason (R): The area under a velocity–time graph equals the displacement.
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. A ball is thrown vertically upwards at 70 m/s. Find (a) the maximum height, (b) the time to reach it, (c) the total time in the air. (Take g = 10 m/s^2.)

10. A car moving at 10 m/s is brought to rest in 50 m. Find the deceleration and the time taken.

11. A body starts at 15 m/s with uniform acceleration 2 m/s^2. How far does it travel in the 8th second?

12. A car starts from rest, accelerates uniformly to 36 m/s in 9 s, moves at that speed for 14 s, then slows uniformly to rest in 10 s. Find the total distance and the average speed.

13. A train 180 m long moving at 108 km/h crosses a bridge 630 m long. How long does it take?

14. A thief running at 15 m/s is 350 m ahead of a police officer running at 25 m/s. How long does the officer take to catch the thief, and how far does the officer run?

15. A stone is dropped from a height of 980 m. How long does it take to reach the ground, and how far does it fall in the last second? (Take g = 10 m/s^2.)

16. A person walks 200 m from home to a market at 6 m/s and returns at 3 m/s. Find the average speed and the average velocity for the whole trip.

Section C — Word problems — 4 × 4 = 16 marks

17. A car passes a stationary police jeep at a constant 6 m/s. At that instant the jeep starts from rest with acceleration 2 m/s^2. (a) When does it catch the car? (b) How far has it travelled? (c) What is its speed then?

18. A ball is thrown upwards at 25 m/s from the top of a tower 120 m high. Find (a) the greatest height above the ground, (b) the time after which it hits the ground, (c) its speed just before it hits the ground. (Take g = 10 m/s^2.)

19. A car starts from rest with acceleration 1 m/s^2 for 9 s, then brakes with deceleration 4 m/s^2 until it stops. Find (a) its greatest speed, (b) the braking time, (c) the total distance, (d) the average speed.

20. Two trains moving towards each other on the same track at 18 m/s and 40 m/s are 351 m apart when both drivers see each other. Each brakes with a deceleration of 2 m/s^2. Will they collide? Show working.

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Answer key

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Q	Answer	Working
1	**(d) 10 s**	$t = (v - u)/a$
2	**(c) 540 m**	$s = ut + \frac{1}{2}at^2$
3	**(d) 8 m**	$v^2 = u^2 - 2as$ with $v = 0$
4	**(c) 68.57 km/h**	$2v_1v_2/(v_1 + v_2)$
5	**(a) velocity**	—
6	**(d) 70 m/s**	$v = \sqrt{(2gh)}$
7	**(a) 5.42 s**	relative speed 36 m/s; distance 195 m
8	**(d) A is false, but R is true.**	A is false: area under the v–t graph = ½ × 7 × 2 + 7 × 2 = 21. R is true.
9	**(a) 245 m; (b) 7 s; (c) 14 s**	$v^2 = u^2 - 2gh$; $v = u - gt$
10	**1 m/s^2; 10 s**	$a = u^2/2s$; $t = u/a$
11	**30 m**	$s_n = u + a(2n - 1)/2$
12	**846 m; 25.64 m/s**	area of the trapezium under the v–t graph
13	**27 s**	108 km/h = 30 m/s; distance 180 + 630
14	**35 s; 875 m**	relative speed 10 m/s
15	**14 s; 135 m**	$h - \frac{1}{2}g(t - 1)^2 = 980 - 845$
16	**Average speed 4 m/s; average velocity 0 (the displacement is zero)**	total time 33.33 + 66.67 s
17	**(a) 6 s; (b) 36 m; (c) 12 m/s**	$6t = \frac{1}{2} \times 2 \times t^2$
18	**(a) 151.25 m; (b) 8 s; (c) 55 m/s**	$-120 = 25t - 5t^2$
19	**(a) 9 m/s; (b) 2.25 s; (c) 50.63 m; (d) 4.5 m/s**	two triangles under the v–t graph
20	**Stopping distances 81 m and 400 m, total 481 m. This is more than 351 m, so they collide.**	stopping distance = $u^2/2a$ for each

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