Understanding Motion through Experience (Advanced)

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. A body with initial velocity 3 m/s moves with an acceleration of 6 m/s^2. The distance it covers in the 10th second is:

(a) 63 m **(b)** 330 m **(c)** 66 m **(d)** 60 m

2. A girl walks 60 m east and then 80 m north. The magnitude of her displacement is:

(a) 140 m **(b)** 20 m **(c)** 100 m **(d)** 105 m

3. Which of these is a scalar quantity?

(a) acceleration **(b)** force **(c)** displacement **(d)** speed

4. Two trains on parallel tracks move in the same direction at 90 km/h and 70 km/h. The speed of one as seen from the other is:

(a) 20 km/h **(b)** 70 km/h **(c)** 160 km/h **(d)** 90 km/h

5. A frame of reference that is at rest or moves with constant velocity is called:

(a) a rotating frame **(b)** a non-inertial frame
(c) an accelerating frame **(d)** an inertial frame

6. Two displacements act one after the other: 8 m east and 38 m west. The resultant displacement is:

(a) 30 m west **(b)** 0 m **(c)** 30 m east **(d)** 46 m west

7. A body starts from rest and moves with uniform acceleration. The ratio of the distances it covers in the 3rd second and the 5th second is:

(a) 9 : 5 **(b)** 3 : 5 **(c)** 9 : 25 **(d)** 5 : 9

8. Assertion (A): A cart starting at 5 m/s with an acceleration of 8 m/s^2 covers 65 m in the 8th second. Reason (R): The distance in the nth second is the distance in n seconds minus the distance in (n − 1) seconds, which gives u + a(2n − 1)/2.

(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 scooter moving at 14 m/s accelerates uniformly at 9 m/s^2. How far does it travel in the 10th second?

10. A ball rolling down a slope starts at 6 m/s and covers 23 m in the 9th second. Find its acceleration.

11. A drone flies 189 km north and then 180 km west. How far is it from its starting point?

12. A cyclist rides 259 m south and then 888 m east. Find (a) the distance travelled and (b) the magnitude of the displacement.

13. A car moving at a certain speed stops in 17 m with its brakes fully on. With the same braking, how far would it take to stop from 4 times that speed?

14. A motorbike speeds up from 7 m/s to 17 m/s with an acceleration of 5 m/s^2. Find (a) the time taken and (b) the distance covered.

15. Car A is 32 m behind car B on a straight road. A moves at 21 m/s and B at 17 m/s in the same direction. How long does A take to catch up with B?

16. A body starting from rest covers 6 m in the first second of uniformly accelerated motion. How far does it go in the 10th second?

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

17. On a map (in km), Vikram's house is at A(3, 1), the bus stop at B(7, 1), a traffic signal at C(7, 13) and the school at D(8, 13). Vikram walks from A to B, then rides the school bus from B to D through C. Find (a) the distance walked, (b) the distance by bus and (c) the magnitude of the displacement from house to school.

18. A toy car is pushed along a floor and its distance from the start O is marked every second: 2 m at 1 s, 6 m at 2 s, 12 m at 3 s, 20 m at 4 s. It moves with uniform acceleration. Find (a) the distance covered in the 3rd second, (b) the acceleration, (c) the initial velocity and (d) the velocity at 4 s.

19. A car moving at 12 m/s accelerates uniformly at 8 m/s^2. Find (a) the distance it covers in the 10th second, (b) the total distance in the first 10 seconds and (c) its velocity at the end of the 10th second.

20. A train moves at 90 km/h. A passenger walks inside it at 7 km/h relative to the train. Find the passenger's speed (a) relative to the ground when walking towards the front, (b) relative to the ground when walking towards the back, and (c) relative to a seated passenger. (d) Another train on a parallel track moves the same way at 40 km/h. What is the speed of the forward-walking passenger relative to it?

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Answer key

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Q	Answer	Working
1	**(d) 60 m**	$s_n = u + a(2n - 1)/2 = 3 + 6 \times 19/2$
2	**(c) 100 m**	the two walks are at right angles: $\sqrt{(60^2 + 80^2)} = 100$
3	**(d) speed**	speed has magnitude only
4	**(a) 20 km/h**	same direction: 90 − 70
5	**(d) an inertial frame**	Newton's laws hold in it without change
6	**(a) 30 m west**	opposite directions: 38 − 8, towards the larger one
7	**(d) 5 : 9**	from rest $s_n = a(2n - 1)/2$, so the ratio is 5 : 9
8	**(a) Both A and R are true, and R is the correct explanation of A.**	A is true: $s_n = 5 + 8 \times 15/2 = 65$. R is true and explains A.
9	**99.5 m**	$s_n = 14 + 9(2 \times 10 - 1)/2$
10	**2 m/s^2**	$23 = 6 + a \times 17/2$, so $a = 2 \times 17 \div 17$
11	**261 km**	$\sqrt{(189^2 + 180^2)} = 261$
12	**(a) 1147 m; (b) 925 m**	(a) 259 + 888; (b) $\sqrt{(259^2 + 888^2)}$
13	**272 m**	$0 = u^2 - 2as$ gives $s \propto u^2$: $17 \times (4)^2$
14	**(a) 2 s; (b) 24 m**	(a) $t = (17 - 7) \div 5$; (b) $s = (17^2 - 7^2) \div (2 \times 5)$
15	**8 s**	relative speed 21 − 17 = 4 m/s; 32 ÷ 4
16	**114 m**	from rest the distances in successive seconds are in the ratio 1 : 3 : 5 …; 6 × 19
17	**(a) 4 km; (b) 13 km; (c) 13 km**	(a) AB = 4; (b) BC + CD = 12 + 1; (c) $AD = \sqrt{(5^2 + 12^2)} = 13$
18	**(a) 6 m; (b) 2 m/s^2; (c) 1 m/s; (d) 9 m/s**	(a) 12 − 6; (b) each second's distance grows by a = 2; (c) $s_1 = u + a/2 = 2$; (d) $v = u + 4a$
19	**(a) 88 m; (b) 520 m; (c) 92 m/s**	(a) $u + a(2n - 1)/2$; (b) $ut + \frac{1}{2}at^2 = 120 + 400$; (c) $u + at$
20	**(a) 97 km/h; (b) 83 km/h; (c) 7 km/h; (d) 57 km/h**	(a) 90 + 7; (b) 90 − 7; (c) the seated passenger shares the train's motion; (d) 97 − 40

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