CLASS 9 SCIENCE

CHAPTER 4 • DESCRIBING MOTION AROUND US

NUMERICAL PROBLEMS • Practice + Answers

Formula Sheet: Average speed = total distance ÷ total time | Average velocity = displacement ÷ time | $a = (v - u)/t$ | $v = u + at$ | $s = ut + \frac{1}{2}at^2$ | $v^2 = u^2 + 2as$ | $s = \frac{1}{2}(u+v)t$ | $v = gt$ | $s = \frac{1}{2}gt^2$

1. A car travels 150 m in 10 s along a straight road. Find its average speed.

Answer: Average speed = distance/time = 150/10 = 15 m/s.

2. A student walks 240 m east in 4 minutes. Find the average speed in m/s.

Answer: Time = 4 × 60 = 240 s. Average speed = 240/240 = 1 m/s.

3. A runner completes a 400 m track in 80 s and returns to the starting point. Find the average speed and average velocity.

Answer: Average speed = 400/80 = 5 m/s. Displacement = 0, so average velocity = 0 m/s.

4. A car travels 200 km north in 3 h and then 200 km south in 2 h. Find its average speed and average velocity.

Answer: Total distance = 400 km; total time = 5 h. Average speed = 80 km/h. Net displacement = 0, so average velocity = 0 km/h.

5. A vehicle moves 60 m in the first 5 s and another 90 m in the next 5 s. Find its average speed for the 10 s interval.

Answer: Total distance = 150 m; total time = 10 s. Average speed = 15 m/s.

6. A bus increases its velocity from 36 km/h to 54 km/h in 10 s. Find its average acceleration.

Answer: 36 km/h = 10 m/s and 54 km/h = 15 m/s. $a = (v-u)/t = (15-10)/10 = 0.5$ m/s².

7. A bus moving at 54 km/h comes to rest in 5 s. Find its average acceleration.

Answer: 54 km/h = 15 m/s. $a = (0-15)/5 = -3$ m/s².

8. A car starts from rest and reaches 24 m/s in 6 s with constant acceleration. Find its acceleration and distance travelled.

Answer: u = 0, v = 24 m/s, t = 6 s. $a = 4$ m/s². $s = (u+v)t/2 = 72$ m.

9. A motorbike has an initial velocity of 28 m/s and stops after travelling 98 m with constant acceleration. Find its acceleration.

Answer: Using $v^2 = u^2 + 2as$: $0 = 28^2 + 2a(98)$. Therefore $a = -4$ m/s².

10. For the motorbike in Problem 9, find the time taken to stop.

Answer: Using $v = u + at$: $0 = 28 - 4t$. Therefore $t = 7$ s.

11. A car starts from rest and accelerates uniformly at 2 m/s² for 8 s. Find its final velocity.

Answer: $v = u + at = 0 + 2\times8 = 16$ m/s.

12. For the car in Problem 11, find the distance travelled in 8 s.

Answer: $s = ut + \tfrac{1}{2}at^2 = 0 + \tfrac{1}{2}\times2\times8^2 = 64$ m.

13. A train moving at 10 m/s accelerates uniformly at 1.5 m/s² for 12 s. Find its final velocity.

Answer: $v = 10 + 1.5\times12 = 28$ m/s.

14. For the train in Problem 13, find the distance travelled in 12 s.

Answer: $s = ut + \tfrac{1}{2}at^2 = 10\times12 + \tfrac{1}{2}\times1.5\times12^2 = 228$ m.

15. A scooter moving at 20 m/s slows uniformly to 8 m/s in 6 s. Find its acceleration.

Answer: $a = (8-20)/6 = -2$ m/s².

16. For the scooter in Problem 15, find the distance travelled during braking.

Answer: $s = (u+v)t/2 = (20+8)\times6/2 = 84$ m.

17. A car starts from rest and reaches 20 m/s in 5 s. It then travels at 20 m/s for 10 s and finally stops uniformly in 6 s. Find the total distance travelled.

Answer: First part: $\frac{1}{2}\times20\times5 = 50$ m. Second part: $20\times10 = 200$ m. Third part: $\frac{1}{2}\times20\times6 = 60$ m. Total = 310 m.

18. A truck slows from 54 km/h to 36 km/h in 36 s with constant acceleration. Find the distance travelled.

Answer: 54 km/h = 15 m/s; 36 km/h = 10 m/s. Average velocity = (15+10)/2 = 12.5 m/s. Distance = $12.5\times36 = 450$ m.

19. A bus travels at 36 km/h. The driver takes 0.5 s to react. During braking, the bus has acceleration -2.5 m/s². Find the total stopping distance.

Answer: 36 km/h = 10 m/s. Reaction distance = $10\times0.5 = 5$ m. Braking distance = $(0^2-10^2)/(2\times-2.5) = 20$ m. Total stopping distance = 25 m.

20. Using Problem 18, if the obstacle is 30 m ahead, will the bus stop before reaching it?

Answer: Stopping distance = 25 m, which is less than 30 m. Yes, it stops 5 m before the obstacle.

21. An object starts from rest and moves with constant acceleration 3 m/s². Find its velocity after 7 s.

Answer: $v = 0 + 3\times7 = 21$ m/s.

22. An object moving at 12 m/s accelerates at 2 m/s² for 5 s. Find its final velocity and displacement.

Answer: $v = 12 + 2\times5 = 22$ m/s. $s = 12\times5 + \frac{1}{2}\times2\times25 = 85$ m.

23. A ball is dropped from rest and falls for 3 s. Take g = 9.8 m/s². Find its final velocity and distance fallen.

Answer: $v = gt = 9.8\times3 = 29.4$ m/s downward. $s = \frac{1}{2}gt^2 = 44.1$ m.

24. An object is dropped from rest and falls for 4 s. Take g = 9.8 m/s². Find its final velocity and distance fallen.

Answer: $v = 9.8\times4 = 39.2$ m/s downward. $s = \frac{1}{2}\times9.8\times16 = 78.4$ m.

25. A velocity–time graph for an object is a rectangle of velocity 12 m/s from 0 to 5 s. Find the displacement.

Answer: Displacement = area under v–t graph = $12\times5 = 60$ m.

26. A velocity–time graph shows velocity increasing uniformly from 5 m/s at 10 s to 10 m/s at 20 s. Find the displacement between 10 s and 20 s.

Answer: Displacement = area of trapezium = ½(5+10)×10 = 75 m.

ANSWER CHECKLIST

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Problem	Final Answer	Problem	Final Answer
1	15 m/s	14	228 m
2	1 m/s	15	–2 m/s²
3	5 m/s; 0 m/s	16	84 m
4	80 km/h; 0 km/h	17	310 m
5	15 m/s	18	450 m
6	0.5 m/s²	19	25 m
7	–3 m/s²	20	Yes; 5 m before obstacle
8	4 m/s²; 72 m	21	21 m/s
9	–4 m/s²	22	22 m/s; 85 m
10	7 s	23	29.4 m/s; 44.1 m
11	16 m/s	24	39.2 m/s; 78.4 m
12	64 m	25	60 m
13	28 m/s	26	75 m

Source alignment: Chapter 4 covers distance, displacement, average speed/velocity, acceleration, motion graphs, kinematic equations and free fall. The textbook itself includes numerical examples involving the bus, car, motorbike, truck, braking distance and velocity–time graphs. ■filecite■turn213file2■L215-L230■ ■filecite■turn213file3■L260-L305■ ■filecite■turn213file0■L36-L53■