3

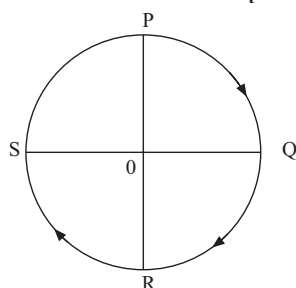# Motion in a Straight Line
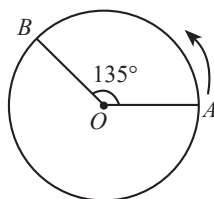
Position, Distance and Displacement

1. A cyclist starts from the point P of a circular ground of radius 2 km and travels along its circumference to the point S. The displacement of a cyclist is: **[04 April, 2024 (Shift-II)]**

(a) 6 km　　(b) $\sqrt{8}$ km　　(c) 4 km　　(d) 8 km

2. A body is moving with constant speed, in a circle of radius 10m. The body completes one revolution in 4s. At the end of 3rd second, the displacement of body (in m) from its starting point is:

[31 Jan, 2023 (Shift-II)]

(a) 30　　(b) 15π　　(c) 5π　　(d) $10\sqrt{2}$

3. A particle is moving with constant speed in a circular path. When the particle turns by an angle 90°, the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$. The value of x will be

[6 April, 2023 (Shift-I)]

(a) 2　　(b) 5　　(c) 1　　(d) 7

4. A person moved from A to B on a circular path as shown in figure. If the distance travelled by him is 60 m, then the magnitude of displacement would be:

(Given $\cos 135° = -0.7$)　　　**[25 July, 2022 (Shift-I)]**

(a) 42 m　　(b) 47 m　　(c) 19 m　　(d) 40 m

5. The velocity of a particle is $v = v_0 + gt + Ft^2$. Its position is $x = 0$ at $t = 0$; then its displacement after time ($t = 1$) is:

[17 March, 2021 (Shift-II)]

(a) $v_0 + g + f$　　　　　(b) $v_0 + \dfrac{g}{2} + \dfrac{F}{3}$

(c) $v_0 + 2g + 3F$　　　　(d) $v_0 + \dfrac{g}{2} + F$

Speed and Velocity

6. A particle is moving in a straight line. The variation of position 'x' as a function of time 't' is given as $x = (t^3 - 6t^2 + 20t + 15)$ m. The velocity of the body when its acceleration becomes zero is:

(a) 4 m/s　(b) 8 m/s　(c) 10 m/s　(d) 6 m/s

[29 Jan, 2024 (Shift-II)]

7. A physical quantity Q is found to depend on quantities a, b, c by the relation $Q = \dfrac{a^4 b^3}{c^2}$ The percentage error in a, b and c are 3%, 4% and 5% respectively. Then, the percentage error in Q is:

[31 Jan, 2024 (Shift-I)]

(a) 66%　(b) 43%　(c) 33%　(d) 14%

8. A particle is moving in one dimension (along x axis) under the action of a variable force. It's initial position was 16 m right of origin. The variation of its position (x) with time (t) is given as $x = -3t^3 + 18t^2 + 16t$, where x is in m and t is in s. The velocity of the particle when its acceleration becomes zero is _____ m/s.

[1 Feb, 2024 (Shift-I)]

9. A train starting from rest first accelerates uniformly up to a speed of 80 km/h for time t, then it moves with a constant speed for time $3t$. The average speed of the train for this duration of journey will be (in km/h): **[6 April, 2024 (Shift-I)]**

(a) 80　　(b) 70　　(c) 30　　(d) 40

10. A particle moves in a straight line so that its displacement x at any time t is given by $x^2 = 1 + t^2$. Its acceleration at any time t is x^{-n} where $n =$ _____. **[6 April, 2024 (Shift-II)]**

11. A particle moving in a straight line covers half the distance with speed 6 m/s. The other half is covered in two equal time intervals with speeds 9 m/s and 15 m/s respectively. The average speed of the particle during the motion is: **[09 April, 2024 (Shift-I)]**

(a) 8.8 m/s　(b) 10 m/s　(c) 9.2 m/s　(d) 8 m/s

12. A car travels a distance of 'x' with speed v_1 and then same distance 'x' with speed v_2 in the same direction. The average speed of the car is: **[25 Jan, 2023 (Shift-I)]**

(a) $\dfrac{v_1 v_2}{2(v_1+v_2)}$ (b) $\dfrac{v_1+v_2}{2}$

(c) $\dfrac{2x}{v_1+v_2}$ (d) $\dfrac{2v_1v_2}{v_1+v_2}$

13. The distance travelled by a particle is related to time t as $x = 4t^2$. The velocity of the particle at $t = 5s$ is. **[25 Jan, 2023 (Shift-II)]**
(a) 40 ms^{-1} (b) 25 ms^{-1} (c) 20 ms^{-1} (d) 8 ms^{-1}

14. A horse rider covers half the distance with 5 m/s speed. The remaining part of the distance was travelled with speed 10 m/s for half the time and with speed 15 m/s for other half of the time. The mean speed of the rider averaged over the whole time of motion is $x/7$ m/s. The value of x is _____ . **[30 Jan, 2023 (Shift-I)]**
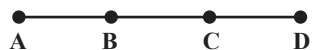
15. A vehicle travels 4 km with speed of 3 km/h and another 4 km with speed of 5 km/h, then its average speed is: **[30 Jan, 2023 (Shift-II)]**
(a) 4.25 km/h   (b) 3.50 km/h
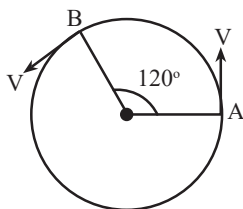(c) 4.00 km/h   (d) 3.75 km/h

16. An object moves with speed v_1, v_2, and v_3 along a line segment AB, BC and CD respectively as shown in figure. Where AB = BC and AD = 3 AB, then average speed of the object will be: **[1 Feb, 2023 (Shift-I)]**

(a) $\dfrac{(v_1+v_2+v_3)}{3}$ (b) $\dfrac{v_1v_2v_3}{3(v_1v_2+v_2v_3+v_3v_1)}$

(c) $\dfrac{3v_1v_2v_3}{v_1v_2+v_2v_3+v_3v_1}$ (d) $\dfrac{(v_1+v_2+v_3)}{3v_1v_2v_3}$

17. As shown in the figure, a particle is moving with constant speed π m/s. Considering its motion from A to B, the magnitude of the average velocity is: **[6 April, 2023 (Shift-II)]**

(a) π m/s (b) $\sqrt{3}\,m/s$

(c) $2\sqrt{3}\,m/s$ (d) $1.5\sqrt{3}\,m/s$

18. A person travels x distance with velocity v_1 and then x distance with velocity v_2 in the same direction. The average velocity of the person is v, then the relation between v, v_1 and v_2 will be: **[10 April, 2023 (Shift-II)]**

(a) $v = v_1 + v_2$ (b) $v = \dfrac{v_1+v_2}{2}$

(c) $\dfrac{2}{v} = \dfrac{1}{v_1}+\dfrac{1}{v_2}$ (d) $\dfrac{1}{v} = \dfrac{1}{v_1}+\dfrac{1}{v_2}$

19. The distance travelled by an object in time t is given by $s = (2.5)t^2$. The instantaneous speed of the object at $t = 5$ s will be: **[13 April, 2023 (Shift-II)]**
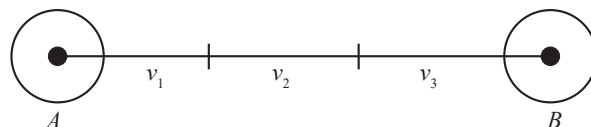(a) 12.5 ms^{-1} (b) 62.5 ms^{-1} (c) 5 ms^{-1} (d) 25 ms^{-1}

20. The position of a particle related to time is given by $x = (5t^2 - 4t + 5)$m. The magnitude of velocity of the particle at $t = $ 2s will be: **[15 April, 2023 (Shift-I)]**
(a) 10 ms^{-1} (b) 14 ms^{-1} (c) 16 ms^{-1} (d) 06 ms^{-1}

21. A car covers AB distance with first one-third at velocity v_1 ms^{-1}, second one-third at v_2 ms^{-1} and last one-third at v_3 ms^{-1}. If $v_3 = 3v_1$, $v_2 = 2v_1$ and $v_1 = 11$ ms^{-1} then the average velocity of the car is _____ ms^{-1}. **[28 June, 2022 (Shift-II)]**

22. The position of a particle as a function of time ts, is given by $x(t) = at + bt^2 - ct^3$ where a, b and c are constants. When the particle attains zero acceleration, then its velocity will be: **[9 April, 2019 (Shift-II)]**

(a) $a+\dfrac{b^2}{4c}$ (b) $a+\dfrac{b^2}{c}$ (c) $a+\dfrac{b^2}{2c}$ (d) $a+\dfrac{b^2}{3c}$

23. A particle is moving with speed $v = b\sqrt{x}$ along positive x-axis. Calculate the speed of the particle at time $t = \tau$ (assume that the particle is at origin at $t = 0$) **[12 April, 2019 (Shift-II)]**

(a) $\dfrac{b^2\tau}{4}$ (b) $\dfrac{b^2\tau}{2}$ (c) $b^2\tau$ (d) $\dfrac{b^2\tau}{\sqrt{2}}$

Constant Acceleration

24. A bullet is fired into a fixed target looses one third of its velocity after travelling 4 cm. It penetrates further D × 10^{-3} m before coming to rest. The value of D is: **[27 Jan, 2024 (Shift-II)]**
(a) 2   (b) 5   (c) 3   (d) 4

25. A body falling under gravity covers two points A and B separated by 80 cm in 2s. The distance of upper point A from the starting point is _____ m (use g = 10 ms^{-2}) **[27 Jan, 2024 (Shift-II)]**
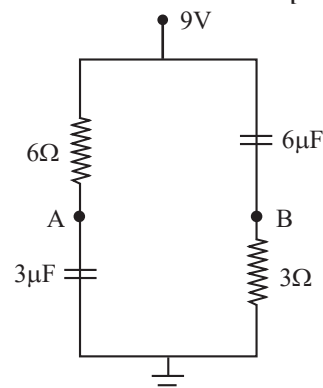
26. A stone of mass 900g is tied to a string and moved in a vertical circle of radius 1m making 10 rpm. The tension in the string, when the stone is at the lowest point is (if $\pi^2 = 9.8$ and g = 9.8 m/s^2) **[29 Jan, 2024 (Shift-I)]**
(a) 97 N   (b) 9.8 N   (c) 8.82 N   (d) 17.8 N

27. In the given figure, the charge stored in 6µF capacitor, when points A and B are joined by a connecting wire is _____µC. **[30 Jan, 2024 (Shift-I)]**

28. A particle initially at rest starts moving from reference point. $x = 0$ along x-axis, with velocity v that varies as $v = 4\sqrt{x}\, m/s$. The acceleration of the particle is _____ ms^{-2}. **[1 Feb, 2024 (Shift-II)]**

29. A body travels 102.5 m in nth second and 115.0 m in $(n + 2)$th second. The acceleration is: **[04 April, 2024 (Shift-I)]**
(a) 9 m/s^2 (b) 6.25 m/s^2 (c) 12.5 m/s^2 (d) 5 m/s^2

30. A bus moving along a straight highway with speed of 72 km/h is brought to halt within 4s after applying the brakes. The distance travelled by the bus during this time (Assume the retardation is uniform) is _____ m. **[04 April, 2024 (Shift-II)]**

31. A body moves on a frictionless plane starting from rest. If S_n is distance moved between $t = n - 1$ and $t = n$ and S_{n-1} is distance moved between $t = n - 2$ and $t = n - 1$, then the ratio $\dfrac{S_{n-1}}{S_n}$ is $\left(1 - \dfrac{2}{x}\right)$ for $n = 10$. The value of x is ....
[05 April, 2024 (Shift-I)]

32. A body projected vertically upwards with a certain speed from the top of a tower reaches the ground in t1. If it is projected vertically downwards from the same point with the same speed, it reaches the ground in t2. Time required to reach the ground, if it is dropped from the top of the tower, is: **[06 April, 2024 (Shift-II)]**
(a) $\sqrt{t_1 t_2}$ (b) $\sqrt{t_1 - t_2}$ (c) $\sqrt{\dfrac{t_1}{t_2}}$ (d) $\sqrt{t_1 + t_2}$

33. Two cars are travelling towards each other at speed of 20 m s^{-1} each. When the cars are 300 m apart, both the drivers apply brakes and the cars retard at the rate of 2 m s^{-2}. The distance between them when they come to rest is: **[09 April, 2024 (Shift-II)]**
(a) 200 m (b) 50 m (c) 100 m (d) 25 m

34. For a train engine moving with speed of 20 ms^{-1}. the driver must apply brakes at a distance of 500m before the station for the train to come to rest at the station. If the brakes were applied at half of this distance, the train engine would cross the station with speed $\sqrt{x}\,ms^{-1}$. The value of x is _____.
(Assuming same retardation is produced by brakes)
[1 Feb, 2023 (Shift-II)]

35. A particle starts with an initial velocity of 10.0ms^{-1} along x-direction and accelerates uniformly at the rate of 2.0 ms^{-2}. The time taken by the particle to reach the velocity of 60.0 ms^{-1} is
[6 April, 2023 (Shift-II)]
(a) 6s (b) 3s (c) 30s (d) 25s

36. A small toy starts moving from the position of rest under a constant acceleration. If it travels a distance of 10 m in t s, the distance travelled by the toy in the next t s will be:
[29 June, 2022 (Shift-II)]
(a) 10 m (b) 20 m (c) 30 m (d) 40 m

37. A car is moving with speed of 150 km/h and after applying the break it will move 27m before it stops. If the same car is moving with a speed of one third the reported speed then it will stop after travelling _____ m distance. **[25 July, 2022 (Shift-I)]**

38. A particle is moving in a straight line such that its velocity is increasing at 5 ms^{-1} per meter. The acceleration of the particle is _____ ms^{-2} at a point where its velocity is 20 ms^{-1}.
[25 July, 2022 (Shift-II)]

39. An engine of a train, moving with uniform acceleration, passes the signal - post with velocity u and the last compartment with velocity v. The velocity with which middle point of the train passes the signal post is : **[25 Feb, 2021 (Shift-I)]**
(a) $\dfrac{u+v}{2}$ (b) $\sqrt{\dfrac{v^2 + u^2}{2}}$ (c) $\dfrac{v-u}{2}$ (d) $\sqrt{\dfrac{v^2 - u^2}{2}}$

40. In a car race on straight road, car A takes a time 't' less than car B at the finish and passes finishing point with a speed 'V' more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then 'v' is equal to
[9 Jan, 2019 (Shift-II)]
(a) $\dfrac{2a_1 a_1}{a_1 + a_2}t$ (b) $\sqrt{2a_1 a_2}t$ (c) $\sqrt{a_1 a_2}\,t$ (d) $\dfrac{a_1 + a_2}{2}t$

Motion Under Gravity

41. A tennis ball is dropped on to the floor from a height of 9.8m. It rebounds to a height 5.0 m. Ball comes in contact with the floor for 0.2 s. The average acceleration during contact is _____ ms^{-2} [Given g = 10 ms^{-1}] **[29 Jan, 2023 (Shift-I)]**

42. A ball is thrown vertically upward with an initial velocity of 150 m/s. The ratio of velocity after 3s and 5s is $\dfrac{x+1}{x}$. The value of x is _____ . **[12 April, 2023 (Shift-1)]**
Take (g = 10 m/s^2).
(a) 6 (b) 5 (c) –5 (d) 10

43. From the top of a tower, a ball is thrown vertically upward which reaches the ground in 6s. A second ball thrown vertically downward from the same position with the same speed reaches the ground in 1.5s. A third ball released, from the rest from the same location, will reach the ground in _____s. **[24 June, 2022 (Shift-I)]**

44. An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to: [Use g = 10 ms^{-2}].
[24 June, 2022 (Shift-II)]
(a) 1 : 1 (b) $\sqrt{2} : \sqrt{3}$ (c) $\sqrt{3} : \sqrt{2}$ (d) 2 : 3

45. An object is thrown vertically upwards. At its maximum height, which of the following quantity becomes zero?
[26 June, 2022 (Shift-I)]
(a) Momentum (b) Potential Energy
(c) Acceleration (d) Force

46. A ball of mass 0.5 kg is dropped from the height of 10 m. The height, at which the magnitude of velocity becomes equal to the magnitude of acceleration due to gravity, is _____m. [Use g = 10 m/s^2]
[26 June, 2022 (Shift-I)]

47. A ball is projected vertically upward with an initial velocity of 50 ms^{-1} at $t = 0$ s. At $t = 2$ s, another ball is projected vertically upward with same velocity. At $t =$ _____ s, second ball will meet the first ball (g = 10 ms^{-2}). **[26 June, 2022 (Shift-II)]**

48. Two balls A and B placed at the top of 180m tall tower. Ball A is released from the top at $t = 0$s. Ball B is thrown vertically down with an initial velocity 'u' at $t = 2$s. After a certain time, both balls meet 100m above the ground. Find the value of 'u' in ms^{-1}.
[use g = 10 ms^{-2}]: **[29 June, 2022 (Shift-I)]**
(a) 10 (b) 15 (c) 20 (d) 30

49. A NCC parade is going at a uniform speed of 9 km/h under a mango tree on which a monkey is sitting at a height of 19.6 m. At any particular instant, the monkey drops a mango. A cadet will receive the mango whose distance from the tree at time of drop is: (Given g = 9.8 m/s²) **[28 July, 2022 (Shift-I)]**

(a) 5 m　　(b) 10 m　　(c) 19.8 m　　(d) 24.5 m

50. A ball is thrown vertically upwards with a velocity of 19.6 ms⁻¹ from the top of a tower. The ball strikes the ground after 6 s. The height from the ground up to which the ball can rise will be $\left(\dfrac{k}{5}\right)m$. The value of k is _____

(use g = 9.8 m/s²) **[28 July, 2022 (Shift-II)]**

51. A ball is thrown up vertically with a certain velocity so that, it reaches a maximum height h. Find the ratio of the times in which it is at height $\dfrac{h}{3}$ while going up and coming down respectively.

[29 July, 2022 (Shift-I)]

(a) $\dfrac{\sqrt{2}-1}{\sqrt{2}+1}$　　(b) $\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$　　(c) $\dfrac{\sqrt{3}-1}{\sqrt{3}+1}$　　(d) $\dfrac{1}{3}$

52. A juggler throws ball vertically upwards with same initial velocity in air. When the first ball reaches its highest positions, he throws the next ball. Assuming the juggler throws n balls per second, the maximum height the balls can reach is **[29 July, 2022 (Shift-II)]**

(a) g/2n　　(b) 2 gn　　(c) g/n　　(d) g/2n²

53. A ball is released from a height h. If t_1 and t_2 be the time required to complete first half and second half of the distance respectively. Then, choose the correct relation between t_1 and t_2.

[29 July, 2022 (Shift-II)]

(a) $t_1 = \left(\sqrt{2}\right)t_2$

(b) $t_1 = \left(\sqrt{2}-1\right)t_2$

(c) $t_2 = \left(\sqrt{2}+1\right)t_1$

(d) $t_2 = \left(\sqrt{2}-1\right)t_1$

54. A balloon was moving upwards with a uniform velocity of 10 m/s. An object of finite mass is dropped from the balloon when it was at a height of 75m from the ground level. The height of the balloon from the ground when object strikes the ground was around: (takes the value of g as 10 m/s²) **[25 July, 2021 (Shift-II)]**

(a) 250 m　　(b) 300 m　　(c) 200 m　　(d) 125 m

55. A stone is dropped from the top of a building. When it crosses a point 5m below the top, another stone starts to fall from a point 25m below the top. Both stones reach the bottom of building simultaneously. The height of the building is: **[25 Feb, 2021 (Shift-II)]**

(a) 35 m　　(b) 45 m　　(c) 50 m　　(d) 25 m

56. Two spherical balls having equal masses with radius of 5 cm each are thrown upwards along the same vertical direction at an interval of 3s with the same initial velocity of 35 m/s, then these balls collide at a height of _____ m. (Take g = 10 m/s²)
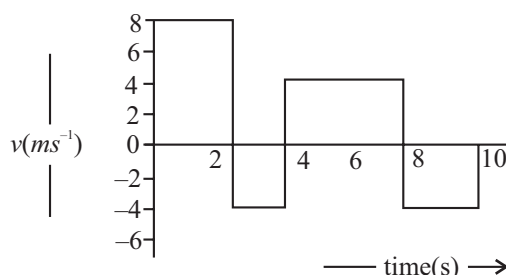
[26 Aug, 2021 (Shift-I)]

57. Water drops are falling from a nozzle of a shower onto the floor, from a height of 9.8m. The drops fall at a regular interval of time. When the first drop strikes the floor, at that instant, the third drop begins to fall. Locate the position of second drop from the floor when the first drop strikes the floor. **[27 Aug, 2021 (Shift-II)]**

(a) 7.35 m　　(b) 2.45 m　　(c) 2.94 m　　(d) 4.18 m

58. A ball is dropped form the top of a 100 m high tower on a planet. In the last 1/2 s before hitting the ground, it covers a distance of 19 m. Acceleration due to gravity (in ms⁻²) near the surface on that planet is _____. **[8 Jan, 2020 (Shift-II)]**

Graphs

59. The velocity time graph of a body moving in a straight line is shown in figure.

The ratio of displacement to distance travelled by the body in time 0 to 10 s is **[24 Jan, 2023 (Shift-II)]**

(a) 1 : 1　　(b) 1 : 4　　(c) 1 : 2　　(d) 1 : 3

60. Match Column-I with Column-II:

Column-I (x-t graphs)		Column-II (v-t graphs)	
A.		I.	
B.		II.	
C.		III.	
D.		IV.	

Choose the correct answer from the options given below:

[30 Jan, 2023 (Shift-I)]

(a) A- II, B-IV, C-III, D-I

(b) A- I, B-II, C-III, D-IV

(c) A- II, B-III, C-IV, D-I

(d) A- I, B-III, C-IV, D-II
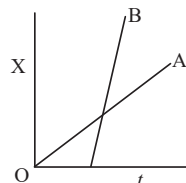
61. Given below are two statements:

Statement-I: Area of the velocity-time graph gives the distance travelled by the body in a given time.

Statement-II: Area under acceleration- time graph is equal to the change in velocity- in the given time.

In the light of given statements, choose the correct answer from the options given below. **[8 April, 2023 (Shift-II)]**

(a) Both Statement-I and Statement-II are true.

(b) Statement-I is correct but Statement-II is false.

(c) Statement-I is incorrect but Statement-II is true.

(d) Both Statement-I and Statement-II are False.

62. The position-time graphs for two students A and B returning from the school to their homes are shown in figure:
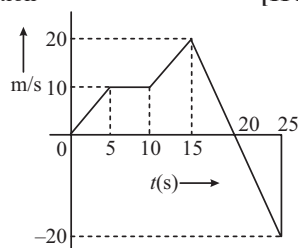

(A) A lives closer to the school

(B) B lives closer to the school

(C) A takes lesser time to reach home

(D) A travels faster than B

(E) B travels faster than A **[10 April, 2023 (Shift-1)]**

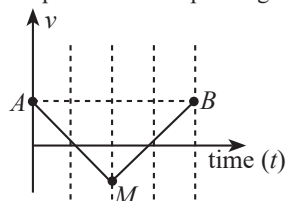Choose the correct answer from the options given below:

(a) (A) and (E) only   (b) (B) and (E) only

(c) (A), (C) and (E) only   (d) (A), (C) and (D) only

63. From the $v - t$ graph shown. The ratio of distance to displacement in 25 s of motion **[11 April, 2023 (Shift-I)]**
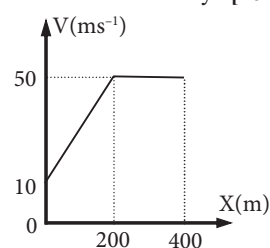

(a) $\dfrac{3}{5}$ (b) $\dfrac{1}{2}$ (c) $\dfrac{5}{3}$ (d) 1

64. If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph?

[24 Feb, 2021 (Shift-I)]

65. The velocity- displacement graph describing the motion of a bicycle is shown in the figure. The acceleration-displacement graph of the bicycle's motion is best described by: **[16 March, 2021 (Shift-I)]**
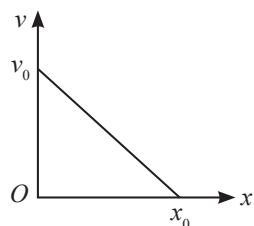

66. The position, velocity and acceleration of a particle moving with a constant acceleration can be represented by
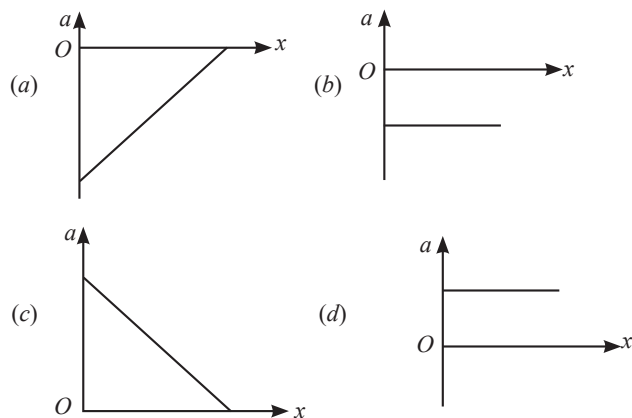
[18 March, 2021 (Shift-I)]

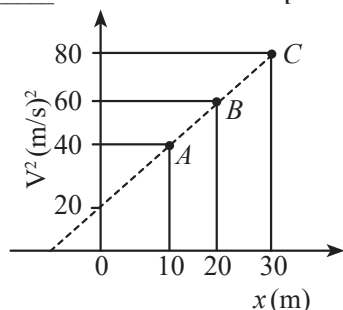**67.** The velocity - displacement graph of a particle is shown in the figure.
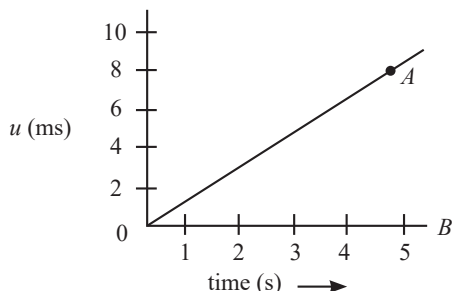
[18 March, 2021 (Shift-II)]

The acceleration - displacement graph of the same particle is represented by:

(a) (b) (c) (d)

68. A particle is moving with constant acceleration 'a'. Following graph shows v^2 versus x (displacement) plot. The acceleration of the particle is _____ m/s^2. **[31 Aug, 2021 (Shift-II)]**
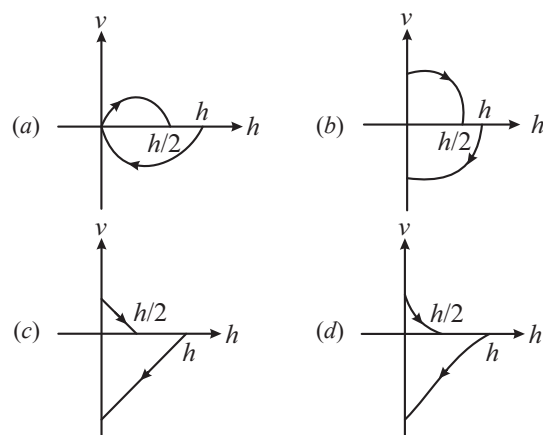

69. The speed versus time graph for a particle is shown in the figure. The distance travelled (in m) by the particle during the time interval $t = 0$ to $t = 5$ s will be _____. **[3 Sep, 2020 (Shift-II)]**
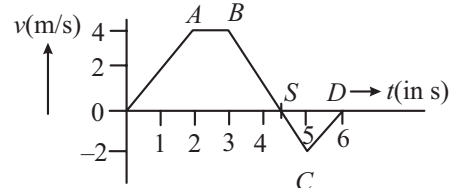

70. A tennis ball is released from a height h and after freely falling on a wooden floor it rebounds and reaches height $h/2$. The velocity versus height of the ball during its motion may be represented graphically by (graph are drawn schematically and on not to scale).
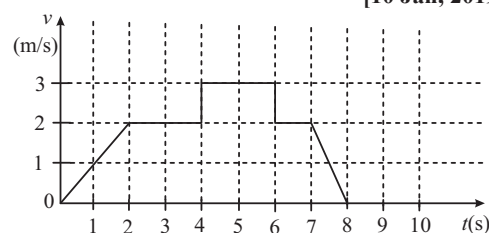
[4 Sep, 2020 (Shift-I)]

(a) (b) (c) (d)

71. Th velocity (v) and time (t) graph of a body in a straight line motion is shown in the figure. The point S is at 4.333 second. The total distance covered by the body in 6 s is **[5 Sep, 2020 (Shift-II)]**

(a) $\dfrac{37}{3}$ m   (b) 11 m   (c) 12 m   (d) $\dfrac{49}{4}$ m

72. A particle starts from the origin at time $t = 0$ and moves along the positive x-axis. The graph of velocity with respect to time is shown in figure. What is the position of the particle at time $t = 5s$?

[10 Jan, 2019 (Shift-II)]

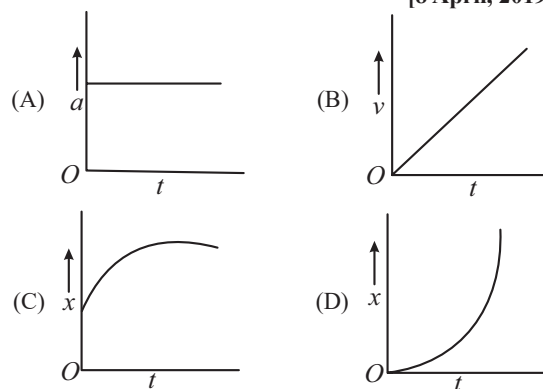**73.** A particle starts from origin O from rest and moves with a uniform acceleration along the positive x-axis. Identify the figure that is not correctly representing the motion qualitatively.

(a = acceleration, v = velocity, x = displacement, t = time)

[8 April, 2019 (Shift-II)]

(a) (A), (B), (C)   (b) (A)
(c) (C)   (d) (B), (C)
(a) 10 m   (b) 6 m   (c) 3 m   (d) 9 m

Variable Acceleration

74. The relation between time t and distance x for a moving body is given as $t = mx^2 + nx$, where m and n are constants. The retardation of the motion is: (Where v stands for velocity)

[25 July, 2021 (Shift-II)]

(a) $2n^2v^2$ (b) $2mnv^3$ (c) $2mv^3$ (d) $2nv^3$

75. The instantaneous velocity of a particle moving in a straight line is given as $v = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1s and 2s is:

[25 July, 2021 (Shift-II)]

(a) $\dfrac{\alpha}{2} + \dfrac{\beta}{3}$ (b) $\dfrac{3}{2}\alpha + \dfrac{7}{3}\beta$

(c) $\dfrac{3}{2}\alpha + \dfrac{7}{2}\beta$ (d) $3\alpha + 7\beta$

76. The distance x covered by a particle in one dimensional motion varies with time t as $x^2 = at^2 + bt + c$. If the acceleration of the particle depends on x as x^{-n}, where n is an integer, the value of n is _____.

[9 Jan, 2020 (Shift-I)]

One Dimensional Relative Motion

77. Train A is moving along two parallel rail tracks towards north with speed 72 km/h and train B is moving towards south with speed 108 km/h. Velocity of train B with respect to A and velocity of ground with respect to B are (in ms^{-1}):

[1 Feb, 2024 (Shift-II)]

(a) -30 and 50 (b) -50 and -30

(c) -50 and 30 (d) 50 and -30

78. Two trains 'A' and 'B' of length 'l' and '$4l$' are travelling into a tunnel of length 'L' in parallel tracks from opposite directions with velocities 108 km/h and 72 km/h, respectively. If train 'A' takes 35s less time than train 'B' to cross the tunnel then, length 'L' of tunnel is (Given $L = 60l$)

[13 April, 2023 (Shift-I)]

(a) 1200 m   (b) 2700 m   (c) 1800 m   (d) 900 m

79. A passenger sitting in a train A moving at 90 km/h observes another train B moving in the opposite direction for 8 s. If the velocity of the train B is 54 km/h, then length of train B is:

[13 April, 2023 (Shift-II)]

(a) 80 m   (b) 200 m   (c) 120 m   (d) 320 m

80. Two buses P and Q start from a point at the same time and move in a straight line and their positions are represented by $X_p(t) = \alpha t + \beta t^2$ and $X_Q(t) = ft - t^2$. At what time, both the buses have same velocity?

[25 June, 2022 (Shift-II)]

(a) $\dfrac{\alpha - f}{1 + \beta}$ (b) $\dfrac{\alpha + f}{2(\beta - 1)}$ (c) $\dfrac{\alpha + f}{2(1 + \beta)}$ (d) $\dfrac{f - \alpha}{2(1 + \beta)}$

81. Train A and train B are running on parallel tracks in opposite directions with speeds of 36 km/hour and 72 km/hour, respectively, A person is walking in train A in the direction opposite to its motion with a speed of 1.8 km/hour. Speed (in ms^{-1}) of this person as observed from train B will be close to: (take the distance between the tracks as negligible)

[2 Sep, 2020 (Shift-I)]

(a) 28.5 ms^{-1} (b) 31.5 ms^{-1} (c) 30.5 ms^{-1} (d) 29.5 ms^{-1}

82. A passenger train of length 60 m travels at a speed of 80 km/hr. Another freight train of length 120 m travels at a speed of 30 km/hr. The ratio of times taken by the passenger train to completely cross the freight train when: (i) they are moving in the same direction, and (ii) in the opposite direction is:

[12 Jan, 2019 (Shift-I)]

(a) $\dfrac{11}{5}$ (b) $\dfrac{5}{2}$ (c) $\dfrac{3}{2}$ (d) $\dfrac{25}{11}$

JEE-Advanced

Position, Distance and Displacement

Single Correct

1. A small block slides without friction down an inclined plane starting from rest. Let S_n be the distance travelled from $t = n - 1$ to $t = n$. Then, $\dfrac{s_n}{s_{n+1}}$ is   **(IIT-JEE 2004)**

(a) $\dfrac{2n-1}{2n}$ (b) $\dfrac{2n+1}{2n-1}$ (c) $\dfrac{2n-1}{2n+1}$ (d) $\dfrac{2n}{2n+1}$

2. A particle of mass m moves on the x-axis as follows: it starts from rest at $t = 0$ from the point $x = 0$ and comes to rest at $t = 1$ at the point $x = 1$ No other information is available about its motion at intermediate times ($0 < t < 1$). If α denotes the instantaneous acceleration of the particle, then   **(IIT-JEE 1993,1984)**

(a) α cannot remain positive for all t in the interval $0 \le t \le 1$

(b) $|\alpha|$ cannot exceed 2 at any point in its path

(c) $|\alpha|$ must be ≥ 4 at some point or points in its path

(d) α must change sign during the motion, but no other assertion can be made with the information given
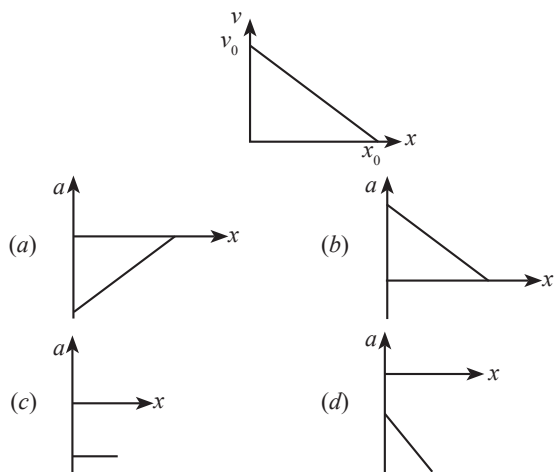
Speed and Velocity

Subjective

3. A particle of mass 10^{-2} kg is moving along the positive X-axis under the influence of a force $F(x) = -k/2x^2$ where $k = 10^{-2}$ Nm^2. At time $t = 0$, it is at $x = 1.0$ m and its velocity $v = 0$

(a) Find its velocity when it reaches $x = 0.5$ m.

(b) Find the time at which it reaches $x = 0.25$ m. **(IIT-JEE 1998)**

Constant Acceleration

Single Correct

4. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement? **(JEE Adv. 2015)**
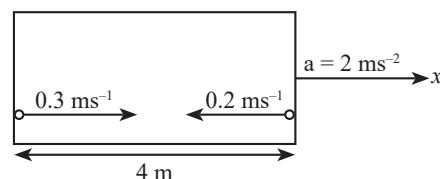

One Dimensional Relative Motion

Numerical Types

5. A rocket is moving in a gravity free space with a constant acceleration of 2 ms^{-2} along $+x$ direction (see figure). The length of a chamber inside the rocket is 4 m. A ball is thrown from the left end of the chamber in $+x$ direction with a speed of 0.3 ms^{-1} relative to the rocket. At the same time, another ball is thrown in $-x$ direction with a speed of 0.2 ms^{-1} from its right end relative to the rocket. The time in seconds when the two balls hit each.

C-50.58 W-41.08 UA-8.34 (JEE Adv. 2014)

ANSWER KEY

JEE-Main

1. (b)	**2.** (d)	**3.** (a)	**4.** (b)	**5.** (b)	**6.** (b)	**7.** (c)	**8.** [52]	**9.** (b)	**10.** [3]
11. (d)	**12.** (d)	**13.** (a)	**14.** [50]	**15.** (d)	**16.** (c)	**17.** (d)	**18.** (c)	**19.** (d)	**20.** (c)
21. [18]	**22.** (d)	**23.** (b)	**24.** (Bonus)	**25.** [45.00]	**26.** (b)	**27.** [36]	**28.** [8]	**29.** (b)	**30.** [40]
31. [19]	**32.** (a)	**33.** (c)	**34.** [200]	**35.** (d)	**36.** (c)	**37.** [3]	**38.** [100]	**39.** (b)	**40.** (c)
41. [120]	**42.** (b)	**43.** [3]	**44.** (b)	**45.** (a)	**46.** [5]	**47.** [6]	**48.** (d)	**49.** (a)	**50.** [392]
51. (b)	**52.** (d)	**53.** (d)	**54.** (d)	**55.** (b)	**56.** [50]	**57.** (a)	**58.** [8]	**59.** (d)	**60.** (a)
61. (c)	**62.** (a)	**63.** (c)	**64.** (a)	**65.** (d)	**66.** (b)	**67.** (a)	**68.** [1]	**69.** [20]	**70.** (b)
71. (a)	**72.** (d)	**73.** (c)	**74.** (c)	**75.** (b)	**76.** [3]	**77.** (c)	**78.** (c)	**79.** (d)	**80.** (d)
81. (d)	**82.** (a)								

JEE-Advanced

1. (c)	**2.** (c)	**4.** (a)	**5.** [8]