# MOTION IN A STRAIGHT LINE IMP QUESTIONS

## Class 11 - Physics

### Section A

1. A car accelerates from rest at a constant rate $\alpha$ for some time after which it decelerates at a constant rate $\beta$ and comes to rest. If total time elapsed is t, then maximum velocity acquired by car will be: **[1]**

   a) $\frac{(\alpha^2+\beta^2)t}{\alpha\beta}$ b) $\frac{\alpha\beta t}{\alpha+\beta}$

   c) $\frac{(\alpha+\beta)t}{\alpha\beta}$ d) $\frac{(\alpha^2-\beta^2)t}{\alpha\beta}$

2. A ball is thrown vertically upward. It has a speed of 10 m/sec when it has reached one-half of its maximum height. How high does the ball rise? Take g = 10 m/s$^2$. **[1]**

   a) 5 m b) 15 m

   c) 10 m d) 20 m

3. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by x = 40 + 12t - t$^3$. How long would the particle travel before coming to rest? **[1]**

   a) 40 m b) 16 m

   c) 56 m d) 24 m

4. A particle moves along a straight line such that its displacement at any time t is given by s = (t$^3$ - 6t$^2$ + 3t + 4) metres. The velocity when the acceleration is zero is: **[1]**

   a) -15 m/s b) 42 m/s

   c) 3 m/s d) -9 m/s

5. Velocity-time curve for a body projected vertically upwards is: **[1]**

   a) parabola b) ellipse

   c) hyperbola d) straight line

6. When a ball is thrown up vertically with velocity $v_0$, it reaches a maximum height of h. If one wishes to triple the maximum height, then the ball should be thrown with velocity. **[1]**

   a) $\frac{3v_0}{2}$ b) $\sqrt{3}v_0$

   c) $3v_0$ d) $9v_0$

7. A ball thrown upward from the top of a tower with speed v reaches the ground in $t_1$ second. If this ball is thrown downward from the top of the same tower with speed v, it reaches the ground in $t_2$ seconds. In what time will the ball reach the ground if it is allowed to fall freely under gravity from the top of the tower? **[1]**

a) $t_1 + t_2$

b) $\frac{t_1 - t_2}{2}$

c) $\sqrt{t_1 t_2}$

d) $\frac{t_1 + t_2}{2}$

8. A rocket is fired vertically from the ground with a resultant vertical acceleration of 10 $ms^{-2}$. The fuel is finished in 1 min and it continues to move up. What is the maximum height reached? **[1]**

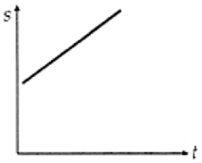
a) 36.4 km

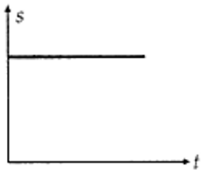
b) 42.3 km

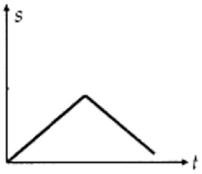
c) 25.6 km

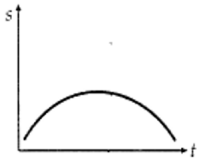
d) 48.4 km

9. Which one of the following graphs represents uniform motion? **[1]**

a) 


b) 


c) 


d) 


10. What will be the ratio of the distances moved by a freely falling body from rest in 4th and 5th seconds of journey? **[1]**

a) 1 : 1

b) 16 : 25

c) 7 : 9

d) 4 : 5

11. A 100 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 1 km is: **[1]**

a) 78 s

b) 68 s

c) 58 s

d) 88 s

12. When a ball is thrown vertically upwards, at the maximum height **[1]**

a) the acceleration is independent of the velocity

b) the acceleration depends on the velocity as a $= \frac{dv}{dt}$

c) the acceleration is present and therefore velocity is not zero

d) the velocity is zero and therefore there is no acceleration acting on the particle

13. A vehicle travels half the distance L with speed $V_1$ and the other half with speed $V_2$, then its average speed is **[1]**

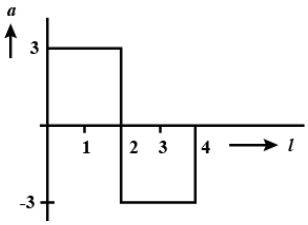
a) $\frac{2V_1+V_2}{V_1+V_2}$

b) $\frac{V_1+V_2}{2}$

c) $\frac{2V_1V_2}{V_1+V_2}$

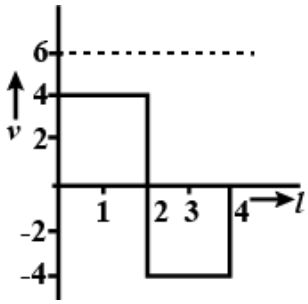
d) $\frac{L(V_1+V_2)}{V_1V_2}$

14. A particle starts from rest at t = 0 and undergoes an acceleration **a** in $ms^{-2}$ with time **t** in seconds which is as shown here: **[1]**

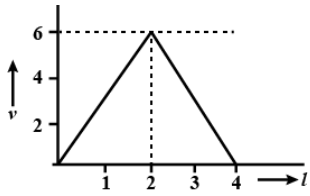



Which one of one following plots represents velocity v in $ms^{-1}$ verses time t in seconds?

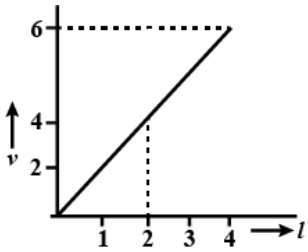
a)



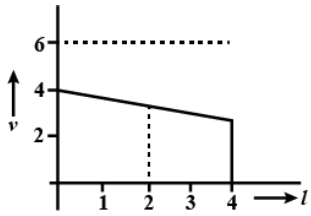

b)




c)




d)




15. The displacement of a particle is given by $x = (t - 2)^2$ where x is in metres and t in seconds. The distance covered by the particle in first 4 seconds is **[1]**

a) 12 m b) 4 m

c) 16 m d) 8 m

16. A man is at a distance of 6 m from a bus. The bus begins to move with a constant acceleration of 3 $ms^{-2}$. In order to catch the bus, the minimum speed with which the man should run towards the bus is: **[1]**

a) 6 $ms^{-1}$ b) 4 $ms^{-1}$

c) 2 $ms^{-1}$ d) 8 $ms^{-1}$

17. A truck accelerates at 1 m / $sec^2$ from rest. What is its velocity in m/s at a time of 2 sec? **[1]**

a) 2 b) 4

c) 1 d) 3

18. A stone falls freely under gravity. It covers distances $h_1$, $h_2$ and $h_3$ in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between $h_1$, $h_2$ and $h_3$ is: **[1]**

a) $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$ b) $h_1 = 2h_2 = 3h_3$

c) $h_1 = h_2 = h_3$ d) $h_1 = 3h_1$ and $h_3 = 3h_2$

19. A ball is dropped from the top of a building 100 m high. At the same instant another ball is thrown upwards with a velocity of 40 m/s from the bottom of the building. The two balls will meet after: **[1]**

a) 5 s b) 2 s

c) 2.5 s d) 3 s

20. The velocity of a particle at an instant is 10 m/s. After 3 s its velocity will become 16 m/s. The velocity at 2 s, **[1]**

before the given instant, will be:

a) 1 m/s b) 4 m/s

c) 6 m/s d) 2 m/s

21. A car traveling at a constant speed of 45.0 m/s passes a trooper hidden behind a billboard. One second after the speeding car passes the billboard; the trooper sets out from the billboard to catch it, accelerating at a constant rate of 3 $m/s^2$. How long does it take her to overtake the car? **[1]**

a) 34.0 s b) 36.0 s

c) 33.0 s d) 31.0 s

22. A body dropped from top of a tower falls through 40 m during the last two seconds of its fall. The height of tower (g = 10 $ms^{-2}$) is: **[1]**

a) 60 m b) 50 m

c) 45 m d) 80 m

23. You drive a car at a speed of 70 km/h in a straight road for 8.4 km, and then the car runs out of petrol. You walk for 30 min to reach petrol. pump at a distance of 2 km. The average velocity from the beginning of your drive till you reach the petrol pump is: **[1]**

a) 35 km/h b) 16.8 km/h

c) 18.6 km/h d) 64 km/h

24. The change in position or displacement ($\Delta x$) divided by the time intervals ($\Delta t$), in which the displacement occurs is known as **[1]**

a) acceleration b) average acceleration

c) speed d) average velocity

25. A jet lands on an aircraft carrier at 63 m/s. What is the displacement of the plane in m while it stopped in 2 s: **[1]**

a) 57.0 b) 60.0

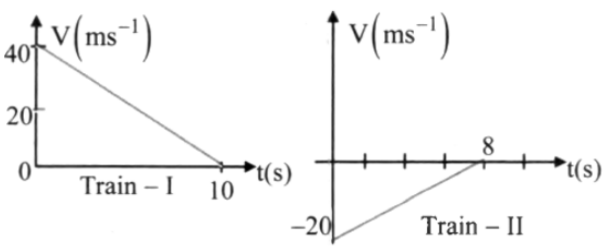
c) 68.0 d) 63.0

26. A jet lands on an aircraft carrier at 63 m/s. What is its acceleration in $m/s^2$ if it stops in 2.0 s? **[1]**

a) -35 b) 34

c) -31.5 d) -33

27. Two trains, which are moving along different tracks in opposite direction are put on the same track by mistake. On noticing the mistake, when the trains are 300 m apart the drivers start slowing down the trains. The graphs given below show decrease in their velocities as function of time. The separation between the trains when both have stopped is **[1]**




a) 120 m b) 60 m

c) 20 m

d) 280 m

28. For motion in 3 dimensions we need **[1]**

a) frame of reference consisting of a clock and a Cartesian system having three mutually $\perp$ axes, (X,Y, and Z)

b) No frame of reference is required a single point will do.

c) No frame of reference is required ; a set of 3 points will do.

d) frame of reference consisting of a clock and a Cartesian system having two mutually $\perp$ axes (X and Y)

29. A car is moving along a straight road with a uniform acceleration. It passes through two points P and Q separated by a distance with velocity 30 km/h and 40 km/h respectively. The velocity of the car midway between P and Q is: **[1]**

a) $20\sqrt{2}$ Km/h

b) 35 Km/h

c) 33.3 Km/h

d) $25\sqrt{2}$ Km/h

30. A ball is dropped from top of a tower of 100 m height. Simultaneously another ball was thrown upward from the bottom of the tower with a speed of 50 m/s. They will cross each other (g = 10 $m/s^2$) after **[1]**

a) 4 sec

b) 3 sec

c) 1 sec

d) 2 sec

**Section B**

31. Draw displacement time graph for uniformly accelerated motion. What is its shape? **[2]**

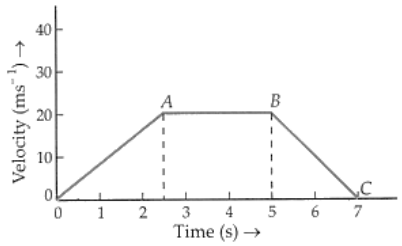
32. Draw velocity-time graph of uniform motion and prove that the area under the velocity-time graph of a particle gives the displacement of the particle in a given time. **[2]**

33. A food packet is released from a helicopter which is rising steadily at 2 $ms^{-1}$. After two seconds: **[2]**

i. What is the velocity of the packet?

ii. How far is it below the helicopter? Take g = 9.8 $ms^{-2}$

34. The velocity-time graph for a vehicle is shown in Figure. Draw acceleration-time graph from it. **[2]**




35. In which of the following examples of motion can the body be considered approximately a point object: **[2]**

i. a railway carriage moving without jerks between two stations,

ii. a monkey sitting on the top of a man cycling smoothly on a circular track,

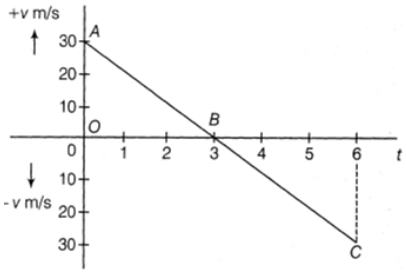
iii. a spinning cricket ball that turns sharply on hitting the ground, and

iv. tumbling beaker that has slipped off the edge of a table?

36. Derive the relation graphically: $s = ut + \frac{1}{2}at^2$ , where symbols have their usual meaning. **[2]**

37. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further will it penetrate before coming to rest assuming that it faces constant resistance to motion? **[2]**

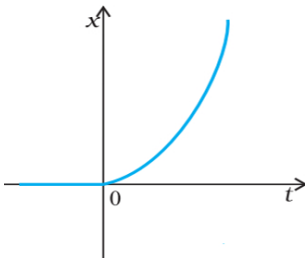
38. With the help of below velocity-time graph, find the **[2]**




i. displacement in first three seconds and

ii. acceleration for the above graph.

39. In given figure shows the x-t plot of one-dimensional motion of a particle. Is it correct to say from the graph that the particle moves in a straight line for t < 0 and on a parabolic path for t > 0? If not, suggest a suitable physical context for this graph. **[2]**




40. If in the case of a motion, displacement is directly proportional to the square of the time elapsed, what do you think about its acceleration i.e., constant or variable? Explain why. **[2]**

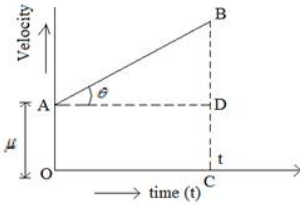
41. A body travels half of its total path in the last second of its free fall from rest. What is the duration of the fall? **[2]**

42. The displacement x of a particle moving in one dimension under the action of constant force is related to the time by the equation $t = \sqrt{x} - 3$ where x is in meters and t is in seconds. Find the velocity of the particle at **[2]**

1. t = 3s
2. t = 6s.

43. A ball is released from the top of a tower of height h metres. It takes T seconds to reach the ground. What is the position of the ball in $\frac{T}{3}$ seconds. **[2]**

44. Establish $s = ut + \frac{1}{2}at^2$ from velocity time graph for a uniform accelerated motion? **[2]**




45. Distinguish between speed and velocity. **[2]**

46. Using integration technique, prove that $v^2 - u^2 = 2as$. **[2]**

47. The displacement (in metre) of a particle moving along x-axis is given by $x = 18t + 15t^2$. Find the instantaneous velocity at t = 0 and t = 2 s. **[2]**

48. Galileo's law of odd numbers: The distances traversed, during equal intervals of time, by a body falling from rest, stand to one another in the same ratio as the odd numbers beginning with unity [namely, 1: 3: 5: 7…...]. Prove it. **[2]**

49. The data regarding the motion of two different objects P and Q are given in the following table. Examine them carefully and state whether the motion of the objects is uniform or non-uniform. **[2]**

| **Time** | **Distance travelled by object P (in m)** | **Distance travelled by Object Q (in m)** |
|---|---|---|
| | | |

| | | |
|---|---|---|
| 9:30 am | 10 | 12 |
| 9:45 am | 20 | 19 |
| 10:00 am | 30 | 23 |
| 10:15 am | 40 | 35 |
| 10:30 am | 50 | 37 |
| 10:45 am | 60 | 41 |
| 11:00 am | 70 | 44 |

50. Using velocity-time graph, prove that: $v^2 - u^2 = 2as$ **[2]**
where symbols have their usual meanings.

51. A body is moving in a straight line along x-axis. Its distance from the origin is given by the equation $x = at^2 - bt^3$, where x is in metre and t is in second. Find **[2]**

i. the average speed of the body in the interval t = 0 and t = 2

ii. its instantaneous speed at t = 2 s.

52. Starting from rest a car accelerates uniformly with 3 $ms^{-2}$ for 5 s and then moves with uniform velocity. Draw the distance-time graph of the motion of the car upto t = 7s. **[2]**

53. A balloon is ascending at the rate of 14 $ms^{-1}$ at a height of 98 m above the ground when the food packet is dropped from the balloon. After how much time and with what velocity does it reach the ground? Take g = 9.8 $ms^{-2}$. **[2]**

54. The displacement x of a particle moving in one dimension under the action of constant force is related to the time by the equation $t = \sqrt{x} - 3$ where x is in meters and t is in seconds. Find the velocity of the particle at **[2]**

i. t = 3s

ii. t = 6s

55. The odometer of Raja's car reads 1700 km at the start of a trip and 2500 km at the end of the trip. The trip took 16 h. What is the average speed of Raja's car in $ms^{-1}$? **[2]**

56. A car moving along a straight highway with a speed of 72 $kmh^{-1}$ is brought to a stop within a distance of 100 m. What is the retardation of the car and how long does it take for the car to stop? **[2]**

57. The relation between t and distance x is $t = ax^2 + bx$ where a and b are constants. Express the instantaneous acceleration in terms of instantaneous velocity. **[2]**

58. The position of an object is given by $x = 2t^2 + 3t$. Find out that its motion is uniform or non - uniform. **[2]**

59. In which of the following examples of motion, can the body be considered approximately a point object? **[2]**

i. A railway carriage moving without jerks between two stations.

ii. A monkey sitting on the top of a man cycling smoothly on a circular track.

iii. A spinning cricket ball that turns sharply on hitting the ground.

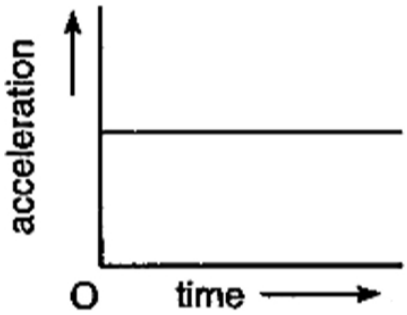
60. Can a body be at rest as well as in motion at the same time? Explain. **[2]**

**Section C**

61. Stopping distance of vehicles: When brakes are applied to a moving vehicle, the distance it travels before stopping is called stopping distance. It is an important factor for road safety and depends on the initial velocity **[3]**

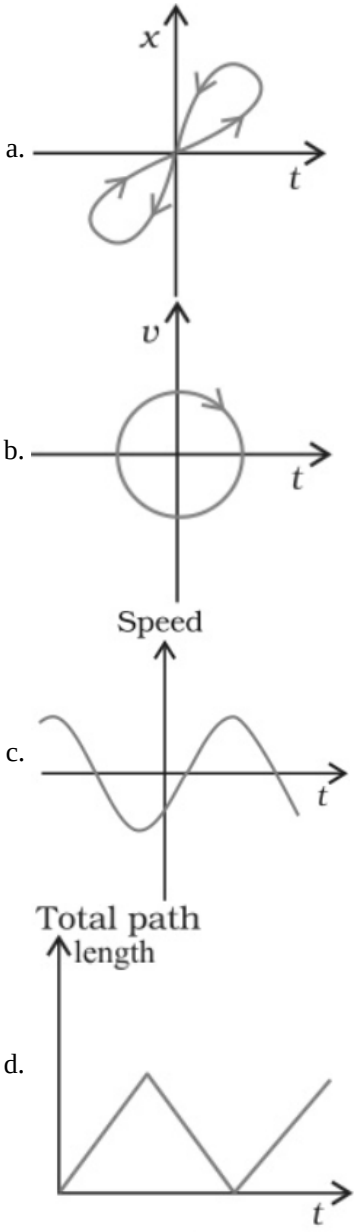
($v_o$) and the braking capacity, or deceleration, –a that is caused by the braking. Derive an expression for stopping distance of a vehicle in terms of $v_o$ and a.

62. Acceleration-time graph of a moving object is shown in figure. Draw the velocity- time graph and displacement-time graph corresponding to this type of motion. **[3]**



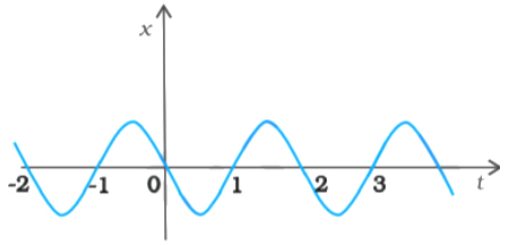

63. An insect crawling up a wall crawls 5 cm upwards in the first minute but then slides 3 cm downwards in the next minute. It again crawls up 5 cm upwards in the third minute but again slides 3 cm downwards in the fourth minute. How long will the insect take to reach a crevice in the wall at a height of 24 cm from its starting point? How does the position-time graph of the insect look like? **[3]**

64. Look at the graphs (a) to (d) (figure) carefully and state, with reasons, which of these cannot possibly represent one-dimensional motion of a particle. **[3]**



65. Use integration technique to prove that the distance travelled in nth second, $s_{nth} = u + \frac{a}{2}(2n - 1)$. **[3]**

66. Figure gives the x-t plot of a particle executing one-dimensional simple harmonic motion. Give the signs of position, velocity and acceleration variables of the particle at t = 0.3 s, 1.2 s, -1.2 s. **[3]**




67. Draw the following graphs (expected nature only) representing motion of an object under free fall. Neglect air resistance. **[3]**

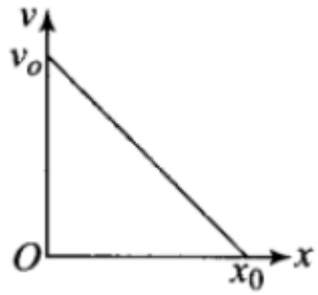
i. Variation of position with respect to time.
ii. Variation of velocity with respect to time.
iii. Variation of acceleration with respect to time.

68. Draw the following graphs for an object projected upward with a velocity $v_0$, which comes back to the same point after some time: **[3]**

i. Acceleration versus time graph,
ii. Speed versus time graph,
iii. Velocity versus time graph.

69. If x, y, z be the distances described by a particle during the pth, qth and rth second respectively, prove that: (q - r) x + (r - p) y + (p - q) z = 0 **[3]**

70. The velocity-displacement graph of a particle is shown in the figure. **[3]**




a. Write the relation between v and x.
b. Obtain the relation between acceleration and displacement and plot it.

71. Show that area under the velocity-time graph of an object moving with constant acceleration in a straight line in certain time interval is equal to the distance covered by the object in that interval. **[3]**

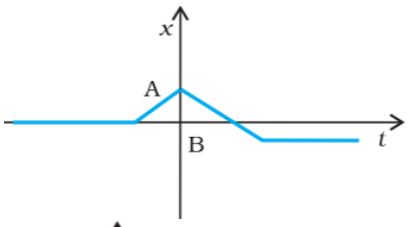
72. A food packet is released from a helicopter which is rising steadily at 2 $ms^{-1}$. The food packet falls on the ground after 6 s. Find the height of the helicopter when **[3]**

i. the food packet was released from it, and
ii. when the food packet just reached the earth.

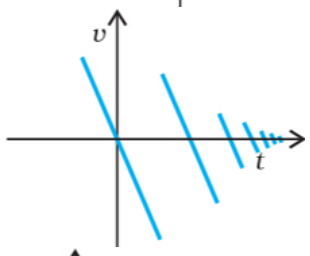
73. At t = 0, a particle is at rest at origin. Its acceleration is 2 $m/s^2$ for the first 3 s and -2 $m/s^2$ for next 3s. Plot the acceleration versus time and velocity versus time graph. **[3]**

74. Suggest a suitable physical situation for each of the following graphs: **[3]**

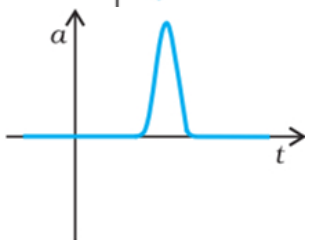
a.




b.




c.




75. A woman starts from her home at 9.00 am, walks with a speed of 5 km $h^{-1}$ on a straight road up to her office 2.5 km away, stays at the office up to 5.00 pm, and returns home by an auto with a speed of 25 km $h^{-1}$. Choose suitable scales and plot the x-t graph of her motion. **[3]**