PHYSICS, CLASS - XI

Motion in a Straight Line, Chapter - 03

Short Answer Type Questions (1 mark)

01. A body makes 5 complete revolutions in a circle of radius 1m. Find the distance and displacement of the body.

02. If the displacement of a body is zero, is the distance covered by it necessarily zero?

03. What is the significance of the slope of the x-t graph?

04. Under what condition will the distance and displacement of a moving object will have the same magnitude. ?

05. If the position of a particle at instant t is given by $x=t^3$, find the acceleration of the particle.

06. When a body accelerates by t, what is the velocity after time 't', when it starts from rest?

07. Can average velocity and instantaneous velocity can be same?

Short Answer Type Questions (2 marks)

08. Given that $S = 5 - 7t - 6t^2$.

(i) Find instantaneous speed as a function of time.

(ii) Find it's initial speed.

09. The displacement of the body is given by $x = 1 + 2t + 3t^2$. Where t represents time. Find the value of instantaneous acceleration.

10. A particle moves along the positive x-axis in such a way that it's co-ordinates varies in time. According to the expression $x = 4 + 2t - 3t^2$ where x is in metre and 't' in seconds.

(i) Find it's initial position and initial velocity of a particle.

(ii) Determine at what time the particle reaches maximum co-ordinates.

(iii) Calculate the position, velocity and acceleration at t = 2 sec.

11. A constant force act on a particle and it's displacement y is related to time (t) by the equation $t = \sqrt{y} + 3$. What is the displacement of the particle when it's velocity is zero?

12. A car covers the 1st half of the distance between two places at a speed of 40 km/h and 2nd half at a 60 km/h. Calculate the average speed of the car.

13. A body travels with a speed of 2 km/h for 10 mins then with a speed of 7 km/h for another 10 mins. Find it's the average speed.

14. A car starts from rest and picks up speed till in 10 sec and thereafter move with uniform speed, till t = 18S, then the breaks are applied and the car stops and 20S after covering 296m. Draw position & time graph.

15. Draw the position-time graph (i) moving with +ve velocity (ii) moving with -ve velocity.

Short Answer Type Questions (3 marks)

16. Draw a graph for position - time for motion with

(i) +ve acceleration (ii) -ve acceleration (iii) zero acceleration

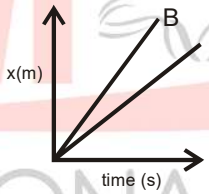
17. Draw the position vs time graph of two objects moving with

(i) equal velocities (ii) unequal velocities in the same direction (iii) unequal velocities in the opposite direction

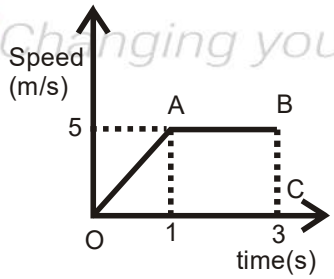
18. Prove that the distance travelled by an object in n^{th} second is given by $S_{nth} = u + \frac{a}{2}(2n-1)$

19. A body covers 12m in the third second of its motion and 20 m in 5th second. Calculate the velocity of the body after 10 seconds.

20. Mention of two bodies A and B are shown in the distance vs time graph which has more speed.

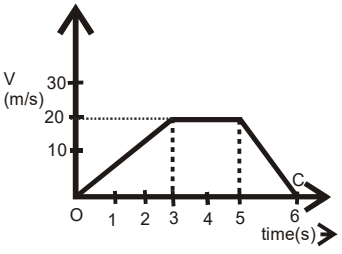


21. Find the acceleration of the body whose speed-time graph is drawn.

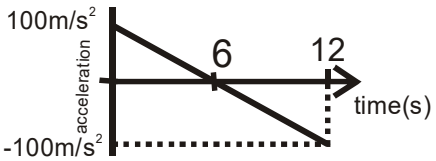


22. The $v-t$ graph of two objects makes angles of 30^0 and 60^0 with the time axis. Find the ratio of their acceleration.

23. Interpret the following speed-time graph and find the acceleration and retardation required. Find the average speed from 0 to 6 sec.



24. Shown in the acceleration time curve. What is the final velocity at t = 12s? If velocity at t = 0 in 200 m/s



25. A woman starts from her home at 9.00 a.m, walks with a speed of 5 km h^{-1} on a straight road upto her office 2.5 km away, stays at the office upto 5.00 p.m 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.

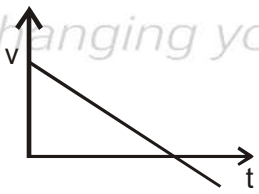
Long Answer Type Questions (5 marks)

26. Derive the equations of motion by calculus method.

27. A car moving along a straight highway with a speed of 126 km/h is brought to stop with a distance of 200m. What is the retardation of the car (assumed uniform) and how long does it take for the car to stop?

28. Two train A and B of length 400m on each are moving on two parallel tracks with a uniform speed of 72 km/h in the same direction, with A ahead of B. The driver of B decided to overtake A and accelerates by 1 m/s^2. If after 50 s the guard of B just crosses driver of A. Calculate the original distance between the two trains.

29. What type of motion does the following velocity-time curve represent?
Convert the velocity and time graph into



(i) $S \sim t$ (ii) $\vec{a} \sim t$ (iii) $\vec{S} \sim t$ (iv) $v \sim t$ (v) $\vec{a} \sim \vec{v}$ (vi) $\vec{v} \sim \vec{s}$ graph.

MODEL QUESTIONS

Very Short Answer type Questions ***(each question 1 mark)***

01. Define Instantaneous velocity.

02. Write two uses of the v-t graph?

03. Can a moving body have relative velocity zero with respect to another body? Give an example.

04. What is the shape of the displacement-time graph for uniform linear motion?

05. Two particles A and B are moving along the same straight line. B is ahead of A. Velocities remaining unchanged, what would be the effect on the magnitude of relative velocity if A is ahead of B?

06. A ball dropped from height h reaches the ground in t second. After what time the ball was passing through a point at height h/2?

07. Define uniformly accelerated motion.

Short Answer type Questions ***(each question 2 marks)***

08. A car moving at a speed of 10 m/s is accelerated at a rate of 2 m/s^2. Find out the velocity after 6 sec.

09. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backwards, followed again by 5 steps forward and 3 steps backwards, and so on. Each step is 1 m long and requires 1 s. Plot the x-t graph of his motion. Determine graphically and otherwise how long the drunkard takes to fall in a pit 13 m away from the start.

10. A jet aeroplane travelling at the speed of 500 kmh^{-1} ejects its products of combustion at the speed of 1500 kmh^{-1} relative to the jet plane. What is the speed of the latter with respect to an observer on the ground?

11. A ball is dropped from a height of 90 m on a floor. At each collision with the floor, the ball loses one-tenth of its speed. Plot the speed-time graph of its motion between t=0 to 12s.

12. A ball is thrown vertically up with a velocity of 20 m/s. Construct time-acceleration and time-displacement graph.

13. Two parallel rail tracks run north-south. Train A moves due north with a speed of 54 km/h^{-1} and train B moves due south with a speed of 90 kmh^{-1}. What is the relative velocity of B with respect of A in ms^{-1}?

14. Differentiate between average speed and the instantaneous speed of an object.

Short Answer type Questions ***(each question 3 marks)***

15. In which of the following examples of motion, can the body be considered approximately a point object:

(a) a railway carriage moving without jerks between two stations.

(b) a monkey sitting on top of a man, cycling smoothly on a circular track.

(c) a spinning cricket ball that turns sharply on hitting the ground.

(d) a tumbling beaker that has slipped off the edge of a table.

16. Draw velocity vs time graph for uniformly accelerated motion. What is its importance?

17. A body starting from rest accelerates uniformly along a straight line at the rate of 10 ms^{-2} for 5 seconds. It moves for 2 seconds with a uniform velocity of 50 ms^{-1}. Then it retards uniformly and comes to rest in 3s. Draw a velocity-time graph of the body and find the total distance travelled by the body.

18. The displacement (in metre) of a particle moving along X-axis is given by $x=18t+5t^2$.

Calculate:

(i) the instantaneous velocity at t=2s,

(ii) average velocity between t=2s and t =3s,

(iii) instantaneous acceleration.

19. A car moving along a straight highway with a speed of 126 km h^{-1} is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform), and how long does it take for the car to stop?

20. Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of 72 km h^{-1} in the same direction, with A ahead of B. The driver of B decides to overtake A and accelerates by 1 ms^{-2}. If after 50 s, the guard of B just brushes past the driver of A, what was the original distance between them?

21. 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 2.5 km h^{-1}. Choose suitable scales and plot the x-t graph of her motion.

Long Answer type Questions ***(each question 5 marks)***

22 (a) Establish the relation $x = v_0 t + \frac{1}{2}at^2$ analytically.

(b) A car moving with a speed of 126 km/h is brought to a stop within a distance of 200 m. Calculate the retardation of the car and the time required to stop it.

23. Draw velocity-time graph of uniformly accelerated motion deduces the equations of motion in distance and time.

24. Derive an equation for the distance covered by a uniformly accelerated body in the n^{th} second of its motion. A body travels half its total path in the last second of its fall from rest. Calculate the time of its fall.

25. A balloon is ascending at the rate of 14 ms^{-1} at a height of 98 m. above the ground when a packet is dropped from the balloon. After how much time and with what velocity does it reach the ground?

26. From the top of a tower 100 m. in height, a ball is dropped, and at the same time, another ball is projected vertically upwards from the ground with a velocity of 25 ms^{-1}. Find when and where the two balls meet. Take g=9.8 ms^{-2}.

27. Two stones are thrown up simultaneously from the edge of a cliff 22 m high with initial speeds of 15 ms^{-1} and 30 ms^{-1} verify that the graph shown in figure correctly represents the time variation of the relative position of the second stone with respect to first. Neglect air resistance and assume that the stones do not rebound after hitting the ground. Take g=10 ms^{-2}.

28. If the position of a particle at instant 't' is given by $x = 2t^3$, find the acceleration of the particle.

29. When a body accelerates by βt , what is the velocity after time, 't' when it starts from rest?

30. Does constant acceleration mean that $x - t$ graph will have a constant slope? Yes/ No

31. Consider that the acceleration of a moving body varies with time. What does the area under the acceleration time graph for any time interval represent?

32. A car starts' accelerating from rest for some time, maintains the velocity for some time and then comes to rest with uniform retardation. Draw $v - t$ graph.

33. The displacement of a particle is given by at^2 . What is the dependency of acceleration on time?

34. A bus starting from rest moves with a uniform acceleration of 0.1 m/s^2 for 2 min. Find (a) the speed acquired and (b) the distance travelled.

35. Point P, Q and R are in a vertical line such that $PQ = QR$. A ball at P is allowed to fall freely. What is the ratio of the times of descent through PQ and QR?

36. A car travelling with a speed of 90 km/h on a straight road is ahead of a scooter travelling with a speed of 60 km/h. How would the relative velocity be altered, if a scooter is ahead of the car?

37. The velocity of a particle is given by the equation $v = 4 + 2(C_1 + C_2 t)$ where C_1 and C_2 are constant. Find the initial velocity and acceleration of the particle.

38. A car starting from rest accelerates at the rate f through a distance s, then continues at a constant speed for some time t and then decelerate at the rate f/2 to come to rest. If the total distance is 5s., then prove that $s = \frac{1}{2} ft^2$.

39. A player throws a ball upwards with an initial speed of 29.4 ms^{-1}.

(a) What is the direction of acceleration during the upward motion of the ball?

(b) What are the velocity and acceleration of the ball at the highest point of its motion?

(c) Choose x = 0 and t = 0 be the location and time at its highest point, vertically downward direction to be the positive direction of the x-axis and give the signs of position, velocity and acceleration of the ball during its upward and downward motion.

(d) To what height does the ball rise and after how long does the ball return to the player's hands? (Take g = 9.8 ms^{-2}) and neglect air resistance)

40. A ball is dropped from a height of 90 m on a floor. At each collision with the floor, the ball loses one-tenth of its speed. Plot the speed-time graph of its motion between t = 0 to 12s (g = 10ms^{-2}).

41. A body is projected vertically upwards from A, the top of a tower it reaches the ground in it t_1 second. If it is projected vertically downwards from A with the same velocity it reaches the ground in t_2 second. If it falls freely, from A, prove that it would reach the ground in $\sqrt{t_1 t_2}$ second.

42. A train takes 4 min to go between stations 2.25 km apart starting and finishing at rest. The acceleration is uniform for the first 40s and the deceleration is uniform for the last 20s. Assuming the velocity to be constant for the remaining time, calculate the maximum speed, acceleration and retardation, use only the graphical method.

43. A train passes a station A at 40 kmh^{-1} and maintains its speed for 7 km and is then uniformly retarded, stopping at B which is 8.5 km from A. A second train starts from A at the instant the first train passes and being accelerated some part of the journey and uniformly retarded for the rest, stops at B at the same times as the first train. Calculate the maximum speed of the second train, use only the graphical method.

44. A motor car moving at a speed of 72 km/h cannot come to a stop is less than 3.0s while for a truck time interval is 5.0 s. On a highway, the car is behind the truck both moving at 72 km/h. The truck gives a signal that it is going to stop at an emergency. At what distance the car should be from the truck so that it does not bump on to (collide with) the truck? Human response time is 0.5 s.

45. A ball is thrown upward with an initial velocity of 100 m/s. After how much time will it return? Draw velocity-time graph for the ball and find from the graph.

(a) Maximum height attained by ball

(b) Height of the ball after 15s. Take g = 10ms^{-2}

46. To parallel rail tracks run North-Sough. Train A moves North with a speed of 54 kmh^{-1} and train B moves South with a speed of 90 kmh^{-1}. What is the

(a) The relative velocity of B with respect to A?

(b) The relative velocity of ground with respect to B?

(c) The velocity of the monkey on the roof of the train A against its motion (with a velocity of 18 kmh^{-1} with respect to trainA) as observed by a man standing on the ground?

47. If body moving with uniform acceleration in the straight line describes successive equal distance in time interval t_1, t_2 and t_3, then show that $\frac{1}{t_1}-\frac{1}{t_2}+\frac{1}{t_3}=\frac{3}{t_1+t_2+t_3}$

48. Can a body have zero velocity and finite acceleration?

49. Is it possible for a body to be accelerated without speeding up or slowing down? If it is so, give example.

50. Plot a graph of velocity-time, for the condition if an object is moving with increasing acceleration and having zero initial velocity.

51. A particle in one-dimensional motion with a positive value of acceleration must be speeding up. Is it true? Explain.

52. Give two examples for the formula $v_{AB}=v_A-v_B$, where the symbols have their usual meaning.

53. Establish a kinetic equation $S=ut+\frac{1}{2}at^2$ from the velocity-time graph for a uniformly accelerated motion.

54. State which of the following situations are possible and give an example for each of these?

(a) An object with a constant acceleration but with zero velocity.

(b) An object moving in a certain direction with an acceleration in the perpendicular direction.

55. A passenger is standing d metres away from a bus. The bus begins to move with constant acceleration (a) To catch the bus, the passenger runs at a constant speed (v) towards the bus. What must be the minimum speed of the passenger so that he may catch the bus?

56. A particle starts moving from the position of rest under constant acceleration. If it travels a distance x in t second, what distance will it travel in next t second?

57. The two ends of a moving train with a constant acceleration passes a certain point with velocities u and v. Show that the velocity with which the middle point of the train passes the same point is $\sqrt{\frac{u^2+v^2}{2}}$.

58. A car starts from rest and accelerates uniformly for 10s to a velocity of 8 m/s, and then it runs at a constant velocity and is finally brought to rest in 64 m with constant retardation. The total distance covered by the car is 584m. Find the values of acceleration, retardation and total time taken.

59. Suppose two trains A and B are moving with uniform velocities along parallel tracks in the same direction and the velocities of A and B be 60 km/h in East and 65 km/h in East. Find the relative velocity of B w.r.t A.

60. Two particles A and B are moving along the same straight line. B is ahead of A. Velocities remaining unchanged, what would be an effect on the magnitude of relative velocity if A ahead of B?

61. Two towns A and B are connected by regular bus service with a bus leaving either direction every t min. A man cycling with a speed of 20 km/h in the direction A to B notices that a bus goes past him every 18 min in the direction of his motion and every 6 min in the opposite direction. What is the period T of the bus service and with what speed (assumed constant) do the buses ply on the road?