PHYSICS

BOOKS - PSEB

MOTION IN A STRAIGHT LINE

Exercise

1. 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.

Answer:

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2. A woman starts from her home at 9.00 am, walks with a speed of $5kmh^{-1}$ 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 $25kmh^{-1}$.Choose suitable scales and plot the x-t graph of her motion.

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3. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward, followed again by 5 steps forward and 3 steps backward, and so on. Each step is 1 in 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.

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

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5. A car moving along a straight highway with 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 ?

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

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7. On a two-lane road, car A is travelling with a speed of $36kmh^{-1}$. Two cars B and C approach car A in opposite directions with a speed of $54kmh^{-1}$ each. At a certain instant, when the distance AB is equal to AC, both being 1 km, B decides to overtake A before C does. What minimum acceleration of car B is required to avoid an accident ?

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8. Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T minutes. A man cycling with a speed of $20kmh^{-1}$ 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 Tof the bus service and with what speed (assumed constant) do the buses ply on the road?

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9. A player throws a ball upwards with an initial speed of $29.4ms^{-1}$:- What is the direction of acceleration during the upward motion of the ball ?

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10. A player throws a ball upwards with an initial speed of $29.4ms^{-1}$:- What are the velocity and acceleration of the ball at the highest point of its motion ?

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11. A player throws a ball upwards with an initial speed of $29.4ms^{-1}$:- What is the direction of acceleration during the upward motion of the ball ?

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12. A player throws a ball upwards with an initial speed of $29.4ms^{-1}$:- To what height does the ball rise and after how long does the ball return to the player's hands ? (Take $g = 9.8ms^{-2}$ and neglect air resistance).

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13. Read each statement below carefully and state with reasons and examples, if it is true or false :- A particle In one-dimensional motion:- with zero speed at an instant may have non-zero acceleration at that instant

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14. Read each statement below carefully and state with reasons and examples, if it is true or false :- A particle In one-dimensional motion:- with zero speed may have non-zero velocity,

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15. Read each statement below carefully and state with reasons and examples, if it is true or false :- A particle In one-dimensional motion:- with constant speed must have zero acceleration,

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16. Read each statement below carefully and state with reasons and examples, if it is true or false :- A particle In one-dimensional motion:- with constant speed must have zero acceleration,

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17. 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 12 s.

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18. Explain clearly, with examples, the distinction between :- magnitude of displacement (sometimes called distance) over an interval of time, and the total length of path covered by a particle over the same interval,

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19. Explain clearly, with examples, the distinction between :- magnitude of average velocity over an interval of time, and the average speed over the same interval. [Average speed of a particle over an interval of time is defined as the total path length divided by the time interval]. Show in both (a) and (b) that the second quantity is either greater than or equal to the first. When is the equality sign true ? [For simplicity, consider one-dimensional motion only].

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20. A man walks on a straight road from his home to a market 2.5 km away with a speed of $5kmh^{-1}$. Finding the market closed, he instantly

turns and walks back home with a speed of $7.5kmh^{-1}$. What is the :- magnitude of average velocity, and

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22. In Exercises 3.13 and 3.14, we have carefully distinguished between average speed and magnitude of average velocity. No such distinction is necessary when we consider instantaneous speed and magnitude of velocity. The instantaneous speed is always equal to the magnitude of instantaneous velocity. Why ?

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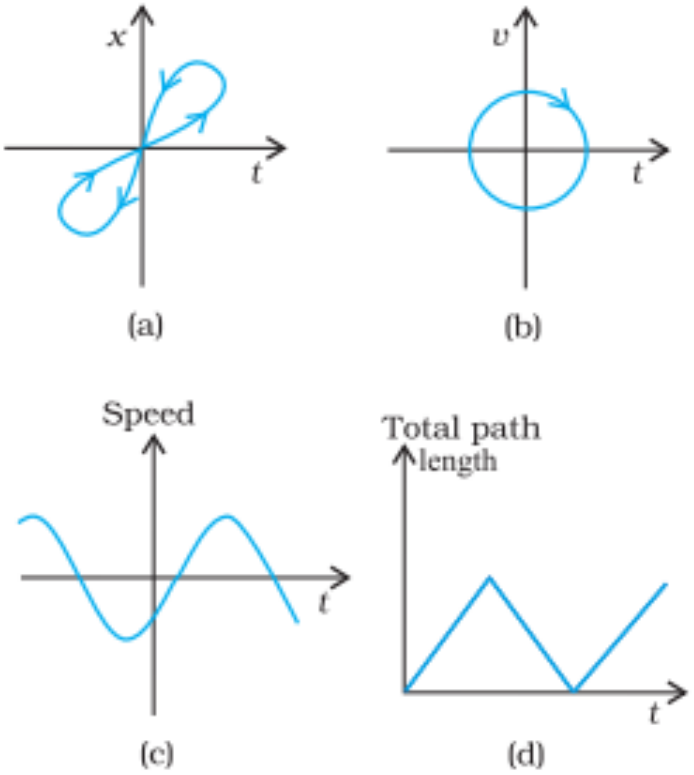
23. Look at the graphs (Fig. 3.20) carefully and state, with reasons, which of these cannot possibly represent one-dimensional motion of a particle.



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24. Figure 3.21 shows the x-t plot of one-dimensional 4 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.

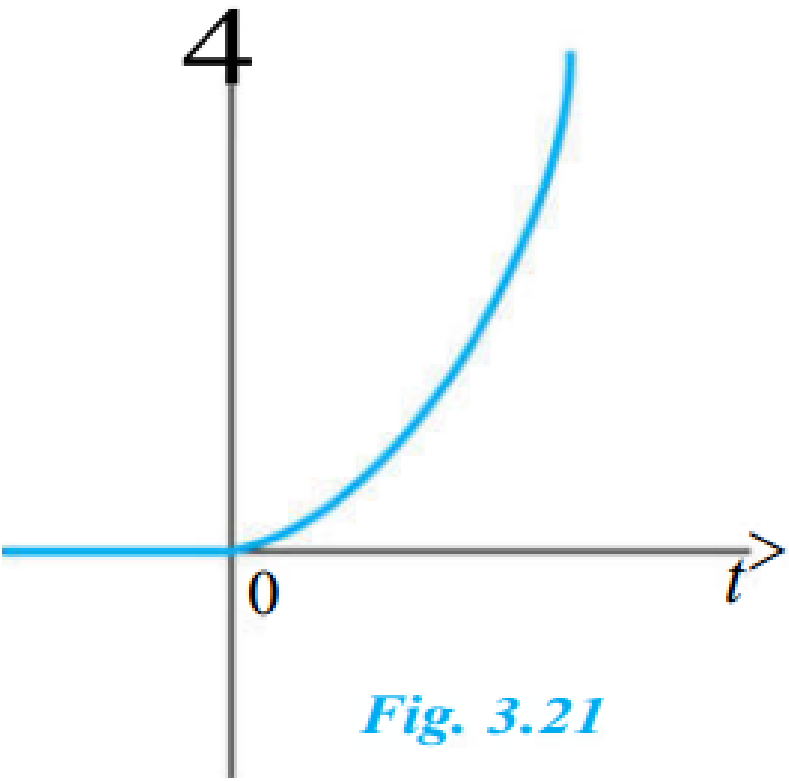

Fig. 3.21

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25. A police van moving on a highway with a speed of $30kmh^{-1}$ fires a bullet at a thiefs car speeding away in the same direction with a speed of $192kmh^{-1}$. If the muzzle speed of the bullet is $150ms^{-1}$ with what

speed does the bullet hit the thiefs car ? (Note: Obtain that speed which is relevant for damaging the thief s car).

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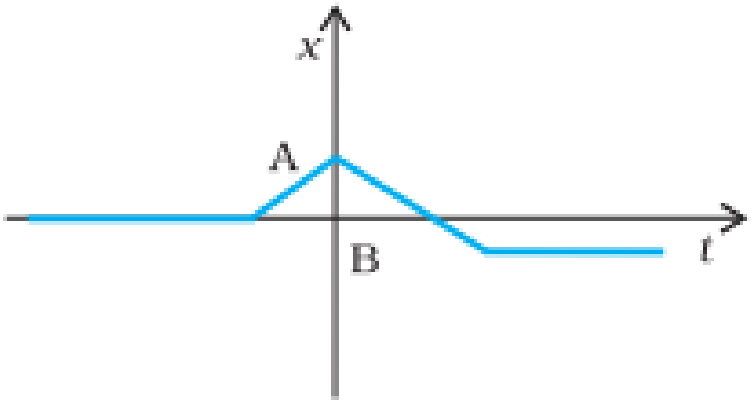
26. Suggest a suitable physical situation for each of the following graphs (Fig 3.22):



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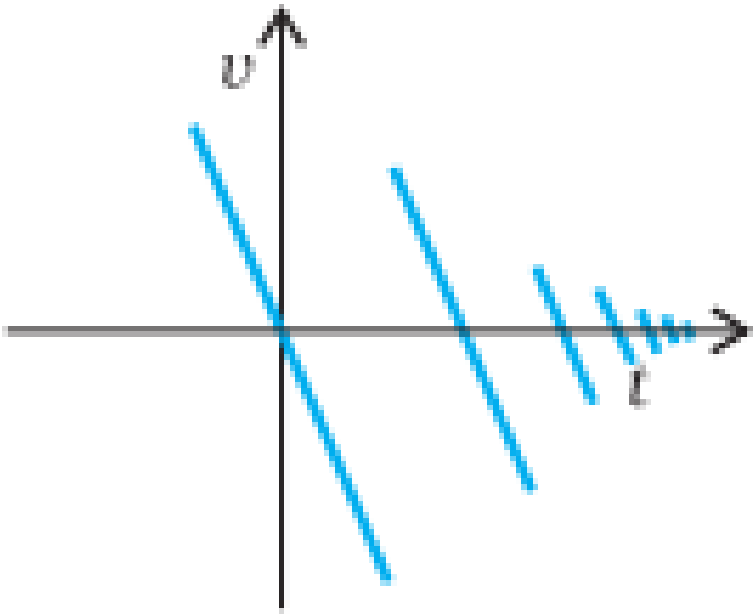
27. Suggest a suitable physical situation for each of the following graphs (Fig 3.22):



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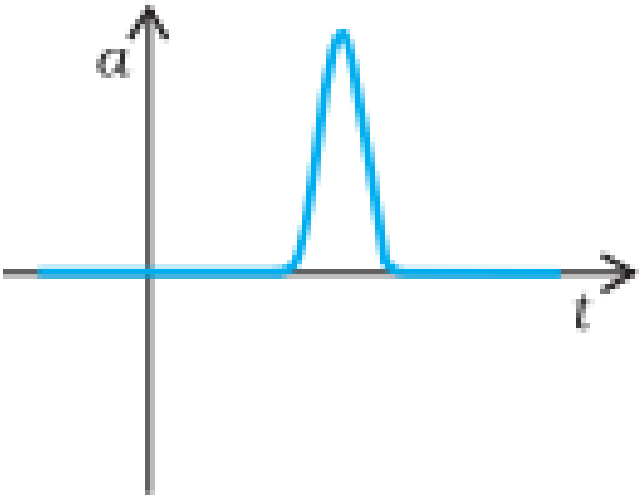
28. Suggest a suitable physical situation for each of the following graphs (Fig 3.22):



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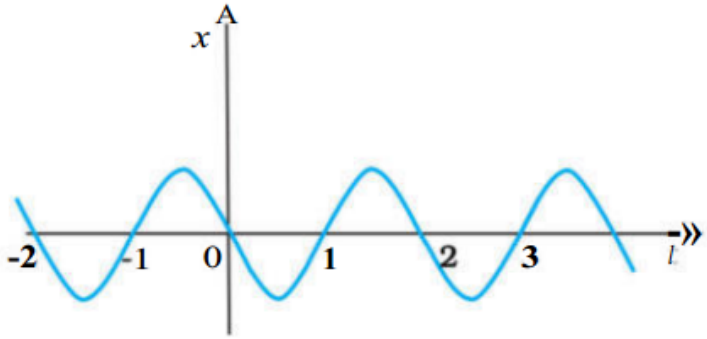
29. Figure 3.23 gives the x-t plot of a particle executing one-dimensional simple harmonic motion. (You will learn about this motion in more detail in Cliapterl4). Give the signs of position, velocity and acceleration

variables of the particle at t = 0.3 s, 1.2 s, - 1.2 s.



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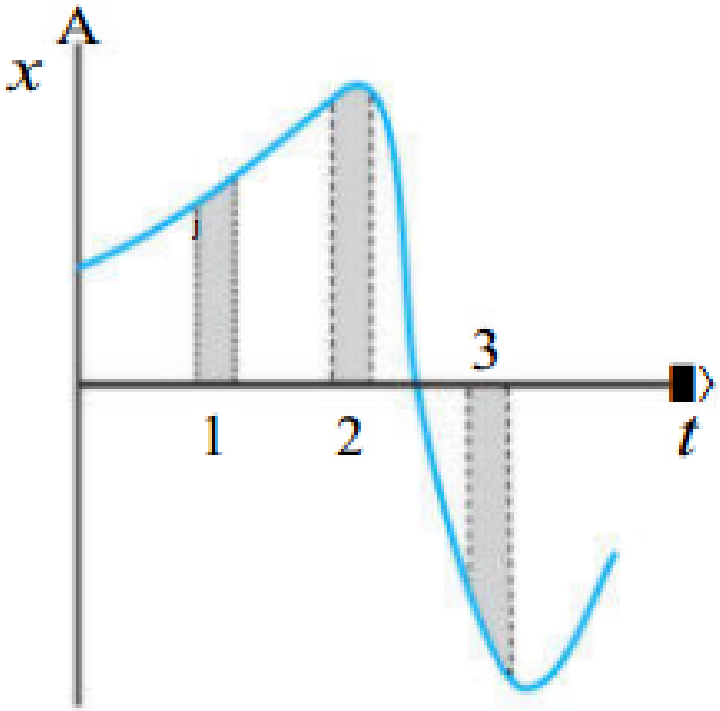
30. Figure 3.24 gives the x-t plot of a particle in one-dimensional motion. Three different equal intervals of time are shown. In which interval is the average speed greatest, and in which is it the least ? Give the sign of

average velocity for each interval.



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31. A three-wheeler starts from rest, accelerates uniformly with $1ms^{-2}$ on a straight road for 10 s, and then moves with uniform velocity. Plot the distance covered by the vehicle during the 11th second (n = 1,2,3....) versus 11. What do you expect this plot to be during accelerated motion : a straight line or a parabola ?

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32. A boy standing on a stationary lift (open from above) throws a ball upwards with the maximum initial speed he can, equal to $49ms^{-1}$. How much time does the ball take to return to his hands? If the lift starts moving up with a uniform speed of $5ms^{-1}$ and the boy again throws the ball up with the maximum speed he can, how long does the ball take to return to his hands ?

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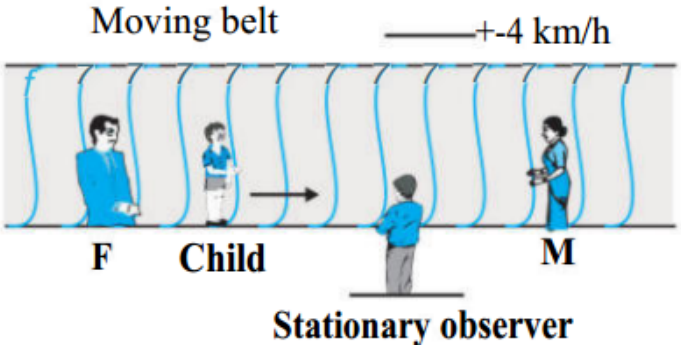
33. On a long horizontally moving belt (Fig. 3.26), a child runs to and fro with a speed $9kmh^{-1}$ (with respect to the belt) between his father and mother located 50 m apart on the moving belt. The belt moves with a speed of $4kmh^{-1}$. For an observer on a stationary platform outside, what is the:- speed of the child running in the direction of motion of the

belt ?.



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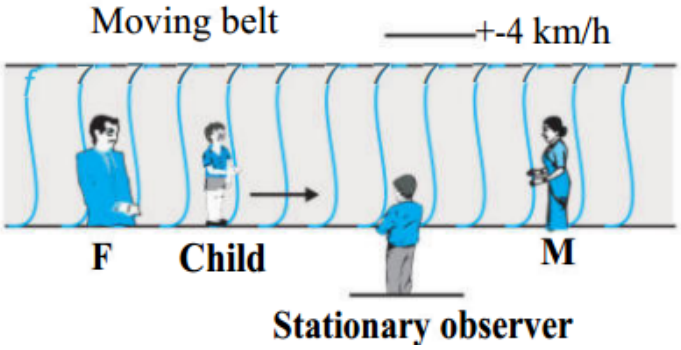
motion of the belt ?



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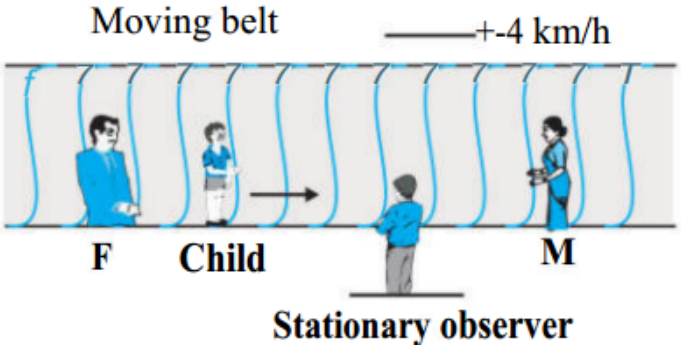
35. On a long horizontally moving belt in figure, a child runs to and fro with a speed $9kmh^{-1}$ (with respect to the belt) between his father and mother located 50 m apart on the moving belt. The belt moves with a speed of $4kmh^{-1}$. For an observer on a stationary platform outside, what is the:- time taken by the child in (a) and (b) ? Which of the answers

alter if motion is viewed by one of the parents ?



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36. Two stones are thrown up simultaneously from the edge of a cliff 200 m high with initial speeds of $15ms^{-1}$ and 30 m s^-1

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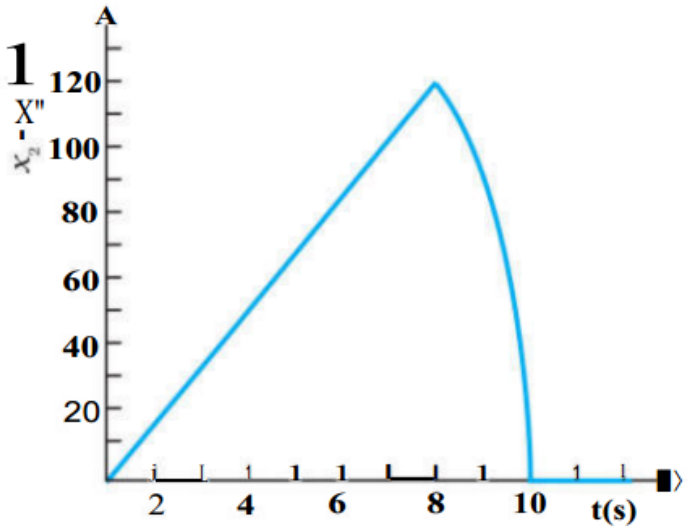
10 m s^-2`. Give the equations for the linear and curved parts of the plot.



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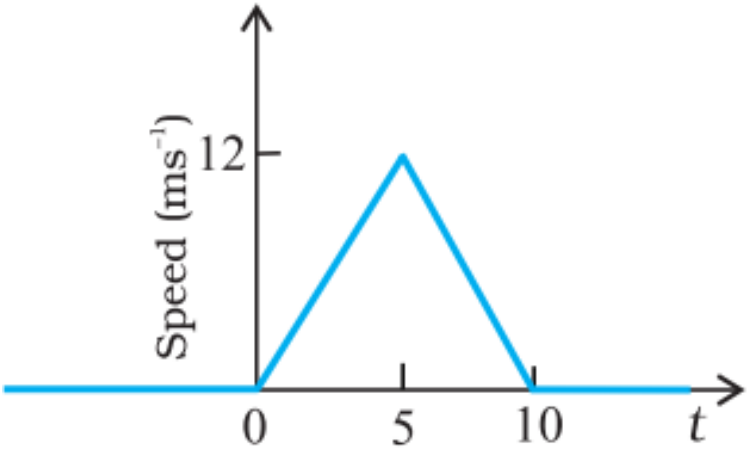
37. The speed-time graph of a particle moving along a fixed direction is shown in Fig. 3.28. Obtain the distance traversed by the particle between:-

t = 0 s to 10 s,



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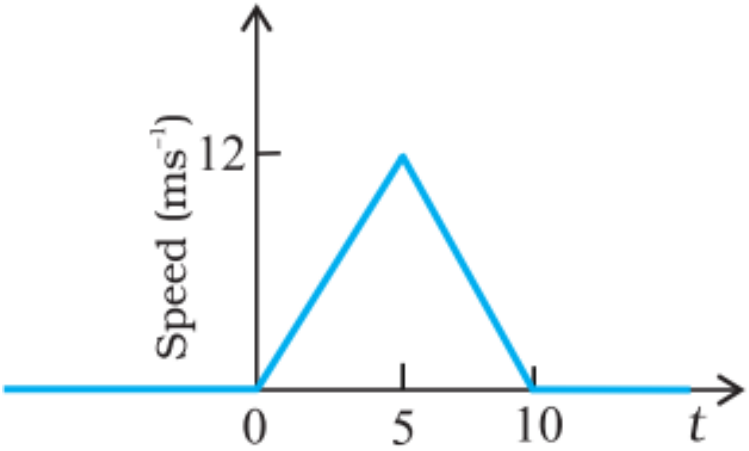

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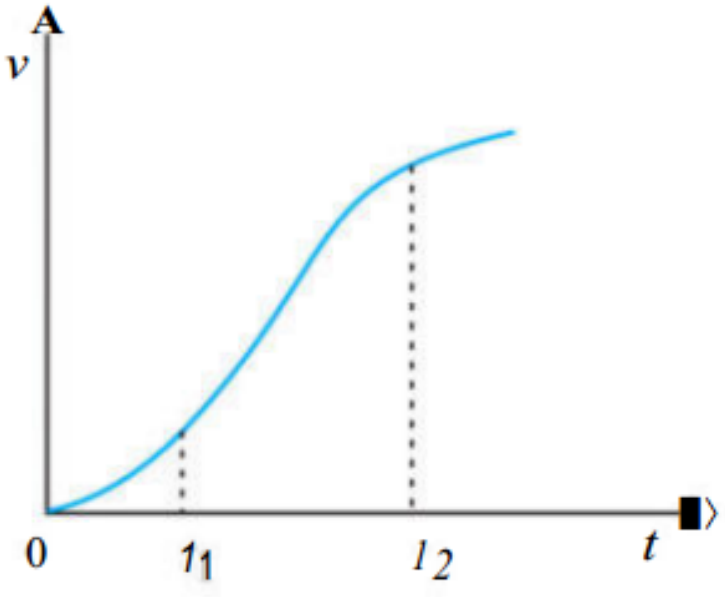
39. The velocity-time graph of a particle in one-dimensional motion is shown in Fig. 3.29 :-Which of the following formulae are correct for describing the motion of the particle over the time-interval $t_1 \rightarrow t_2$:-

$$x(t_2) = x(t_1) + v(t_1)(t_2 - t_1) + \left(\frac{1}{2}\right)a(t_2 - t_1)^2$$



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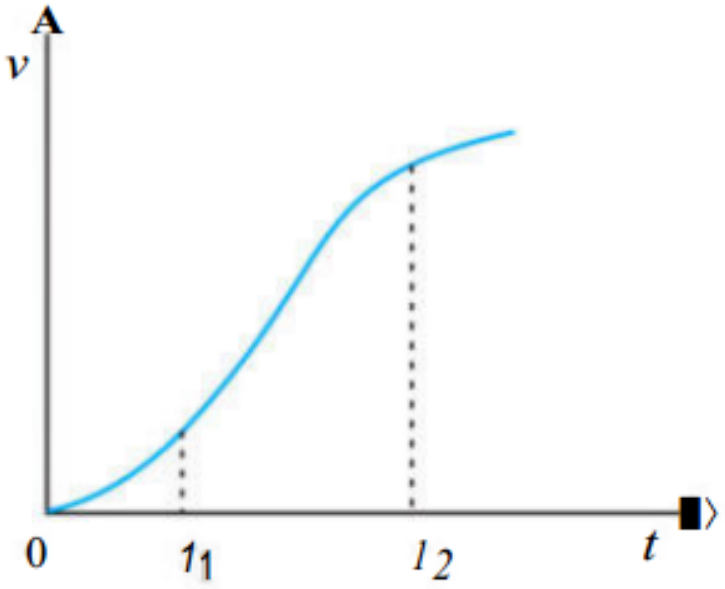
40. The velocity-time graph of a particle in one-dimensional motion is shown in Fig. 3.29 :- Which of the following formulae are correct for describing the motion of the particle over the time-interval:-

$v(t_2) = v(t_1) + a(t_2 - t_1)$



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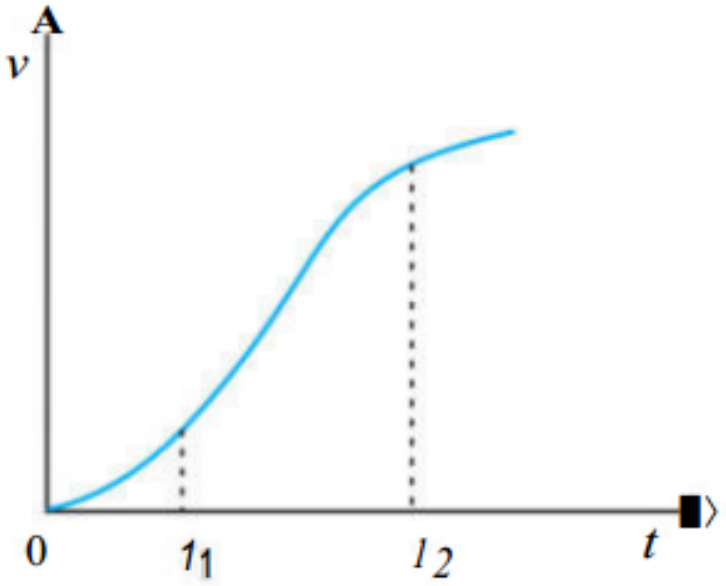
41. The velocity-time graph of a particle in one-dimensional motion is shown in Fig. 3.29 :- Which of the following formulae are correct for describing the motion of the particle over the time-interval:-

$$v_a vera \geq = \frac{x(t_2) - x(t_1)}{t_2 - t_1}$$



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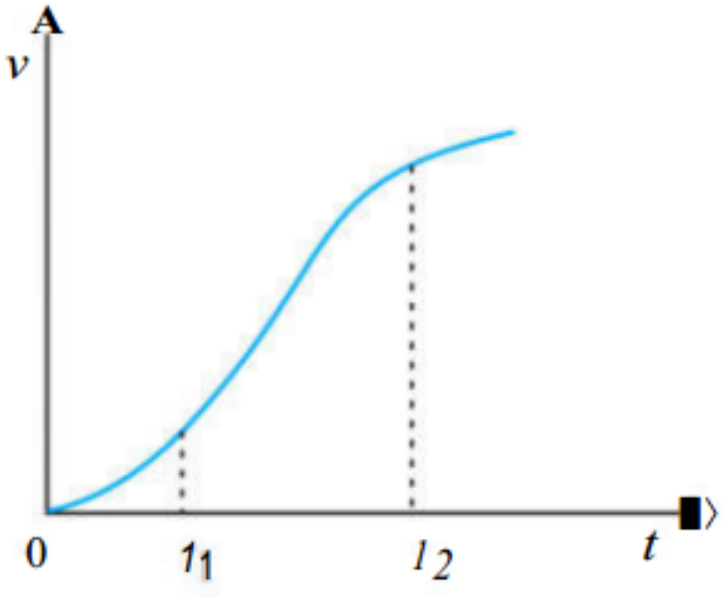
42. The velocity-time graph of a particle in one-dimensional motion is shown in Fig. 3.29 :- Which of the following formulae are correct for describing the motion of the particle over the time-interval:-

$x(t_2) = x(t_1) + v_a vera \geq (t_2 - t_1) + \left(\frac{1}{2}\right) a_a vera \geq (t_2 - t_1)^2$



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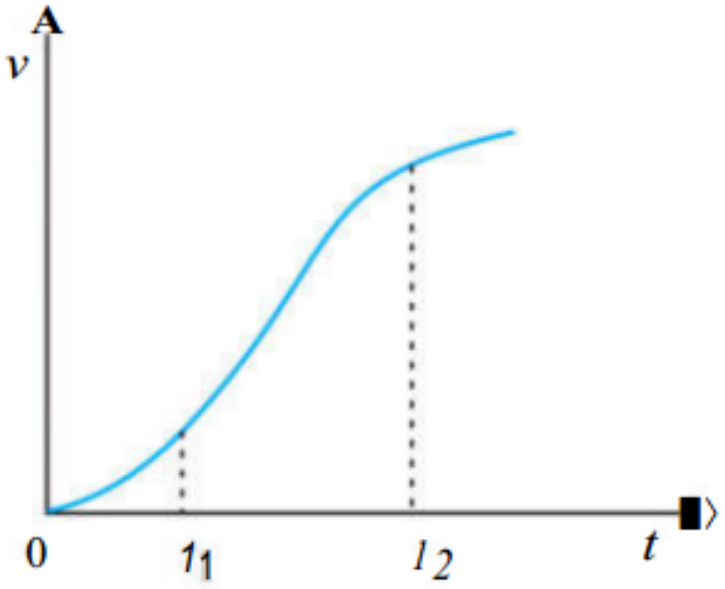
43. The velocity-time graph of a particle in one-dimensional motion is shown in Fig. 3.29 :- Which of the following formulae are correct for describing the motion of the particle over the time-interval:- $x(t_2) - x(t_1)$ area under the v-t curve bounded by the t-axis and the

dotted line shown.



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