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Mathematics

9709/42

Paper 4 Mechanics

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Question No(1)

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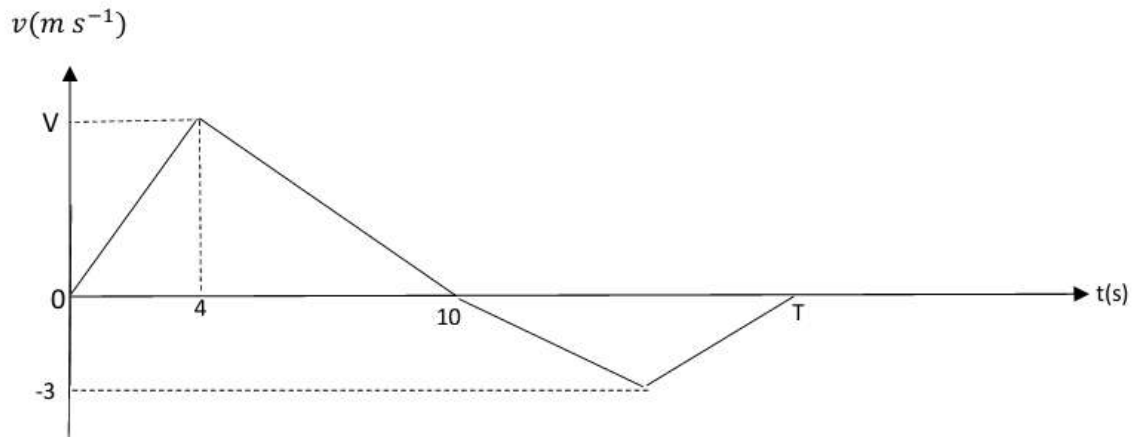


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Question No (1)

The velocity of a particle moving in a straight line at time t seconds after leaving a fixed point O is $v \text{ m s}^{-1}$. The diagram shows a velocity-time graph which models the motion of the particle from $t=0$ to $t=T$. The graph consists of four straight line segments. The particle accelerates from rest to a speed of $V \text{ m s}^{-1}$ over a period of 4 s, and then decelerates at $\frac{5}{3} \text{ m s}^{-2}$ to instantaneous rest over a period of 6 s. The particle then travels back towards O , reaching a maximum speed of 3 m s^{-1} before coming to rest at time $t=T$.

(a) Find the value of V .

(b) Given that the total distance travelled by the particle from $t=0$ to $t=T$ is 68 m, find the value of T .

Solution: (a)

DATE :- (1)

From the graph

$$\text{decelerates} = \frac{\text{change in velocity}}{\text{change in time}}$$

$$-\frac{5}{3} = \frac{0-V}{10-4}$$

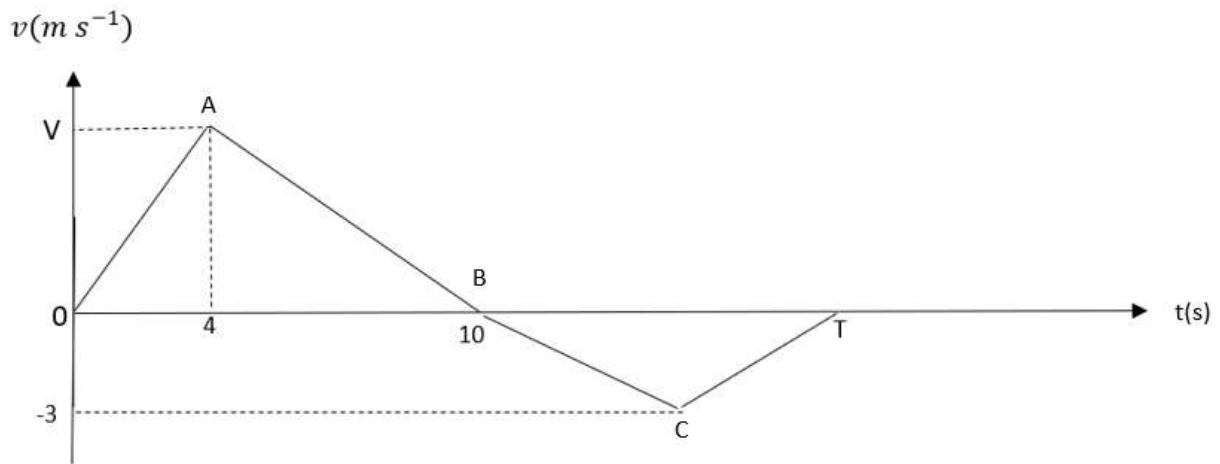
$$-\frac{5}{3} = \frac{-V}{6}$$

$$V = \frac{5}{3} \times 6$$

$$V = 10$$

-ve
due to
decelerate

(b)



From graph

$$\begin{aligned} \text{total distance} &= \text{Area under the curves} \\ &= \text{Area under } OAB + \text{Area under } BCT \\ &= \text{Area of triangle } OAB + \text{Area of triangle } BCT \\ &= \frac{1}{2} \text{ base} \times \text{height} + \frac{1}{2} \text{ Base} \times \text{height} \\ &= \frac{1}{2} (10-0)V + \frac{1}{2} (T-10)3 \end{aligned}$$

$$= \frac{1}{2} 10 \times 10 + \frac{1}{2} (T-10)3 \quad \leftarrow v=10$$

As the total distance is 68 m

$$\Rightarrow 68 = \frac{100}{2} + \frac{3}{2} (T-10)$$

$$68 - \frac{100}{2} = \frac{3}{2} (T-10)$$

$$T-10 = \frac{2(68-50)}{3} = \frac{2}{3} (18) = 12$$

$$T = 12 + 10 = 22 \text{ sec}$$