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Mathematics 9709/42

Paper 4 Mechanics **October/November 2024**

Question No(1)

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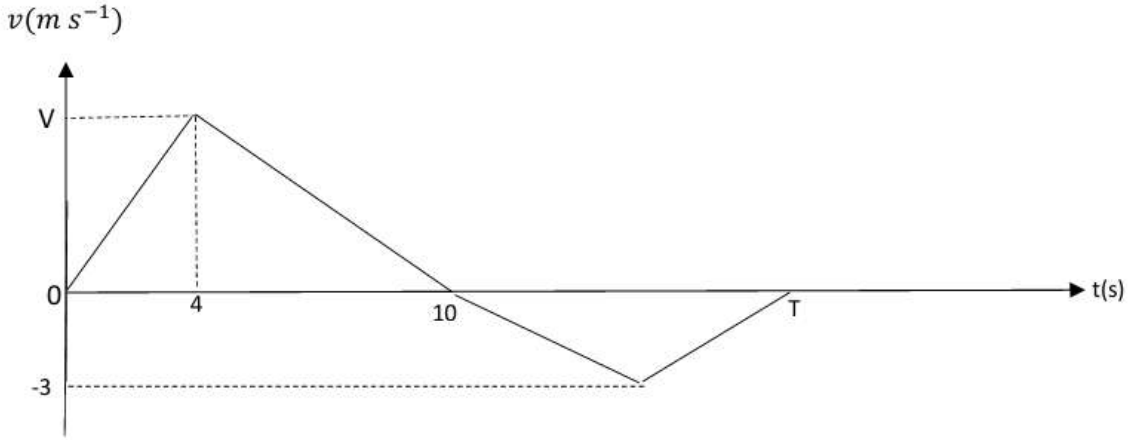
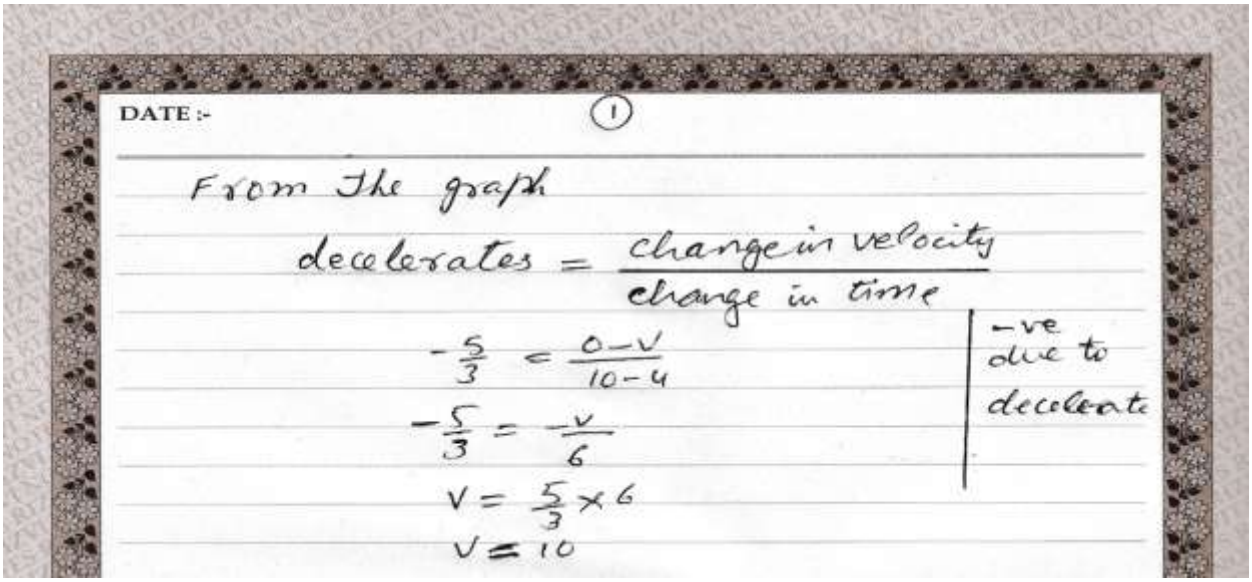


The velocity of a particle moving in a straight line at time t seconds after leaving a fixed point O is v m s^{-1}. The diagram shows a velocity-time graph which models the motion of the particle from t =0 to t= T. The graph consists of four straight line segments. The particle accelerates from rest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

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

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

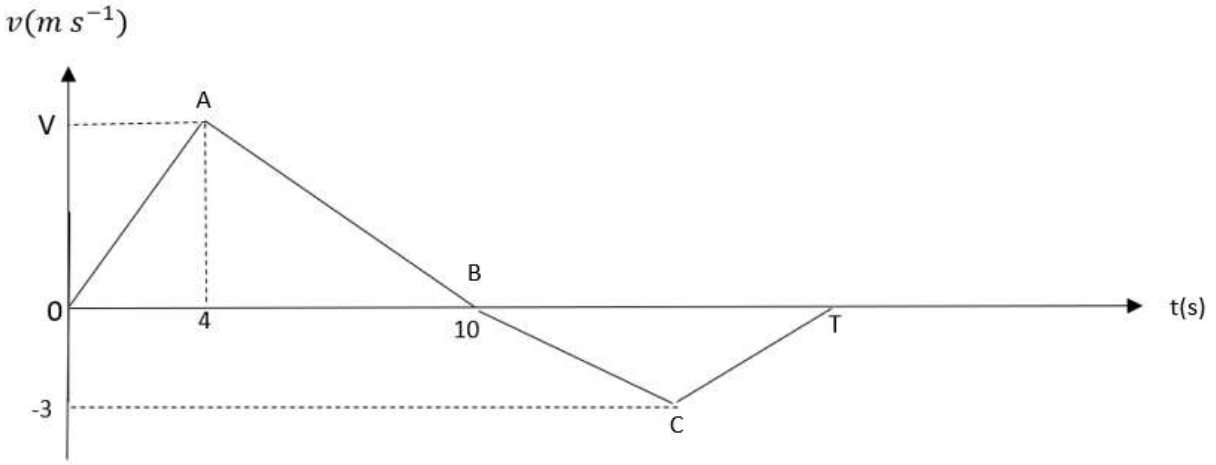
$$-\frac{5}{3} = \frac{-V}{6}$$

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

$$V = 10$$

-ve due to decelerate

(b)



From graph

total distance = Area under the curves

= Area under OAB + Area under BCT

= Area of triangle OAB + Area of triangle BCT

$= \frac{1}{2}$ base x height + $\frac{1}{2}$ Base x height

$= \frac{1}{2}(10-0)V + \frac{1}{2}(T-10)3$

$= \frac{1}{2}\,10 \times 10 + \frac{1}{2}(T-10)3$ $\quad \because V = 10$

As the total distance is 68 m

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

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

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

$T = 12+10 = 22$ Sec