

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise B, Question 20

Question:

Two cars are initially 36 m apart travelling in the same direction along a straight, horizontal road. The car in front is initially travelling at 10 m s^{-1} , but decelerating at 2 m s^{-2} . The other car travels at a constant 15 m s^{-1} .

(a) Model the cars as particles. By finding the distance travelled by each car after t seconds, show that the distance between the two cars is $36 - 5t - t^2$ metres. Find when they would collide if neither car takes avoiding action.

(b) Would it be necessary to revise your answers to part (a) if the cars were not modelled as particles? Give reasons to support your answer. [A]

Solution:

$$\text{1st car, } s = ut$$

$$s_1 = 15t$$

$$\text{2nd car, } s = ut + \frac{1}{2}at^2$$

$$s_2 = 10t + \frac{1}{2}(-2)t^2$$

$$s_2 = 10t - t^2$$

$$\begin{aligned} \text{(a) } \therefore \text{ distance between them} &= 36 + s_2 - s_1 \\ &= 36 + (10t - t^2) - (15t) \\ &= 36 - 5t - t^2 \text{ metres.} \end{aligned}$$

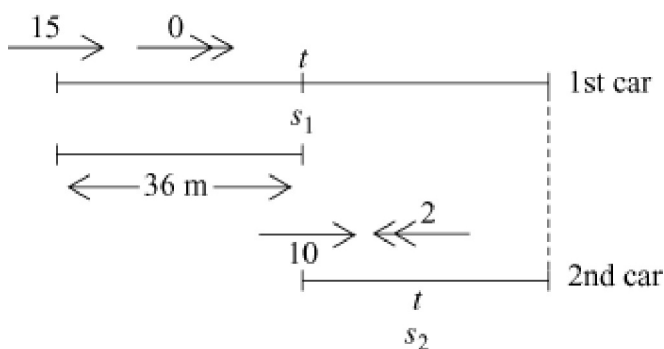
$$\therefore \text{ when collide, } 36 - 5t - t^2 = 0$$

$$\text{i.e. } 0 = t^2 + 5t - 36$$

$$0 = (t + 9)(t - 4)$$

$$\text{i.e. } t = -9 \text{ but can't have negative time, or } t = 4 \text{ seconds}$$

$$\therefore t = 4 \text{ seconds}$$



(b) No, as vehicles are 36 m apart.

