

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise B, Question 18

Question:

Two cars, A and B , are initially at rest side by side. A starts off on a straight track with an acceleration of 2 m s^{-2} . Five seconds later B starts off on a parallel track to A , with acceleration 3.125 m s^{-2} .

(a) Calculate the distance travelled by A after 5 seconds.

(b) Calculate the time taken for B to catch up with A .

(c) Find the speeds of A and B at that time.

Solution:

$$\text{For } A, s = ut + \frac{1}{2}at^2$$

$$(a) s_1 = 0 \times 5 + \frac{1}{2} \times 2 \times 5^2$$

$$s_1 = 25 \text{ metres}$$

$$\text{1st part, } A, v = u + at$$

$$v_1 = 0 + 2 \times 5 = 10 \text{ m s}^{-1}$$

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

$$s_2 = 10t_2 + \frac{1}{2} \times 2 \times t_2^2$$

$$(b) \text{ i.e. } s_2 = 10t_2 + t_2^2$$

$$B, s = ut + \frac{1}{2}at^2$$

$$s_3 = 0 \times t_2 + \frac{1}{2} \times 3.125 \times t_2^2$$

$$\text{i.e. } s_3 = 1.5625t_2^2$$

when B catches A , $s_3 = s_1 + s_2$

$$\text{i.e. } 1.5625t_2^2 = 25 + (10t_2 + t_2^2)$$

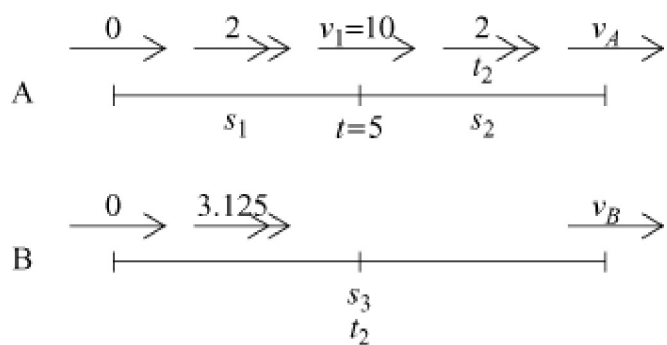
$$\text{i.e. } 0.5625t_2^2 - 10t_2 - 25 = 0$$

$$\therefore t_2 = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(0.5625)(-25)}}{2 \times 0.5625}$$

$$\therefore t_2 = 20 \text{ or } t_2 = -2.222... \text{ but time can't be negative}$$

$$\therefore t_2 = 20 \text{ seconds}$$

(c) A, 2nd part, $v = u + at$ $v_A = 10 + 2 \times 20 = 50 \text{ m s}^{-1}$
 B, $v = u + at$ $v_B = 0 + 3.125 \times 20 = 62.5 \text{ m s}^{-1}$



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