Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

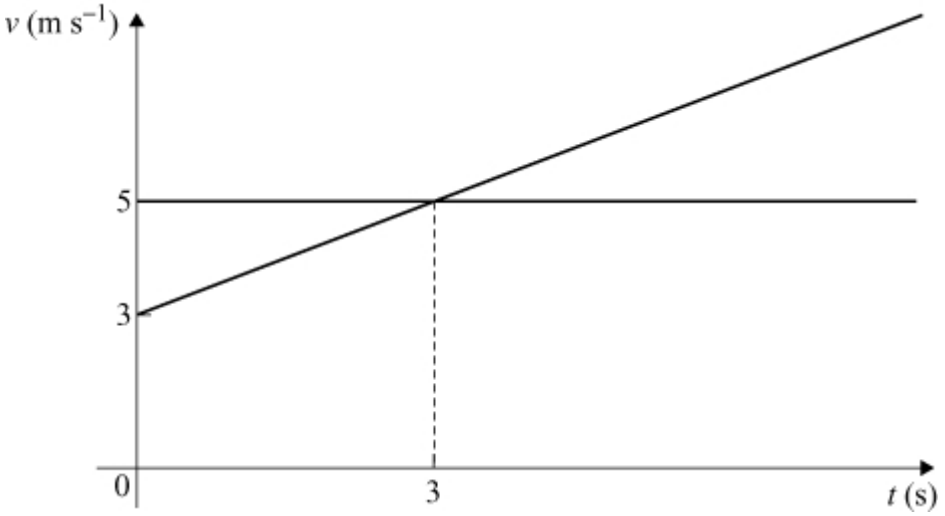
Exercise A, Question 8

Question:

The velocity-time graph shows the motion of a car and a bicycle as they travel along a straight horizontal road. When $t = 0$, the car and bicycle pass a traffic light on the road. At the traffic light, the bicycle is travelling at a constant velocity of $5\ \text{m}\ \text{s}^{-1}$, but the car is travelling at $3\ \text{m}\ \text{s}^{-1}$ and accelerating.

(a) (i) Explain how the graph indicates that the acceleration of the car is constant.
(ii) Find the acceleration of the car.

(b) When $t = T$, the car has travelled twice as far from the traffic light as the bicycle. Find the value of T. [A]



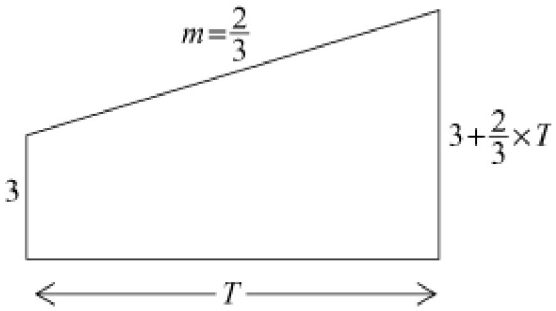
Solution:

(a) (i) The graph is a straight line i.e. the gradient is constant: the gradient is the acceleration, so it is constant.

(ii) Acceleration $= \frac{(5-3)}{3} = \frac{2}{3}\ \text{m}\ \text{s}^{-2}$

(b) at time T distance by bicycle $= 5 \times T = 5T$ metres

$$\text{distance by car} = \frac{[3 + (3 + \frac{2}{3}T)]}{2} \times T$$



but "distance by car" $= 2 \times$ "distance by bicycle"

$\therefore \dfrac{[\,3 + (\,3 + \frac{2}{3}T\,)\,]}{2} \times T = 2 \times 5T$

$\therefore\ [\,3 + 3 + \frac{2}{3}T\,] \times T = 2 \times 2 \times 5T$

$[\,6 + \frac{2}{3}T\,] \times T = 20T$

$\therefore T = 0$ (at the start) is invalid or $6 + \frac{2}{3}T = 20$

i.e. $\frac{2}{3}T = 20 - 6$

i.e. $\frac{2}{3}T = 14$

$\therefore T = \dfrac{14}{(\frac{2}{3})}$

$T = 21$ seconds