

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise B, Question 16

Question:

As a train leaves a station it accelerates, from rest, at 0.8 m s^{-2} for 30 seconds, travels at a constant speed for the next 5 minutes and then slows down, stopping in 20 seconds at a second station. Assume that the train moves along a straight track.

(a) Find the maximum speed of the train.

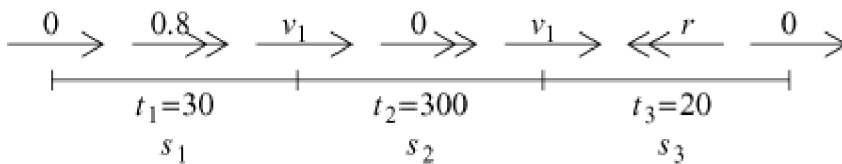
(b) Find the distance travelled by the train between the stations, clearly stating any assumptions that you have made. [A]

Solution:

(a) 1st part, $v = u + at$

$$v_1 = 0 + 0.8 \times 30$$

$$v_1 = 24 \text{ m s}^{-1}$$



(b) 1st part, $s = ut + \frac{1}{2}at^2$

$$s_1 = 0 \times 30 + \frac{1}{2} \times 0.8 \times 30^2 = 360 \text{ metres}$$

2nd part, $s = ut$

$$s_2 = 24 \times 300 = 7200 \text{ metres}$$

$$\text{3rd part, } s = \frac{(u+v)}{2} t$$

$$s_3 = \frac{(24+0)}{2} \times 20 = 240 \text{ metres}$$

$$\begin{aligned} \therefore \text{total distance} &= s_1 + s_2 + s_3 = 360 + 7200 + 240 \\ &= 7800 \text{ metres} \end{aligned}$$

The assumptions are

- the acceleration in the first part of the motion remains constant
- the deceleration in the final part of the motion is constant.