

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise B, Question 10

Question:

The world record for the men's 100 m sprint was 9.83 seconds. Assume that the last 40 m was run at constant speed and that the acceleration during the first 60 m was constant.

(a) Calculate this speed.

(b) Calculate the acceleration of the athlete.

Solution:

$$(a) \frac{1}{2} \times t_1 \times v = 60 \rightarrow t_1 = \frac{120}{v}$$

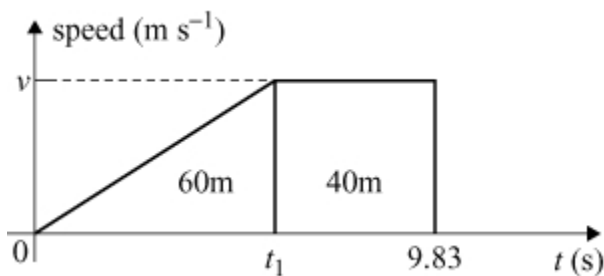
$$(9.83 - t_1) \times v = 40$$

$$\therefore \left(9.83 - \frac{120}{v}\right) \times v = 40$$

$$\therefore 9.83v - 120 = 40$$

$$\therefore 9.83v = 40 + 120, \text{ i.e. } 9.83v = 160$$

$$\therefore v = \frac{160}{9.83} = 16.276\dots = 16.3 \text{ m s}^{-1} \text{ (3 s.f.)}$$



$$(b) \text{ acceleration} = \frac{v}{t_1}$$

but $\frac{1}{2} \times t_1 \times 16.276\dots = 60$ from the first equation

$$\therefore t_1 = \frac{60 \times 2}{16.276\dots}$$

$$t_1 = 7.3725 \text{ s}$$

$$\therefore \text{ acceleration} = \frac{16.276\dots}{7.3725}$$

$$= 2.21 \text{ m s}^{-2} \text{ (3 s.f.)}$$