Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise C, Question 4

Question:

A rocket rises vertically from ground level to a height of 100 m in 10 seconds. Assume that the acceleration of the rocket is constant and that it starts at rest.

(a) Find the acceleration of the rocket and its speed at a height of 100 m.
After these 10 seconds the rocket runs out of fuel, but continues to move vertically under the influence of gravity.
(b) Find the maximum height reached by the rocket.

Solution:

(a)

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

$$100 = 0 \times 10 + \frac{1}{2} \times a \times 10^2$$

$$\therefore 100 = 50a$$

$$a = 2 \text{ m s}^{-2}$$

$$v = u + at$$

$$v_1 = 0 + 2 \times 10$$

$$v_1 = 20 \text{ m s}^{-1}$$

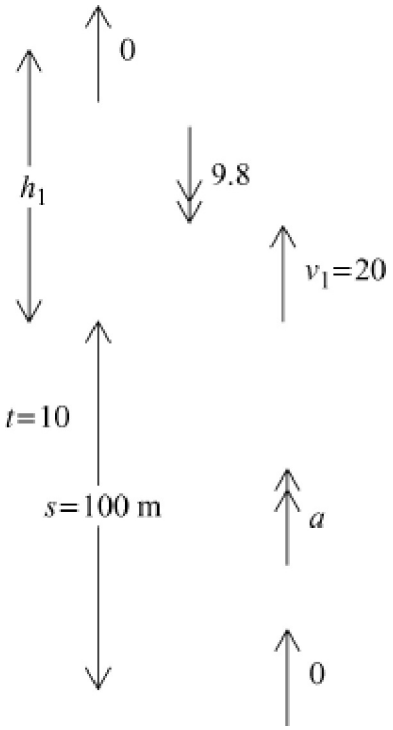
or

$$s = \frac{(u+v)}{2} . t$$

$$100 = \frac{(0+v_1)}{2} \times 10$$

$$\therefore 100 = 5v_1$$

$$v_1 = 20 \text{ m s}^{-1}$$



$v^2 = u^2 + 2as$

$0^2 = 20^2 + 2(-9.8)(h_1)$

(b) $\therefore 19.6h_1 = 400$

$\therefore h_1 = \frac{400}{19.6} = 20.408...$

$\therefore$ maximum height $= 100 + 20.408... = 120.408...$

$= 120$ m (3 s.f.)