

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise Test yourself, Question 3

Question:

A stone is thrown vertically upwards from a height of 2 m above ground level. It reaches a maximum height of 5 m above ground level.

- (a) Find the initial velocity of the stone.
 (b) Find the velocity of the stone when it hits the ground.
 (c) How long is the stone in the air?

Solution:

$$v^2 = u^2 + 2as, \uparrow$$

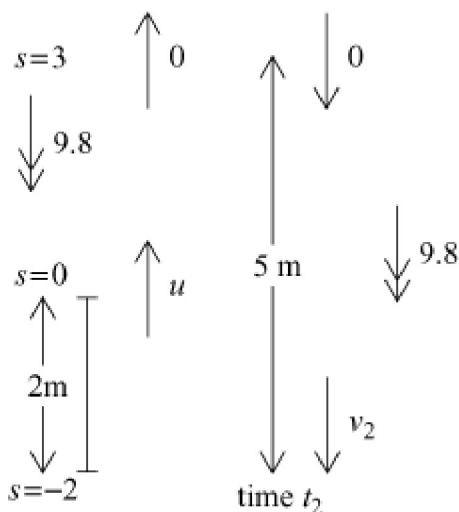
$$0^2 = u^2 + 2(-9.8)(3)$$

$$58.8 = u^2$$

$$(a) \therefore u = \sqrt{58.8}$$

$$= 7.6681\dots$$

$$u = 7.67 \text{ m s}^{-1} \text{ (3 s.f.)}$$



- (b) In downward part of the motion

$$v^2 = u^2 + 2as, \downarrow$$

$$v_2^2 = 0^2 + 2(9.8)(5)$$

$$v_2^2 = 98$$

$$\therefore v_2 = \sqrt{98} = 9.8994\dots$$

$$v_2 = 9.90 \text{ m s}^{-1} \text{ (3 s.f.)}$$

$$\begin{aligned}
 s &= ut + \frac{1}{2}at^2, \quad \uparrow \text{ for whole motion} \\
 -2 &= \sqrt{58.8} \times t_2 + \frac{1}{2}(-9.8) \times t_2^2 \\
 \text{(c)} \quad \therefore 4.9t_2^2 - \sqrt{58.8} \times t_2 - 2 &= 0 \\
 t_2 &= \frac{-(-\sqrt{58.8}) \pm \sqrt{(-\sqrt{58.8})^2 - 4(4.9)(-2)}}{2 \times 4.9} \\
 t_2 &= 1.7926... \text{ or } t = -0.22769 \text{ but time can't be negative} \\
 \therefore t_2 &= 1.79 \text{ seconds (3 s.f.)}
 \end{aligned}$$

© Harcourt Education Ltd 2005