Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

7 Projectiles

Exercise B, Question 3

Question:

The horizontal and vertical components of the initial velocity of a cricket ball are 20 m s^{-1} and 25 m s^{-1}. Assume that $g = 10$ m s^{-2}.

(a) Find the range of the projectile on a horizontal surface.

(b) If the ball is caught when it is at a height of 1.5 m and travelling downwards, find the time of flight and the horizontal distance travelled by the ball.

Solution:

(a) The position of the cricket ball is given by

$x = 20t$

$y = 25t - \frac{1}{2}gt^2$

For the range, $y = 0 \quad \Rightarrow \quad t = 0$ (not required) or $t = \frac{25}{\frac{1}{2}g}$

$\therefore t = 5$ s (using $g = 10$)

Range is $20 \times 5 = 100$ m

(b) The ball is caught when $y = 1.5$

$\therefore 1.5 = 25t - \frac{1}{2}gt^2$

$10t^2 - 50t + 3 = 0$ (using $g = 10$)

$t = \frac{50 \pm \sqrt{50^2 - 4 \times 10 \times 3}}{2 \times 10}$

$= \frac{50 \pm 48.785}{20}$

= 4.939s (only the larger value is required as the ball is travelling downwards).

$\therefore$ Time of flight is 4.94 s

The horizontal distance, $x = 20 \times 4.939$

$= 98.8$ m .