

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

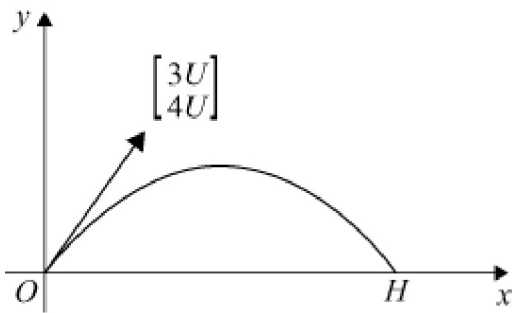
7 Projectiles

Exercise B, Question 16

Question:

George throws a ball from a point O , with velocity $\begin{bmatrix} 3U \\ 4U \end{bmatrix}$. The ball subsequently lands at a point H , which is at the same horizontal level as O , as shown in the diagram.

- (a) Show that the time taken by the ball to travel from O to H is $\frac{8U}{g}$.
- (b) Find, in terms of g and U , the distance OH .
- (c) Find, in terms of U , the initial speed of the ball.
- (d) Find, in terms of g and U , the two times during the flight from O to H when the ball is moving with speed $\sqrt{18U}$. [A]



Solution:

- (a) In vector form, the position of the ball, relative to O , is $\begin{bmatrix} 3Ut \\ 4Ut - \frac{1}{2}gt^2 \end{bmatrix}$

$$\text{At } H, \text{ height is zero} \Rightarrow 4Ut - \frac{1}{2}gt^2 = 0$$

$$\therefore t = 0 \text{ (not required) or } t = \frac{8U}{g}$$

$$\therefore \text{Time taken is } \frac{8U}{g}$$

- (b) Distance OH is $3Ut = 3U \cdot \frac{8U}{g}$
- $$= 24 \frac{U^2}{g}$$

(c) The initial speed is $\sqrt{(3U)^2 + (4U)^2}$
 $= 5U$

(d) The velocity of the ball is $\left[\frac{3U}{4U - gt} \right]$

\therefore The speed is $\sqrt{(3U)^2 + (4U - gt)^2}$
 When the ball is moving with speed $\sqrt{18U}$,

$$18U^2 = 9U^2 + 16U^2 - 8Ugt + g^2t^2$$

$$g^2t^2 - 8Ugt + 7U^2 = 0$$

$$(gt - 7U)(gt - U) = 0$$

$$\therefore t = \frac{U}{g} \text{ and } \frac{7U}{g} .$$