

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

7 Projectiles

Exercise B, Question 5

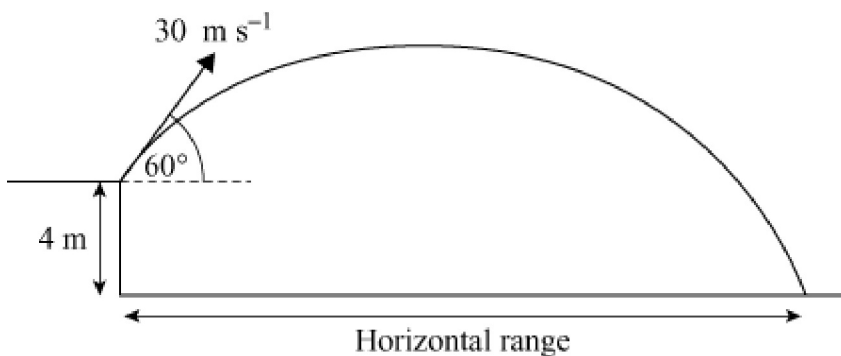
Question:

A golf ball is hit from a position that is 4 metres higher than the horizontal area where the ball lands. The initial velocity of the ball is 30 m s^{-1} at an angle of 60° above the horizontal.

(a) Show that the maximum height of the ball, above the landing area, is approximately 38.4 metres.

(b) Show that the ball hits the ground approximately 5.45 seconds after it has been hit.

(c) Hence calculate the horizontal range of the ball to the nearest metre. [A]



Solution:

(a) The position of the golf ball, from the point of projection, is

$$\begin{aligned} \text{given by } x &= 30 \cos 60^\circ t \\ y &= 30 \sin 60^\circ t - \frac{1}{2}gt^2 \quad [1] \end{aligned}$$

$$\begin{aligned} \text{For the maximum height, } v^2 &= u^2 + 2as \text{ vertically gives} \\ 0 &= (30 \sin 60^\circ)^2 - 2gs \\ s &= \frac{(30 \sin 60^\circ)^2}{2g} \\ &= 34.4 \text{ m} \end{aligned}$$

Hence height above the landing area is $34.4 + 4 = 38.4 \text{ m}$

The ball hits the ground when $y = -4$

$$[1] \Rightarrow -4 = 30 \sin 60^\circ t - \frac{1}{2}gt^2$$

$$\begin{aligned} \text{(b) } 4.9t^2 - 25.98t - 4 &= 0 \\ t &= \frac{25.98 \pm \sqrt{25.98^2 + 4 \times 4.9 \times 4}}{2 \times 4.9} \end{aligned}$$

$$\text{Time} = 5.45 \text{ s (only positive value is required)}$$

(c) The horizontal range, x is $30 \cos 60^\circ \times 5.45$
 $= 81.79 \text{ m}$

\therefore The horizontal range is 82 m (to the nearest metre).

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