Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

7 Projectiles

Exercise A, Question 7

Question:

A golf ball is struck at a point O on the ground and moves with an initial velocity of $20\ \text{m}\ \text{s}^{-1}$ at an angle of 53° to the horizontal. The ball subsequently lands at a point X which is on the same horizontal level as Q.

(a) Show that the time taken by the ball to reach the point X is approximately 3.26 seconds.

(b) Calculate the distance OX.

(c) State:
(i) the least speed of the ball during its flight from O to X,
(ii) the direction of motion of the ball when this least speed occurs. [A]

Solution:

(a) The equations of motion of a projectile give

$$x = 20\cos 53° t$$

$$y = 20\sin 53° t - \frac{1}{2}gt^2$$

Ball reaches X when $y = 0$,

$$\therefore t = 0 \text{ (not required) or } \frac{20\sin 53°}{\frac{1}{2}g} = 3.26\ \text{s}$$

(b) OX, $x = 20\cos 53° \times 3.26$
$= 39.2\ \text{m}$

(c) (i) The horizontal speed does not change.
$\therefore$ The least speed of the ball is when the vertical velocity is zero,
i.e. the least speed is $20\cos 53° = 12.0\ \text{m}\ \text{s}^{-1}$.
(ii) The ball is moving horizontally.