

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

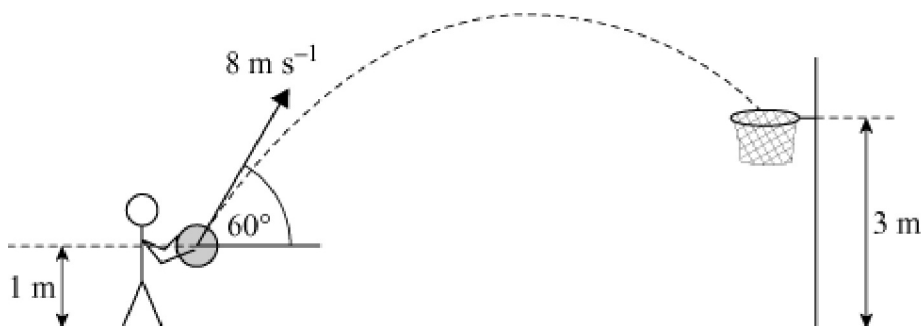
7 Projectiles

Exercise B, Question 11

Question:

A ball is thrown so that it passes through the centre of a basket ball hoop, as shown in the diagram. The ball is thrown from a height of 1 metre and the hoop is at a height of 3 metres above the ground. The initial velocity of the ball is 8 m s^{-1} at an angle of 60° above the horizontal.

- (a) Find the maximum height of the ball above the ground.
- (b) Find the time that it takes for the ball to reach the centre of the hoop.
- (c) Find the horizontal distance from the initial position of the ball to the centre of the hoop. [A]



Solution:

- (a) The position of the ball, relative to the point of throwing, is given by

$$x = 8 \cos 60^\circ t \quad [1]$$

$$y = 8 \sin 60^\circ t - \frac{1}{2}gt^2 \quad [2]$$

For maximum height, $v^2 = u^2 + 2as$ vertically, gives

$$0 = (8 \sin 60^\circ)^2 - 2gs$$

$$s = \frac{(8 \sin 60^\circ)^2}{2g} = 2.45 \text{ m}$$

\therefore Maximum height of ball above the ground is $1 + 2.45 = 3.45 \text{ m}$

- (b) To reach the centre of the hoop, $y = 2$

$$[2] \Rightarrow 2 = 8 \sin 60^\circ t - \frac{1}{2}gt^2$$

$$4.9t^2 - 6.928t + 2 = 0$$

$$t = \frac{6.928 \pm \sqrt{6.928^2 - 4 \times 4.9 \times 2}}{2 \times 4.9}$$

$= 1.01 \text{ s}$ (require largest value of t as projectile is downwards at the hoop).

Time taken is 1.01s

(c) From [1] horizontal distance, $x = 8 \cos 60^\circ \times 1.01$
 $= 4.04 \text{ m} .$

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