

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

Exam style practice papers

Exercise MM1B, Question 8

Question:

A shot is thrown with an initial velocity 10 m s^{-1} , at an angle of 40° above the horizontal.

(a) A simple model assumes that the height of release of the shot is zero. Calculate the range of the shot. (5 marks)

(b) In fact the shot is released at a height of 1.8 m. What would happen if the shot was thrown in this way inside a hall of length 20 m and height 3.5 m? (6 marks)

Solution:

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

$$x = 10 \cos 40^\circ t$$

$$y = 10 \sin 40^\circ t - \frac{1}{2}gt^2$$

At the range, its height, y , is zero.

$$\therefore 10 \sin 40^\circ t - \frac{1}{2}gt^2 = 0$$

$$t = 0 \text{ (not required) or } t = \frac{10 \sin 40^\circ}{\frac{1}{2}g}$$

$$t = 1.3118s$$

$$\begin{aligned} \text{Range, } x &= 10 \cos 40^\circ \times 1.3118 \\ &= 10.049 \end{aligned}$$

$$\therefore \text{Range is } 10.0 \text{ m}$$

(b) For the maximum height of the shot,

$$\text{Using } v^2 = u^2 + 2as,$$

$$0 = (10 \sin 40^\circ)^2 - 2gs$$

$$s = \frac{(10 \sin 40^\circ)^2}{2g}$$

$$s = 2.108 \text{ m}$$

\therefore The shot reaches a height of

$$2.108 + 1.8 = 3.908 \text{ m above the floor.}$$

Hence it will hit the roof of the hall as the shot will rise to a height of 3.91 m.