

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

## 7 Projectiles

### Exercise A, Question 1

#### Question:

A rugby ball is kicked from ground level so that its initial velocity is  $18 \text{ m s}^{-1}$  and at an angle of  $45^\circ$  above the horizontal. Find:

- (a) the time of flight,
- (b) the range,
- (c) the maximum height of the ball.

#### Solution:

$$x = v \cos \theta t \quad \Rightarrow \quad x = 18 \cos 45^\circ t$$

$$(a) \quad y = v \sin \theta t - \frac{1}{2}gt^2 \quad \Rightarrow \quad y = 18 \sin 45^\circ t - \frac{1}{2}gt^2$$

$$\text{For time of flight, } y = 0 \quad \Rightarrow \quad 18 \sin 45^\circ t - \frac{1}{2}gt^2 = 0$$

$$t = 0 \text{ (not required) or } t = \frac{18 \sin 45^\circ}{\frac{1}{2}g}$$

$$= 2.60 \text{ s}$$

$$(b) \quad \text{Range, } x, \text{ is } 18 \cos 45^\circ \times 2.60$$

$$= 33.1 \text{ m}$$

(c) At maximum height, vertical component of velocity is zero

$$\therefore v = u + at \quad \Rightarrow \quad 0 = 18 \sin 45^\circ - gt$$

$$t = 1.30 \text{ sec}$$

$$\text{Maximum height, } y = 18 \sin 45^\circ \times 1.30 - \frac{1}{2}g(1.30)^2$$

$$= 8.27 \text{ m .}$$