

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

## 7 Projectiles

### Exercise B, Question 4

#### Question:

A stone is thrown up at an angle of  $30^\circ$  to the horizontal with a speed of  $20 \text{ m s}^{-1}$  from the edge of a cliff 15 m above sea level so that the stone lands in the sea. Find how long the stone is in the air and how far from the base of the cliff it lands.

#### Solution:

The position of the stone is given by

$$x = 20 \cos 30^\circ t$$

$$y = 20 \sin 30^\circ t - \frac{1}{2}gt^2 \text{ measured from the top of the cliff.}$$

It lands in the sea when  $y = -15$ ,

$$\therefore -15 = 20 \sin 30^\circ t - \frac{1}{2}gt^2$$

$$4.9t^2 - 10t - 15 = 0$$

$$t = \frac{10 \pm \sqrt{10^2 + 4 \times 4.9 \times 15}}{2 \times 4.9}$$

$$= 3.0458 \text{ s (ignore the negative value)}$$

Time of flight 3.05 s

$$\begin{aligned} \text{Distance from base of cliff, } x &= 20 \cos 30^\circ \times 3.05 \\ &= 52.8 \text{ m.} \end{aligned}$$