

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

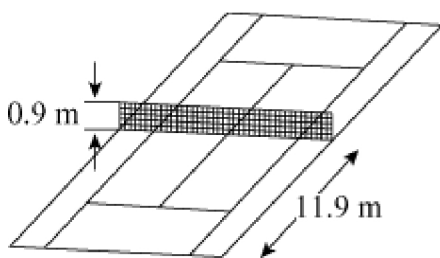
## 7 Projectiles

### Exercise B, Question 12

#### Question:

A tennis player plays a ball with speed  $20 \text{ m s}^{-1}$  horizontally straight down the court from the backline.

- (a) What is the least height at which she can play the ball to clear the net?  
 (b) How far behind the net does the ball land when it is played at this height?



#### Solution:

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

$$x = 20t \quad [1]$$

$$y = -\frac{1}{2}gt^2 \quad [2]$$

$$\begin{aligned} \text{When } x = 11.9, \quad t &= \frac{11.9}{20} \\ &= 0.595 \text{ s} \end{aligned}$$

$$\begin{aligned} \therefore y &= -\frac{1}{2}g(0.595)^2 \\ &= -1.73472 \end{aligned}$$

The ball must be at least 0.9 m above the ground at the net;

$\therefore$  The least height at which the ball must be played is

$$\begin{aligned} 0.9 + 1.7347 &= 2.6347 \\ &= 2.63 \text{ m (to 3 s.f.)} \end{aligned}$$

- (b) When ball is played at this height (2.6347 m), ball hits the ground when

$$y = -2.6347$$

$$\text{From [2] } 2.6347 = \frac{1}{2}gt^2$$

$$t = \sqrt{\frac{2.6347}{\frac{1}{2}g}}$$

$$= 0.73328 \text{ s}$$

[1]  $\Rightarrow$  Horizontal distance travelled in this time is

$$20 \times 0.73328 = 14.6655 \text{ m}$$

$$\text{i.e. the ball will land } = 14.6655 - 11.9$$

$$= 2.7655 \text{ m behind the net.}$$

The ball lands 2.77 m behind the net.

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