

## 8.2) Vector methods with projectiles

## Worked example

A ball is struck by a racket from a point  $A$  which has position vector  $40j$  m relative to a fixed origin  $O$ . Immediately after being struck, the ball has velocity  $(7i + 10j)$   $\text{ms}^{-1}$ , where  $i$  and  $j$  are unit vectors horizontally and vertically respectively. After being struck, the ball travels freely under gravity until it strikes the ground at point  $B$ .

- Find the speed of the ball 3 seconds after being struck.
- Find an expression for the position vector,  $r$ , of the ball relative to  $O$  at time  $t$  seconds.
- Hence determine the distance  $OB$ .

## Your turn

A ball is struck by a racket from a point  $A$  which has position vector  $20j$  m relative to a fixed origin  $O$ . Immediately after being struck, the ball has velocity  $(5i + 8j)$   $\text{ms}^{-1}$ , where  $i$  and  $j$  are unit vectors horizontally and vertically respectively. After being struck, the ball travels freely under gravity until it strikes the ground at point  $B$ .

- Find the speed of the ball 1.5 seconds after being struck.
- Find an expression for the position vector,  $r$ , of the ball relative to  $O$  at time  $t$  seconds.
- Hence determine the distance  $OB$ .

a)  $8.4 \text{ ms}^{-1}$  (2 sf)

b)  $((5t)\mathbf{i} + (8t - 4.9t^2 + 20)\mathbf{j}) \text{ m}$

c)  $15 \text{ m}$  (2 sf)

## Worked example

The point  $O$  is a fixed point on a horizontal plane.

A ball is projected from  $O$  with velocity  $(4\mathbf{i} + 8\mathbf{j}) \text{ ms}^{-1}$ .

The ball passes through a point  $A$  at time  $t$  seconds after projection. The point  $B$  is on the horizontal plane vertically below  $A$ . It is given that  $OB = 4AB$ . Find:

- The value of  $t$
- The speed of the ball at the instant it passes through  $A$

## Your turn

The point  $O$  is a fixed point on a horizontal plane.

A ball is projected from  $O$  with velocity  $(6\mathbf{i} + 12\mathbf{j}) \text{ ms}^{-1}$ .

The ball passes through a point  $A$  at time  $t$  seconds after projection. The point  $B$  is on the horizontal plane vertically below  $A$ . It is given that  $OB = 2AB$ . Find:

- The value of  $t$
- The speed of the ball at the instant it passes through  $A$

a)  $t = 1.8$  (2 sf)

b)  $8.5 \text{ ms}^{-1}$  (2 sf)