Vector Methods with Projectiles

Previously we considered the initial speed of the projectile and the angle of projection. But we could also **use a velocity vector to represent the initial projection** (vectors have both direction and magnitude) and subsequent motion.

Example

A ball is projected from the origin with velocity $(12\boldsymbol{i} + 24\boldsymbol{j})$ms^{-1} where $\boldsymbol{i}$ and $\boldsymbol{j}$ are horizontal and vertical unit vectors respectively. The particle moves freely under gravity. Find:

a) The position vector of the ball after 3s

b) The speed of the ball after 3s

c) The ball strikes the ground at point B. Determine the distance OB

Example

A particle *P* is projected with velocity $(4p\boldsymbol{i} + 5p\boldsymbol{j})$ ms^{-1} from a point *O* on a horizontal plane, where $\boldsymbol{i}$ and $\boldsymbol{j}$ are horizontal and vertical unit vectors respectively.
The particle *P* strikes the plane at the point *A,* which is 800 m from *O*.

a) Show that $p = 14$.

b) Find the time of flight from *O* to *A*.

The particle *P* passes through a point *B* with speed 60 m s^{-1}.

c) Find the height of *B* above the horizontal plane.

Test Your Understanding *(EdExcel M2 Jan 2012 Q7)*

[*In this question, the unit vectors* **i** *and* **j** *are horizontal and vertical respectively.*]

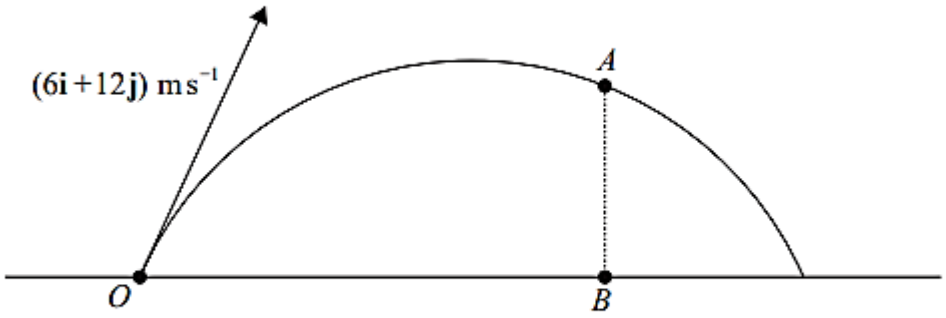

Figure 3

The point O is a fixed point on a horizontal plane. A ball is projected from O with velocity $(6\mathbf{i}+12\mathbf{j})$ m s^{-1}, and passes through the point A at time t seconds after projection. The point B is on the horizontal plane vertically below A, as shown in Figure 3. It is given that $OB = 2AB$.

Find

(a) the value of t,

(7)

(b) the speed, V m s^{-1}, of the ball at the instant when it passes through A.

(5)

At another point C on the path the speed of the ball is also V m s^{-1}.

(c) Find the time taken for the ball to travel from O to C.

(3)

Exercise 8B Page 166