

**Topic assessment**

1. In this question,  $\mathbf{i}$  and  $\mathbf{j}$  are the standard unit vectors in the  $Ox$  and  $Oy$  directions.

An object has initial position  $(2\mathbf{i} - \mathbf{j})$  m and velocity  $(-\mathbf{i} + 4\mathbf{j})$   $\text{ms}^{-1}$ . It has a constant acceleration of  $(2\mathbf{i} + 5\mathbf{j})$   $\text{ms}^{-2}$ .

Calculate the object's velocity and position after four seconds. [5]

2. The position vector,  $\mathbf{r}$ , of a particle at time  $t$  is given by

$$\mathbf{r} = t^2\mathbf{i} + (5t - 2t^2)\mathbf{j},$$

where  $\mathbf{i}$  and  $\mathbf{j}$  are the standard unit vectors, lengths are in metres and time is in seconds.

(i) Find an expression for the acceleration of the particle. [4]

(ii) Is the particle ever at rest? [2]

3. A particle has acceleration  $\mathbf{a} = \begin{pmatrix} 2t \\ 3 \end{pmatrix}$   $\text{ms}^{-2}$  at time  $t$ . Initially the particle has

velocity  $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$   $\text{ms}^{-1}$  and is at the point  $(2, 0)$ . Find the position vector of the particle at time  $t$ . [6]

4. A particle moves in two dimensions with constant acceleration. Initially it has position vector  $3\mathbf{i} + 2\mathbf{j}$  m and velocity  $\mathbf{i} + \mathbf{j}$   $\text{ms}^{-1}$ . After 4 seconds it has position vector  $7\mathbf{i} - 4\mathbf{j}$  m. What is its velocity at that time? [4]

5. A particle has velocity  $\mathbf{v} = (2t + 1)\mathbf{i} - (3t^2 - 1)\mathbf{j}$   $\text{ms}^{-1}$  and is initially at the origin. Find its distance from the origin after 3 seconds. [4]

**Total 25 marks**