1. A particle P moves with constant acceleration $(2\mathbf{i} - 3\mathbf{j})\,\mathrm{m\,s^{-2}}$

At time $t = 0$, P is moving with velocity $4\mathbf{i}\,\mathrm{m\,s^{-1}}$

(a) Find the velocity of P at time $t = 2$ seconds.

(2)

At time $t = 0$, the position vector of P relative to a fixed origin O is $(\mathbf{i} + \mathbf{j})\,\mathrm{m}$.

(b) Find the position vector of P relative to O at time $t = 3$ seconds.

(2)

(a) "constant acceleration" means we can use 'suvat'.

$a = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ $u = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$ $t = 2$ $v = ?$

Equation we need is $v = u + at$

$\Rightarrow v = \begin{pmatrix} 4 \\ 0 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} 2 = \begin{pmatrix} 4 + 2(2) \\ 0 - 3(2) \end{pmatrix} = \begin{pmatrix} 8 \\ -6 \end{pmatrix} \mathrm{ms^{-1}}$ (2 marks)

(b) Now, position $s = ut + \frac{1}{2}at^2$

$= \begin{pmatrix} 4 \\ 0 \end{pmatrix} 3 + \frac{1}{2} \begin{pmatrix} 2 \\ -3 \end{pmatrix} 3^2 = \begin{pmatrix} 12 \\ 0 \end{pmatrix} + \frac{1}{2} \begin{pmatrix} 18 \\ -27 \end{pmatrix}$

$= \begin{pmatrix} 21 \\ -13\frac{1}{2} \end{pmatrix} \mathrm{m}$

but this would be position relative to Origin $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

Because particle starts at $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ position at $t = 3$

$= \begin{pmatrix} 1 \\ 1 \end{pmatrix} + \begin{pmatrix} 21 \\ -13\frac{1}{2} \end{pmatrix} = \begin{pmatrix} 22 \\ -12\frac{1}{2} \end{pmatrix} \mathrm{m}$. (2 marks)