2 A particle of mass 5 kg has constant acceleration. Initially, the particle is at $\begin{pmatrix}-1\\2\end{pmatrix}$ m with velocity $\begin{pmatrix}2\\-3\end{pmatrix}$ m s$^{-1}$; after 4 seconds the particle has velocity $\begin{pmatrix}12\\9\end{pmatrix}$ m s$^{-1}$.

→ Initial velocity

Initial Position ↑

→ Final Velocity.

(i) Calculate the acceleration of the particle. [2]

(ii) Calculate the position of the particle at the end of the 4 seconds. [3]

(iii) Calculate the force acting on the particle. [2]

i. $v = u + at \rightarrow \frac{v-u}{t} = a$

$v = \begin{pmatrix}12\\9\end{pmatrix} ms^{-1}$, $u = \begin{pmatrix}2\\-3\end{pmatrix} ms^{-1}$ $t = 4$

$\left(\begin{pmatrix}12\\9\end{pmatrix} - \begin{pmatrix}2\\-3\end{pmatrix}\right) \div 4 \left\{ \begin{pmatrix}10\\12\end{pmatrix} \div 4 = a = \begin{pmatrix}2.5\\3\end{pmatrix} ms^{-2} \right.$

ii. $s = s_0 + ut + \frac{1}{2}at^2$

$s_0 = \begin{pmatrix}-1\\2\end{pmatrix} m$, $a = \begin{pmatrix}2.5\\3\end{pmatrix} ms^{-2}$

$\begin{pmatrix}-1\\2\end{pmatrix} + \left(\begin{pmatrix}2\\-3\end{pmatrix} \times 4\right) + \left(\frac{1}{2} \times \begin{pmatrix}2.5\\3\end{pmatrix} \times 4^2\right) = s$

$\begin{pmatrix}-1\\2\end{pmatrix} + \begin{pmatrix}8\\-12\end{pmatrix} + \left(\frac{1}{2}\, 16 \begin{pmatrix}2.5\\3\end{pmatrix}\right) = s$

$\begin{pmatrix}-1\\2\end{pmatrix} + \begin{pmatrix}8\\-12\end{pmatrix} + \begin{pmatrix}20\\24\end{pmatrix} = \begin{pmatrix}27\\14\end{pmatrix} m$

iii. $F = ma$

mass = 5 kg

$F = 5 \times \begin{pmatrix}2.5\\3\end{pmatrix} = \begin{pmatrix}12.5\\15\end{pmatrix} N$