**1.** At time $t$ seconds ($t \geqslant 0$), a particle $P$ is modelled as having velocity $\mathbf{v}\,\text{ms}^{-1}$, where

$$\mathbf{v} = (3t^2 - 12t)\mathbf{i} + (9t^2 - 3t)\mathbf{j}$$

and having acceleration $\mathbf{a}\,\text{ms}^{-2}$

(a) Find $\mathbf{a}$ in terms of $\mathbf{i}$, $\mathbf{j}$ and $t$.

**(2)**

When $t = 0$, $P$ is at the origin $O$.

At time $t$ seconds ($t \geqslant 0$), $P$ has position vector $\mathbf{r}$ metres relative to $O$.

(b) Find $\mathbf{r}$ in terms of $\mathbf{i}$, $\mathbf{j}$ and $t$.

**(2)**

At the instant when $\mathbf{a} = \lambda\mathbf{j}$, where $\lambda$ is a constant, $P$ is at the point $A$.

(c) Find the position vector of $A$ relative to $O$.

**(4)**