3. [*In this question, the perpendicular unit vectors* **i** *and* **j** *are in a horizontal plane.*]

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

A particle Q is moving on a smooth horizontal plane.

At time t seconds, $t \geqslant 0$, the position vector of Q, relative to a fixed origin, is **r** metres and the velocity of Q is $\mathbf{v}\,\text{m s}^{-1}$

It is given that $\mathbf{v} = (2t + 3)\mathbf{i} + (t^2 - 5t - 15)\mathbf{j}$

(a) Find the acceleration of Q when $t = 4$

(2)

When $t = 1$, $\mathbf{r} = 6\mathbf{i} - 2\mathbf{j}$

(b) Find an exact expression for **r** in terms of t, **i** and **j**

(4)

When $t = T$, particle Q is moving in the direction of the vector $5\mathbf{i} - 3\mathbf{j}$

(c) Find the exact speed of Q when $t = T$

(5)

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Question 3 continued

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Question 3 continued

(Total for Question 3 is 11 marks)