1. At time t seconds ($t \geq 0$), a particle P has position vector $\mathbf{p}$ metres, with respect to a fixed origin O, where

$$\mathbf{p} = (3t^2 - 6t + 4)\mathbf{i} + (3t^3 - 4t)\mathbf{j}.$$

Find

(a) the velocity of P at time t seconds,

(2)

(b) the value of t when P is moving parallel to the vector $\mathbf{i}$.

(3)

When $t = 1$, the particle P receives an impulse of $(2\mathbf{i} - 6\mathbf{j})$ N s. Given that the mass of P is 0.5 kg,

(c) find the velocity of P immediately after the impulse.

(4)
(Total 9 marks)

1. (a)	$\dot{\mathbf{p}} = (6t - 6)\mathbf{i} + (9t^2 - 4)\mathbf{j}$ (m s^{-1})		M1A1	2
(b)	$9t^2 - 4 = 0$		M1	
	$t = \dfrac{2}{3}$		DM1A1	3
(c)	$t = 1 \Rightarrow \dot{\mathbf{p}} = 5\mathbf{j}$	ft their $\dot{\mathbf{p}}$	B1ft	
	(+/–) $2\mathbf{i} - 6\mathbf{j} = 0.5(\mathbf{v} - 5\mathbf{j})$		M1	
	$\mathbf{v} = 4\mathbf{i} - 7\mathbf{j}$ (m s^{-1})		M1 A1	4

[9]

1. The candidates did well in this question compared to similar questions on previous papers.

(a) This was usually well answered with most candidates confident in using the **i**, **j** notation in the differentiation. A very small minority of candidates chose to integrate. The differentiation was well done but there was an occasional misread of $3t^3$ as $3t^2$.

(b) The majority of candidates used the **j** component of their velocity to find the value of t but some used the **i** component in error. A very small number used the **j** component of ***p***. Candidates starting with the correct equation, $9t^2 – 4 = 0$, often made errors in their attempt to solve for t; common incorrect answers included 2/9, 4/3 and 3/2. Some candidates demonstrated little understanding of what the question was asking for.

(c) Impulse was well understood but there were still some candidates confused between the initial and the final velocity. There were also some elegant solutions to provide the velocity in terms of t and going no further. Here too some candidates lost the final mark due to algebraic or sign errors.