Question	Scheme	Marks
1(a)	Use $\mathbf{r} = \int \mathbf{v}\,\mathrm{d}t$	M1
	Correct integration Eg $\left(t^3 + 6t^2 + 12t\right)\mathbf{i} + \left(\frac{5}{3}t^3 + 5t^2\right)\mathbf{j} + (\mathbf{C})$ Or $(t+2)^3\,\mathbf{i} + \left(\frac{5}{3}t^3 + 5t^2\right)\mathbf{j} + (K)$	A1
	Complete method using $t = 0, \mathbf{r} = -30\mathbf{i} - 45\mathbf{j}$ (m) and substitute $t = 3$ Indefinite integration Use of $t = 0, \mathbf{r} = -30\mathbf{i} - 45\mathbf{j}$ (m) to find constant of integration and substitute $t = 3$. Definite integration Use of $\mathbf{r} = \left(-30\mathbf{i} - 45\mathbf{j}\right) + \int_0^3 \mathbf{v}\,\mathrm{d}t$	DM1
	$\mathbf{r} = 87\mathbf{i} + 45\mathbf{j}$ (m)	A1
		(4)
1(b)	Use $\mathbf{a} = \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t}$	M1
	Correct differentiation $\mathbf{a} = \left(6t + 12\right)\mathbf{i} + \left(10t + 10\right)\mathbf{j}$	A1
	Substitute $t = 3$ and find magnitude	DM1
	$\lvert\mathbf{a}\rvert = 50\left(\mathrm{m\,s^{-2}}\right)$	A1
		(4)
1(c)	$3(T+2)^2 = 10T(T+2)$ $\left(3T + 6 = 10T\right) \quad \left(7T^2 + 8T - 12 = 0\right)$	M1
	$T = \frac{6}{7}$	A1
		(2)
		(10)
	Notes	
1(a)		
M1	Integrate to obtain **r**. Powers increase by 1 in both components. Condone working with separated components. Condone missing brackets with **i-j** notation. M0 for *suvat.*	
A1	Correct integration. Condone missing constant of integration.	
DM1	• Dependent on the preceding M1. • Must have a constant of integration before using $t = 3$ (unless using definite integration) • Must use $\left(-30\mathbf{i} - 45\mathbf{j}\right)$ • Must substitute $t = 3$ Condone working with separated components. DM0 if substitution of $t = 3$ occurs before finding + C.	

	$\left(t^3+6t^2+12t-30\right)\mathbf{i}+\left(\frac{5}{3}t^3+5t^2-45\right)\mathbf{j}$ $\quad C=\left(-30\mathbf{i}-45\mathbf{j}\right)$ $\left(\left(t+2\right)^3-38\right)\mathbf{i}+\left(\frac{5}{3}t^3+5t^2-45\right)\mathbf{j}$ $\quad K=\left(-38\mathbf{i}-45\mathbf{j}\right)$	
A1	Correct answer, accept column vector $\begin{pmatrix}87\\45\end{pmatrix}$ A0 for poor notation in final answer eg $\begin{pmatrix}87\mathbf{i}\\45\mathbf{j}\end{pmatrix}$ ISW if they continue and find |**r**|	
1(b)		
M1	Differentiate to obtain **a**. Powers decrease by 1 in both components. Condone working with separated components and missing brackets with **i**-**j** notation. M0 for *suvat*	
A1	Correct differentiation	
M1	Dependent on the preceding M1 Use of Pythagoras seen or implied $\sqrt{30^2+40^2}$	
A1	Correct only	
1(c)		
M1	Correct method using the ratio of **i** and **j** components of **v**. Form an equation in T only. Accept working in t or T.	
A1	0.86 or better. Condone t instead of T.	