Question	Scheme	Marks	AOs
	N.B. In this question you must show all stages of your working. Solutions relying entirely on calculator technology are not acceptable.		
4(a)	Differentiate s with respect to t	M1	1.1b
	$(v=)6t^2-24t+18$	A1	1.1b
	Equate their v to 0 and solve for t	M1	1.1b
	$t=1$ or $t=3$	A1	1.1b
		(4)	
(b)	Finds values of s for $t=4$ and their two values of t, in the interval $0\leqslant t\leqslant 4$ Their t values must have come from solving $v = 0$, a 3 term quadratic. ($s_1=8,\ s_3=0,\ s_4=8$ are the actual values) Could be seen or implied by at least 2 correct s values for their t values. Could see: $f(1), f(3), f(4)$ where $f(t)=\int 6t^2-24t+18\ \mathrm{d}t$ but must see this integrated before the substitution. **N.B.** M0 if one of their two values is not in the interval $0\leqslant t\leqslant 4$ Ignore any extra values of s found.	M1	1.1b
	Total distance $=\left(s_1\left(-s_0\right)\right)+\left(s_1-s_3\right)+\left(s_4-s_3\right)$ oe Could see: $\left[f(t)\right]_0^1-\left[f(t)\right]_1^3+\left[f(t)\right]_3^4$ evaluated **OR** e.g. $=\left(s_1\left(-s_0\right)\right)+\left(s_1-s_2\right)+\left(s_2-s_3\right)+\left(s_4-s_3\right)$	M1	2.1
	= 24 (m)	A1	1.1b
		(3)	
(c)	Attempt to find the value of t for the maximum speed e.g. by using the symmetry of the function **N.B.** this can be implied by use of $t = 2$ to find MAX v. **OR** by differentiating v with respect to t , equating to 0 and solving for t **OR** by completing the square: $v = 6(t-2)^2-6$	M1	2.1
	$t=2$, seen or implied	A1	1.1b
	$v=6\left(\mathrm{m\,s^{-1}}\right)$ Must be positive.	A1	1.1b

	N.B. $t = 2$, $v = 6$ only, with no working, scores M1A1A1 $t = 2$ only with no working, is M1A1A0 $v = 6$ only with no working can score M1A1A1 $(2, -6)$ only scores M0.		
		(3)	
			Total 10 marks

Notes:

(a)

M1: Differentiate, with at least 2 powers decreasing by 1

A1: Correct expression

M1: Solve a 3 term quadratic = 0, obtained by differentiating s.
N.B. Must see some working for this as a calculator solution is not permitted.

A1: cao

(b)

M1: Clear attempt to find the relevant s values, ignoring any extras..
Condone if they integrate their v and obtain an incorrect expression for s.

M1: Correct use of their s values to find the required distance.

A1: Correct only

(c)

M1: Any complete method to obtain t
$(a = 12t - 24 = 0 \rightarrow t = 2)$

A1: Seen or implied e.g. in $6(t-2)^2 - 6$

A1: Correct only.

N.B. The first 2 marks can be scored if they are using $v = t^2 - 4t + 3$