Question number	Scheme	Marks
4 (a)	$v = \int (6t - 12)\ \mathrm{d}t = 3t^2 - 12t\ (+c)$ When $t = 0$, $v = 0$ so $c = 0$ $v = 3t^2 - 12t = 3 \times 2^2 - 12 \times 2 = -12\ (\text{m/s})$	M1A1 A1cso [3]
(b)	$v = 0,\ \ 3t^2 - 12t = 0 \Rightarrow 3t(t - 4) = 0 \Rightarrow T = 4$	M1A1 [2]
(c)	$s = \int (3t^2 - 12t)\ \mathrm{d}t = t^3 - 6t^2\ (+k)$ $d = \left\| \left[t^3 - 6t^2 \right]_0^4 \right\| + \left[t^3 - 6t^2 \right]_4^8 = 32 + 160 = 192\ (\text{m})$	M1 M1A1 [3]
Alternative		
(c)	$s = \int (3t^2 - 12t)\ \mathrm{d}t = t^3 - 6t^2\ (+k)$ At time $t = 0$, distance $= 0$, $k = 0$ $t = 4$ $s = 4^3 - 6 \times 4^2 = 64 - 96 = -32$ $t = 8$ $s = 8^3 - 6 \times 8^2 = 512 - 384 = 128$ Total distance travelled $= 32 + 32 + 128 = 192\ (\text{m})$	M1 M1 A1
		Total 8 marks

(a)	M1	Attempt to integrate $6t - 12$, must see power of t increased by one in either term and no decrease in powers. Do not accept $v = t(6t - 12)$.
	A1	Correct result of integration. Constant is not required.
	A1cso	Correct velocity. Negative sign is required. Must show or state constant $= 0$.
(b)	M1	$3t^2 - 12t = 0$ and attempt to solve. ft their integration if M1 awarded in (a).
	A1	$T = 4$ Allow $t = 4$. Do not allow if $T = 0$ is also given as an option.
(c)	M1	Attempt to integrate their velocity providing it includes at least one term in t^2 or higher powers. Must see power of t increased by one in at least one term and no decrease in powers. Do not accept $s = t \times$ their v.
	M1	Attempt to use limits of 0 to 4 and 4 to 8 and then add the magnitudes of the two values. ft their $T = 4$ if M1 awarded in (b).
	A1	192
Alternative		
(c)	M1	Attempt to integrate their velocity providing it includes at least one term in t^2 or higher powers. Must see power of t increased by one in at least one term and no decrease in powers. Do not accept $v = t(6t - 12)$.
	M1	Substitute and attempt to find distance when $t = 4$ and when $t = 8$. Working to confirm $k = 0$ must be shown. ft their $T = 4$ if M1 awarded in (b).
	A1	192