Question	Scheme	Marks	AOs
8(a)	Multiply out and differentiate *wrt* to time (or use of product rule i.e. must have two terms with correct structure)	M1	1.1a
	$v = 2t^3 - 3t^2 + t$	A1	1.1b
	$2t^3 - 3t^2 + t = 0$ and solve: $t(2t-1)(t-1) = 0$	**DM**1	1.1b
	$t = 0$ or $t = \frac{1}{2}$ or $t = 1$; any two	A1	1.1b
	All three	A1	1.1b
		(5)	
(b)	Find x when $t = 0, \frac{1}{2}$, 1 and 2 : $(0, \frac{1}{32}, 0, 2)$	M1	2.1
	Distance = $\frac{1}{32} + \frac{1}{32} + 2$	M1	2.1
	$2\frac{1}{16}$ (m) oe or 2.06 or better	A1	1.1b
		(3)	
(c)	$x = \frac{1}{2}t^2(t-1)^2$	M1	3.1a
	$\frac{1}{2}$ perfect square so $x \geq 0$ i.e. never negative	A1 cso	2.4
		(2)	
			(10 marks)

Notes:

(a)

M1: Must have 3 terms and at least two powers going down by 1

A1: A correct expression

DM1: Dependent on first M, for equating to zero and attempting to solve a <u>cubic</u>

A1: Any two of the three values (Two correct answers can imply a correct method)

A1: The third value

(b)

M1: For attempting to find the values of x (at least two) at their t values found in (a) or at t =2 or equivalent e.g. they may integrate their v and sub in at least two of their t values

M1: Using a correct strategy to combine their distances (must have at least 3 distances)

A1: $2\frac{1}{16}$ (m) oe or 2.06 or better
(c) **M1:** Identify strategy to solve the problem such as: (i) writing x as $\frac{1}{2} \times$ perfect square (ii) or using x values identified in (b). (iii) or using calculus i.e. identifying min points on x–t graph. (iv) or using x-t graph. **A1 cso :** Fully correct explanation to show that $x \geq 0$ i.e. never negative