

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1	States that differentiation is required or makes an attempt to differentiate. Multiplying an exponent down and reducing the exponent by one would constitute an attempt.	M1	3.1b	6th Uses differentiation to solve problems in kinematics.
	Correctly differentiates $s = \frac{1}{6}(8t^3 - 105t^2 + 144t + 540)$ to get either $v = 4t^2 - 35t + 24$ or $v = \frac{1}{6}(24t^2 - 210t + 144)$	M1	1.1b	
	States or implies that P is at rest when $4t^2 - 35t + 24 = 0$ or $v = \frac{1}{6}(24t^2 - 210t + 144)$	M1	3.1b	
	Solves to find $t = 0.75$ and $t = 8$ by either factorising or using the quadratic formula.	A1	1.1b	
	Substitutes $t = 0.75$ into $s = \frac{1}{6}(8t^3 - 105t^2 + 144t + 540)$ to get $s = \frac{3159}{32}$ or 98.71... (m). Accept awrt 98.7 (m).	M1	1.1b	
	Substitutes $t = 8$ into $s = \frac{1}{6}(8t^3 - 105t^2 + 144t + 540)$ to get $s = -\frac{466}{3}$ or -155.3... (m). Accept awrt -155.3 (m).	M1	1.1b	
	Correctly finds the distance between the points as $98.7... + 155.3... = 254... (m)$. Accept awrt 254 (m).	A1 ft	3.5	
		(7)		

(7 marks)

Notes

1

Award the final two method marks for a correct substitution using their values for t , and the final accuracy mark for a correct subtraction using their values.

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2	Makes an attempt to integrate $a = \frac{1}{500}(20t^2 - t^3)$ Raising power by one would constitute an attempt.	M1	3.1b	6th Uses differentiation to solve problems in kinematics.
	Correctly finds $v = \frac{1}{500}\left(\frac{20}{3}t^3 - \frac{1}{4}t^4\right)$. Note that $C = 0$.	A1	1.1b	
	Makes an attempt to integrate $v = \frac{1}{500}\left(\frac{20}{3}t^3 - \frac{1}{4}t^4\right)$. Raising power by one would constitute an attempt.	M1	3.1b	
	Correctly finds $s = \frac{1}{500}\left(\frac{20}{12}t^4 - \frac{1}{20}t^5\right)$. Note that $C = 0$.	A1	1.1b	
	Substitutes $t = 10$ into $s = \frac{1}{500}\left(\frac{20}{12}t^4 - \frac{1}{20}t^5\right)$ to obtain $s = \frac{70}{3}$ (m). Accept awrt 23.3 (m).	A1 ft	1.1b	
		(5)		

(5 marks)

Notes

2

Award the final accuracy mark for a correct substitution using their equation for displacement.

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3a	Makes an attempt to substitute $t = 25$ into $s = 30t - 0.4t^2$. For example $s = 30(25) - 0.4(25)^2$ is seen.	M1	1.1b	5th Use equations of motion to solve problems in unfamiliar contexts.
	Correctly states that $AB = 500$ (m). Accept $s = 500$ (m).	A1	1.1b	
		(2)		
3b	Differentiates $s = 30t - 0.4t^2$ to obtain $v = 30 - 0.8t$	M1	3.1b	6th Solve problems using calculus and the equations of motion.
	Differentiates $v = 30 - 0.8t$ to obtain $a = -0.8$	M1	3.1b	
	States that $a = -0.8$ (m s^{-2}) is a constant as it does not depend on t .	A1	3.5a	
		(3)		
3c	States distance of the car from point A is $s_1 = 30t - 0.4t^2$	M1	3.3	6th Solve problems using calculus and the equations of motion.
	$u = 2$ and $a = 0.1$ and an attempt to use $s = ut + \frac{1}{2}at^2$ is seen.	M1	3.3	
	States distance of the runner from point B is $s_2 = 2t + 0.05t^2$	M1	1.1b	
	States that the runner and the car will pass each other when their distances total 500 (m), or writes $s_1 + s_2 = 500$ (m) or writes $30t - 0.4t^2 + 2t + 0.05t^2 = 500$	M1	3.3	
	States that $0.35t^2 - 32t + 500 = 0$ or equivalent.	A1	1.1b	
	Solves to find $t = 20$ (s). Answer does not need to state that $t = \frac{500}{7}$ or 71.4... (s) is not in the given range.	A1	1.1b	
	Makes an attempt to substitute $t = 20$ into $s_1 = 30t - 0.4t^2$ or $s_2 = 2t + 0.05t^2$.	M1	1.1b	
	Correctly states they will pass each other 440 (m) from A or 60 (m) from B.	A1 ft	3.5a	
		(8)		
(13 marks)				
Notes				