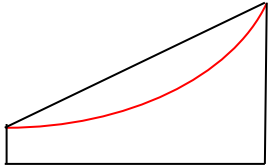| Question	Scheme	Marks	AOs
2	<table><tr><td>Time (s)</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr><tr><td>Speed (m s^{-1})</td><td>2</td><td>5</td><td>10</td><td>18</td><td>28</td><td>42</td></tr></table>		

(a)	Uses an allowable method to estimate the area under the curve. E.g.		
	Way 1: an attempt at the trapezium rule (see below)		
	Way 2: $\{s=\}\left(\dfrac{2+42}{2}\right)(25)\ \{=550\}$		
	Way 3: $42=2+25(a)\Rightarrow a=1.6\Rightarrow s=2(25)+(0.5)(1.6)(25)^2\{=550\}$		
	Way 4: $\{d=\}(2)(5)+5(5)+10(5)+18(5)+28(5)\ \{=63(5)=315\}$	M1	3.1a
	Way 5: $\{d=\}\ 5(5)+10(5)+18(5)+28(5)+42(5)\ \{=103(5)=515\}$		
	Way 6: $\{d=\}\ \dfrac{315+515}{2}\ \{=415\}$		
	Way 7: $\{d=\}\left(\dfrac{2+5+10+18+28+42}{6}\right)(25)\ \{=437.5\}$		
	$\dfrac{1}{2}\times(5)\times[2+2(5+10+18+28)+42]$ or $\dfrac{1}{2}\times[\ "315"+"515"\ ]$	M1	1.1b
	$=415\ \{m\}$	A1	1.1b
		(3)	
(b) **Alt 1**	**Uses a Way 1, Way 2, Way 3, Way 5, Way 6 or Way 7 method in (a)**		
	Overestimate **and** a relevant explanation e.g. • {top of} trapezia lie above the curve • Area of trapezia > area under curve • An appropriate diagram which gives reference to the extra area • Curve is convex • $\dfrac{d^2y}{dx^2}>0$ • Acceleration is {continually} increasing • The gradient of the curve is {continually} increasing • All the rectangles are above the curve (Way 5)	B1ft	2.4
		(1)	
(b) **Alt 2**	**Uses a Way 4 method in (a)**		
	Underestimate **and** a relevant explanation e.g. • All the rectangles are below the curve	B1ft	2.4
		(1)	
			(4 marks)

Notes for Question 2	
(a)	
M1:	A low-level problem-solving mark for using an allowable method to estimate the area under the curve. E.g.
	Way 1: See scheme. Allow $\lambda(2+2(5+10+18+28)+42);\ \lambda>0$ for 1st M1
	Way 2: Uses $s=\left(\dfrac{u+v}{2}\right)t$ which is equivalent to finding the area of a large trapezium
	Way 3: Complete method using a uniform acceleration equation.
	Way 4: Sums rectangles lying below the curve. Condone a slip on one of the speeds.
	Way 5: Sums rectangles lying above the curve. Condone a slip on one of the speeds.
	Way 6: Average the result of Way 3 and Way 4. Equivalent to Way 1.
	Way 7: Applies (average speed)$\times$(time)

	Notes for Question 2 Continued
(a)	*continued*
M1:	Correct trapezium rule method with $h = 5$. Condone a slip on one of the speeds. The '2' and '42' should be in the correct place in the [......].
A1:	415
Note:	Units do not have to be stated
Note:	Give final A0 for giving a final answer with incorrect units. e.g. give final A0 for 415 km or 415 ms^{-1}
Note:	Only the 1st M1 can only be scored for Way 2, Way 3, Way 4, Way 5 and Way 7 methods
Note:	Full marks in part (a) can only be scored by using a Way 1 or a Way 6 method.
Note:	Give M0 M0 A0 for $\{d =\} 2(5) + 5(5) + 10(5) + 18(5) + 28(5) + 42(5) \ \{= 105(5) = 525\}$ (i.e. using too many rectangles)
Note	Condone M1 M0 A0 for $\left[\dfrac{(2+10)}{2}(10) + \dfrac{(10+18)}{2}(5) + \dfrac{(18+28)}{2}(5) + \dfrac{(28+42)}{2}(5) \right] = 395$ m
Note:	Give M1 M1 A1 for $5\left[\dfrac{(2+5)}{2} + \dfrac{(5+10)}{2} + \dfrac{(10+18)}{2} + \dfrac{(18+28)}{2} + \dfrac{(28+42)}{2} \right] = 415$ m
Note:	Give M1 M1 A1 for $\dfrac{5}{2}(2+42) + 5(5+10+18+28) = 415$ m
Note:	**Bracketing mistake:** **Unless the final calculated answer implies that the method has been applied correctly** give M1 M0 A0 for $\dfrac{5}{2}(2) + 2(5+10+18+28) + 42 \ \{= 169\}$ give M1 M0 A0 for $\dfrac{5}{2}(2+42) + 2(5+10+18+28) \ \{= 232\}$
Note:	Give M0 M0 A0 for a Simpson's Rule Method
(b)	**Alt 1**
B1ft:	**This mark depends on both an answer to part (a) being obtained and the first M in part (a)** See scheme
Note:	Allow the explanation "curve concaves upwards"
Note:	Do not allow explanations such as "curve is concave" or "curve concaves downwards"
Note:	Do not allow explanation "gradient of the curve is positive"
Note:	Do not allow explanations which refer to "friction" or "air resistance"
Note:	The diagram opposite is sufficient as an explanation. It must show the top of a trapezium lying above the curve.
(b)	**Alt 2**
B1ft:	**This mark depends on both an answer to part (a) being obtained and the first M in part (a)** See scheme
Note:	Do not allow explanations which refer to "friction" or "air-resistance"