Question			Answer	Marks	Guidance	
1	(i)		$y' = 1 + 8x^{-3}$ $y'' = -24x^{-4}$ oe	M2 A1 **[3]**	M1 for just $8x^{-3}$ or $1 - 8x^{-3}$	but not just $\frac{-24}{x^4}$ as AG
1	(ii)		their $y' = 0$ soi $x = -2$ $y = -3$ substitution of $x = -2$: $\frac{-24}{(-2)^4}$ < 0 or $= -1.5$ oe correctly obtained isw	M1 A1 A1 M1 A1 **[5]**	 A0 if more than one x-value A0 if more than one y-value or considering signs of gradient either side of -2 with negative x-values signs for gradients identified to verify maximum	 $x = -2$ must have been correctly obtained for all marks after first M1 condone any bracket error must follow from M1 A1 A0 M1 or better
1	(iii)		$y = -5$ soi substitution of $x = -1$ in their y' grad normal $= {}^{-1}/_{\text{their} -7}$ $y -$ their$(-5) =$ their ${}^{1}/_{7}(x - -1)$ $-x + 7y + 34 = 0$ oe	B1 M1 M1* M1dep* A1 **[5]**	 may be implied by -7 may be implied by eg ${}^{1}/_{7}$ or their $(-5) =$ their ${}^{1}/_{7} \times (-1) + c$ allow eg $y - \frac{1}{7}x + \frac{34}{7} = 0$	 must see $= 0$ do not allow eg $y = \frac{x}{7} - \frac{34}{7}$

Question			Answer	Marks	Guidance	
2	**(i)**		$y' = 3x^2 - 5$	M1		
			their $y' = 0$	M1		
			(1.3, – 4.3) cao	A1	or A1 for $x = \pm\sqrt{\frac{5}{3}}$ oe soi	
			(– 1.3, 4.3) cao	A1	allow if not written as co-ordinates if pairing is clear	ignore any work relating to second derivative
				[4]		
2	**(ii)**		crosses axes at (0, 0)	B1	condone x and y intercepts not written as co-ordinates; may be on graph	See examples in Appendix
			and $(\pm\sqrt{5}, 0)$	B1	±(2.23 to 2.24) implies $\pm\sqrt{5}$	
			sketch of cubic with turning points in correct quadrants and of correct orientation and passing through origin	B1		must meet the x-axis three times B0 eg if more than 1 point of inflection
			x-intercepts $\pm\sqrt{5}$ marked	B1	may be in decimal form (±2.2…)	
				[4]		
2	**(iii)**		substitution of $x = 1$ in $f'(x) = 3x^2 - 5$	M1		sight of – 2 does not necessarily imply M1: check $f'(x) = 3x^2 - 5$ is correct in part (i)
			– 2	A1		
			$y - -4 = (\text{their } f'(1)) \times (x - 1)$ oe	M1*	or $-4 = -2\times(1) + c$	
			$-2x - 2 = x^3 - 5x$ and completion to given result www	M1dep*		
			use of Factor theorem in $x^3 - 3x + 2$ with – or ± 2	M1	or any other valid method; must be shown	eg long division or comparing coefficients to find $(x - 1)(x^2 + x - 2)$ or $(x + 2)(x^2 - 2x + 1)$ is enough for M1 with both factors correct
			$x = -2$ obtained correctly	A1		NB M0A0 for $x(x^2 - 3) = -2$ so $x = -2$ or $x^2 - 3 = -2$ oe
				[6]		

3	**i**	$y' = 3x^2 - 6x$ use of $y' = 0$ (0, 1) or (2, –3) sign of y'' used to test or y' either side	B1 M1 A2 T1	condone one error A1 for one correct or $x = 0$, 2 SC B1 for (0,1) from their y' Dep't on M1 or y either side or clear cubic sketch	5	
	ii	$y'(-1) = 3 + 6 = 9$ $3x^2 - 6x = 9$ $x = 3$ At P $y = 1$ grad normal = –1/9 cao $y - 1 = -1/9\ (x - 3)$ intercepts 12 and 4/3or use of $\int_0^{12} \frac{4}{3} - \frac{1}{9}x \ dx$ (their normal) ½ × 12 × 4/3 cao	B1 M1 A1 B1 B1 M1 B1 A1	 ft for their y' implies the M1 ft their (3, 1) and their grad, not 9 ft their normal (linear)	8	13

4	**i**	$7 - 2x$ $x = 2$, gradient = 3 $x = 2, y = 4$ y – their 4 = their grad $(x - 2)$ subst $y = 0$ in their linear eqn completion to $x = \frac{2}{3}$ (ans given)	M1 A1 B1 M1 M1 A1	 differentiation must be used or use of y = their $mx + c$ and subst (2, their 4), dependent on diffn seen	6
	ii	f(1) = 0 or factorising to $(x - 1)(6 - x)$ or $(x - 1)(x - 6)$ 6 www	1 1	or using quadratic formula correctly to obtain $x = 1$	2
	iii	$\frac{7}{2}x^2 - \frac{1}{3}x^3 - 6x$ value at 2 − value at 1 $2\frac{1}{6}$ or 2.16 to 2.17 $\frac{1}{2} \times \frac{4}{3} \times 4$ − their integral 0.5 o.e.	M1 M1 A1 M1 A1	for two terms correct; ignore $+c$ ft attempt at integration only	5

5	**i**	$3x^2 - 6$	2	1 if one error	2
	ii	$-\sqrt{2} < x < \sqrt{2}$	3	M1 for using their $y' = 0$ B1 f.t. for both roots found	3
	iii	subst $x = -1$ in their y' $[=-3]$ $y = 7$ when $x = -1$ $y + 3x = 4$ $x^3 - 6x + 2 = -3x + 4$ $(2, -2)$ c.a.o.	B1 M1 A1 M1 A1,A1	f.t. f.t. 3 terms f.t.	6