Question			Answer	Marks	Guidance	
1	(i)		$kx^{\frac{1}{3}-1}$ oe $4x^{\frac{-2}{3}}$ isw cao	**M1** **A1** **[2]**	k is any non-zero constant ignore + c	 allow any equivalent exact simplified form
1	(ii)		kx^{-3+1} oe $-3x^{-2}$ isw $+ c$	**M1** **A1** **A1** **[3]**	k is any non-zero constant	 allow any equivalent exact simplified form

2			$3x^2 - 6$ seen *their* $y' = 0$ or $y' > 0$ or $y' \geq 0$ $\sqrt{2}$ and $-\sqrt{2}$ identified $x < -\sqrt{2}$ or $x \leq -\sqrt{2}$ isw $x > \sqrt{2}$ or $x \geq \sqrt{2}$	**B1** **M1** **A1** **A1** **A1** **[5]**	 must be quadratic with at least one of only two terms correct may be implied by use with inequalities or by ±1.41[4213562] to 3 sf or more if **A1A0A0**, allow **SC1** for fully correct answer in decimal form to 3 sf or more or **A2** for $\lvert x \rvert > \sqrt{2}$ or $\lvert x \rvert \geq \sqrt{2}$	 $\lvert x \rvert = \sqrt{2}$ implies **A1** NB **just** $-\sqrt{2} > x > \sqrt{2}$ or $\sqrt{2} < x < -\sqrt{2}$ or $x > \pm\sqrt{2}$ implies the first **A1** then **A0A0**

3			$\frac{2.4-3.6}{2.2-2}$ oe − 6 cao	M1 A1 **[2]**		M1 may be embedded eg in equation of straight line B2 if unsupported ignore subsequent work irrelevant to finding the gradient

4	**(i)**		$-10x^{-6}$ isw	**B1** **B1** **[2]**	for – 10 for x^{-6} ignore + *c* and *y* =	if **B0B0** then **SC1** for $-5\times 2x^{-5-1}$ or better soi
4	**(ii)**		$y = x^{1/3}$ soi kx^{n-1} $\frac{1}{3}x^{-\frac{2}{3}}$ isw	**B1** **M1** **A1** **[3]**	condone $y' = x^{1/3}$ if differentiation follows ft their fractional *n* ignore + *c* and *y* =	 allow 0.333 or better

5	**(i)**		ruled line touching curve at $x = 2$ their $\frac{y_2 - y_1}{x_2 - x_1}$ from their *tangent* answer in range 2.5 to 3.0 inclusive	**M1** **M1** **A1** **[3]**	 may be on graph or in working; must use correct points from their line their tangent may be at another point both **M1**s must be awarded	intent to touch, but must not clearly cut curve **M0** for reciprocal, (value is approx 2.773)
5	**(ii)**		3.482202253... and 4.59479342... rot to 3 or more sf 2.78 to 2.7815 or 2.8	**B1** **B1** **[2]**	 mark the final answer	 2.781477917..

6			$\frac{1}{2}x^{-\frac{1}{2}} - 3x^{-2}$ oe; isw	B3 **[3]**	need not be simplified B2 for one term correct ignore + *c*	if B0 allow M1 for either $x^{1/2}$ or x^{-1} seen before differentiation deduct one mark for extra term in *x*

7	(i) $m = \frac{\sqrt{1+2\times4.1}-\sqrt{1+2\times4}}{4.1-4}$ s.o.i grad = $\frac{\sqrt{9.2}-\sqrt{9}}{4.1-4}$ s.o.i 0.3315 cao	**M1** **M1** **A1**		no marks for use of Chain Rule or any other attempt to differentiate **SC2** for 0.33…. appearing only embedded in equation of chord
7	(ii) selection of value in (4, 4.1) and 4 or of two values in [3.9, 4.1] centred on 4 answer closer to 1/3 than 0.3315(...)	**M1** **A1**		allow selection of 4 and value in (3.9, 4)

8	attempt to integrate $6x^2 + 12x^{\frac{1}{2}}$ [y =] $2x^3 + 8x^{1.5}$ + c Substitution of (4, 10) [y =] $2x^3 + 8a^{1.5}$ –182 or c = –182	**M1** **A2** **M1** **A1**	accept un-simplified; **A1** for 2 terms correct dependent on attempted integral with + c term

9	[f′(x) =] 12 − 3x^2 their f′(x) > 0 or = 0 soi −2 < x < 2	B1 M1 A1	condone −2 ≤ x ≤ 2 or "between -2 and 2"	3

10	$y' = 6 \times \frac{3}{2} x^{\frac{1}{2}}$ or $9x^{\frac{1}{2}}$ o.e. $y'' = \frac{9}{2} x^{-\frac{1}{2}}$ o.e. √36 = 6 used interim step to obtain $\frac{3}{4}$	2 1 M1 A1	1 if one error in coeff or power, or extra term f.t. their y′ only if fractional power f.t. their y″ www answer given	5

11	[y =] $3x - x^3/3$ + c subst of (6, 1) in their eqn with c $y = 3x - x^3/3 + 55$ c.a.o	B1 B1 M1 A1	 Dep't on integration attempt Dep't on B0B1 Allow c = 55 isw	4

12	√x = $x^{½}$ soi $18x^2$, ½ $x^{-½}$ 36x A$x^{-3/2}$ (from B$x^{-½}$)	B1 B1B1 B1 B1	 –1 if d/dx(3) not = 0 any A,B	5