Mark Scheme 4723
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1 Attempt use of quotient rule to find derivative M1 allow for numerator 'wrong way round'; or attempt use of product rule

Obtain $\frac{2(3x-1)-3(2x+1)}{(3x-1)^2}$ A1 or equiv

Obtain $-\frac{5}{4}$ for gradient A1 or equiv

Attempt eqn of straight line with numerical gradient M1 obtained from their $\frac{dy}{dx}$; tangent not normal

Obtain $5x + 4y - 11 = 0$ A1 **5** or similar equiv

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2 (i) Attempt complete method for finding cot θ M1 rt-angled triangle, identities, calculator, …

Obtain $\frac{5}{12}$ A1 **2** or exact equiv

(ii) Attempt relevant identity for cos 2θ M1 $\pm 2\cos^2\theta \pm 1$ or $\pm 1 \pm 2\sin^2\theta$ or $\pm(\cos^2\theta - \sin^2\theta)$

State correct identity with correct value(s) substituted A1

Obtain $-\frac{119}{169}$ A1 **3** correct answer only earns 3/3

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3 (a) Sketch reasonable attempt at $y = x^5$ *B1 accept non-zero gradient at *O* but curvature to be correct in first and third quadrants

Sketch straight line with negative gradient *B1 existing at least in (part of) first quadrant

Indicate in some way single point of intersection B1 **3** dep *B1 *B1

(b) Obtain correct first iterate B1 allow if not part of subsequent iteration

Carry out process to find at least 3 iterates in all M1

Obtain at least 1 correct iterate after the first A1 allow for recovery after error; showing at least 3 d.p. in iterates

Conclude 2.175 A1 **4** answer required to precisely 3 d.p.

[0 → 2.21236 → 2.17412 → 2.17480 → 2.17479;
1 → 2.19540 → 2.17442 → 2.17480 → 2.17479;
2 → 2.17791 → 2.17473 → 2.17479 → 2.17479;
3 → 2.15983 → 2.17506 → 2.17479 → 2.17479]

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4 (i) Obtain derivative of form $k(4t+9)^{-\frac{1}{2}}$ M1 any constant *k*

Obtain correct $2(4t+9)^{-\frac{1}{2}}$ A1 or (unsimplified) equiv

Obtain derivative of form $k\,e^{\frac{1}{2}x+1}$ M1 any constant *k* different from 6

Obtain correct $3e^{\frac{1}{2}x+1}$ A1 **4** or equiv

(ii) Either: Form product of two derivatives M1 numerical or algebraic

Substitute for *t* and *x* in product M1 using *t* = 4 and calculated value of *x*

Obtain 39.7 A1 **3** allow ±0.1; allow greater accuracy

Or: Obtain $k(4t+9)^n e^{\frac{1}{2}(4t+9)^{\frac{1}{2}}+1}$ M1 differentiating $y = 6e^{\frac{1}{2}(4t+9)^{\frac{1}{2}}+1}$

Obtain correct $6(4t+9)^{-\frac{1}{2}} e^{\frac{1}{2}(4t+9)^{\frac{1}{2}}+1}$ A1 or equiv

Substitute *t* = 4 to obtain 39.7 A1 **(3)** allow ±0.1; allow greater accuracy

5 (i) Obtain $R = \sqrt{17}$ or 4.12 or 4.1 B1 or greater accuracy

Attempt recognisable process for finding α M1 allow for sin/cos confusion

Obtain $\alpha = 14$ A1 **3** or greater accuracy 14.036…

(ii)	Attempt to find at least one value of $\theta + \alpha$	M1		
	Obtain or imply value 61	A1√		following R value; or value rounding to 61
	Obtain 46.9	A1		allow ±0.1; allow greater accuracy
	Show correct process for obtaining second angle	M1		
	Obtain –75	A1	**5**	allow ±0.1; allow greater accuracy; max of 4/5 if extra angles between –180 and 180

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6 **(i)**	Obtain integral of form $k(3x + 2)^{\frac{1}{2}}$	M1		any constant k
	Obtain correct $\frac{2}{3}(3x + 2)^{\frac{1}{2}}$	A1		or equiv
	Substitute limits 0 and 2 and attempt evaluation	M1		for integral of form $k(3x + 2)^n$
	Obtain $\frac{2}{3}(8^{\frac{1}{2}} - 2^{\frac{1}{2}})$	A1	**4**	or exact equiv suitably simplified
(ii)	State or imply $\pi\int \frac{1}{3x+2}\,\mathrm{d}x$ or unsimplified version	B1		allow if dx absent or wrong
	Obtain integral of form $k\ln(3x + 2)$	M1		any constant k involving π or not
	Obtain $\frac{1}{3}\pi\ln(3x + 2)$ or $\frac{1}{3}\ln(3x + 2)$	A1		
	Show correct use of ln a – ln b property	M1		
	Obtain $\frac{1}{3}\pi\ln 4$	A1	**5**	or (similarly simplified) equiv

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7 **(i)**	State a in x-direction	B1		or clear equiv
	State factor 2 in x-direction	B1	**2**	or clear equiv
(ii)	Show (largely) increasing function crossing x-axis	M1		with correct curvature
	Show curve in first and fourth quadrants only	A1	**2**	not touching y-axis and with no maximum point; ignore intercept
(iii)	Show attempt at reflecting negative part in x-axis	M1		
	Show (more or less) correct graph	A1√	**2**	following their graph in **(ii)** and showing correct curvatures
(**iv**)	Identify $2a$ as asymptote or $2a + 2$ as intercept	B1		allow anywhere in question
	State $2a < x \leq 2a + 2$	B1	**2**	allow < or ≤ for each inequality

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8 **(i)**	Obtain $-2x\mathrm{e}^{-x^2}$ as derivative of e^{-x^2}	B1		
	Attempt product rule	*M1		allow if sign errors or no chain rule
	Obtain $8x^7\mathrm{e}^{-x^2} - 2x^9\mathrm{e}^{-x^2}$	A1		or (unsimplified) equiv
	Either: Equate first derivative to zero and attempt solution	M1		dep *M; taking at least one step of solution
	Confirm 2	A1	**5**	AG
	Or: Substitute 2 into derivative and show attempt at evaluation	M1		
	Obtain 0	A1	**(5)**	AG; necessary correct detail required

(ii)	Attempt calculation involving attempts at y values	M1		with each of 1, 4, 2 present at least once as coefficients
	Attempt $k(y_0 + 4y_1 + 2y_2 + 4y_3 + y_4)$	M1		with attempts at five y values corresponding to correct x values
	Obtain $\frac{1}{6}(0 + 4 \times 0.00304 + 2 \times 0.36788 + 4 \times 2.70127 + 4.68880)$	A1		or equiv with at least 3 d.p. or exact values
	Obtain 2.707	A1	**4**	or greater accuracy; allow ±0.001
(iii)	Attempt 4(y value) – 2(part **(ii)**)	M1		or equiv
	Obtain 13.3	A1	**2**	or greater accuracy; allow ±0.1

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9 **(i)**	State $-2 \leq y \leq 2$	B1		allow <; any notation
	State $y \leq 4$	B1	**2**	allow <; any notation
(ii)	Show correct process for composition	M1		right way round
	Obtain or imply 0.959 and hence 2.16	A1		AG; necessary detail required
	Obtain g(0.5) = 3.5	B1		or (unsimplified) equiv
	Observe that 3.5 not in domain of f	B1	**4**	or equiv
(iii)	Relate quadratic expression to at least one end of range of f	M1		or equiv
	Obtain both of $4 - 2x^2 < -2$ and $4 - 2x^2 > 2$	A1		or equiv; allow any sign in each (< or ≤ or > or ≥ or =)
	Obtain at least two of the x values $-\sqrt{3}, -1, 1, \sqrt{3}$	A1		
	Obtain all four of the x values	A1		
	Attempt solution involving four x values	M1		to produce at least two sets of values
	Obtain $x < -\sqrt{3}, \quad -1 < x < 1, \quad x > \sqrt{3}$	A1	**6**	allow ≤ instead of < and/or ≥ instead of >