

**Mark Scheme 4723
January 2007**

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 $\cot \theta$	M1	rt-angled triangle, identities, calculator, ...
	Obtain $\frac{5}{12}$	A1	2 or exact equiv
(ii)	Attempt relevant identity for $\cos 2\theta$	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.
	[$0 \rightarrow 2.21236 \rightarrow 2.17412 \rightarrow 2.17480 \rightarrow 2.17479$; $1 \rightarrow 2.19540 \rightarrow 2.17442 \rightarrow 2.17480 \rightarrow 2.17479$; $2 \rightarrow 2.17791 \rightarrow 2.17473 \rightarrow 2.17479 \rightarrow 2.17479$; $3 \rightarrow 2.15983 \rightarrow 2.17506 \rightarrow 2.17479 \rightarrow 2.17479$]		
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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 $ke^{\frac{1}{2}x+1}$	M1	any constant k different from 6
	Obtain correct $3e^{\frac{1}{2}x+1}$	A1	4 or equiv
(ii)	<u>Either:</u> 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
	<u>Or:</u> 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 $\theta + \alpha$ Obtain or imply value 61 Obtain 46.9 Show correct process for obtaining second angle Obtain -75	M1 A1√ A1 M1 A1	following R value; or value rounding to 61 allow ± 0.1 ; allow greater accuracy 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 $k(3x + 2)^{\frac{1}{2}}$ Obtain correct $\frac{2}{3}(3x + 2)^{\frac{1}{2}}$ Substitute limits 0 and 2 and attempt evaluation Obtain $\frac{2}{3}(8^{\frac{1}{2}} - 2^{\frac{1}{2}})$	M1 A1 M1 A1	any constant k or equiv for integral of form $k(3x + 2)^n$ 4 or exact equiv suitably simplified
(ii)	State or imply $\pi \int \frac{1}{3x + 2} dx$ or unsimplified version Obtain integral of form $k \ln(3x + 2)$ Obtain $\frac{1}{3}\pi \ln(3x + 2)$ or $\frac{1}{3}\ln(3x + 2)$ Show correct use of $\ln a - \ln b$ property Obtain $\frac{1}{3}\pi \ln 4$	B1 M1 A1 M1 A1	allow if dx absent or wrong any constant k involving π or not 5 or (similarly simplified) equiv
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7 (i)	State a in x -direction State factor 2 in x -direction	B1 B1	or clear equiv 2 or clear equiv
(ii)	Show (largely) increasing function crossing x -axis Show curve in first and fourth quadrants only	M1 A1	with correct curvature 2 not touching y -axis and with no maximum point; ignore intercept
(iii)	Show attempt at reflecting negative part in x -axis Show (more or less) correct graph	M1 A1√	2 following their graph in (ii) and showing correct curvatures
(iv)	Identify $2a$ as asymptote or $2a + 2$ as intercept State $2a < x \leq 2a + 2$	B1 B1	allow anywhere in question 2 allow $<$ or \leq for each inequality
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8 (i)	Obtain $-2xe^{-x^2}$ as derivative of e^{-x^2} Attempt product rule Obtain $8x^7e^{-x^2} - 2x^9e^{-x^2}$ <u>Either:</u> Equate first derivative to zero and attempt solution Confirm 2 <u>Or:</u> Substitute 2 into derivative and show attempt at evaluation Obtain 0	B1 *M1 A1 M1 A1 M1 A1	allow if sign errors or no chain rule or (unsimplified) equiv dep *M; taking at least one step of solution 5 AG (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 $4(y \text{ value}) - 2(\text{part (ii)})$	M1 or equiv
Obtain 13.3	A1 2 or greater accuracy; allow ± 0.1

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 \leq or $>$ or \geq 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 $x < -\sqrt{3}, -1 < x < 1, x > \sqrt{3}$	A1 6 allow \leq instead of $<$ and/or \geq instead of $>$