Mark Scheme 4723
January 2006

1	Obtain integral of form $k \ln x$	**M1**		[any non-zero constant k; or equiv such as $k \ln 3x$]
	Obtain $3 \ln 8 - 3 \ln 2$	**A1**		[or exact equiv]
	Attempt use of at least one relevant log property	**M1**		[would be earned by initial $\ln x^3$]
	Obtain $3 \ln 4$ or $\ln 8^3 - \ln 2^3$ and hence $\ln 64$	**A1**	**4**	[**AG**; with no errors]

2	Attempt use of identity linking $\sec^2\theta$, $\tan^2\theta$ and 1	**M1**		[to write eqn in terms of tan θ]
	Obtain $\tan^2\theta - 4\tan\theta + 3 = 0$	**A1**		[or correct unsimplified equiv]
	Attempt solution of quadratic eqn to find two values of tan θ	**M1**		[any 3 term quadratic eqn in tan θ]
	Obtain at least two correct answers	**A1**		[after correct solution of eqn]
	Obtain all four of 45, 225, 71.6, 251.6	**A1**	**5**	[allow greater accuracy or angles to nearest degree – and no other answers between 0 and 360]

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3 (a)	Attempt use of product rule	**M1**		[involving … + …]
	Obtain $2x(x+1)^6$ …	**A1**		
	Obtain … + $6x^2(x+1)^5$	**A1**	**3**	[or equivs; ignore subsequent attempt at simplification]
(b)	Attempt use of quotient rule	**M1**		[or, with adjustment, product rule; allow u / v confusion]
	Obtain $\dfrac{(x^2-3)2x-(x^2+3)2x}{(x^2-3)^2}$	**A1**		[or equiv]
	Obtain –3	**A1**	**3**	[from correct derivative only]

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4 (i)	State $y \le 2$	**B1**	**1**	[or equiv; allow <; allow any letter or none]
(ii)	Show correct process for composition of functions	**M1**		[numerical or algebraic]
	Obtain 0 and hence 2	**A1**	**2**	[and no other value]
(iii)	State a range of values with 2 as one end-point	**M1**		[continuous set, not just integers]
	State $0 < k \le 2$	**A1**	**2**	[with correct < and ≤ now]

5	Obtain integral of form $k(1-2x)^6$	**M1**		[any non-zero constant k]
	Obtain correct $-\frac{1}{12}(1-2x)^6$	**A1**		[or unsimplified equiv; allow + c]
	Use limits to obtain $\frac{1}{12}$	**A1**		[or exact (unsimplified) equiv]
	Obtain integral of form $k\,e^{2x-1}$	**M1**		[or equiv; any non-zero constant k]
	Obtain correct $\frac{1}{2}e^{2x-1} - x$	**A1**		[or equiv; allow + c]
	Use limits to obtain $-\frac{1}{2}e^{-1}$	**A1**		[or exact (unsimplified) equiv]
	Show correct process for finding required area	**M1**		[at any stage of solution; if process involves two definite integrals, second must be negative]
	Obtain $\frac{1}{12} + \frac{1}{2}e^{-1}$	**A1**	**8**	[or exact equiv; no + c]

6 (a)	Either:	State proportion $\frac{440}{275}$	**B1**		
		Attempt calculation involving proportion	**M1**		[involving multn and X value]
		Obtain 704	**A1**	**3**	
	Or:	Use formula of form $275\,e^{kt}$ or $275\,a^{t}$	**M1**		[or equiv]
		Obtain $k = 0.047$ or $a = \sqrt[10]{1.6}$	**A1**		[or equiv]
		Obtain 704	**A1**	**(3)**	[allow ±0.5]
(b)(i)		Attempt correct process involving logarithm	**M1**		[or equiv including systematic trial and improvement attempt]
		Obtain $\ln\frac{20}{80} = -0.02t$	**A1**		[or equiv]
		Obtain 69	**A1**	**3**	[or greater accuracy; scheme for T&I: M1A2]
(ii)		Differentiate to obtain $k\,e^{-0.02t}$	**M1**		[any constant k different from 80]
		Obtain $-1.6\,e^{-0.02t}$ (or $1.6\,e^{-0.02t}$)	**A1**		[or unsimplified equiv]
		Obtain 0.88	**A1**	**3**	[or greater accuracy; allow –0.88]

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7 (i)		Sketch curve showing (at least) translation in x direction	**M1**		[either positive or negative]
		Show correct sketch with one of 2 and 3π indicated	**A1**		
		… and with other one of 2 and 3π indicated	**A1**	**3**	
(ii)		Draw straight line through O with positive gradient	**B1**	**1**	[label and explanation not required]
(iii)		Attempt calculations using 1.8 and 1.9	**M1**		[allow here if degrees used]
		Obtain correct values and indicate change of sign	**A1**	**2**	[or equiv; x = 1.8: LHS = 1.93, diff = 0.13; x = 1.9: LHS = 1.35, diff = -0.55; radians needed now]
(iv)		Obtain correct first iterate 1.79 or 1.78	**B1**		[or greater accuracy]
		Attempt correct process to produce at least 3 iterates	**M1**		
		Obtain 1.82	**A1**		[answer required to exactly 2 d.p.; $2 \to 1.7859 \to 1.8280 \to 1.8200$; SR: answer 1.82 only - B2]
		Attempt rearrangement of $3\cos^{-1}(x-1) = x$ or of $x = 1 + \cos(\frac{1}{3}x)$	**M1**		[involving at least two steps]
		Obtain required formula or equation respectively	**A1**	**5**	

8	**(i)**	Differentiate to obtain $kx(5-x^2)^{-1}$	**M1**	[any non-zero constant]
		Obtain correct $-2x(5-x^2)^{-1}$	**A1**	[or equiv]
		Obtain –4 for value of derivative	**A1**	
		Attempt equation of straight line through (2, 0) with numerical value of gradient obtained from attempt at derivative	**M1**	[not for attempt at eqn of normal]
		Obtain $y = -4x + 8$	**A1** **5**	[or equiv]
	(ii)	State or imply $h = \frac{1}{2}$	**B1**	
		Attempt calculation involving attempts at y values	**M1**	[addition with each of coefficients 1, 2, 4 occurring at least once]
		Obtain $k(\ln 5 + 4\ln 4.75 + 2\ln 4 + 4\ln 2.75 + \ln 1)$	**A1**	[or equiv perhaps with decimals; any constant k]
		Obtain 2.44	**A1** **4**	[allow ±0.01]
	(iii)	Attempt difference of two areas	**M1**	[allow if area of their triangle < area A]
		Obtain 8 – 2.44 and hence 5.56	**A1√** **2**	[following their tangent and area of A providing answer positive]

9	**(i)**	State $\sin 2\theta \cos\theta + \cos 2\theta \sin\theta$	**B1**	
		Use at least one of $\sin 2\theta = 2\sin\theta\cos\theta$ and $\cos 2\theta = 1 - 2\sin^2\theta$	**B1**	
		Attempt complete process to express in terms of $\sin\theta$	**M1**	[using correct identities]
		Obtain $3\sin\theta - 4\sin^3\theta$	**A1** **4**	[**AG**; all correctly obtained]
	(ii)	State 3	**B1**	
		Obtain expression involving $\sin 10\alpha$	**M1**	[allow θ/α confusion]
		Obtain 9	**A1** **3**	[and no other value]
	(iii)	Recognise cosec 2β as $\frac{1}{\sin 2\beta}$	**B1**	[allow θ/β confusion]
		Attempt to express equation in terms of $\sin 2\beta$ only	**M1**	[or equiv involving $\cos 2\beta$]
		Attempt to find non-zero value of $\sin 2\beta$	**M1**	[or of $\cos 2\beta$]
		Obtain at least $\sin 2\beta = \sqrt{\frac{5}{12}}$	**A1**	[or equiv, exact or approx]
		Attempt correct process to find two values of β	**M1**	[provided equation is $\sin 2\beta = k$; or equiv with $\cos 2\beta$]
		Obtain 20.1, 69.9	**A1** **6**	[and no others between 0 and 90]