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]

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2	Attempt use of identity linking $\sec^2 \theta$, $\tan^2 \theta$ and 1	**M1**	[to write eqn in terms of $\tan \theta$]
	Obtain $\tan^2 \theta - 4 \tan \theta + 3 = 0$	**A1**	[or correct unsimplified equiv]
	Attempt solution of quadratic eqn to find two values of $\tan \theta$	**M1**	[any 3 term quadratic eqn in $\tan \theta$]
	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 $\le$ now]

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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) <u>Either</u>: State proportion $\frac{440}{275}$ **B1**

              Attempt calculation involving
              proportion **M1** [involving multn and X value]
              Obtain 704 **A1 3**

      <u>Or</u>: 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 $-1.6e^{-0.02t}$ (or $1.6e^{-0.02t}$) **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 $k(\ln5+4\ln4.75+2\ln4+4\ln2.75+\ln1)$ **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]

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9 **(i)** State $\sin2\theta\cos\theta+\cos2\theta\sin\theta$ **B1**

Use at least one of $\sin2\theta=2\sin\theta\cos\theta$ and
   $\cos2\theta=1-2\sin^2\theta$ **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 $\sin10\alpha$ **M1**   [allow θ/α confusion]

Obtain 9   **A1** **3**   [and no other value]

 (iii) Recognise cosec 2β as $\dfrac{1}{\sin2\beta}$ **B1**   [allow θ/β confusion]

Attempt to express equation in terms
of $\sin2\beta$ only   **M1**   [or equiv involving $\cos2\beta$]

Attempt to find non-zero value of $\sin2\beta$ **M1**   [or of $\cos2\beta$]

Obtain at least $\sin2\beta=\sqrt{\frac{5}{12}}$ **A1**   [or equiv, exact or approx]

Attempt correct process to find two values of β **M1**   [provided equation is $\sin2\beta=k$; or
         equiv with $\cos2\beta$]

Obtain 20.1, 69.9   **A1** **6**   [and no others between 0 and 90]