Mark Scheme for June 2010
OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today’s society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners’ meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

© OCR 2010

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk
1   (i)  Attempt use of product rule
       Obtain $3x^2e^{2x} + 2x^xe^{2x}$
       M1 producing … + … form
       A1 2 or equiv

   (ii) Attempt use of chain rule to produce $\frac{kx}{3+2x^2}$ form
       Obtain $\frac{4x}{3+2x^2}$
       M1 any constant $k$
       A1 2

   (iii) Attempt use of quotient rule
       Obtain $\frac{2x+1-2x}{(2x+1)^2}$ or $(2x+1)^{-1} - 2x(2x+1)^{-2}$
       M1 or equiv; condone $u/v$ confusions
       A1 2 or (unsimplified) equiv

       [If … + c included in all three parts and all three parts otherwise correct, award M1A1, M1A1, M1A0; otherwise ignore any inclusion of … + c. ]

2   (i)  Obtain one of $\pm \ln(\pm x \pm 4)$
       Obtain correct equation $y = -\ln(x-4)$
       M1 2 or equiv; condone use of modulus signs instead of brackets

   (ii) State, in any order, S, S and T
       State T, then S, then S
       M1 or equiv such as $S^2$, T or 2S, T
       A1 2 or equiv (note that $S$, $T^9$ and $S$, $T^3$, S are alternative correct answers)

3   (i)  Use $\csc\theta = \frac{1}{\sin\theta}$
       Attempt to express equation in terms of $\sin\theta$
       M1 using $\cos2\theta = \pm 1 \pm 2\sin^2\theta$ or equiv
       Obtain or clearly imply $6\sin^2\theta - 11\sin\theta - 10 = 0$
       A1 3 or $-6\sin^2\theta + 11\sin\theta + 10 = 0$

   (ii) Attempt solution to obtain at least one value of $\sin\theta$
       Obtain $-41.8$
       Obtain $-138$
       M1 should be $s = -\frac{4}{3}, \frac{4}{3}$
       A1 allow −42 or greater accuracy
       A1 3 or greater accuracy; and no others between −180 and 180

       [Answer(s) only; award 0 out of 3.]
4  (i) Either: Integrate to obtain \( k \ln x \)  
Use at least one relevant logarithm property M1  
Obtain \( k \ln 3 = \ln 81 \) and hence \( k = 4 \) A1 \( \text{AG} \); accurate work required  

**Or 1:** (where solution involves no use of a logarithm property)  
Integrate to obtain \( k \ln x \) B1  
Obtain correct explicit expression for \( k \) and conclude \( k = 4 \) with no error seen B2 \( \text{AG} \); e.g. \( k = \frac{\ln 81}{\ln 6 - \ln 2} = 4 \)  

**Or 2:** (where solution involves verification of result by initial substitution of 4 for \( k \))  
Integrate to obtain \( 4 \ln x \) B1  
Use at least one relevant logarithm property M1  
Obtain \( \ln 81 \) legitimately with no error seen A1 \( \text{AG} \); accurate work required  

(ii) State volume involves \( \pi \int \left(\frac{4}{x}\right)^2 \, dx \) B1 possibly implied  
Obtain integral of form \( k_1 x^{-1} \) M1 any constant \( k_1 \) including \( \pi \) or not  
Use correct process for finding volume produced from \( S \) M1 \( \int (k_2 2^2 - k_1 y^2) \, dx \), including \( \pi \) or not with correct limits indicated; or equiv  
Obtain \( 16 \pi - \frac{16}{3} \pi \) and hence \( \frac{20}{3} \pi \) A1 \( \text{AG} \) or exact equiv  

---

5  (i) Attempt process for finding both critical values M1 squaring both sides to obtain 3 terms on each side or considering 2 different linear eqns/inequalities  
Obtain \( -4 \) A1  
Obtain \( \frac{2}{3} \) A1  
Attempt process for solving inequality M1 table, sketch, …; needs two critical values; implied by plausible answer  
Obtain \( -4 \leq x \leq \frac{2}{3} \) A1 \( \text{AG} \) with \( \leq \) and not <  

(ii) Use correct process to find value of \( |x + 2| \) using any value A1 … whether part of answer to (i) or not  
Obtain \( 2 \frac{2}{3} \) or \( \frac{2}{3} \) A1 \( \text{AG} \) dependent on 5 marks awarded in part (i)
6 (i) Attempt calculations involving 1.0 and 1.1

Obtain \(-0.57\) and \(0.76\)

Refer to sign change (or equiv for rearranged eqn)

\(\text{A1 or values to 1 dp (rounded or truncated); or equivs (where eqn rearranged)}\)

\(\text{A1 3 AG; following correct work only}\)

(ii) Obtain correct first iterate

Carry out iteration process

Obtain at least 3 correct iterates

\(\text{A1 showing at least 3 dp}\)

Obtain \(1.05083\)

\(\text{answer required to exactly 5 d.p.}\)

\(\text{[1} \rightarrow 1.047198 \rightarrow 1.050571 \rightarrow 1.050809 \rightarrow 1.050826 \rightarrow 1.050827;\)

\(1.05 \rightarrow 1.050769 \rightarrow 1.050823 \rightarrow 1.050827 \rightarrow 1.050827;\)

\(1.1 \rightarrow 1.054268 \rightarrow 1.051070 \rightarrow 1.050844 \rightarrow 1.050829 \rightarrow 1.050827;\)

\(\text{[1} \rightarrow 1.050769 \rightarrow 1.050823 \rightarrow 1.050827 \rightarrow 1.050827;\)

\(\text{[1} \rightarrow 1.054268 \rightarrow 1.051070 \rightarrow 1.050844 \rightarrow 1.050829 \rightarrow 1.050827;\)

(iii) State or imply \(\frac{22}{3} \sec^2 2x = 1 + \tan^2 2x\)

Relate to earlier equation

Obtain \(2x = 1.05083\) and hence 0.525

\(\text{A1 \sqrt{3}}\)

\(\text{following their answer to (ii); or greater accuracy}\)

\(\text{[SC: Rearrange to obtain } x = \frac{1}{2} \cos^{-1} (2x + 3)^{\frac{1}{2}} \text{]}

Use iterative process to obtain 0.525

\(\text{B1 2 or greater accuracy}\)

\(\text{[10]}\)

7 Differentiate to obtain \(k_1 (3x-1)^\frac{3}{5}\)

Obtain correct \(12(3x-1)^\frac{3}{5}\)

Substitute 1 to obtain 96

Attempt to find \(x\)-coordinate of \(Q\)

Obtain \(\frac{5}{6}\)

Integrate to obtain \(k_2 (3x-1)^\frac{5}{5}\)

Obtain correct \(\frac{k}{15}(3x-1)^\frac{5}{5}\)

Use limits \(\frac{1}{3}\) and 1 to obtain \(\frac{k}{15}\)

Attempt to find shaded area by correct process

Obtain \((\frac{k}{15} - \frac{1}{3} \times \frac{1}{6} \times 16 \text{ and hence}) \frac{4}{5}\)

\(\text{A1 or equiv}\)

\(\text{[10]}\)

8 (i) Obtain \(R = 3\sqrt{2}\) or \(R = \sqrt{18}\) or \(R = 4.24\)

Attempt to find value of \(\alpha\)

Obtain \(\frac{1}{4}\) or 0.785

\(\text{B1 or equiv}\)

\(\text{M1 any constant } k_1\)

\(\text{A1 or (unsimplified) equiv}\)

\(\text{M1 using tangent with } y = 0 \text{ or using gradient}\)

\(\text{A1 or exact equiv}\)

(ii) a Equate \(x - \alpha\) to \(\frac{1}{4}\pi\) or attempt solution

\(\text{of } 3\cos x + 3\sin x = 0\)

Obtain \(\frac{1}{4}\pi\)

\(\text{M1 condone sin/cos muddles and degrees}\)

\(\text{A1 3 in radians now}\)

b Attempt correct process to find value of \(3x - \alpha\)

\(\text{*M1 with attempt at rearranging } T(3x) = \frac{\pi}{3}\sqrt{6}\)

Obtain at least one correct exact value of \(3x - \alpha\)

\(\text{A1 } \pm \frac{1}{6}\pi, \pm \frac{1}{3}\pi, \ldots\)

\(\text{A1 4}\)
9 (i) Attempt to find $x$-coord of stationary point or complete square \( M1 \)
Obtain \( \left( \frac{1}{2}, -9 \right) \) or \( 4\left(x - \frac{1}{2}\right)^2 - 9 \) or \(-9\) \( A1 \) or equiv
State \( f(x) \geq -9 \) \( A1 \) 3 using any notation; with \( \geq \)

(ii) Make one correct (perhaps general) relevant statement \( B1 \) not \(-1\), \( f \) is many-one, …; maybe implied if attempt is specific to this \( f \)
Conclude with correct evidence related to this \( f \) \( B1 \) 2 AG; (more or less) correct sketch; correct relevant calculations, …

(iii) Either: Attempt to find expression for \( g^{-1} \) \( *M1 \) or equiv
Obtain \( \frac{1}{a}(x - b) \)
Compare \( \frac{1}{a}(x - b) \) and \( ax + b \) \( A1 \) or equiv
Obtain at least \( -\frac{b}{a} = b \) and hence \( a = -1 \) \( A1 \) 4 AG; necessary detail required; or equiv
[SC1: first two steps as above, then substitute \( a = -1 \): max possible M1A1B1]
[SC2: substitute \( a = -1 \) at start: Attempt to find inverse \( M1 \) Obtain \(-x + b\) and conclude \( A1 \) 2]

Or: State or imply that \( y = g^{-1}(x) \) is reflection of \( y = g(x) \) in line \( y = x \) \( B1 \)
State that line unchanged by this reflection is perpendicular to \( y = x \) \( M2 \)
Conclude that \( a \) is \(-1\) \( A1 \) 4

(iv) State or imply that \( gf(x) = -(4x^2 - 12x) + b \) \( B1 \)
Attempt use of discriminant or relate to range of \( f \) \( M1 \) or equiv
Obtain \( 64 + 16b < 0 \) or \( 9 + b < 5 \) \( A1 \) or equiv
Obtain \( b < -4 \) \( A1 \) 4