Mark Scheme for June 2010
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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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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) \[ f(2) = 8 + 4a - 2a - 14 \]
\[ 2a - 6 = 0 \]
\[ a = 3 \quad \text{M1*} \]

\[ \text{Attempt } f(2) \text{ or equiv, including inspection / long division / coefficient matching} \]

\[ \text{M1d*} \]

\[ \text{Equate attempt at } f(2), \text{ or attempt at remainder, to 0 and attempt to solve} \]

\[ \text{Obtain } a = 3 \quad \text{A1} \quad 3 \]

(ii) \[ f(-1) = -1 + 3 + 3 - 14 \]
\[ = -9 \quad \text{M1} \]

\[ \text{Attempt } f(-1) \text{ or equiv, including inspection / long division / coefficient matching} \]

\[ \text{Obtain } -9 \text{ (or } 2a - 15, \text{ following their } a) \quad \text{A1 ft} \quad 2 \]

2 (i) \[ \text{area } \approx \frac{1}{3} \times 3 \times \left( \sqrt{8} + 2\left(\sqrt{11 + \frac{1}{4}}\right) + \sqrt{17} \right) \]
\[ \approx 20.8 \quad \text{B1} \]

\[ \text{State or imply at least 3 of the 4 correct } y\text{-coords, and no others} \]

\[ \text{M1} \]

\[ \text{Use correct trapezium rule, any } h, \text{ to find area between } x = 1 \text{ and } x = 10 \]

\[ \text{M1} \]

\[ \text{Correct } h \text{ (soi) for their } y\text{-values – must be at equal intervals} \]

\[ \text{A1} \quad 4 \quad \text{Obtain } 20.8 \text{ (allow } 20.7) \]

(ii) use more strips / narrower strips \[ \text{B1} \quad 1 \]

\[ \text{Any mention of increasing } n \text{ or decreasing } h \]

3 (i) \[ (1 + \frac{1}{2}x)^{10} = 1 + 5x + 11.25x^2 + 15x^3 \]
\[ \text{B1} \]

\[ \text{Obtain } 1 + 5x \]

\[ \text{M1} \]

\[ \text{Attempt at least the third (or fourth) term of the binomial expansion, including coeffs} \]

\[ \text{A1} \]

\[ \text{Obtain } 11.25x^2 \]

\[ \text{A1} \]

\[ \text{Obtain } 15x^3 \]

4

(ii) \[ \text{coeff of } x^3 = (3 \times 15) + (4 \times 11.25) + (2 \times 5) \]
\[ = 100 \quad \text{M1} \]

\[ \text{Attempt at least one relevant term, with or without powers of } x \]

\[ \text{A1 ft} \]

\[ \text{Obtain correct (un simplified) terms (not necessarily summed) – either coefficients or still with powers of } x \text{ involved} \]

\[ \text{A1} \quad 3 \quad \text{Obtain } 100 \]
4 (i) \( u_1 = 6, u_2 = 11, u_3 = 16 \)  

<table>
<thead>
<tr>
<th>Mark</th>
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<tbody>
<tr>
<td>B1</td>
<td>State 6, 11, 16</td>
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</table>

(ii) \( S_{40} = \frac{40}{2} (2 \times 6 + 39 \times 5) = 4140 \)  

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<tbody>
<tr>
<td>M1</td>
<td>Show intention to sum the first 40 terms of a sequence</td>
</tr>
<tr>
<td>M1</td>
<td>Attempt sum of their AP from (i), with ( n = 40, a = ) their ( u_1 ) and ( d = ) their ( u_2 - u_1 )</td>
</tr>
<tr>
<td>A1</td>
<td>Obtain 4140</td>
</tr>
</tbody>
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(iii) \( w_3 = 56 \)  

\( 5p + 1 = 56 \) or \( 6 + (p - 1) \times 5 = 56 \)  

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<tr>
<td>B1</td>
<td>State or imply ( w_3 = 56 )</td>
</tr>
<tr>
<td>M1</td>
<td>Attempt to solve ( u_p = k )</td>
</tr>
<tr>
<td>A1</td>
<td>Obtain ( p = 11 )</td>
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5 (i) \( \frac{\sin \theta}{8} = \frac{\sin 65}{11} \)  

\( \theta = 41.2^\circ \)  

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<tbody>
<tr>
<td>M1</td>
<td>Attempt use of correct sine rule</td>
</tr>
<tr>
<td>A1</td>
<td>Obtain 41.2(^\circ), or better</td>
</tr>
</tbody>
</table>

(ii) a  

\( 180 - (2 \times 65) = 50^\circ \) or \( 65 \times \frac{\pi}{180} = 1.134 \)  

\( 50 \times \frac{\pi}{180} = 0.873 \) A.G. \( \pi - (2 \times 1.134) = 0.873 \)  

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<tr>
<td>M1</td>
<td>Use conversion factor of ( \frac{\pi}{180} )</td>
</tr>
<tr>
<td>A1</td>
<td>Show 0.873 radians convincingly (AG)</td>
</tr>
</tbody>
</table>

(ii) b  

area sector = \( \frac{1}{2} \times 8^2 \times 0.873 = 27.9 \)  

area triangle = \( \frac{1}{2} \times 8^2 \times \sin 0.873 = 24.5 \)  

area segment = 27.9 – 24.5 = 3.41  

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<tr>
<td>M1</td>
<td>Attempt area of sector, using ( \frac{1}{2} r^2 \theta )</td>
</tr>
<tr>
<td>M1</td>
<td>Attempt area of triangle using ( \frac{1}{2} r^2 \sin \theta )</td>
</tr>
<tr>
<td>M1</td>
<td>Subtract area of triangle from area of sector</td>
</tr>
<tr>
<td>A1</td>
<td>Obtain 3.41 or 3.42</td>
</tr>
</tbody>
</table>
6 a  
\[ \int \left( x^2 + 4x \right) \, dx = \left[ \frac{1}{3} x^3 + 2x^2 \right]_0^b \]
\[ = \left( \frac{125}{3} + 50 \right) - (9 + 18) \]
\[ = 64 \frac{2}{3} \]
M1 Attempt integration
A1 Obtain \( \frac{1}{3} x^3 + 2x^2 \)
M1 Use limits \( x = 3, 5 \) – correct order & subtraction

b  
\[ \int \left( 2 - 6 \sqrt[3]{y} \right) \, dy = 2y - 4y^{\frac{2}{3}} + c \]
B1 State \( 2y \)
M1 Obtain \( ky^{\frac{2}{3}} \)
A1 3 Obtain \( -4y^{\frac{2}{3}} \) (condone absence of \( +c \))

C  
\[ \int 8x^{-3} \, dx = \left[ \frac{-4}{x^2} \right]_1^y \]
\[ = \left( 0 \right) - \left( -4 \right) \]
\[ = 4 \]
B1 State or imply \( \frac{1}{x^2} = x^{-3} \)
M1 Attempt integration of \( kx^n \)
A1 Obtain correct \(-4x^{-2} \) (+c)

A1 ft 4 Obtain 4 (or \( -k \) following their \( kx^2 \))

7 (i)  
\[ \frac{\sin^2 x - \cos^2 x}{1 - \sin^2 x} = \frac{\sin^2 x - \cos^2 x}{\cos^2 x} \]
\[ = \frac{\sin^2 x - \cos^2 x}{\cos^2 x} \]
\[ = \frac{\sin^2 x}{\cos^2 x} - \frac{\cos^2 x}{\cos^2 x} \]
\[ = \tan^2 x - 1 \]
M1 Use either \( \sin^2 x + \cos^2 x = 1 \), or \( \tan x = \frac{\sin x}{\cos x} \)
A1 2 Use other identity to obtain given answer convincingly.

(ii)  
\[ \tan^2 x - 1 = 5 - \tan x \]
\[ \tan^2 x + \tan x - 6 = 0 \]
\[ (\tan x - 2)(\tan x + 3) = 0 \]
\[ \tan x = 2, \tan x = -3 \]
\[ x = 63.4^\circ, 243^\circ, x = 108^\circ, 288^\circ \]
B1 State correct equation
M1 Attempt to solve three term quadratic in \( \tan x \)
A1 Obtain 2 and -3 as roots of their quadratic
M1 Attempt to solve \( \tan x = k \) (at least one root)
A1 ft Obtain at least 2 correct roots
A1 6 Obtain all 4 correct roots
8 a  \[ \log 5^{3w-1} = \log 4^{250} \]
\[ (3w-1) \log 5 = 250 \log 4 \]
\[ 3w - 1 = \frac{250 \log 4}{\log 5} \]
\[ w = 72.1 \]  
\[ \text{M1*} \text{ Introduce logarithms throughout} \]
\[ \text{M1*} \text{ Use } \log a^b = b \log a \text{ at least once} \]
\[ \text{A1} \text{ Obtain } (3w-1) \log 5 = 250 \log 4 \text{ or equiv} \]
\[ \text{M1d*} \text{ Attempt solution of linear equation} \]
\[ \text{A1} \text{ Obtain 72.1, or better} \]

b  \[ \log \left( \frac{5y+1}{3} \right) = 4 \]
\[ \frac{5y+1}{3} = x^4 \]
\[ 5y + 1 = 3x^4 \]
\[ y = \frac{3x^4 - 1}{5} \]  
\[ \text{M1} \text{ Use } \log a - \log b = \log \frac{a}{b} \text{ or equiv} \]
\[ \text{M1} \text{ Use } f(y) = x^4 \text{ as inverse of } \log \text{, } f(y) = 4 \]
\[ \text{M1} \text{ Attempt to make } y \text{ the subject of } f(y) = x^4 \]
\[ \text{A1} \text{ Obtain } y = \frac{3x^4 - 1}{5} , \text{ or equiv} \]

9 (i)  \[ ar = a + d, \quad ar^3 = a + 2d \]
\[ 2ar - ar^3 = a \]
\[ ar^3 - 2ar + a = 0 \]
\[ r^3 - 2r + 1 = 0 \]  
\[ \text{A1} \text{ Show } r^3 - 2r + 1 = 0 \text{ convincingly} \]

(ii)  \[ f(r) = (r-1)(r^2 + r - 1) \]
\[ r = \frac{-1 \pm \sqrt{5}}{2} \]
\[ \text{M1*} \text{ Attempt to find quadratic factor} \]
\[ \text{A1} \text{ Obtain } r^2 + r - 1 \]
\[ \text{M1d*} \text{ Attempt to solve quadratic} \]
\[ \text{A1} \text{ Obtain } r = \frac{-1 + \sqrt{5}}{2} \text{ only} \]

(iii)  \[ a = r, \quad \frac{a}{1-r} = 3 + \sqrt{5} \]
\[ a = \frac{3 - \sqrt{5}}{2} (3 + \sqrt{5}) \]
\[ a = \frac{9}{2} - \frac{1}{2} \]
\[ a = 2 \]  
\[ \text{M1} \text{ Equate } S_n \text{ to } 3 + \sqrt{5} \]
\[ \text{A1} \text{ Obtain } \frac{a}{1 - \left( \frac{3 + \sqrt{5}}{2} \right)} = 3 + \sqrt{5} \]
\[ \text{M1} \text{ Attempt to find } a \]
\[ \text{A1} \text{ Obtain } a = 2 \]