Mark Scheme for June 2010
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1 (i) \( f(2) = 8 + 4a - 2a - 14 \)
\[ 2a - 6 = 0 \]
\[ a = 3 \]

**M1**
Attempt \( f(2) \) or equiv, including inspection / long division / coefficient matching

**M1d**
Equate attempt at \( f(2) \), or attempt at remainder, to 0 and attempt to solve

**A1**
Obtain \( a = 3 \)

(ii) \( f(-1) = -1 + 3 + 3 - 14 \)
\[ = -9 \]

**M1**
Attempt \( f(-1) \) or equiv, including inspection / long division / coefficient matching

**A1 ft**
Obtain -9 (or \( 2a - 15 \), following their \( a \))

2 (i) \[ \text{area} \approx \frac{1}{2} \times 3 \times \left( \sqrt{8} + 2\left(\sqrt{11} + \frac{1}{\sqrt{14}}\right) + \sqrt{17} \right) \]
\[ \approx 20.8 \]

**B1**
State or imply at least 3 of the 4 correct \( y \)-coords , and no others

**M1**
Use correct trapezium rule, any \( h \), to find area between \( x = 1 \) and \( x = 10 \)

**M1**
Correct \( h \) (soi) for their \( y \)-values – must be at equal intervals

**A1**
Obtain 20.8 (allow 20.7)

(ii) use more strips / narrower strips

**B1**
Any mention of increasing \( n \) or decreasing \( h \)

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

**B1**
Obtain \( 1 + 5x \)

**M1**
Attempt at least the third (or fourth) term of the binomial expansion, including coeffs

**A1**
Obtain \( 11.25x^2 \)

**A1**
Obtain \( 15x^3 \)

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

**M1**
Attempt at least one relevant term, with or without powers of \( x \)

**A1 ft**
Obtain correct (unsimplified) terms (not necessarily summed) – either coefficients or still with powers of \( x \) involved

**A1**
Obtain 100
4 (i) \( u_1 = 6, u_2 = 11, u_3 = 16 \)\[
\begin{array}{ll}
B1 & 1 \text{ State } 6, 11, 16 \\
\end{array}
\]

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

\begin{array}{ll}
M1 & \text{Show intention to sum the first 40 terms of a sequence} \\
M1 & \text{Attempt sum of their AP from (i), with } n = 40, a = \text{their } u_1 \text{ and } d = \text{their } u_2 - u_1 \\
A1 & 3 \text{ Obtain } 4140 \\
\end{array}

(iii) \( w_3 = 56 \)

\begin{array}{ll}
M1 & \text{State or imply } w_3 = 56 \\
M1 & \text{Attempt to solve } u_p = k \\
A1 & 3 \text{ Obtain } p = 11 \\
\end{array}

5 (i) \[
\frac{\sin \theta}{8} = \frac{\sin 65}{11}
\]

\begin{array}{ll}
M1 & \text{Attempt use of correct sine rule} \\
A1 & 2 \text{ Obtain } 41.2^\circ, \text{ or better} \\
\end{array}

(ii) a \[
180 - (2 \times 65) = 50^\circ \text{ or } 65 \times \frac{\pi}{180} = 1.134 \\
50 \times \frac{\pi}{180} = 0.873 \text{ A.G. } \pi - (2 \times 1.134) = 0.873 \\
\]

\begin{array}{ll}
M1 & \text{Use conversion factor of } \frac{\pi}{180} \\
A1 & 2 \text{ Show } 0.873 \text{ radians convincingly (AG)} \\
\end{array}

(ii) b \[
\text{area sector } = \frac{1}{2} \times 8^2 \times 0.873 = 27.9 \\
\text{area triangle } = \frac{1}{2} \times 8^2 \times \sin 0.873 = 24.5 \\
\text{area segment } = 27.9 - 24.5 = 3.41 \\
\]

\begin{array}{ll}
M1 & \text{Attempt area of sector, using } \frac{1}{2} \times r^2 \theta \\
M1 & \text{Attempt area of triangle using } \frac{1}{2} \times r^2 \sin \theta \\
M1 & \text{Subtract area of triangle from area of sector} \\
A1 & 4 \text{ Obtain } 3.41 \text{ or } 3.42 \\
\end{array}
6 a  \[ \int \left( x^2 + 4x \right) dx = \left[ \frac{1}{3} x^3 + 2x^2 \right]_b^a \]

\[ = \left( \frac{125}{3} + 50 \right) - (9 + 18) \]

\[ = 64 \frac{2}{3} \]

M1 Attempt integration
A1 Obtain \( \frac{1}{3} x^3 + 2x^2 \)
M1 Use limits \( x = 3 \), 5 – correct order & subtraction

b  \[ \int \left( 2 - 6\sqrt{y} \right) dy = 2y - 4y^\frac{3}{2} + c \]

B1 State 2y
M1 Obtain \( ky^\frac{3}{2} \)
A1 3 Obtain \(-4y^\frac{3}{2}\) (condone absence of + c)

\[ \int \left( 8x^{-3} \right) dx = \left[ -\frac{4}{x^2} \right]_1^3 \]

\[ = (0) - (-4) \]

\[ = 4 \]

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) \[ \frac{\sin^2 x - \cos^2 x}{1 - \sin^2 x} = \frac{\sin^2 x - \cos^2 x}{\cos^2 x} \]

\[ = \frac{\sin^2 x}{\cos^2 x} - \frac{\cos^2 x}{\cos^2 x} \]

\[ = \tan^2 x - 1 \]

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)
A1ft Obtain at least 2 correct roots
A1 6 Obtain all 4 correct roots
8 a  \[ \log 5^{3w-1} = \log 4^{250} \]

\[ (3w-1) \log 5 = 250 \log 4 \]

\[ 3w - 1 = \frac{250 \log 4}{\log 5} \]

\[ w = 72.1 \]

M1* Introduce logarithms throughout

M1* Use \( a^b = b \log a \) at least once

A1 Obtain \( (3w-1) \log 5 = 250 \log 4 \) or equiv

M1d* Attempt solution of linear equation

A1 Obtain 72.1, or better

b \[ \frac{5y+1}{3} = 4 \]

\[ 5y + 1 = x^4 \]

\[ 5y + 1 = 3x^4 \]

\[ y = \frac{3x^4 - 1}{5} \]

M1 Use \( \log a - \log b = \log \frac{a}{b} \) or equiv

M1 Use \( f(y) = x^4 \) as inverse of \( \log \), \( f(y) = 4 \)

M1 Attempt to make \( y \) the subject of \( f(y) = x^4 \)

A1 4 Obtain \( y = \frac{3x^4 - 1}{5} \), or equiv

9 (i) \[ ar = a + d, \quad ar^3 = a + 2d \]

\[ 2ar - ar^3 = a \]

\[ ar^3 - 2ar + a = 0 \]

\[ r^3 - 2r + 1 = 0 \quad \text{A.G.} \]

M1 Attempt to link terms of AP and GP, implicitly or explicitly.

M1 Attempt to eliminate \( d \), implicitly or explicitly, to show given equation.

A1 3 Show \( r^3 - 2r + 1 = 0 \) convincingly

(ii) \( f(r) = (r-1)(r^2 + r - 1) \)

\[ r = \frac{-1 \pm \sqrt{5}}{2} \]

Hence \( r = \frac{-1 + \sqrt{5}}{2} \)

M1* Identify \( r - 1 \) as factor or \( r = 1 \) as root

M1 Attempt to find quadratic factor

A1 Obtain \( r^2 + r - 1 \)

M1d* Attempt to solve quadratic

A1 5 Obtain \( r = \frac{-1 + \sqrt{5}}{2} \) only

(iii) \[ \frac{a}{1-r} = 3 + \sqrt{5} \]

\[ a = \left( \frac{3}{2} - \frac{\sqrt{5}}{2} \right)(3 + \sqrt{5}) \]

\[ a = \frac{9}{2} - \frac{5}{2} \]

\[ a = 2 \]

M1 Equate \( S_n \) to \( 3 + \sqrt{5} \)

A1 Obtain \( \frac{a}{1 - \left( \frac{-3 + \sqrt{5}}{2} \right)} = 3 + \sqrt{5} \)

M1 Attempt to find \( a \)

A1 4 Obtain \( a = 2 \)
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