Mark Scheme for June 2010
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1

Establish result true for $n = 1$ or $n = 2$

Add next term to given sum formula

Attempt to factorise or expand and simplify to correct expression

Correct expression obtained

Specific statement of induction conclusion

2

(i) $(-7)$

Obtain a single value

Obtain correct answer as a matrix

(ii) $BA = \begin{pmatrix} 5 & -20 \\ 3 & -12 \end{pmatrix}$

Obtain a $2 \times 2$ matrix

All elements correct

$4C$ seen or implied by correct answer

Obtain correct answer, ft for a slip in $BA$

3

Either

$\frac{2}{3} n(n+1)(2n+1) - 2n(n+1) + n$

$\frac{1}{3} n(2n-1)(2n+1)$

Or

$\sum_{i=1}^{2n} r^2 - 4 \sum_{i=1}^{n} r^2$

$\frac{1}{6} \times 2n(2n+1)(4n+1) - 4 \times \frac{1}{6} n(n+1)(2n+1)$

$\frac{1}{3} n(2n-1)(2n+1)$

Express as a sum of 3 terms

Use standard sum results

Correct unsimplified answer

Attempt to factorise

Obtain at least factor of $n$ and a quadratic

Obtain correct answer a.e.f.

Express as difference of 2 $\sum r^2$ series

Use standard result

Correct unsimplified answer

Attempt to factorise

Obtain at least factor of $n$

Obtain correct answer
4 (i) \( 5 + 12i \)
\[
\begin{align*}
\text{Correct real and imaginary parts} \\
\text{Correct modulus} \\
\text{Correct argument}
\end{align*}
\]

(ii) 
\[
\frac{-11}{85} + \frac{27}{85}i
\]

Obtain correct numerator
Obtain correct denominator

5 (a) 
\[
\begin{pmatrix}
0 & 1 \\
1 & 0
\end{pmatrix}
\]

Each column correct
SC B2 use correct matrix from MF1
Can be trig form

(b) (i) 

(ii) 

Stretch, in \( x \)-direction sf 5
Rotation, 60° clockwise

6 (i) (a) 

(b) 

Circle centre (3, –4), through origin
Vertical line, clearly \( x = 3 \)

(ii) 

Inside their circle
And to right of their line, if vertical
7

**Either**

\[ \alpha + \beta = -2k \quad \alpha \beta = k \]

\[ y^2 - 4ky + 4k = 0 \]

**Or**

\[ \alpha + \beta = -2k \]

\[ y = \frac{-2k}{x} \]

\[ y^2 - 4ky + 4k = 0 \]

**B1B1** State or use correct results
**M1** Attempt to find sum of new roots
**A1** Obtain 4k
**M1** Attempt to find product of new roots
**A1** Obtain 4k
**B1ft** Correct quadratic equation a.e.f.

\[ \frac{-k \pm \sqrt{k^2 - k}}{2k} \]

\[ \frac{\alpha + \beta}{\alpha} = \frac{2k}{k + \sqrt{k^2 - k}}, \quad \frac{\alpha + \beta}{\beta} = \frac{2k}{k - \sqrt{k^2 - k}} \]

\[ y^2 - 4ky + 4k = 0 \]

**B1** Find roots of original equation
**B1** Express both new roots in terms of k

**M1** Attempt to find sum of new roots
**A1** Obtain 4k
**M1** Attempt to find product of new roots
**A1** Obtain 4k
**B1ft** Correct quadratic equation a.e.f.
8

(i) M1 Attempt to rationalise denominator or cross multiply
A1 2 Obtain given answer correctly

(ii) M1 Express terms as differences using (i)
M1 Attempt this for at least 1st three terms
A1 1st three terms all correct
A1 Last two terms all correct
M1 Show pairs cancelling
A1 6 Obtain correct answer, in terms of n

\[ \frac{1}{2}(\sqrt{n+2} + \sqrt{n+1} - \sqrt{2} - 1) \]

(iii) B1 1 Sensible statement for divergence

9

(i) M1 Show correct expansion process for 3 x 3
M1 Correct evaluation of any 2 x 2
A1 3 Obtain correct answer

\[ \det A = a^2 - a \]

(ii) (a) M1 Find a pair of inconsistent equations
A1 State inconsistent or no solutions

(b) M1 Find a repeated equation
A1 State non unique solutions

(c) B1 State that det A is non-zero or find correct solution
B1 6 State unique solution

SC if detA incorrect, can score 2 marks for correct deduction of a unique solution, but only once

10

(i) M1 Attempt to equate real and imaginary parts
A1 Obtain both results
M1 Eliminate to obtain quadratic in \( x^2 \) or \( y^2 \)
M1 Solve to obtain \( x \) or \( y \) value
A1 5 Obtain correct answer as a complex no.

\[ x^2 - y^2 = 3 \quad xy = 2 \]

\[ z = 2 + i \]

(ii) B1 1 Obtain given answer correctly

(iii) M1 Attempt to solve quadratic equation
A1 Obtain correct answers
M1 Choose negative sign
M1 Relate required value to conjugate of (i)
A1 5 Obtain correct answer

\[ w^3 = 2 \pm 11i \]

\[ w = 2 - i \]