1

B1		Establish result true for $n = 1$or $n = 2$
M1		Add next term to given sum formula
M1		Attempt to factorise or expand and simplify to correct expression
A1		Correct expression obtained
A1	**5**	Specific statement of induction conclusion

5

---

2 **(i)** (-7)

M1		Obtain a single value
A1	**2**	Obtain correct answer as a matrix

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

$\begin{pmatrix} -7 & -20 \\ 11 & -20 \end{pmatrix}$

M1		Obtain a 2×2 matrix
A1		All elements correct
B1		4**C** seen or implied by correct answer
B1ft	**4**	Obtain correct answer, ft for a slip in **BA**

6

---

3 Either

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

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

Or

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

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

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

M1		Express as a sum of 3 terms
M1		Use standard sum results
A1		Correct unsimplified answer
M1		Attempt to factorise
A1		Obtain at least factor of n and a quadratic
A1	**6**	Obtain correct answer a.e.f.
M1		Express as difference of 2 $\sum r^2$ series
M1		Use standard result
A1		Correct unsimplified answer
M1		Attempt to factorise
A1		Obtain at least factor of n
A1		Obtain correct answer

6

4	**(i)**	5 + 12i 13 67.4^{o} or 1.18	B1B1 B1ft B1ft **4**	Correct real and imaginary parts Correct modulus Correct argument
	(ii)	$-\frac{11}{85}-\frac{27}{85}\mathrm{i}$	M1 A1 A1 **3**	Multiply by conjugate Obtain correct numerator Obtain correct denominator
			7	
5	**(a)**	$\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$	B1B1**2**	Each column correct **SC B2 use correct matrix from MF1** **Can be trig form**
	(b)	**(i)** **(ii)**	B1B1**2** B1B1**2**	Stretch, in x-direction sf 5 Rotation, 60^{o} clockwise
			6	
6	**(i)**	**(a)** **(b)**	B1B1**2** B1B1**2**	Circle centre (3, –4), through origin Vertical line, clearly $x = 3$
	(ii)		B1ft B1ft **2**	Inside their circle And to right of their line, if vertical
			6	

7 *Either*

$\alpha+\beta=-2k \quad \alpha\beta=k$

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 **7** Correct quadratic equation a.e.f.

$y^2-4ky+4k=0$

Or

$\alpha+\beta=-2k$

$\frac{-2k}{\alpha}$

$y=\frac{-2k}{x}$

B1 State or use correct result

B1 State or imply form of new roots

B1 State correct substitution

M1 Rearrange and substitute for x

A1 Correct unsimplified equation

M1 Attempt to clear fractions

A1 Correct quadratic equation a.e.f.

$y^2-4ky+4k=0$

Or

$-k\pm\sqrt{k^2-k}$

B1 Find roots of original equation

$\frac{\alpha+\beta}{\alpha}=\frac{2k}{k+\sqrt{k^2-k}}, \frac{\alpha+\beta}{\beta}=\frac{2k}{k-\sqrt{k^2-k}}$

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.

$y^2-4ky+4k=0$

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
		$\frac{1}{2}(\sqrt{n+2}+\sqrt{n+1}-\sqrt{2}-1)$	A1	6	Obtain correct answer, in terms of n
	(iii)		B1	1	Sensible statement for divergence
				9	
9	(i)		M1		Show correct expansion process for 3 x 3
			M1		Correct evaluation of any 2 x 2
		det **A** = $a^2 - a$	A1	3	Obtain correct answer
	(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
				9	
10	(i)		M1		Attempt to equate real and imaginary parts
		$x^2 - y^2 = 3 \quad xy = 2$	A1		Obtain both results
			M1		Eliminate to obtain quadratic in x^2 or y^2
			M1		Solve to obtain x or y value
		$z = 2 + \mathrm{i}$	A1	5	Obtain correct answer as a complex no.
	(ii)		B1	1	Obtain **given** answer correctly
	(iii)		M1		Attempt to solve quadratic equation
		$w^3 = 2 \pm 11\,\mathrm{i}$	A1		Obtain correct answers
			M1		Choose negative sign
			M1		Relate required value to conjugate of (i)
		$w = 2 - \mathrm{i}$	A1	5	Obtain correct answer
				11	