RECOGNISING ACHIEVEMENT

GCE

Mathematics

Advanced GCE

Unit **4725:** Further Pure Mathematics 1

Mark Scheme for June 2011

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1	**(i)**	$\begin{pmatrix} 4 & 4a \\ 12 & 0 \end{pmatrix}$	B1		3**B** seen or implied
			B1		2 elements correct
			B1	**3**	Other 2 elements correct, a.e.f., including brackets
	(ii)	$\begin{pmatrix} 4+4a & 3a \\ 4 & 1 \end{pmatrix}$	M1		Sensible attempt at matrix multiplication for **AB** or **BA**
			A1	**2**	Obtain correct answer
			$\boxed{5}$		
2			B1		Establish result true for n = 1 or 2
			M1*		Add next term to given sum formula
			DM1		Combine with correct denominator
			A1		Obtain correct expression convincingly
			A1	**5**	Specific statement of induction conclusion, provided 1st 4 marks earned
			$\boxed{5}$		
3		$k^2 - 16$	B1		Obtain correct det
			M1		Equate their det to 0
		$k = \pm 4$	A1	**3**	Obtain correct answers
			$\boxed{3}$		
4			M1		Express as sum of two series
		$3 \times \frac{1}{6} \times 2n(2n+1)(4n+1) - \frac{1}{2} \times 2n$	A1 A1		Each term correct a.e.f.
			M1		Attempt to factorise
		$2n^2(4n+3)$	A2	**6**	Completely correct answer, (A1 if one factor not found)
			$\boxed{6}$		
5	**(i)**	$\lvert a \rvert = 2$	B1		Correct modulus
		$\arg a = 60°, \frac{\pi}{3}$, 1.05	B1	**2**	Correct argument
	(ii)		B1		Circle
			B1		Centre $(1, \sqrt{3})$
			B1		Through origin, centre $(\pm 1, \pm\sqrt{3})$ and another y intercept
			B1		Vertical line
			B1*		Through a or their centre, with +ve gradient
			DB1		Correct half line
				6	
			$\boxed{8}$		

6		M1		Show correct expansion process for 3×3 or multiplication of **C** and adj**C**
		M1		Correct evaluation of any 2×2
	det **C** = $\Delta = 5a-5$	A1		Obtain correct answer
		M1		Show correct process for adjoint entries
	$\frac{1}{\Delta}\begin{pmatrix}5 & -4 & 1\\ -5 & 4a & -a\\ 5 & -3a-1 & 2a-1\end{pmatrix}$	A1		Obtain at least 4 correct entries in adjoint
		A1		Obtain completely correct adjoint
		B1	**7**	Divide their adjoint by their determinant
		$\boxed{7}$		
7	**(i)**	B1	**1**	Obtain **given** answer correctly
	(ii)	M1		Express at least 1st two and last two terms using (i)
		A1		1st two terms correct
		A1		Last two terms correct
		M1		Show that correct terms cancel
	$\frac{3}{2}-\frac{1}{n}-\frac{1}{(n+1)}$	A1	**5**	Obtain correct answer, a.e.f. in terms of *n*
	(iii)	B1ft		Sum to infinity stated or implied or start at 1000 as in (ii)
		M1		S_∞ – their (ii) with *n* = 999 or 1000 or show correct cancelling
	$\frac{1999}{999000}$	A1	**3**	Obtain correct answer, a.e.f.
				(condone 0.002)
		$\boxed{9}$		
8	**(i)**	B1		(0, 3) seen
		B1		(3, 0) seen
		B1	**3**	Square with A ’ B’ and C’ positioned correctly
	(ii) $\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$ **or** $\begin{pmatrix}0 & -1\\ -1 & 0\end{pmatrix}$	B1*		Reflection in *y* = *x* or *y* = -*x*
		DB1		Correct matrix, dep on stating reflection
	$\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix}$ **or** $\begin{pmatrix}-3 & 0\\ 0 & -3\end{pmatrix}$	B1*		Enlargement scale factor 3 or s.f. -3
		DB1	**4**	Correct matrix, dep on stating enlargement **S.C. B2 for a pair of transformations consistent with their diagram.**
		$\boxed{7}$		

9	(i)	16 + 30i	B1	1	State correct value
	(ii)		M1		Use $a = -$ (sum of roots)
		$a = -32$	A1		Obtain correct answer
			M1		Use b = product of roots
		$b = 1156$	A1	4	Obtain correct answer
			M1		Substitute, expand and equate imag. parts
			A1		Obtain **a** = -32
			M1		Equate real parts
			A1		Obtain b = 1156
	(iii)		M1		Attempt to equate real and imaginary parts of $(p+iq)^2$ & 16 – 30i or root from (ii)
		$p^2 - q^2 = 16$ and $pq = -15$	A1		Obtain both results cao
			M1		Obtain quadratic in p^2 or q^2
			M1		Solve to obtain $p = (\pm)5$ or $q = (\pm)3$
			A1		Obtain 2 correct answers as complex nos
			M1		Attempt at all 4 roots
		$\pm$ (5 ± 3i)	A1	7	State other two roots as complex nos
			$\boxed{12}$		
10	(i)				
		$\frac{1}{u^{\frac{3}{2}}} + \frac{3}{u} + 2 = 0$	B1		Use substitution correctly
		EITHER	M1		Rearrange
			M1		Square
		$\frac{9}{u^2} + \frac{12}{u} + 4 = \frac{1}{u^3}$	A1		Obtain correct equation
		$4u^3 + 12u^2 + 9u - 1 = 0$	A1	5	Obtain **given** answer
		OR			
		e. g. $(2u^{3/2} + 3u^{1/2} + 1)(2u^{3/2} + 3u^{1/2} - 1) = 0$	M2		Multiply their equation in u by appropriate related expression
			A2		Obtain **given** answer
	(ii)		B1		Stated or imply that $u = \frac{1}{x^2}$
			M1		Use $-\frac{b}{a}$
		-3	A1		Obtain correct answer
			M1		Use $\frac{c}{a}$
		$\frac{9}{4}$	A1	5	Obtain correct answer
			$\boxed{10}$		

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