OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics

Advanced Subsidiary GCE

Unit **4725:** Further Pure Mathematics 1

Mark Scheme for June 2013

Oxford Cambridge and RSA Examinations

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

Annotation in scoris	**Meaning**
✓and ✖	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
aef	Any equivalent form

Subject-specific Marking Instructions for GCE Mathematics Pure strand

a. Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded e
It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is d
in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be ju
answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working mus
looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect meth
must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award mark
the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) yo
your Team Leader.

c. The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Meth
usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just t
intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in ha
substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M ma
specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unle
Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E

A given result is to be established or a result has to be explained. This usually requires more working or explan th of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where through the correct answer as part of a wrong argument.

d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme spec otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particula dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has or a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, w steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incor Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mar rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not sh image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-quest

f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwis expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. S the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regard cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt Team Leader.

g. Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h. For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain un according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally app this may differ for some units. This is achieved by withholding one A mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

Question			Answer	Marks	Guidan
1			$\sqrt{3}$ $2\sqrt{3}$ $3-\sqrt{3}i$ $-\sqrt{3}\,i$	M1 A1 M1 A1FT B1FT B1FT **[6]**	Use correct trig expression Obtain correct answer Correct expression for modulus Obtain correct answer aef Correct conjugate seen or implied Correct answer
2	(i)		$\begin{pmatrix}7 & 23\end{pmatrix}$	B1B1 **[2]**	Each element correct, missing brackets B1 only
2	(ii)		$\begin{pmatrix}6 & -15\\ 4 & -10\end{pmatrix}$ det **CB** = 0 singular	M1 A1 A1 A1FT A1FT **[5]**	Obtain 2 × 2 matrix Obtain 2 correct elements Obtain other 2 correct elements Obtain their det **CB,** must be a 2 × 2 matrix Correct conclusion from their det **CB**
3			$x^2-y^2=11$ and $xy=6\sqrt{5}$ $\pm(2\sqrt{5}+3i)$	M1 A1 M1* DM1 A1 A1 **[6]**	Attempt to equate real and imaginary parts of $(x+iy)^2$ Obtain both results cao Obtain a quadratic in x^2 or y^2 Solve a 3 term quadratic to obtain a value for x or y Obtain 1 correct answer as complex number Obtain only the other correct answer
4			$2\left(2^{k+1}-2\right)+2$ or $2^{k+1}+2^{k+1}-2$	B1 M1 A1 A1 A1 B1 **[6]**	Establish result true for $n = 1$ or $n = 2$ Multiply **M** and $\mathbf{M}^k$, either order Obtain correct element Obtain other 3 correct elements Obtain $2^{k+2}-2$ convincingly Specific statement of induction conclusion, provided verified for $n = 1$

Question			Answer	Marks	Guid
5			$4\times\frac{1}{4}n^2(n+1)^2-3\times\frac{1}{6}n(n+1)(2n+1)+\frac{1}{2}n(n+1)$	M1	Express as sum of three series
				A1	Obtain 2 correct (unsimplified) terms
				A1	Obtain correct 3rd (unsimplified) term
			$n^3(n+1)$	M1	Attempt to factorise, at least factor of n
				A2	Obtain correct answer, A1 if not fully factorised
				[6]	
6	(i)			M1	Use arg $(z-a)=\theta$ in equation for l condone missing
			$\arg(z-3i)=\frac{1}{4}\pi$	A1	Obtain correct answer
				M1	Use $\lvert z-a\rvert=k$ in equation for C, k must be real
			$\lvert z-3i\rvert=3$	A1	Obtain correct answer
				[4]	
	(ii)		$\lvert z-3i\rvert\le 3$ or e.g. $x^2+(y-3)^2\le 9$	B1	Obtain correct inequality, or answer consistent with s
			$\frac{1}{4}\pi\le\arg(z-3i)\le\frac{1}{2}\pi$ or $y\ge x+3,\ x\ge 0$	B1 B1	Each correct single inequality, or answer consistent wi
				[3]	**SC if < used consistently, but otherwise all correct,**
7	(i)		$\begin{pmatrix}0&1\\-1&0\end{pmatrix}$	B1B1	Each column correct
				[2]	
	(ii)		$\begin{pmatrix}1&0\\0&-1\end{pmatrix}$	B1B1	Each column correct
				[2]	
	(iii)		$\begin{pmatrix}0&1\\1&0\end{pmatrix}$	M1	Attempt at matrix multiplication in correct order
				A1FT	Obtain correct answer from their **(i)** and **(ii)**
				[2]	
	(iv)		Reflection, in $y=x$	B1B1	Correct description of their **(iii) only**
				[2]	

Question			Answer	Marks	Guid
8			*Either*		
			$\sum\alpha = -\frac{6}{k}, \sum\alpha\beta = \frac{1}{k}$	B1B1	Correct values stated or used
			$\sum\alpha\beta + 2\sum\alpha + 3$	M1	Expand brackets
				A1	Obtain correct expression aef
			$3 - \frac{11}{k}$	M1	Use their values, in terms of *k*, for $\sum\alpha$ and $\sum\alpha\beta$
				A1	Obtain correct answer aef
				[6]	
			Or		
				B1	State or use substitution $x = u - 1$
				M1	Expand and attempt to simplify coefficients
			$ku^3 + (6-3k)u^2 + (3k-11)u + 2 - k = 0$	A1 A1	Obtain at least correct 1st and 3rd terms
				M1	Use their "$\frac{c}{a}$"
			$3 - \frac{11}{k}$	A1	Obtain correct answer a.e.f.
9	(i)			M1	Use correct denominator or partial fractions
				A1	Obtain **given** answer convincingly
				[2]	
	(ii)			M1	Express at least 1st two and last term using **(i)**
				A1	All terms correct
				M1	Show correct terms cancelling
			$\frac{1}{2} - \frac{1}{6n+2}$	A1	Obtain correct unsimplified answer
				M1	Include $\frac{1}{3}$ and combine their sum as a single fraction
				A1	Obtain **given** answer
				[6]	

Question			Answer	Marks	Guid
10	(i)			M1	Show correct expansion process for 3 × 3
				M1	Correct evaluation of any 2 × 2
			$a + 3$	A1	Obtain correct answer
				M1	Use det **A** = 0
			$a = -3$	A1FT	Obtain correct answer from their det **A**
				[5]	
	(ii)		$\frac{1}{a+3}\begin{pmatrix} 1 & -1 & 1 \\ 7 & a-4 & 1-2a \\ -11 & 8-a & 3a-2 \end{pmatrix}$	M1	Show correct processes for adjoint entries
				A1	Obtain at least 4 correct entries in adjoint
				A1	Obtain completely correct adjoint
				B1	Divide adjoint by their det **A**
			$\frac{1}{a+3}\begin{pmatrix} 2 \\ 2-4a \\ 7a-1 \end{pmatrix}$	M1	Pre-multiply column matrix by their $\mathbf{A}^{-1}$
				A2	Obtain correct answer, A1 for 1 element correct
				[7]	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553