OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4751:** Introduction to Advanced Mathematics

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 and abbreviations

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

Subject-specific Marking Instructions for GCE Mathematics (MEI) 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 no full marks. 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 sc to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but w judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key working must always be 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* incor work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark sch according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or cand involved) you should contact 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 underst marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficie just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied t problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be associated 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 explanati establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working fo correc ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this wo pply candidate passes 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 says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indic mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that whe once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied be given.

e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (ac not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermedia solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable the mark scheme 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 mark 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question ev shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rat by-question.

f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figure norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where should not normally be penalised, while answers which are grossly over- or under-specified should normally resul mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue sho the mark scheme rationale. If in doubt, contact your 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 do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what ap (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 unchanged, award the mark according to the scheme but following through from the candidate's data. A penalty is then applied to the mark that is awarded in the question. This is appropriate, though 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	Guidanc	
1			$y = -0.5x + 3$ oe www isw	3 [3]	B2 for $2y = -x + 6$ oe or M1 for gradient $= -\frac{1}{2}$ oe seen or used and M1 for $y - 1 =$ *their m* $(x - 4)$	for or M1 for $y =$ substituted
2			substitution to eliminate one variable simplification to $ax = b$ or $ax - b = 0$ form, or equivalent for y (0.7, 0.1) oe or $x = 0.7$, $y = 0.1$ oe isw	M1 M1 A2 [4]	or multiplication to make one pair of coefficients the same; condone one error in either method or appropriate subtraction / addition; condone one error in either method A1 each	independent c
3	(i)		25	2 [2]	M1 for $\left(\frac{10}{2}\right)^2$ or $\left(\frac{1}{0.2}\right)^2$ oe soi or for $\frac{1}{0.04}$ oe	ie M1 for one correctly M0 for just $\frac{}{0}$
3	(ii)		$8a^9$	3 [3]	B2 for 8 or M1 for $16^{\frac{1}{4}} = 2$ soi and B1 for a^9	ignore ± eg M1 for 2^3;

4			$r=\sqrt{\dfrac{3V}{\pi(a+b)}}$ oe www as final answer	3 **[3]**	M1 for dealing correctly with 3 and M1 for dealing correctly with $\pi(a + b)$, ft and M1 for correctly finding square root, ft *their* 'r^2 ='; square root symbol must extend below the fraction line	le-d w p condon M0 if ±... or for M3, final
5			f(2) = 18 seen or used $32 + 2k - 20 = 18$ oe [k =] 3	M1 A1 A1 **[3]**	or long division oe as far as obtaining a remainder (ie not involving x) and equating that remainder to 18 (there may be errors along the way) after long division: $2(k + 16) - 20 = 18$ oe	 A0 for just 2^5 implied by fu

6			−2560 www	4 **[4]**	B3 for 2560 from correct term (NB coefficient of x^4 is 2560) or B3 for neg answer following $10 \times 4 \times -64$ and then an error in multiplication or M2 for $10 \times 2^2 \times (-4)^3$ oe; must have multn signs or be followed by a clear attempt at multn; or M1 for $2^2 \times (-4)^3$ oe (condone missing brackets) or for 10 used or for 1 5 10 10 5 1 seen for those who find the coefft of x^2 instead: allow M1 for 10 used or for 1 5 10 10 5 1 seen ; and a further SC1 if they get 1280, similarly for finding coefficient of x^4 as 2560	rms f x but eg 1 gets M2 on condone miss for $10 \times 2^2 \times$ ${}^5C_3$ or factoria sufficient but 10 may be un M1 only for e table with no of attempt at [lack of neg s means that th eligible for ju
7	**(i)**		$5^{3.5}$ oe or $k = 7/2$ oe	2 **[2]**	M1 for $125 = 5^3$ or $\sqrt{5} = 5^{\frac{1}{2}}$ soi	M0 for just ar reference to 1

7	(ii)		attempting to multiply numerator and denominator of fraction by $1+2\sqrt{5}$	M1		ds a 10 are av wrongly multiplied by
			denominator = –19 soi	M1	must be obtained correctly, but independent of first M1	eg M1 for den minus sign in or with attem numerator
			$8+3\sqrt{5}$	A1 **[3]**		
8			$3(x-2)^2-7$ isw or $a=3$, $b=2$ $c=7$ www	4	B1 each for $a=3$, $b=2$ oe and B2 for $c=7$ oe or M1 for $[-]\frac{7}{3}$ or for $5-their\ a(their\ b)^2$ or for $\frac{5}{3}-(their\ b)^2$ soi	condone omis ignore '= 0' may be implie
			–7 or ft	B1 **[5]**	B0 for (2, –7)	may be obtain with calculus
9	(i)		$3n$ isw	1 **[1]**	accept equivalent general explanation	

9	**(ii)**		at least one of $(n-1)^2$ and $(n+1)^2$ correctly expanded	M1	must be seen	st n^2
			$3n^2 + 2$	B1		accept e expansions
			comment eg $3n^2$ is always a multiple of 3 so remainder after dividing by 3 is always 2	B1	dep on previous B1 B0 for just saying that 2 is not divisible by 3 – must comment on $3n^2$ term as well allow B1 for $\frac{3n^2+2}{3} = n^2 + \frac{2}{3}$	SC: n, $n+1$, obtain first M similar comm
				[3]		
10	**(i)**		[radius =] $\sqrt{20}$ or $2\sqrt{5}$ isw	B1	B0 for $\pm\sqrt{20}$ oe	
			[centre =] (3, 2)	B1		condone lack coordinates, h
				[2]		

10	**(ii)**		substitution of $x = 0$ or $y = 0$ into circle equation	M1	or use of Pythagoras with radius and a coordinate of the centre eg $20 - 2^2$ or $h^2 + 3^2 = 20$ ft their centre and/or radius	may m a bod int allow M1 fo $(y - 2)^2 = 20$
			$(x - 7)(x + 1)$ [=0]	M1	no ft from wrong quadratic; for factors giving two terms correct, or formula or completing square used with at most one error	completing sq at least $(x - a$ following use for attempt to
			(7, 0) and (–1, 0) isw	A1	accept $x = 7$ or -1 (both required)	
			$[y =]\dfrac{4 \pm \sqrt{(-4)^2 - 4 \times 1 \times (-7)}}{2}$ oe	M1	no ft from wrong quadratic; for formula or completing square used with at most one error	completing sq at least $(y - a$ following use for attempt to
			$\left(0, 2 \pm \sqrt{11}\right)$ or $\left(0, \dfrac{4 \pm \sqrt{44}}{2}\right)$ isw	A1 **[5]**	accept $y = \dfrac{4 \pm \sqrt{44}}{2}$ oe isw	annotation is earned in this each mark ea

10	**(iii)**		show both A and B are on circle	B1	explicit substitution in circle equation and at least one stage of interim working required oe	se o an
			(4, 5)	B2	B1 each or M1 for $\left(\frac{7+1}{2}, \frac{6+4}{2}\right)$	
			$\sqrt{10}$	B2	from correct midpoint and centre used; B1 for $\pm\sqrt{10}$ M1 for $(4-3)^2 + (5-2)^2$ or $1^2 + 3^2$ or ft their centre and/or midpoint, or for the square root of this	may be a long of ½ AB and no ft if one co as that of cent formula/Pytha centre correct annotation is earned in this each mark ear
				[5]		

11	**(i)**		sketch of cubic the right way up, with two tps and clearly crossing the x axis in 3 places	B1		n to ba at en turning doubling (continue to s y-axis or in 3 must clearly axis at both
			crossing/reaching the x-axis at $-4, -2$ and 1.5	B1	intersections must be shown correctly labelled or worked out nearby; mark intent	accept curve between 1 an
			intersection of y-axis at -24	B1 **[3]**		NB to find –2 f(x) here, whi this is done, p by (iii)A to al appears again
11	**(ii)**		-2, 0 and 7/2 oe isw or ft their intersections	2 **[2]**	B1 for 2 correct or ft or for (–2, 0) (0, 0) and (3.5, 0) or M1 for $(x + 2)\,x\,(2x - 7)$ oe or SC1 for –6, –4 and –1/2 oe	

11	**(iii)**	(*A*)	correct expansion of product of 2 brackets of f(x)	M1	need not be simplified; condone lack of brackets for M1 or allow M1 for expansion of all 3 brackets, showing all terms, with at most one error: $2x^3 + 4x^2 + 8x^2 - 3x^2 + 16x - 12x - 6x - 24$	$5x$ – or 8 may be part (i) wo image for (iii) than in (i)
			correct expansion of quadratic and linear and completion to given answer	A1 **[2]**	for correct completion if all 3 brackets already expanded, with some reference to show why –24 changes to –9	condone lack gone on to ex '+15' appeari NB answer gi process

11	**(iii)**	(*B*)	g(1) = 2 + 9 – 2 – 9 [=0]	B1	allow this mark for (x – 1) shown to be a factor and a statement that this means that x = 1 is a root [of g(x) = 0] oe	t g(9
			attempt at division by (x − 1) as far as $2x^3 - 2x^2$ in working	M1	or inspection with at least two terms of quadratic factor correct	M0 for div unless further 0 shown, but M1A1
			correctly obtaining $2x^2 + 11x + 9$	A1	allow B2 for another linear factor found by the factor theorem	NB mixture o this part – ma eg three uses or two uses pl factor;
			factorising a correct quadratic factor	M1	for factors giving two terms correct; eg allow M1 for factorising $2x^2 + 7x - 9$ after division by x + 1	allow M1 for –1 and –18/4 formula
			$(2x + 9)(x + 1)(x - 1)$ isw	A1 **[5]**	allow $2(x + 9/2)(x + 1)(x - 1)$ oe; dependent on 2nd M1 only; condone omission of first factor found; ignore '= 0' seen	SC alternative allow first M and then seco factorisation

12	(i)		$y = 2x + 3$ drawn accurately (–1.6 to –1.7, –0.2 to –0.3) (2.1 to 2.2, 7.2 to 7.4)	M1 B1 B1 **[3]**	at least as far as intersecting curve twice intersections may be in form $x = ...$, $y = ...$	ight (2, 1 if marking by relevant to (ii and in (ii) to a
12	(ii)		$\frac{1}{x-2} = 2x+3$ $1 = (2x + 3)(x – 2)$ $1 = 2x^2 – x – 6$ oe $\frac{1 \pm \sqrt{1^2 - 4 \times 2 \times -7}}{2 \times 2}$ oe $\frac{1 \pm \sqrt{57}}{4}$ isw	M1 M1 A1 M1 A1 **[5]**	or attempt at elimination of x by rearrangement and substitution condone lack of brackets for correct expansion; need not be simplified; NB A0 for $2x^2 – x – 7 = 0$ without expansion seen [given answer] use of formula or completing square on given equation, with at most one error isw eg coordinates; after completing square, accept $\frac{1}{4} \pm \sqrt{\frac{57}{16}}$ or better	may be seen i part (i) work a image for (ii) rather than in implies first M implies secon after $\frac{1}{x-2} = 2$ completing sc at least [2](x - stage oe with

12	**(iii)**		$\frac{1}{x-2}=-x+k$ and attempt at rearrangement	M1		
			$x^2-(k+2)x+2k+1[=0]$	M1	for simplifying and rearranging to zero; condone one error; collection of x terms with bracket not required	eg M1 b or M1 for x
			$b^2-4ac=0$ oe seen or used	M1		= 0 may not b implied by th
			$[k=]$ 0 or 4 as final answer, both required	A1 **[4]**	SC1 for 0 and 4 found if 3rd M1 not earned (may or may not have earned first two Ms)	eg obtained g calculus and/ range

Appendix: revised tolerances for modified papers for visually impaired candidates (graph in 12(i) with c ures)

12	**(i)**		$y = 2x + 3$ drawn accurately	M1	at least as far as intersecting curve twice	ru t (2, 7)
			(–1.6 to –1.**8**, –0.2 to –0.3)	B1	intersections may be in form $x = ...$, $y = ...$	
			(2.1 to 2.**3**, 7.**1** to 7.4)	B1		
				[3]		if marking by relevant to (ii and in (ii) to a

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