

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4752**: Concepts for Advanced Mathematics

Mark Scheme for January 2013

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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.

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Annotations

Annotation	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

- 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 either 0 or 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 scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the 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* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are 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 understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the 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 given unless the 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 explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a 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 the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep *’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in 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, when two or more 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 incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in 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 marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

- f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in 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 examiners should 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 appears to be the last (complete) attempt and ignore the others.

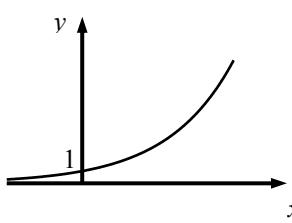
NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally 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	Guidance	
1		$kx^{\frac{5}{2}}$ $k = 12$ $+ c$	M1 A1 A1 [3]		
2	(i)	converging + valid reason	1 [1]		eg converges to 0, $r = \frac{1}{2}$, difference between terms decreasing, sum of terms converges to 6, G.P. with $ r < 1$
2	(ii)	neither + valid reason	1 [1]		eg divergent oe, A.P., $d = 4$ oe, convergent and periodic ruled out with correct reasons
2	(iii)	periodic + valid reason	1 [1]		eg repeating cycle of terms
3	(i)	(0.8, -2) oe	2 [2]	B1 each coordinate	SC0 for (4, -2)
3	(ii)	Translation $\begin{pmatrix} 90 \\ 0 \end{pmatrix}$ oe	B1 B1 [2]	or eg 270 to left	allow B2 for rotation through 180° about (45, 0) oe

Question		Answer	Marks	Guidance	
4	(i)	$1.2r = 4.2$ 3.5 cao	M1 A1 [2]	or $\frac{68.7549...}{360} \times 2\pi r = 4.2$ with θ to 3 sf or better	B2 if correct answer unsupported
4	(ii)	$\cos 0.6 = \frac{d}{\text{their } 3.5}$ 2.888.. to 2.9	M1 A1 [2]	or $\cos 34.377.. = \frac{d}{\text{their } 3.5}$ with θ to 3 sf or better	or correct use of Sine Rule with 0.9708 (55.623°) or area = $5.709 = 0.5 \times h \times 3.952$, or $3.5^2 - 1.976^2 = d^2$
5		gradient = $\frac{4\sqrt{9.5} - 12}{9.5 - 9}$ 0.6577 to 0.66 $9 < x_C < 9.5$	M1 A1 B1 [3]	or 0.657656...isw	$4\sqrt{38} - 24$ $4\sqrt{38} - 24$ allow $8.53 \leq x_C < 9$
6		$6x^2 + 18x - 24$ their $6x^2 + 18x - 24 = 0$ or > 0 or ≥ 0 -4 and +1 identified oe $x < -4$ and $x > 1$ cao	B1 M1 A1 A1 [4]	or sketch of $y = 6x^2 + 18x - 24$ with attempt to find x -intercepts or $x \leq -4$ and $x \geq 1$	if B0M0 then SC2 for fully correct answer

Question		Answer	Marks	Guidance
7		$\cos A = \frac{105^2 + 92^2 - 75^2}{2 \times 105 \times 92}$ oe 0.717598...soi $A = 44.14345\dots^\circ$ soi $[0.770448553\dots]$ $\frac{1}{2} \times 92 \times 105 \times \sin(\text{their } A)$ 3360 or 3361 to 3365	M1 A1 A1 M1 A1 [5]	or $\cos B = \frac{75^2 + 92^2 - 105^2}{2 \times 75 \times 92}$ oe 0.2220289...soi $B = 77.1717719\dots^\circ$ soi $[1.346901422]$ or $\frac{1}{2} \times 75 \times 92 \times \sin(\text{their } B)$ or M3 for $\sqrt{136(136 - 75)(136 - 105)(136 - 92)}$ A2 for correct answer 3360 or 3363 - 3364
8	(i)		M1 A1 [2]	for curve of correct shape in both quadrants through (0, 1) shown on graph or in commentary SC1 for curve correct in 1 st quadrant and touching (0,1) or identified in commentary

Question		Answer	Marks	Guidance	
8	(ii)	$5x - 1 = \frac{\log_{10} 500\,000}{\log_{10} 3}$ $x = \left(\frac{\log_{10} 500\,000}{\log_{10} 3} + 1 \right) \div 5$ $[x =] 2.588 \text{ to } 2.59$	M1 M1 A1 [3]	or $5x - 1 = \log_3 500\,000$ $x = (\log_3 500\,000 + 1) \div 5$ oe; or B3 www	condone omission of base 10 use of logs in other bases may earn full marks if unsupported, B3 for correct answer to 3 sf or more www
9	(i)	$\left(\frac{\sin \theta}{\cos \theta} \right)^2 = 1 \text{ oe}$ $\sin \theta = \cos^2 \theta \text{ and completion to given result}$	M1 A1 [2]	www	
9	(ii)	$\sin^2 \theta + \sin \theta - 1 [= 0]$ $[\sin \theta =] \frac{-1 \pm \sqrt{5}}{2} \text{ oe}$ may be implied by correct answers $[\theta =] 38.17\dots, \text{ or } 38.2 \text{ and } 141.83\dots, 141.8 \text{ or } 142$	M1 A1 A1 [3]	allow 1 on RHS if attempt to complete square may be implied by correct answers ignore extra values outside range, A0 if extra values in range or in radians NB 0.6662 and 2.4754 if working in radian mode earns M1A1A0	condone $y^2 + y - 1 = 0$ mark to benefit of candidate ignore any work with negative root & condone omission of negative root with no comment eg M1 for 0.618... if unsupported, B1 for one of these, B2 for both. If both values correct with extra values in range, then B1 . NB 0.6662 and 2.4754 to 3sf or more

Question		Answer	Marks	Guidance	
10	(i)	<p>at A $y = 3$</p> $\frac{dy}{dx} = 2x - 4$ <p>their $\frac{dy}{dx} = 2 \times 4 - 4$</p> <p>grad of normal = $^{-1}/_{\text{their } 4}$</p> $y - 3 = (-^1/4) \times (x - 4) \text{ oe isw}$ <p>substitution of $y = 0$ and completion to given result with at least 1 correct interim step www</p>	B1 B1 M1* M1dep* A1 A1 [6]	must follow from attempt at differentiation or substitution of $x = 16$ to obtain $y = 0$	correct interim step may occur before substitution
10	(ii)	<p>at B, $x = 3$</p> $F[x] = \frac{x^3}{3} - \frac{4x^2}{2} + 3x$ <p>$F[4] - F[\text{their } 3]$</p> <p>area of triangle = 18 soi</p> <p>area of region = $19\frac{1}{3}$ oe isw</p>	B1 M1* M1* dep B1 A1 [5]	may be embedded condone one error, must be three terms, ignore $+ c$ dependent on integration attempted 19.3 or better	may be embedded in final answer

Question			Answer	Marks	Guidance
11	(i)	(A)	$2A + D = 25$ oe $4A + 6D = 250$ oe $D = 50,$ $A = -12.5$ oe	B1 B1 B1 B1 [4]	condone lower-case a and d
11	(i)	(B)	$\frac{50}{2}(2 \times \text{their } A + 49 \times \text{their } D) [= 60\,625]$ or $\frac{20}{2}(2 \times \text{their } A + 19 \times \text{their } D) [= 9250]$ their " $S_{50} - S_{20}$ " 51 375 cao	M1 M1 A1 [3]	or $a = \text{their } A + 20D$ $S_{30} = \frac{30}{2}(a + l)$ oe with $l = \text{their } A + 49D$ $S_{30} = \frac{30}{2}(2 \times \text{their } 987.5 + 29 \times \text{their } 50)$

Question		Answer	Marks	Guidance	
11	(ii)	$\frac{a(r^2 - 1)}{r-1} = 25 \quad \text{or} \quad \frac{a(r^4 - 1)}{r-1} = 250$ $\frac{a(r^4 - 1)}{r-1} = \frac{250}{25} \text{ oe}$ $\frac{a(r^2 - 1)}{(r-1)}$ <p>and completion to given result www</p> <p>use of $r^4 - 1 = (r^2 - 1)(r^2 + 1)$ to obtain $r^2 + 1 = 10$ www</p> <p>$r = \pm 3$</p> <p>$a = 6.25 \text{ or } -12.5 \text{ oe}$</p>	B1 M1 M1 A1 A1 [5]	<p>allow $a(1 + r)$ as the denominator in the quadruple-decker fraction</p> <p>$r^2 = x$ oe may be used</p> <p>or M1 for valid alternative algebraic approaches eg using $a(1 + r) = 25$ and $ar^2 + ar^3 = ar^2(1 + r) = 225$</p> <p>or B2 for all four values correct, B1 for both r values or both a values or one pair of correct values if second M mark not earned</p>	
12	(i)	$\log_{10}p = \log_{10}a + \log_{10}10^{kt}$ $\log_{10}p = \log_{10}a + kt$ www	M1 A1 [2]	condone omission of base;	if unsupported, B2 for correct equation
12	(ii)	<p>2.02, 2.13, 2.23</p> <p>plots correct ruled line of best fit</p>	B1 B1f.t. B1 [3]	<p>allow given to more sig figs</p> <p>to nearest half square</p> <p>y-intercept between 1.65 and 1.7 and at least one point on or above the line and at least one point on or below the line</p>	<p>2.022304623..., 2.129657673, 2.229707433</p> <p>ft their plots</p> <p>must cover range from $x = 9$ to 49</p>

Question		Answer	Marks	Guidance	
12	(iii)	0.0105 to 0.0125 for k 1.66 to 1.69 for $\log_{10}a$ or 45.7 to 49.0 for a	B1 B1		must be connected to k must be connected to a
		$\log_{10}p = \text{their } kt + \text{their } \log_{10}a$ $p = \text{their } "47.9 \times 10^{0.0115t}" \text{ or } 10^{1.6785+0.0115t}$,	B1 B1 [4]	must be a correct form for equation of line and with their y -intercept and their gradient (may be found from graph or from table, must be correct method) as above, “47.9” and “0.0115” must follow from correct method	
12	(iv)	45.7 to 49.0 million	1 [1]	‘million’ needed, not just the value of p	
12	(v)	reading from graph at 2.301.. their 54 2014 cao	M1* M1dep* A1 [3]	or $\log_{10}200 = \text{"log}_{10}a + kt"$ eg for their $t = \frac{\log 200 - 1.68}{0.0115}$ if unsupported, allow B3 only if consistent with graph	or $200 = "10^{\log a + kt}"$, oe or $200 = "10^{\log a + 0.0115t}"$, oe or $M1$ for their $t = \frac{\log \frac{200}{47.9}}{0.0115}$

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

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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