

GCE

Mathematics (MEI)

Unit **4752**: Concepts for Advanced Mathematics

Advanced Subsidiary GCE

Mark Scheme for June 2014

1. Annotations and abbreviations

Annotation in scoris	Meaning
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
✓ 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

2. 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 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		$kx^{\frac{5}{2}+1}$ $2x^{\frac{7}{2}}$ cao $+ c$	M1 A1 A1 [3]	k is any non-zero constant	
2	(i)	$21\left(\frac{1}{1+2} + \frac{1}{2+2} + \frac{1}{3+2} + \frac{1}{4+2} + \frac{1}{5+2}\right)$ oe soi 22.95 or $\frac{459}{20}$ or $22\frac{19}{20}$	M1 A1 [2]	may be implied by correct answer	NB 7 + 5.25 + 4.2 + 3.5 + 3 M0 if extra terms or terms missing
2	(ii)	$a + 45$ cao $\frac{10}{2} a + a + their45$ $5(2a + 45)$ or $10a + 225$ cao isw	B1 M1 A1 [3]	mark the final answer must be explicitly stated or $\frac{10}{2} 2a + (10 - 1) \times 5$ ignore further work attempting to find a	condone wrongly attributed answers B2 if correct answer derived from adding terms separately
3		$\frac{2.4 - 3.6}{2.2 - 2}$ oe - 6 cao	M1 A1 [2]	M1 may be embedded eg in equation of straight line B2 if unsupported ignore subsequent work irrelevant to finding the gradient	

Question		Answer	Marks	Guidance	
4	(i)	(6, -1.5) oe	B2 [2]	B1 for each value; allow $x = 6, y = -1.5$	SC0 for (6, -3)
4	(ii)	(2, -3)	B2 [2]	B1 for each value; allow $x = 2, y = -3$	SC0 for (6, -3)
5		$5.9^2 + 8.5^2 - 2 \times 5.9 \times 8.5 \times \cos 72$ 107 – 31 or better 8.7(2...)	M1 M1 A1 [3]	76.(...) or 204.(...) (radians)	or 64.(.....) (grad) NB 6.76cos72 or 2.08(8954882..) scores M1M0 if M0M0, B3 for 8.72 or better if unsupported or 8.7(2...) if obtained from other valid method
6		$\frac{1}{2} \times 12.4^2 \times 2.1 (= 161.448)$ $\frac{1}{2} \times 12.4^2 \times \sin 2.1 (= 66.3 \text{ to } 66.4)$ or $\frac{1}{2} \times 21.5(121..) \times 6.16(9...)$ their 161.448 – their 66.36 95 to 95.1	M1* M1* M1dep* A1 [4]	or $\pi \times \frac{120.32}{360} \times 12.4^2$ angle in degrees to 3 sf or better	angle in degrees to 3 sf or better may be implied by 2.81(7168325...) (degrees) or 2.53(5559362) (grad) if unsupported, B4 for 95.08(446) r.o.t. to 4 sf or better

Question		Answer	Marks	Guidance
7		$ar = 24$ (i) $\frac{a}{1-r} = 150$ (ii) correct substitution to eliminate one unknown $r = 0.8$ or 0.2 $a = 30$ or $a = 120$	B1* B1* M1dep* A1 A1 [5]	allow $ar^{2-1} = 24$ eg subst. of $a = 150(1-r)$ or $r = \frac{150-a}{150}$ in (i) alternatively, subst. of $a = \frac{24}{r}$ or $r = \frac{24}{a}$ in (ii) or A1 for each correct pair of values ignore incorrect pairing if correct values already correctly attributed
8		$\frac{\sqrt{\sin^2 \theta}}{\sin \theta}$ or $\frac{\cos \theta \sqrt{\sin^2 \theta}}{\sin \theta}$ $\frac{\cos \theta}{\cos \theta}$ $\cos \theta$ cao	M1 M1 A1 [3]	correct substitution for numerator correct substitution for denominator A0 if follows wrong working or B3 www or if unsupported allow maximum of M1M1 if $\pm\sqrt{\sin^2 \theta}$ oe substituted mark the final answer but ignore attempts to solve for θ allow recovery from omission of θ

Question		Answer	Marks	Guidance	
9		71.5(6505118..) soi	M1	or 1.24(9045772..) (rad) or 79.5(1672353..) (grad)	39.75836177..., 139.75..., 239.75... 339.75...(grad) for second A1, ignore extra values outside range, A0 if extra values in range
		35.7 to 36	A1	if A0, SC1 for all four answers in radians or grad r.o.t to 3 or more sf 0.62452286, 2.195319213, 3.76611554, 5.336911867 (rad), but 0 if extra values in range	
		125.78..., 215.78..., 305.78... to 3 or more sf	A1	if M1A0A0, SC1 for 251.565..., 431.565..., 611.565...	
			[3]		
10		$(x + 1) \log 3 = 2x \log 5$ oe	M1	or $x + 1 = 2x \log_3 5$ or $(x + 1) \log_3 3 = 2x$	allow recovery from omission of brackets in later working NB $0.477121254 = 0.920818754x$ $- 1.929947041x = - 1$ $1.317393806x = 0.682606194..$
		$\log 3 = x(2 \log 5 - \log 3)$ oe	A1	$x(1 - 2 \log_3 5) = - 1$ oe or $x(2 - \log_5 3) = \log_5 3$ oe	
		$\frac{\log 3}{2 \log 5 - \log 3}$ oe	A1	$\frac{1}{2 \log_3 5 - 1}$ oe or $\frac{\log_5 3}{2 - \log_5 3}$ oe	
		0.518 cao	A1		
			[4]	answer only does not score	

Question		Answer	Marks	Guidance	
11	(i)	$y' = 1 + 8x^{-3}$ $y'' = -24x^{-4}$ oe	M2 A1 [3]	M1 for just $8x^{-3}$ or $1 - 8x^{-3}$	but not just $\frac{-24}{x^4}$ as AG
11	(ii)	their $y' = 0$ soi $x = -2$ $y = -3$ substitution of $x = -2$: $\frac{-24}{(-2)^4}$ < 0 or $= -1.5$ oe correctly obtained isw	M1 A1 A1 M1 A1 [5]	A0 if more than one x -value A0 if more than one y -value or considering signs of gradient either side of -2 with negative x -values signs for gradients identified to verify maximum	$x = -2$ must have been correctly obtained for all marks after first M1 condone any bracket error must follow from M1 A1 A0 M1 or better
11	(iii)	$y = -5$ soi substitution of $x = -1$ in their y' grad normal $= \frac{-1}{\text{their } -7}$ $y - \text{their } (-5) = \text{their } \frac{1}{7}(x - (-1))$ $-x + 7y + 34 = 0$ oe	B1 M1 M1* M1dep* A1 [5]	may be implied by -7 may be implied by eg $\frac{1}{7}$ or their $(-5) = \text{their } \frac{1}{7} \times (-1) + c$ allow eg $y - \frac{1}{7}x + \frac{34}{7} = 0$	must see $= 0$ do not allow eg $y = \frac{x}{7} - \frac{34}{7}$

Question		Answer	Marks	Guidance	
12	(i)	$h = 3$ soi	B1	allow if used with 6 separate trapezia	
		$\frac{3}{2} 9 + 9.1 + 2(10.7 + 11.7 + 11.9 + 11.0)$	M1	basic shape of formula correct with their 3; omission of brackets may be recovered later; M0 if any x -values used (NB $y_0 = 9$ and $x_3 = 9$, so check position)	
		all y -values correctly placed in formula	B1	condone omission of outer brackets	
		163.05 or 163.1 or 163 isw	A1	answer only does not score	
			[4]	or B1 + B3 if 5 separate trapezia calculated to give correct answer NB 29.55 + 33.6 + 35.4 + 34.35 + 30.15	
12	(ii)	(A)	$-0.001 \times 12^3 - 0.025 \times 12^2 + 0.6 \times 12 + 9$ soi	M1	may be implied by 10.872, 10.87 or 10.9
			± 0.128 [m] or ± 12.8 cm or ± 128 mm isw	A1	B2 if unsupported

Question			Answer	Marks	Guidance
12	(ii)	(B)	$F[x] = \frac{-0.001x^4}{4} - \frac{0.025x^3}{3} + \frac{0.6x^2}{2} + 9x$ F(15) [- F(0)] soi 161.7 to 162	M2 M1 A1 [4]	M1 if three terms correct ; ignore + c dependent on at least two terms correct in F[x] A0 if a numerical value is assigned to c condone F(15) + 0 answer only does not score NB allow misread if minus sign omitted in first term if consistent in (A) and (B). 187.03...
13	(i)		$\log_{10}h = \log_{10}a + bt$ www $m = b, c = \log_{10}a$	B1 B1 [2]	condone omission of base must be clearly stated : linking equations is insufficient
13	(ii)		-0.15, 0[.00], 0.23, 0.36, 0.56, 0.67, 0.78, 0.91, 1.08, 1.2[0] plots correct (tolerance half square) single ruled line of best fit for values of x from 5 to 50 inclusive	B2 B1 B1 [4]	B1 if 1 error condone 1 error – see overlay line must not go outside overlay between $x = 5$ and $x = 50$ no ft available for plots

Question		Answer	Marks	Guidance
13	(iii)	$-0.3 \leq y\text{-intercept} \leq -0.22$ valid method to find gradient of line $h = \text{their } a \times 10^{\text{their } bt}$ or $h = 10^{\text{their } \log a + \text{their } bt}$ $0.028 \leq b \leq 0.032$ and $0.5 \leq a \leq 0.603$ or $-0.3 \leq \log a \leq -0.22$	B1 M1 M1 A1 [4]	may be implied by $0.5 \leq a \leq 0.603$ may be embedded in equation; may be implied by eg m between 0.025 and 0.035 condone values from table; condone slips eg in reading from graph if B1M1M0, then SC1 for $\log h = \log a + \text{their } bt$ isw if both values in the acceptable range for A1
13	(iv)	$a10^{60b} - a10^{50b}$ their values for a and b 8.0 to 26.1 inclusive	M1 A1 [2]	or $10^{\log a + b \times 60} - 10^{\log a + b \times 50}$ or their values for $\log a$ and b condone 15.9 as second term may follow starting with $\log h = \log a + \text{their } bt$ NB A0 for estimate without clear valid method using model; both marks available even if a or b or both are outside range in (iii)
13	(v)	comment on the continuing reduction in thickness and its consequences	B1 [1]	eg in long term, it predicts that reduction in thickness will continue to increase, even when the glacier has completely melted