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

	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			$5.9^2 + 8.5^2 − 2 \times 5.9 \times 8.5 \times \cos 72$	M1	
			$107 − 31$ or better	M1	76.(….) or 204.(…) (radians) or 64.(…..) (grad) NB 6.76cos72 or 2.08(8954882..) scores M1M0
			$8.7(2…)$	A1 [3]	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)	M1*	or $\pi \times \dfrac{120.32}{360} \times 12.4^2$ angle in degrees to 3 sf or better
			$\frac{1}{2} \times 12.4^2 \times \sin 2.1$ (= 66.3 to 66.4) or $\frac{1}{2} \times 21.5(121..) \times 6.16(9…)$	M1*	angle in degrees to 3 sf or better may be implied by 2.81(7168325…) (degrees) or 2.53(5559362) (grad)
			their 161.448 – their 66.36 95 to 95.1	M1dep* A1 [4]	if unsupported, B4 for 95.08(446) r.o.t. to 4 sf or better

Question	Answer	Marks	Guidance
7	$ar = 24$ (i)	B1*		allow $ar^{2-1} = 24$
	$\dfrac{a}{1-r} = 150$ (ii)	B1*		
	correct substitution to eliminate one unknown	M1dep*	eg subst. of $a = 150(1-r)$ or $r = \dfrac{150-a}{150}$ in (i) alternatively, subst. of $a = \dfrac{24}{r}$ or $r = \dfrac{24}{a}$ in (ii)	if M0, B1 for both values of r and B1 for both values of a, or B1 for each pair of correct values NB $150r^2 - 150r + 24 \,[= 0]$ $a^2 - 150a + 3600 \,[= 0]$
	$r = 0.8$ or 0.2	A1	or A1 for each correct pair of values	A0 if wrongly attributed
	$a = 30$ or $a = 120$	A1	ignore incorrect pairing if correct values already correctly attributed	A0 if wrongly attributed
		[5]		
8	$\dfrac{\sqrt{\sin^2\theta}}{\dfrac{\sin\theta}{\cos\theta}}$ or $\dfrac{\cos\theta\sqrt{\sin^2\theta}}{\sin\theta}$	M1	correct substitution for numerator	allow maximum of M1M1 if
		M1	correct substitution for denominator	$\pm\sqrt{\sin^2\theta}$ oe substituted
	$\cos\theta$ cao	A1	A0 if follows wrong working or B3 www or if unsupported	mark the final answer but ignore attempts to solve for θ allow recovery from omission of θ
		[3]		

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

Question			Answer	Marks	Guidance	
11	**(i)**		$y' = 1 + 8x^{-3}$	M2	M1 for just $8x^{-3}$ or $1 - 8x^{-3}$	
			$y'' = -24x^{-4}$ oe	A1		but not just $\dfrac{-24}{x^4}$ as AG
				[3]		
11	**(ii)**		their $y' = 0$ soi	M1		
			$x = -2$	A1	A0 if more than one x-value	$x = -2$ must have been correctly obtained for all marks after first M1
			$y = -3$	A1	A0 if more than one y-value	
			substitution of $x = -2$: $\dfrac{-24}{(-2)^4}$	M1	or considering signs of gradient either side of -2 with negative x-values	condone any bracket error
			< 0 or $= -1.5$ oe correctly obtained isw	A1	signs for gradients identified to verify maximum	must follow from M1 A1 A0 M1 or better
				[5]		
11	**(iii)**		$y = -5$ soi	B1		
			substitution of $x = -1$ in their y'	M1	may be implied by -7	
			grad normal $= {}^{-1}/_{\text{their} - 7}$	M1*	may be implied by eg $^1/_7$	
			$y - \text{their}(-5) = \text{their } {}^1/_7(x - -1)$	M1dep*	or their $(-5) = $ their $^1/_7 \times (-1) + c$	
					allow eg $\quad y - \dfrac{1}{7}x + \dfrac{34}{7} = 0$	must see $= 0$
			$-x + 7y + 34 = 0$ oe	A1		do not allow eg $y = \dfrac{x}{7} - \dfrac{34}{7}$
				[5]		

Question			Answer	Marks	Guidance	
12	(i)		$h = 3$ soi	B1		allow if used with 6 separate trapezia
			$\dfrac{3}{2}\ 9 + 9.1 + 2(10.7 + 11.7 + 11.9 + 11.0)$	M1	basic shape of formula correct with their 3; omission of brackets may be recovered later; M0 if any x-values used (NB $y0 = 9$ and $x3 = 9$, so check position)	with 3, 4 or 5 y-values in middle bracket, eg $\dfrac{3}{2}\ 9 + 2(10.7 + 11.7 + 11.9) + 11.0$
			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	or **B1** + **B3** if 5 separate trapezia calculated to give correct answer NB 29.55 + 33.6 + 35.4 + 34.35 + 30.15
				[4]		
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	NB allow misread if minus sign omitted in first term if consistent in (A) and (B). Lose A1 in this part only
			±0.128[m] or ±12.8cm or ±128mm isw	A1	B2 if unsupported	appropriate units must be stated if answer not given in metres
				[2]		

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

	Question		Answer	Marks	Guidance	
13	**(iii)**		$-0.3 \leq$ y-intercept ≤ -0.22	B1	may be implied by $0.5 \leq a \leq 0.603$	
			valid method to find gradient of line	M1	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
			$h = \text{their}a \times 10^{\text{their}bt}$ or $h = 10^{\text{their}\log a + \text{their}bt}$	M1		if B1M1M0, then SC1 for $\log h = \log a + \text{their}bt$ isw
			$0.028 \leq b \leq 0.032$ and $0.5 \leq a \leq 0.603$ or $-0.3 \leq \log a \leq -0.22$	A1		if both values in the acceptable range for A1
				[4]		
13	**(iv)**		$a10^{60b} - a10^{50b}$ their values for a and b	M1	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 $\log h = \log a + \text{their}bt$
			8.0 to 26.1 inclusive	A1		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)
				[2]		
13	**(v)**		comment on the **continuing reduction** in thickness **and** its consequences	B1	eg in long term, it predicts that reduction in thickness will continue to increase, even when the glacier has completely melted	
				[1]		