OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4752**: Concepts for Advanced Mathematics

Advanced Subsidiary GCE

Mark Scheme for June 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 assessor	**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 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	(i)		$3\times1+2+3\times2+2+3\times3+2+3\times4+2+3\times5+2$ oe soi	B1	or $3\times\frac{1}{2}\times5\times(5+1)+2\times5$	or $\frac{5}{2}\left[2\times5+(5-1)\times3\right]$
			55	B1 [2]		**B2** for 55 unsupported
1	(ii)		$4.2 + 5d = 1.8$ soi	M1	or $(1.8-4.2)\div5$ oe	**M0** for $(4.2 – 1.8) \div 5$ if not recovered
			-0.48 or $-\frac{12}{25}$ isw	A1 [2]		**B2** for correct answer unsupported
2	(i)		$2x^2$ oe	B1		ignore + *c* for the first two marks
			F[5] – F[1]	M1	where F[*x*] = kx^2	
			48 cao	A1 [3]		no marks for 48 unsupported **A0** for 48 + *c*
2	(ii)		$kx^{\frac{1}{2}+1}$ seen	M1		
			$4x^{\frac{3}{2}}+c$ or $4\sqrt{x^3}+c$ or $4\left(\sqrt{x}\right)^3+c$ isw	A1 [2]		

Question			Answer	Marks	Guidance	
3	(i)		$\frac{\log_{10} 0.2 - \log_{10} 0.1}{0.2 - 0.1}$ or eg $\frac{-0.7 - -1}{0.2 - 0.1}$ seen	M1	**NB** $\frac{\log_{10} 2}{0.1}$ or $\frac{0.3}{0.1}$ allow – 0.69 to – 0.7 for $\log_{10} 2$ in gradient formula for **M1**	condone omission of base 10;
			3.01 to 3.0103 isw or $10\log_{10} 2$ isw oe	A1		**B2** for 3.01… unsupported
				[2]		
3	(ii)		one point C marked on curve between A and B or before A	B1		condone omission of label of C
				[1]		
4			$\left[\frac{dy}{dx} =\right] kx^2$ soi	M1	$k > 0$	**NB** $6x^2$
			when $x = 2$, $\left[\frac{dy}{dx} =\right]$ 24	A1		
			$-\frac{1}{their\ 24}$	M1	their 24 must come from evaluating their derivative	**M0** if their 24 from elsewhere eg integration
			$x = 2,\ y = 16$	B1	**NB** $y - 16 = -\frac{1}{24}(x - 2)$	
			$x + 24y = 386$ oe	A1	coefficients in any exact form eg $\frac{1}{24}x + y = \frac{193}{12}$ but not rounded or truncated decimals	
				[5]		
5	(i)		stretch	M1	do not allow "squash" or "enlargement"	**M0** if two transformations described
			parallel to y-axis oe, scale factor 2 oe	A1	both required	
				[2]		

Question			Answer	Marks	Guidance	
5	(ii)		translation (not "shift" or "move")	M1	if **M0** allow **SC1** for eg "shift 3 units in x-direction" but not "transformation 3 units in the x-direction"	**M0** if two transformations described
			of $\begin{pmatrix}3\\0\end{pmatrix}$, or 3 units parallel to x-axis oe	A1		
				[2]		
6			kx^4	M1	$k > 0$	must **not** follow from use of $y = mx + c$
			$3x^4$	A1	may be seen later	
			$-7x + c$	B1	must follow from integration	
			$10 = (\text{their } 3) \times 2^4 - 7 \times 2 + c$ oe	M1	must be 3 terms on RHS including term in x^4, term in x and "c";	must **not** follow from use of $y = mx + c$
			$y = 3x^4 - 7x - 24$	A1	or $y = 3x^4 - 7x + c$ and $c = -24$ stated isw	must see "$y =$" or "f(x) = " at some point for **A1**
				[5]		
7	(i)		curve of increasing gradient in 1st and 2nd quadrant which does not cut x-axis but tends towards it in 2nd quadrant	M1	**M0** if curves up in 2nd quadrant or back in 1st quadrant	condone touching x-axis
			through (0, 1)	A1	intercept may be identified in supporting commentary or on graph	condone axes not labelled
				[2]		

Question			Answer	Marks	Guidance	
7	(ii)		$\log_a\left(\frac{x^5\times 6}{2x}\right)$ oe	**B1**	**NB** $\log_a(3x^4)$ may be embedded in combining of all terms on RHS **NB** $\log_a(3a^3x^4)$	condone omission of base
			correct attempt to remove logs on both sides	**M1**	eg $w = a^{3+\log_a x^5-\log_a 2x+\log_a 6}$ may follow incorrect combination of log terms	condone omission of base, may be awarded before **B1**
			$[w =]3a^3x^4$ cao	**A1**		
				[3]		
8			$6(1-\sin^2 x)$ seen	**M1**		or $6(1-\cos^2 x)$ substituted in given result to obtain $6\cos^2 x = 5 - \sin x$ with at least one correct intermediate step
			eg $6-6\sin^2 x = 5-\sin x$		at least one correct intermediate step to obtain **given** answer	
			$6\sin^2 x - \sin x - 1 = 0$	**A1**		
			$\frac{1}{2}$ and $-\frac{1}{3}$ found	**B1**	both required; allow – 0.33 or better	
			$x = \pi/6, 5\pi/6$ [0.52 to 0.524, 2.61799 to 2.62] 3.48 to 3.48143, 5.94 to 5.9435	**B2**	**B1** for 2 correct, to 2 dp or more if **B0** allow **SC1** for all four answers in degrees with no extras: 30, 150, 340.5 – 341, 199 – 199.5	if **B2** deduct 1 mark for extra values in range; ignore extra values outside range
				[5]		

Question			Answer	Marks	Guidance	
9	(i)		correct rearrangement of $400 = \pi r^2 h$ seen, where h is not in the denominator	**B1**	eg $h = \frac{400}{\pi r^2}, rh = \frac{400}{\pi r}, \pi rh = \frac{400}{r}$ or $2\pi rh = \frac{2\times 400}{r}$	allow embedded versions of these
			substitution seen to obtain given answer $A = 2\pi r^2 + \frac{800}{r}$ not from wrong working	**B1** **[2]**	if **B0B0** allow **SC2** for eg $400 = \pi r^2 h$ used $\frac{800}{r} = \frac{2\times 400}{r}\left(\text{or } \frac{2V}{r}\right) = \frac{2\times \pi r^2 h}{r}$ used to obtain $A = 2\pi r^2 + 2\pi rh$	must see all the steps if starting from $A = 2\pi r^2 + \frac{800}{r}$
9	(ii)		$\left(\frac{dA}{dr} =\right) 4\pi r - \frac{800}{r^2}$ oe	**B1** **B1**	for first term for second term	A maximum of **B1B0B1B0** is available if 2nd term left in terms of h
			$\left(\frac{d^2A}{dr^2} =\right) 4\pi + \frac{1600}{r^3}$ oe	**B1** **B1** **[4]**	**FT** to give non-zero first term **FT** negative power of r to give non-zero second term	
9	(iii)		their $\frac{dA}{dr} = 0$ seen	**M1**		
			$r = \sqrt[3]{\frac{200}{\pi}}$ or 3.99...isw	**A1**	**A0** for two or more values eg r = 0, 3.99 or ± 3.99	**NB** 3.99294542466
			$\frac{d^2A}{dr^2} > 0$ justified so minimum oe or check gradient either side of *their* positive r	**B1**	eg $4\pi > 0$ and $\frac{1600}{r^3} > 0$ **NB** 12π or 37.699… to 38	simply stating that second derivative is positive is insufficient
			A = 300 to 301	**A1** **[4]**	**NB** 300.530027931	ignore units

Question			Answer	Marks	Guidance	
10	(i)		$[AE^2 =] 32^2 + 15^2 - 2 \times 32 \times 15 \times \cos 116$ AE = 40.86…to two or more s.f. isw	**M1** **A1** **[2]**	**NB** 1669.836301 implies **M1**	**NB** 2181.72…or 46.709 implies **M1** (radians)
10	(ii)		$\frac{\sin A}{15} = \frac{\sin 116}{their\ 40.86}$ or $\frac{\sin E}{32} = \frac{\sin 116}{their\ 40.86}$ h = 32× *their* sin A or 15×*their* sin E h = 10.5 to 10.6 isw *Alternatively* $\frac{1}{2} \times 32 \times 15 \times \sin 116 = \frac{1}{2} \times their\ 40.86 \times h$ $h = \frac{32 \times 15 \times \sin 116}{their\ 40.86}$ h = 10.5 to 10.6 isw	**M1*** **M1dep*** **A1** **M1** **M1** **A1** **[3]**	$\cos A = \frac{32^2 + their\ 40.86^2 - 15^2}{2 \times 32 \times their\ 40.86}$ or $\cos E = \frac{15^2 + their\ 40.86^2 - 32^2}{2 \times 15 \times their\ 40.86}$ or $\sqrt{32^2 - their\ AX^2}$ or $\sqrt{15^2 - their\ EX^2}$	A = 19.3 and E = 44.7 X is the foot of the perpendicular from D to AE **NB** 30.2 and 10.7

Question			Answer	Marks	Guidance	
10	(iii)		$\frac{116}{360}\times\pi\times10^2$	M1	or $\frac{1}{2}\times10^2\times\frac{29\pi}{45}$ oe	**NB** $\frac{29\pi}{45}=2.02458...$ **M0** for ½×10²×116
			101 or 101.2 to 101.23	A1		
			$\frac{1}{2}\times32\times15\times\sin116$ soi	M1	or $\frac{1}{2}\times$ *their* AE $\times$ *their h* ; may be implied by 215.7 to 216	
			114 to 115 [m²]	A1 [4]		
10	(iv)		$\tan26=\frac{x}{80}$ or $\tan64=\frac{80}{x}$ or $\frac{x}{\sin26}=\frac{80}{\sin64}$ oe soi	M1	(*x* is length CF where F is foot of perpendicular from D to BC or length DG where G is foot of perpendicular from C to AD produced) **NB** *x* = 39(.0186070853) or BC = 71.(0…) may imply **M1**	*alternatively* **B3** for (area AEH) awrt 260 and (area HECB) 3640 – 3650 where H is the foot of the perpendicular from E to AB, or **B2** for one of these *Alternatively* **B3** for (area AEC) awrt 1060 and (area ABC) awrt 2840 or **B2** for one of these
			(area of field =) 80 × 32 + ½ × 80 × *their* 39.0 or $\frac{80}{2}\left[32+\left(32+\textit{their}\ \ 39.0\right)\right]$	M1	or 80 × [32 + *their* 39.0] – ½ × 80 × *their* 39.0	
			4120 to 4121	A1	**NB** 4120.74428341	allow **B3** for 4120 to 4121 not from wrong working
			area of ADE is 5.2 to 5.24% isw of area of ADCB	B1 [4]	or area of AECB is 94.76 to 94.8% isw of area ADCB	or 3905 > 3709 (area of car park > 90% of field)

Question			Answer	Marks	Guidance	
11	(i)		[year 10]			**B0** for any which are wrongly attributed
			A : 39 000	**B1**		
			B : 38 783.205…isw r.o.t. to 6 or more significant figures	**B1**	or 38 800 or 38 780 or 38 783	
			[year 11]			
			A : 40 000	**B1**		
			B : 40 722.365…isw r.o.t. to 6 or more significant figures	**B1**	or 40 700 or 40 720 or 40 722	
				[4]		
	(ii)		A: $\frac{17}{2}(2\times 30000+16\times 1000)$ or $\frac{17}{2}(30000+46000)$	**M1**	if **M0** and **B0** allow **SC1** for 30 000 + 31 000 +…+ 46 000 = 646 000	if **M0** then **B2** for complete sum written out and correct answer obtained
			= 646 000	**A1**	646 000 unsupported is **M0A0**	
			B: $\frac{25000(1.05^{17}-1)}{1.05-1}$	**M1**	if **M0** and **B0** allow **SC1** for 25 000 + 25 000 × 1.05 + …+ 25 000 × 1.05^{16} = 646 009.15…	if **M0** then **B2** for complete sum written out and correct answer obtained
			= 646 009.15…r.o.t. to 6 significant figures or more	**A1**	646 009…unsupported is **M0A0** **A0** for 646 000 only after award of **M1**	
				[4]		

Question	Answer	Marks	Guidance	
(iii)	$\frac{25000(1.05^n - 1)}{1.05 - 1} > M$	M1	allow eg $\frac{25000(1 - 1.05^n)}{-0.05} > M$	condone = or <
	$1.05^n > \frac{M + 500000}{500000}$ www oe	A1	at least one correct intermediate step to obtain correct inequality with 1.05^n isolated on LHS	
	$\log_{10} 1.05^n > \log_{10}\left(\frac{M + 500000}{500000}\right)$ oe eg $n \log_{10} 1.05 > \log_{10}(M + 500000) - \log_{10} 500000$	A1		condone omission of brackets on RHS and/or omission of base
	$n > \frac{\log_{10}(M + 500000) - \log_{10} 500000}{\log_{10} 1.05}$ www	A1	following at least one correct intermediate step	
	26 cao	B1	**NB** $n > 25.08\ldots$	**B0** for $n > 26$
	Alternatively $\frac{25000(1.05^n - 1)}{1.05 - 1} > M$	M1		
	$\log_{10}(500\,000 \times 1.05^n) > \log_{10}(M + 500\,000)$ oe	A1	following at least one correct intermediate step	
	$\log_{10}(1.05^n) > \log_{10}(M + 500\,000) - \log_{10}500\,000$ oe	A1	following at least one correct intermediate step	
	$n > \frac{\log_{10}(M + 500000) - \log_{10} 500000}{\log_{10} 1.05}$ www	A1		
	26 cao	B1 [5]	**NB** $n > 25.08\ldots$	**B0** for $n > 26$

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

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

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