Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

AS GCE MATHEMATICS (MEI)

4752/01 Concepts for Advanced Mathematics (C2)

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4752/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

1 **(i)** Differentiate $12\sqrt[3]{x}$. **[2]**

(ii) Integrate $\frac{6}{x^3}$. **[3]**

2 A sequence is defined by $u_1 = 2$ and $u_{k+1} = \frac{10}{u_k^2}$.

Calculate $\sum_{k=1}^{4} u_k$. **[3]**

3 An arithmetic progression has tenth term 11.1 and fiftieth term 7.1. Find the first term and the common difference. Find also the sum of the first fifty terms of the progression. **[5]**

4 A sector of a circle has angle 1.5 radians and area $27\,\text{cm}^2$. Find the perimeter of the sector. **[4]**

5 Use calculus to find the set of values of x for which $x^3 - 6x$ is an increasing function. **[5]**

6 **(i)** On the same axes, sketch the curves $y = 3^x$ and $y = 3^{2x}$, identifying clearly which is which. **[3]**

(ii) Given that $3^{2x} = 729$, find in either order the values of 3^x and x. **[2]**

7 Show that the equation $\sin^2 x = 3\cos x - 2$ can be expressed as a quadratic equation in $\cos x$ and hence solve the equation for values of x between 0 and 2π. **[5]**

8 Fig. 8 shows the graph of $\log_{10} y$ against $\log_{10} x$. It is a straight line passing through the points $(2, 8)$ and $(0, 2)$.

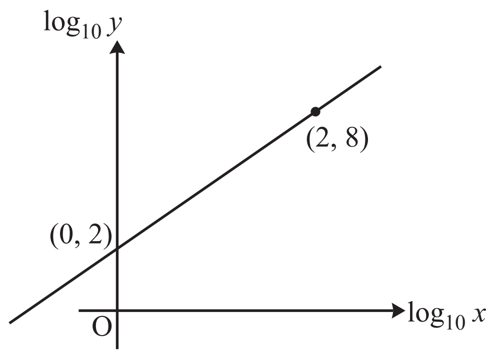

Fig. 8

Find the equation relating $\log_{10} y$ and $\log_{10} x$ and hence find the equation relating y and x. **[4]**

Section B (36 marks)

9

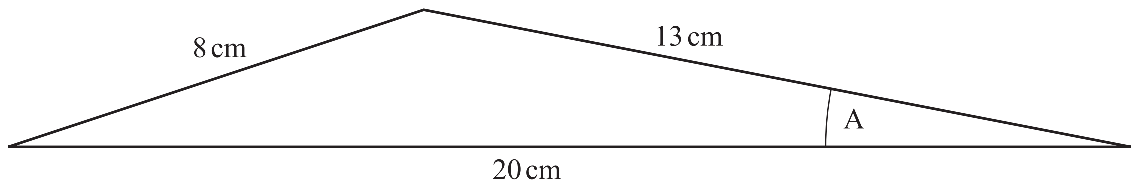

Fig. 9.1

(i) Jean is designing a model aeroplane. Fig. 9.1 shows her first sketch of the wing's cross-section. Calculate angle A and the area of the cross-section. **[5]**

(ii) Jean then modifies her design for the wing. Fig. 9.2 shows the new cross-section, with 1 unit for each of x and y representing one centimetre.

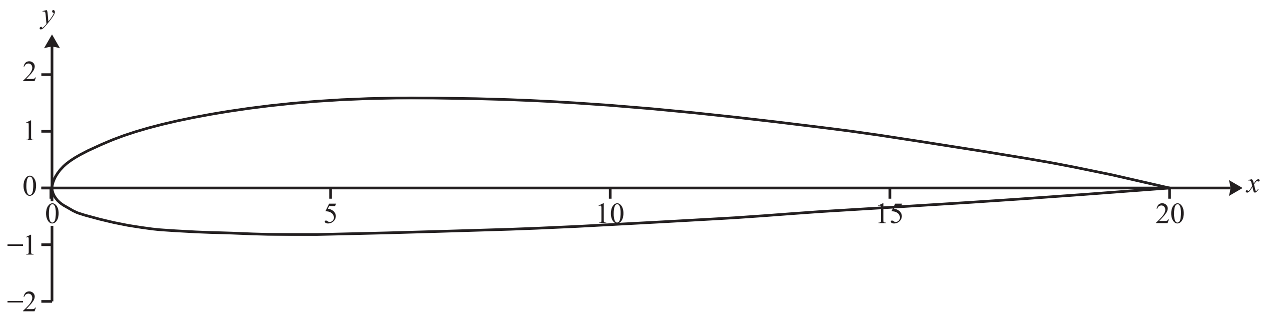

Fig. 9.2

Here are some of the coordinates that Jean used to draw the new cross-section.

Upper surface		Lower surface	
x	y	x	y
0	0	0	0
4	1.45	4	−0.85
8	1.56	8	−0.76
12	1.27	12	−0.55
16	1.04	16	−0.30
20	0	20	0

Use the trapezium rule with trapezia of width 4 cm to calculate an estimate of the area of this cross-section. **[6]**

10 The gradient of a curve is given by $\frac{dy}{dx} = 4x + 3$. The curve passes through the point $(2, 9)$.

(i) Find the equation of the tangent to the curve at the point $(2, 9)$. **[3]**

(ii) Find the equation of the curve and the coordinates of its points of intersection with the x-axis. Find also the coordinates of the minimum point of this curve. **[7]**

(iii) Find the equation of the curve after it has been stretched parallel to the x-axis with scale factor $\frac{1}{2}$. Write down the coordinates of the minimum point of the transformed curve. **[3]**

11 Jill has 3 daughters and no sons. They are generation 1 of Jill's descendants.

Each of her daughters has 3 daughters and no sons. Jill's 9 granddaughters are generation 2 of her descendants. Each of her granddaughters has 3 daughters and no sons; they are descendant generation 3.

Jill decides to investigate what would happen if this pattern continues, with each descendant having 3 daughters and no sons.

(i) How many of Jill's descendants would there be in generation 8? **[2]**

(ii) How many of Jill's descendants would there be altogether in the first 15 generations? **[3]**

(iii) After n generations, Jill would have over a million descendants altogether. Show that n satisfies the inequality

$$n > \frac{\log_{10} 2000003}{\log_{10} 3} - 1.$$

Hence find the least possible value of n. **[4]**

(iv) How many **fewer** descendants would Jill have altogether in 15 generations if instead of having 3 daughters, she and each subsequent descendant has 2 daughters? **[3]**

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

AS GCE MATHEMATICS (MEI)

4752/01 Concepts for Advanced Mathematics (C2)

PRINTED ANSWER BOOK

Candidates answer on this Printed Answer Book.

OCR supplied materials:
- Question Paper 4752/01 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

Turn over

Section A (36 marks)

1 (i)	
1 (ii)	
2	
3	

4	
5	

6 (i)	
6 (ii)	

7

8

Section B (36 marks)

9 (i)

9 (ii)

Upper surface		Lower surface	
x	y	x	y
0	0	0	0
4	1.45	4	−0.85
8	1.56	8	−0.76
12	1.27	12	−0.55
16	1.04	16	−0.30
20	0	20	0

10 (i)	
10 (ii)	
	(answer space continued on next page)

10 (ii)	**(continued)**
10 (iii)	

11 (i)	
11 (ii)	

11 (iii)	
11 (iv)	

PLEASE DO NOT WRITE ON THIS PAGE

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 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)		$kx^{\frac{1}{3}-1}$ oe	**M1**	k is any non-zero constant	
			$4x^{\frac{-2}{3}}$ isw cao	**A1**	ignore + c	allow any equivalent exact simplified form
				[2]		
1	(ii)		kx^{-3+1} oe	**M1**	k is any non-zero constant	
			$-3x^{-2}$ isw	**A1**		allow any equivalent exact simplified form
			+ c	**A1**		
				[3]		
2			$u_2 = \frac{10}{2^2}, u_3 = \frac{10}{\text{their } 2.5^2}, u_4 = \frac{10}{\text{their } 1.6^2}$ isw	**M1***		NB 2.5, 1.6, 3.90625 or $\frac{10}{4}, \frac{8}{5}, \frac{125}{32}$
			$2 + u_2 + u_3 + u_4$ soi	**M1dep***	must be the sum of 4 terms only	may be implied by eg sight of 3.9 and answer of 10.0
						NB 2.5, 1.1, 0.625 scores **M0M0**
			10.00625 or $\frac{1601}{160}$ or $10\frac{1}{80}$ cao isw	**A1**	**B3** if unsupported	
				[3]		

3			$a + (10 - 1)d = 11.1$ and $a + (50 - 1)d = 7.1$	**M1**	may be implied by $40d = \pm4$ or embedded in attempt to solve	condone one slip in coefficient of d
			$d = -0.1$	**A1**	if unsupported, **B2** for one of these and **B3** for both	
			$a = 12$	**A1**		
			$\frac{1}{2} \times 50(their\ a + 7.1)$ with $a > 11.1$	**M1**	or $\frac{50}{2}(2a + (50-1)d)$ with $a > 11.1$ and $d < 0$	
			477.5 or 477½ or $\frac{955}{2}$ cao	**A1**		if **M0**, **B2** for any form of correct answer www
				[5]		
4			27 = ½ r^2 × 1.5 oe	**M1**	or $27 = \frac{85.943669...}{360} \times \pi r^2$	angle in degrees rounded to 2 sf or more
			$r = 6$ soi	**A1**	may be embedded in formula for arc length	may be implied by later work eg 9 or 21
			their r × 1.5	**M1**	or their $\frac{85.943639}{360} \times 2\pi \times$ their r	if r is incorrect, we must **see** their r × 1.5 [+ 2r] for **M1** if r is correct, **M1** may be implied by 9 or 21
			21 [cm] cao	**A1**	allow full marks for recovery from working with rounded value of θ in degree form	**B4** for 21 unsupported www
				[4]		

5			$3x^2 - 6$ seen	**B1**		
			their $y' = 0$ or $y' > 0$ or $y' \geq 0$	**M1**	must be quadratic with at least one of only two terms correct	
			$\sqrt{2}$ and $-\sqrt{2}$ identified	**A1**	may be implied by use with inequalities or by ±1.41[4213562] to 3 sf or more	$\lvert x \rvert = \sqrt{2}$ implies **A1**
			$x < -\sqrt{2}$ or $x \leq -\sqrt{2}$ isw	**A1**	if **A1A0A0**, allow **SC1** for fully correct answer in decimal form to 3 sf or more	NB **just** $-\sqrt{2} > x > \sqrt{2}$ or $\sqrt{2} < x < -\sqrt{2}$ or $x > \pm\sqrt{2}$ implies the first **A1** then **A0A0**
			$x > \sqrt{2}$ or $x \geq \sqrt{2}$	**A1**	or **A2** for $\lvert x \rvert > \sqrt{2}$ or $\lvert x \rvert \geq \sqrt{2}$	
				[5]		
6	**(i)**		both curves with positive gradients in 1st and 2nd quadrants; ignore labels for this mark	**M1**	do not award if clearly not exponential shape; condone touching negative *x*-axis but not crossing it	consider each curve independently; ignore scales and points apart from (0, 1)
			both through (0, 1)	**A1**		allow if indicated in table of values or commentary if not marked on graph
			$y = 3^{2x}$ above $y = 3^x$ in first quadrant and below it in second	**A1**	must be clearly labelled, **A0** if wrongly attributed or if coincide for negative *x* from (0, 1)	if **M0** allow **SC1** for one graph fully correct
				[3]		
6	**(ii)**		$x = 3$	**B1**	**B0** if wrongly attributed	
			$3^x = 27$	**B1**	**B0** if wrongly attributed	allow $3^3 = 27$ with $x = 3$ stated
				[2]		

7			$1 - \cos^2 x = 3\cos x - 2$ oe	**M1***		
			$\cos^2 x + 3\cos x - 3$ [= 0]	**M1*dep**	or $-\cos^2 x - 3\cos x + 3 = 0$	condone one sign error *or* constant term of -1 (in LH version) or $+1$ (in RH version)
			$\cos x =$ their $\dfrac{-3+\sqrt{21}}{2}$ or $\cos x =$ their 0.79 to 0.7913 soi	**M1**	dependent on award of previous method mark, must be correct for their quadratic	ignore other values (eg –3.79...); condone recovery from x = 0.791287847…but **M0** if no recovery
			[x =] 0.6578 to 0.66 isw cao	**A1**	**A0** for eg 0.66π if 0.66 not seen separately	NB x = 0.65788395…
			[x =] 5.625 to 5.63 isw cao	**A1**	if **A1A1** extra values in range incur a penalty of 1; ignore extra values outside range	NB x = 5.625301357…
				[5]	if **A0A0** allow **SC1** for 37.69 to 37.7° *and* 322 to 322.31° *or* for (0.209 to 0.21)π *and* (1.79 to 1.791)π	no **SC** mark available if extra values in range
8			$m = 3$ seen	**B1**		
			$\log y = m\log x + 2$ or $\log y = m\log x + \log 100$	**M1**	or $\log y - 8 = m(\log x - 2)$	condone lack of base; "$c = 2$" is insufficient
			$\log y = \log x^3 + 2$ or $\log y = \log x^3 + \log 100$ or better	**M1**	or $10^{\log y} = 10^{3\log x + 2}$ or $10^{3\log x + \log 100}$ or better	condone lack of base, but not bases other than 10 unless fully recovered
			$y = 100x^3$ or $y = 10^{3\log x + 2}$ or $y = 10^{\log x^3 + 2}$ www isw	**A1**	$y = 10^{3\log x + \log 100}$ or $y = 10^{\log x^3 + \log 100}$	
				[4]		

9	(i)		$[\cos A =]\frac{20^2+13^2-8^2}{2\times 13\times 20}$	**M1***	or $8^2 = 20^2+13^2-2\times 13\times 20\times \cos A$	
			$[\cos A =]\frac{505}{520}$ oe soi	**A1**	or 0.971 to 0.9712	
			$A =$ 13.79 to 13.8° or 14°	**A1**	or 0.24077 to 0.241 or 0.24 (radians); allow **B3** if given to 3sf or more unsupported	or 15.32 (grad)
			[Area =] ½ × 20 × 13 × sin *their A*	**M1dep***	or **M1** for eg ½ × 20 × 8 × sin 22.8, as long as angle calculated correctly from their *A* (other angles are 22.79824…° and 143.40645..° or 36.59355..°)	or $\sqrt{\frac{41}{2}(\frac{41}{2}-8)(\frac{41}{2}-13)(\frac{41}{2}-20)}$ NB $13\sin A$ = 3.099899192 if ½×*b*×*h* used
			30.99 to 31.01 isw or $\frac{5\sqrt{615}}{4}$ oe isw	**A1** **[5]**	allow **B2** for unsupported answer within range	

9	**(ii)**		$h = 4$ soi	**B1**		
			$\frac{\text{their } 4}{2} \times (0 + 0 + 2(1.45+1.56+1.27+1.04))$ *or* $\frac{\text{their } 4}{2} \times (0 + 0 + 2(\pm 0.85 \pm 0.76 \pm 0.55 \pm 0.30))$	**M1***	shape of formula correct with 2, 3 or 4 y-values in inner bracket with their h; allow recovery from bracket errors **M0** if any non-zero x-values used or if y-values used twice	eg $\frac{\text{their } 4}{2} \times \{1.45 + 1.04 + 2(1.56 + 1.27)\}$; signs must be consistent in 2nd alternative
				B1	all y-values correctly placed with their h, condone omission of zeros and/or omission of outer brackets	
			either 21.28 or $\pm$ 9.84	**A1**		or **B1** + **B3*** if area of 2 triangles and 3 trapezia calculated to give correct answer www The final **M1dep* A1** may then be earned. NB 2.9 + 6.02 + 5.66 + 4.62 + 2.08 or $\pm$ 1.7 $\pm$ 3.22 $\pm$ 2.62 $\pm$ 1.7 $\pm$ 0.60 with consistent signs throughout
			their 21.28 + their 9.84	**M1dep***		
			31.12	**A1**	ignore subsequent rounding, but **A0** if answer spoiled by eg multiplication by 20	

9	(ii)		*alternatively*			
			$h = 4$ soi	**B1**		
			attempt to find all y-values	**M1**	$y_{upper} - y_{lower}$	**M0** if values are added to obtain 0.60, 0.80 etc
			2.3, 2.32, 1.82, 1.34	**A1**	all y-values correct	
			$\frac{\text{their } 4}{2} \times (0 + 0 + 2(2.3+2.32+1.82+1.34))$	**M1**	shape of formula correct with 2, 3 or 4 of their y-values in inner bracket with their h; allow recovery from bracket errors **M0** if any non-zero x-values used or if y-values used twice	eg ½ × 4 × {2.3 + 1.34 + 2(2.32+1.82)}
				B1FT	all their y-values correctly placed, condone omission of zeros and/or omission of outer brackets	
			31.12	**A1**	ignore subsequent rounding, but **A0** if answer spoiled by eg multiplication by 20	or **B1M1A1** + **B3** if area of 2 triangles and 3 trapezia calculated to give correct answer www NB 4.6 + 9.24 + 8.28 + 6.32 + 2.68
				[6]		

10	**(i)**		$\left[\frac{dy}{dx}=\right]$ 4 × 2 + 3 or 11 isw	**M1***		
			9 = their (4 × 2 + 3) × 2 + *c*	**M1dep***	or *y* – 9 = their (4 × 2 + 3) × (*x* – 2)	
			y = 11*x* – 13 or *y* = 11*x* + *c* and *c* = −13 stated isw	**A1**	or *y* – 9 = 11(*x* – 2) isw	
				[3]		
10	**(ii)**		$\frac{4x^2}{2}+3x$	**M1***		
			[*y* =] $2x^2 + 3x + c$	**A1**	must see "2" and " + *c*"; may be earned later eg after attempt to find *c*	
			$9 = 2\times2^2 + 3\times2 + c$	**M1dep***	must include constant, which may be implied by answer	
			$y = 2x^2 + 3x - 5$ cao	**A1**	allow first 4 marks for $y = 2x^2 + 3x + c$ and $c = -5$ stated	
			(1, 0) *and* (–2.5, 0) oe cao	**B1**	or for *x* = 1, *y* = 0 and *x* = −2.5, *y* = 0	**B0** for just stating *x* = 1 and *x* = −2.5
			$x=-\frac{3}{4}$	**B1**		
			$y=-\frac{49}{8}$	**B1**	–6.125 or − 6⅛	
				[7]		

10	**(iii)**		substitution to obtain [y =] f(2x) in polynomial form	**M1**	f(x) must be the quadratic in x with linear and constant term obtained in part (ii), may be in factorised form	or their $x = 1 \rightarrow$ their 0.5 and their $x = -2.5 \rightarrow$ their $x = -1.25$
			$y = (2x - 1)(4x + 5)$ or $y = 8x^2 + 6x - 5$ or $y = 2\left(2x + \frac{3}{4}\right)^2 - \frac{49}{8}$	**A1FT**	must be simplified to one of these forms, **FT** their quadratic in x with linear and constant term obtained in part (ii)	hence $y = (2x - 1)(4x + 5)$ FT their x-intercepts from their quadratic in x with linear and constant term obtained in part (ii)
			$\left(-\frac{3}{8}, -\frac{49}{8}\right)$ oe	**B1** **[3]**	or **FT** their (both non-zero) co-ordinates for minimum point or their quadratic in x with linear and constant term obtained in part (ii)	
11	**(i)**		3×3^7 oe	**M1**	condone 1×3^7	do not award if only seen in sum of terms of GP
			6561	**A1** **[2]**	or **B2** if unsupported	if **0, SC1** for 2187 unsupported
11	**(ii)**		valid attempt to sum a GP with $r = 3$ and $n = 15$	**M1**	eg $3 + 3^2 + \ldots\ldots + 3^{15}$	must see at least first two terms and last term NB 7 174 453 implies **M1** from $1 + 3 + \ldots + 3^{14}$
			$\frac{3(3^{15} - 1)}{3 - 1}$ oe	**M1**		
			21 523 359	**A1** **[3]**	or **B2** if **M1M0** or **B3** if unsupported	

11	(iii)		$\frac{3(3^n - 1)}{3-1} > 1000\,000$ oe	**M1***		**M0** for working backwards **M0** if = or < used
			eg $3^{n+1} > 2000003$ or $3^n > \frac{2000000}{3} + 1$ www			
			correctly taking logs of both sides	**M1dep***	eg $\log 3^{n+1} > \log 2000003$ www or $\log 3^n + \log 3 > \log 2000003$ www; may be implied by next stage of working	at least one previous progressive interim step needed with no wrong working; **M0dep*** for $\log(3^n - 1) > \ldots$
			eg $(n + 1)\log 3 > \log 2000003$ or $n\log 3 > \log 2000003 - \log 3$			
			eg $n + 1 > \frac{\log 2000003}{\log 3}$ and completion to $n > \frac{\log 2000003}{\log 3} - 1$	**A1**	without any wrong working	do not allow recovery from bracket errors at any stage
			$n = 13$ seen	**B1**	**B0** for $n \geq 13$ or $n > 13$	
				[4]		
11	(iv)		valid attempt to sum a GP with $r = 2$ and $n = 15$	**M1***	if correct eg $2 + 2^2 + \ldots\ldots. + 2^{15} = 65\,534$	NB 32767 implies **M1** from $1 + 2 + \ldots + 2^{14}$
			their 21 523 359 – their 65 534	**M1dep***	with their 65 534 < their 21 523 359	
			21 457 825 isw	**A1**	allow **B3** for 21 457 825 unsupported	
				[3]		

4752 Concepts for Advanced Mathematics (C2)

General Comments:

The paper was accessible to the majority of candidates, and most seemed well-prepared. A significant minority of candidates demonstrated a fair degree of understanding of Core 2 syllabus material, but failed to do themselves justice in the examination because of poor (GCSE level) algebra, careless arithmetical slips and failing to read the question correctly. Premature approximation followed by over-specification of final answers also cost some candidates easy marks.

Most candidates presented their work neatly and clearly, but in some cases work was very difficult to follow, and candidates should understand the importance of presenting a clear mathematical argument, especially when there is a "show that" request in the question.

The handing out of 16 page answer booklets to candidates who need extra space is unhelpful: often only one page is used.

It is disappointing to see some candidates misquoting formulae that are given to them in the booklet, notably in question 4.

Centres are advised that using a graphical calculator to avoid a demand to use calculus, for example in question 5, or to solve an equation for example in question 7 will earn no credit unless the relevant working is presented.

Comments on Individual Questions

Question 1

Part (i)

This was done well. A small minority of candidates failed to score: most problems were caused by a failure to put the original function into index form correctly.

Part (ii)

A few candidates differentiated or tried to integrate both the numerator and the denominator independently, but most knew what to do here and went on to score 2 or 3 marks. A significant minority of candidates neglected to add '+ *c*', thereby losing an easy mark.

Question 2

A little under half of candidates achieved full marks on this question. Approximately 20% prematurely rounded their answers and lost the final accuracy mark, and a few found the sum of the second to fifth terms inclusive instead of the first to fourth. The most common error for those who failed to score at all was to treat the sequence as being defined algebraically, but a few candidates misused the formula for the sum of an arithmetic or geometric progression.

Question 3

Most candidates knew what to do here, but a surprisingly high number misread "fiftieth" as "fifteenth", and a few misread "fiftieth" as "fifth". A few then also misread one of the numbers. However, most read fifty correctly. The majority went on to solve their equations successfully, but a surprising number obtained a positive value for d and simply carried on, without stopping to think that this could not possibly be correct. Candidates would to well to ask themselves whether or not their answer is sensible in the context of the original question. It seemed that many candidates simply didn't see the request to find the sum of the first fifty terms, and stopped after finding a and d.

Question 4

This was very well done: approximately two thirds of candidates obtained full marks. Some candidates converted to degrees and lost the accuracy marks and a few candidates used incorrect formulae.

Question 5

The majority of candidates differentiated successfully and went on to identify $\pm\sqrt{2}$ correctly. A few neglected the negative root, losing an easy mark. Thereafter candidates went astray in a variety of ways. Many candidates used incorrect forms when writing their inequalities. $x > \pm\sqrt{2}$ was seen frequently and many candidates combined their separate inequalities in illegal ways such as $\sqrt{2} < x < -\sqrt{2}$. These candidates were penalised if the correct inequalities were not seen first. Candidates should realise that it is good practise to write the two inequalities separately first, before any attempt is made to combine them. Some candidates decimalised $\pm\sqrt{2}$ were penalised for having a slight inaccuracy in their answer.

A few candidates didn't differentiate at all, thereby ignoring the instruction to use calculus and so made no progress.

Question 6

Part (i)

A small number of candidates drew two curves of totally different shapes, which was surprising, but most knew the correct shape and although many sketches were sloppily presented, and marks were lost through omitting to identify (0, 1) or by allowing the curves to coalesce through the second quadrant.

Part (ii)

This was very well done. Nearly all candidates correctly found $x = 3$; a few then evaluated 3^3 as 6, 9 or 81.

Question 7

A few candidates were unable to eliminate $\sin^2\theta$ legitimately, but all bar the weakest candidates managed at least 2 marks here. A small number of candidates made errors when rearranging to zero – generally with the constant term.

Some were using x for $\cos x$ in their quadratic formula and not recovering the 'cos'. This was unfortunate. Candidates must realise that this is not a useful practice. Even those who made other substitutions often failed to give their evaluated formula a subject and then confused themselves.

Some candidates resorted to rounded decimals very quickly and made premature approximation errors in their answers, thus losing one or more accuracy mark.

Quite a few candidates were finding the second angle by adding 0.66 to 1.5π rather than subtracting it from 2π.

A fair number of candidates worked in degrees – a good number of these were allowed the SC1 for a pair of correct answers. When the question stipulates angles over a range such as "between 0 and 2π", the expectation is that their angles will be in radians, not degrees.

Question 8

A minority of candidates found this question straightforward and produced fully correct solutions. However, the majority struggled or failed to give sufficient detail of their working to earn full credit.

A good number found the gradient of the line as 3. Some used $\frac{\log 6}{\log 2}$, indicating the common misconception of the model. log*y* = 3log*x* + log 2 was very common as a second statement. Those who earned the second mark very often lost the third for statements such as *y* = 3*x* + 2 (removing all the "logs") or $y = x^3 + 100$, without log*y* = logx^3 + 2, or equivalent, having been seen. It is important that each step should be shown as correct final answers were often seen following incorrect working, which of course do not score.

A few candidates knew that the final model was of the form $y = ax^b$ and also demonstrated that *b* was the gradient and *a* was $10^{\text{(the intercept)}}$, producing the correct equation relating *y* and *x*. Many of these candidates would have done better to re-read the question as most of them omitted to state the equation relating log*y* and log*x*, which was one of the demands of the question.

Question 9

Part (i)

Most candidates used the Cosine rule correctly to calculate angle A and most went on to calculate the area correctly using ½absinC. A minority complicated matters by splitting the triangle into 2 right angle triangles, calculating the height and then using Pythagoras to calculate the base of each triangle and hence the area of each separately. A few candidates unnecessarily found one of the other angles and then used ½absinC. In both cases this usually resulted in a loss of accuracy so their final answer was outside the permissible range. Similarly, some candidates rounded their value for cos*A* and went on to lose both accuracy marks. Approximately three quarters of candidates scored full marks.

Part (ii)

Most candidates used the trapezium rule separately for the upper and lower areas, with a smaller number recognising that the total area could be calculated with a single application. The most common error was omitting the outside pair of brackets in the formula and this was rarely recovered. Another common error was the failure to recognise that the absolute areas should be summed, with candidates subtracting the lower area from the upper. A surprising error for several candidates was getting the value of h incorrect as this was not only clear from the table, but also explicitly stated in the question. Nevertheless, a significant majority scored full marks.

Question 10

Part (i)

The majority of candidates gained full marks on this question. A few found the gradient correctly and then went on to find the equation of the normal, and some candidates integrated and found the equation of the curve.

Part (ii)

Most candidates integrated successfully. A few omitted '+ *c*' and made little progress thereafter, but the majority successfully obtained the equation of the curve. Many candidates failed to give the co-ordinates in a correct form or transposed the signs, thus losing an accuracy mark. Most candidates used the given derivative to find the co-ordinates of the minimum point, but it was surprising how many made a sign error and then couldn't obtain the correct value for *y*. A significant number of candidates completed the square instead of using the derivative, and most lost accuracy.

Part (iii)

Very few candidates realised that they needed to work with f(2*x*) to find the new equation. The majority of those who did adopt the correct approach often went wrong, usually with the first term. In order to earn the method mark by this approach examiners needed to see the substitution: many candidates just wrote down $y = 4x^2 + 6x - 5$ and failed to score. It may have been the case that the correct approach was being attempted, but this answer was also seen resulting from totally wrong working!

A few candidates successfully worked with the images of the intercepts following the stretch, but often failed to simplify the answer correctly.

A minority of candidates earned the third mark, either as a follow through mark or for a fully correct answer. However, many candidates multiplied the *x* value by 2, or halved the *y* value instead or as well.

Question 11

Part (i)

Many candidates found this a straightforward question and answered it successfully. 3×3^7 or 3^8 was frequently seen as the method. 1×3^7 was seen occasionally as was an unsupported 2187. Many candidates opted for longer methods, which included lists of powers of 3 and/or diagrams.

Part (ii)

This was answered successfully by the majority of the candidates, including those who simply worked out the terms of the GP and added them. Stronger candidates achieved a correct answer from a correct formula although there was a good number of unsupported correct answers. A variety of incorrect formulae were in evidence, among the more common were: $\frac{1(3^{15}-1)}{3-1}$, $\frac{3(3^{14}-1)}{3-1}$. and $\frac{3(3^{15}-1)}{15-1}$

Many candidates listed the terms either evaluated or expressed as powers and summed their list to achieve a correct result.

Part (iii)

This part differentiated well between the best and good candidates. Setting up the initial inequality proved beyond many, even those who had successfully used the formula for the sum of a GP in part (ii). There were some splendid examples of well-argued proofs, but getting beyond the first M1 was unusual. Those who started with the $1-3^n$ version of the formula were rarely successful, as basic rules of inequalities when multiplying by a negative were forgotten. Some candidates also thought that $3 \times 3^n = 9^n$. The taking of logs produced problems. Sadly, many candidates who managed to get started with the inequality, didn't answer the last part, whereas weak candidates often went straight for this. A surprising number of candidates thought it perfectly reasonable to have non-integer numbers of generations.

Part (iv)

Those candidates who answered parts (i) and (ii) successfully usually went on to achieve full marks in part (iv). A few worked with the fifteenth term, rather than the sum of the first fifteen terms.

GCE Mathematics (MEI)											
				Max Mark	a	b	c	d	e	u
4751	01	C1 – MEI Introduction to advanced mathematics (AS)	Raw	72	63	58	53	48	43	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – MEI Concepts for advanced mathematics (AS)	Raw	72	56	50	44	39	34	0
			UMS	100	80	70	60	50	40	0
4753	01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	56	51	46	41	36	0
4753	02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753	82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4754	01	C4 – MEI Applications of advanced mathematics (A2)	Raw	90	74	67	60	54	48	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – MEI Further concepts for advanced mathematics (AS)	Raw	72	62	57	53	49	45	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – MEI Further methods for advanced mathematics (A2)	Raw	72	65	58	52	46	40	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – MEI Further applications of advanced mathematics (A2)	Raw	72	59	52	46	40	34	0
			UMS	100	80	70	60	50	40	0
4758	01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	63	57	51	45	38	0
4758	02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758	82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4761	01	M1 – MEI Mechanics 1 (AS)	Raw	72	62	54	46	39	32	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – MEI Mechanics 2 (A2)	Raw	72	54	47	40	33	27	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – MEI Mechanics 3 (A2)	Raw	72	64	56	48	41	34	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – MEI Mechanics 4 (A2)	Raw	72	53	45	38	31	24	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – MEI Statistics 1 (AS)	Raw	72	61	54	47	41	35	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – MEI Statistics 2 (A2)	Raw	72	65	60	55	50	46	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – MEI Statistics 3 (A2)	Raw	72	64	58	52	47	42	0
			UMS	100	80	70	60	50	40	0
4769	01	S4 – MEI Statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4771	01	D1 – MEI Decision mathematics 1 (AS)	Raw	72	56	51	46	41	37	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – MEI Decision mathematics 2 (A2)	Raw	72	54	49	44	39	34	0
			UMS	100	80	70	60	50	40	0
4773	01	DC – MEI Decision mathematics computation (A2)	Raw	72	46	40	34	29	24	0
			UMS	100	80	70	60	50	40	0
4776	01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	56	50	45	40	34	0
4776	02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776	82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
			UMS	100	80	70	60	50	40	0
4777	01	NC – MEI Numerical computation (A2)	Raw	72	55	47	39	32	25	0
			UMS	100	80	70	60	50	40	0
4798	01	FPT - Further pure mathematics with technology (A2)	Raw	72	57	49	41	33	26	0
			UMS	100	80	70	60	50	40	0

OCR
Oxford Cambridge and RSA

GCE Statistics (MEI)										
			Max Mark	a	b	c	d	e	u
G241	01 Statistics 1 MEI (Z1)	Raw	72	61	54	47	41	35	0
		UMS	100	80	70	60	50	40	0
G242	01 Statistics 2 MEI (Z2)	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243	01 Statistics 3 MEI (Z3)	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0

GCE Quantitative Methods (MEI)									
			Max Mark	a	b	c	d	e	u
G244	01 Introduction to Quantitative Methods MEI	Raw	72	58	50	43	36	28	0
G244	02 Introduction to Quantitative Methods MEI	Raw	18	14	12	10	8	7	0
		UMS	100	80	70	60	50	40	0
G245	01 Statistics 1 MEI	Raw	72	61	54	47	41	35	0
		UMS	100	80	70	60	50	40	0
G246	01 Decision 1 MEI	Raw	72	56	51	46	41	37	0
		UMS	100	80	70	60	50	40	0