OCR
RECOGNISING ACHIEVEMENT

Friday 18 January 2013 – Afternoon

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 in the centre of 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 **8** 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.

This paper has been pre modified for carrier language

Section A (36 marks)

1 Find $\int 30x^{\frac{3}{2}}\,dx$. **[3]**

2 For each of the following sequences, state with a reason whether it is convergent, periodic or neither. Each sequence continues in the pattern established by the given terms.

(i) $3,\ \frac{3}{2},\ \frac{3}{4},\ \frac{3}{8},\ \ldots$ **[1]**

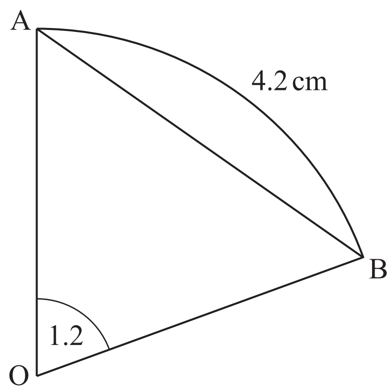
(ii) $3,\ 7,\ 11,\ 15,\ \ldots$ **[1]**

(iii) $3,\ 5,\ -3,\ -5,\ 3,\ 5,\ -3,\ -5,\ \ldots$ **[1]**

3 **(i)** The point P (4, –2) lies on the curve $y = \mathrm{f}(x)$. Find the coordinates of the image of P when the curve is transformed to $y = \mathrm{f}(5x)$. **[2]**

(ii) Describe fully a single transformation which maps the curve $y = \sin x°$ onto the curve $y = \sin(x - 90)°$. **[2]**

4



Not to scale

Fig. 4

Fig. 4 shows sector OAB with sector angle 1.2 radians and arc length 4.2 cm. It also shows chord AB.

(i) Find the radius of this sector. **[2]**

(ii) Calculate the perpendicular distance of the chord AB from O. **[2]**

5 A and B are points on the curve $y = 4\sqrt{x}$. Point A has coordinates (9, 12) and point B has x-coordinate 9.5. Find the gradient of the chord AB.

The gradient of AB is an approximation to the gradient of the curve at A. State the x-coordinate of a point C on the curve such that the gradient of AC is a closer approximation. **[3]**

6 Differentiate $2x^3 + 9x^2 - 24x$. Hence find the set of values of x for which the function $\mathrm{f}(x) = 2x^3 + 9x^2 - 24x$ is increasing. **[4]**

7 Fig. 7 shows a sketch of a village green ABC which is bounded by three straight roads. AB = 92 m, BC = 75 m and AC = 105 m.

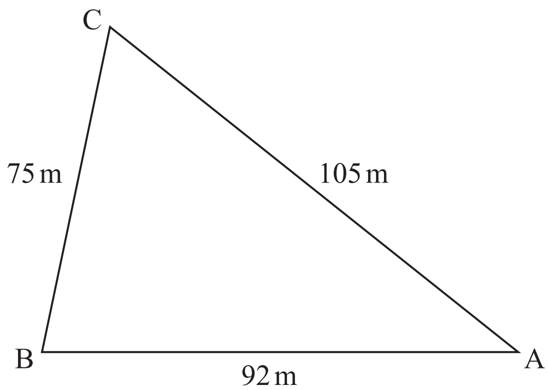


Fig. 7

Calculate the area of the village green. **[5]**

8 **(i)** Sketch the graph of $y = 3^x$. **[2]**

(ii) Solve the equation $3^{5x-1} = 500\,000$. **[3]**

9 **(i)** Show that the equation $\dfrac{\tan\theta}{\cos\theta} = 1$ may be rewritten as $\sin\theta = 1 - \sin^2\theta$. **[2]**

(ii) Hence solve the equation $\dfrac{\tan\theta}{\cos\theta} = 1$ for $0° \leqslant \theta \leqslant 360°$. **[3]**

Section B (36 marks)

10 Fig. 10 shows a sketch of the curve $y = x^2 - 4x + 3$. The point A on the curve has x-coordinate 4. At point B the curve crosses the x-axis.

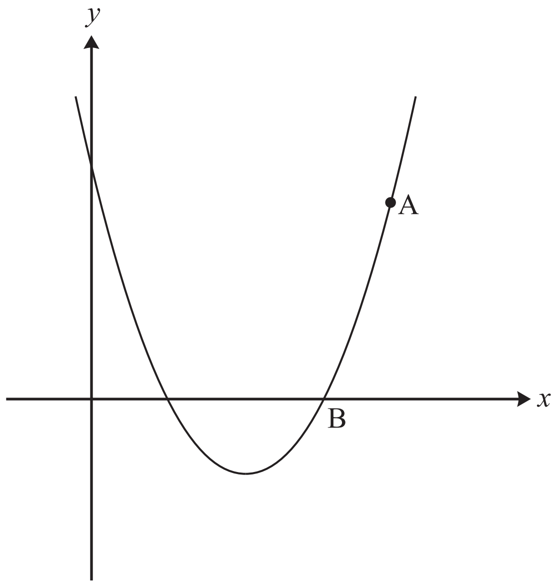


Fig. 10

(i) Use calculus to find the equation of the normal to the curve at A and show that this normal intersects the x-axis at C (16, 0). **[6]**

(ii) Find the area of the region ABC bounded by the curve, the normal at A and the x-axis. **[5]**

11 **(i)** An arithmetic progression has first term A and common difference D. The sum of its first two terms is 25 and the sum of its first four terms is 250.

(A) Find the values of A and D. **[4]**

(B) Find the sum of the 21st to 50th terms inclusive of this sequence. **[3]**

(ii) A geometric progression has first term a and common ratio r, with $r \neq \pm 1$. The sum of its first two terms is 25 and the sum of its first four terms is 250.

Use the formula for the sum of a geometric progression to show that $\dfrac{r^4 - 1}{r^2 - 1} = 10$ and hence or otherwise find algebraically the possible values of r and the corresponding values of a. **[5]**

12 The table shows population data for a country.

Year	1969	1979	1989	1999	2009
Population in millions (p)	58.81	80.35	105.27	134.79	169.71

The data may be represented by an exponential model of growth. Using t as the number of years after 1960, a suitable model is $p = a \times 10^{kt}$.

(i) Derive an equation for $\log_{10} p$ in terms of a, k and t. **[2]**

(ii) Complete the table and draw the graph of $\log_{10} p$ against t, drawing a line of best fit by eye. **[3]**

(iii) Use your line of best fit to express $\log_{10} p$ in terms of t and hence find p in terms of t. **[4]**

(iv) According to the model, what was the population in 1960? **[1]**

(v) According to the model, when will the population reach 200 million? **[3]**

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RECOGNISING ACHIEVEMENT

Friday 18 January 2013 – Afternoon

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

* 4 7 5 2 0 1 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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DC (NF/CGW) 63714/3

Section A (36 marks)

1	
2 (i)	
2 (ii)	
2 (iii)	
3 (i)	

3 (ii)	
4 (i)	
4 (ii)	
5	

6	
7	
8 (i)	

8 (ii)	
9 (i)	
9 (ii)	

Section B (36 marks)

10 (i)	

10 (ii)	

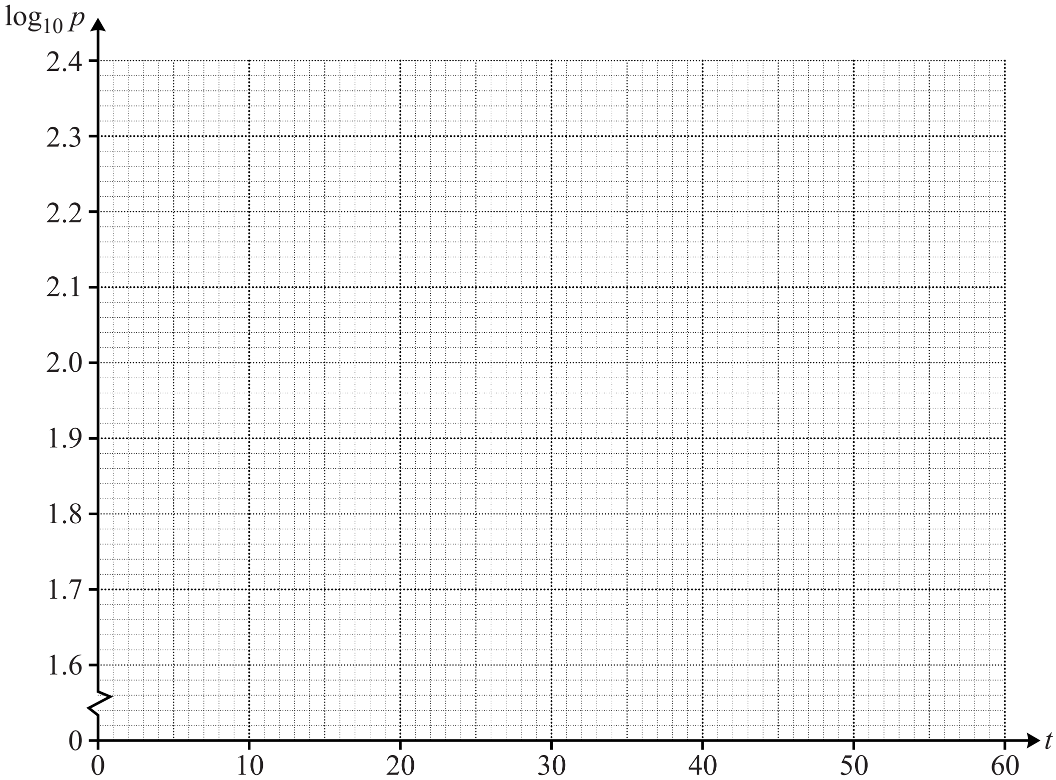
11 (i)(*A*)	
11 (i)(*B*)	

11 (ii)

12 (i)

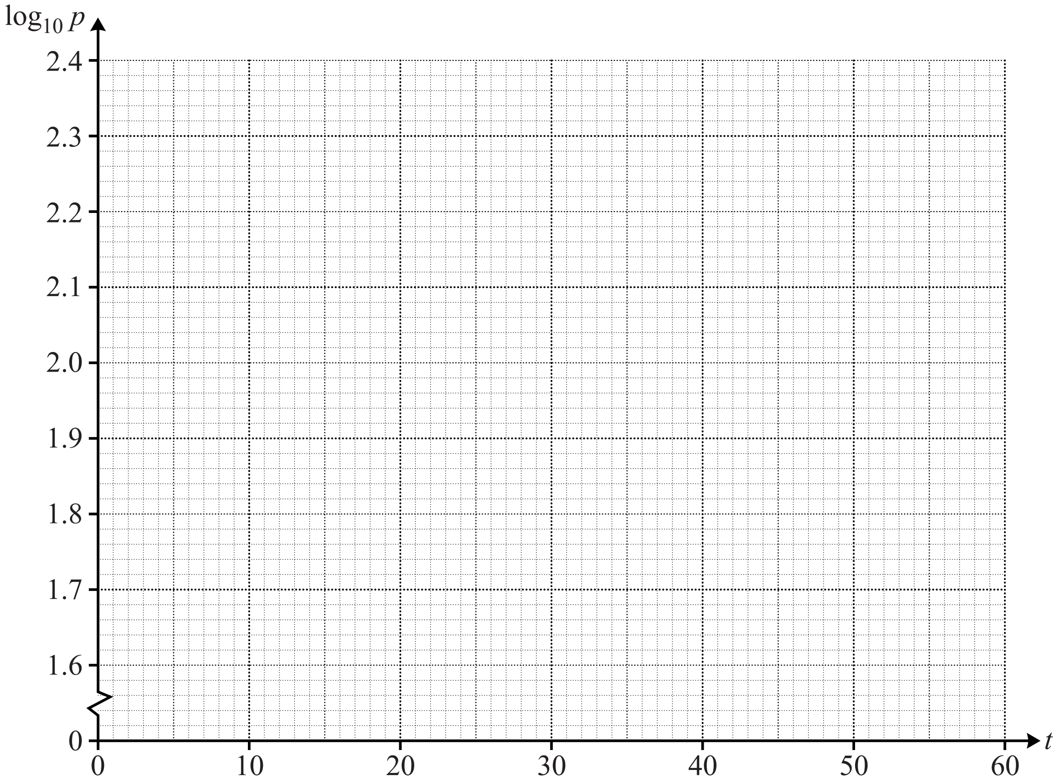
12 (ii)

Year	1969	1979	1989	1999	2009
Number of years after 1960 (t)	9	19	29	39	49
Population in millions (p)	58.81	80.35	105.27	134.79	169.71
$\log_{10} p$	1.77	1.90			



A spare copy of this graph paper can be found on page 12.

12 (iii)	
12 (iv)	
12 (v)	

12 (ii)	**Spare copy of graph paper for question 12(ii).** 

RECOGNISING ACHIEVEMENT

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GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4752:** Concepts for Advanced Mathematics

Mark Scheme for January 2013

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.

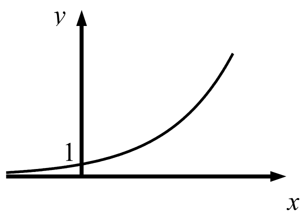
NB Follow these maths-specific instructions rather than those in the assessor handbook.

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, $r = ½$, 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 × h × 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 $8.53 \le x_C < 9$
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 $x \le -4$ and $x \ge 1$	or sketch of $y = 6x^2 + 18x - 24$ with attempt to find x-intercepts if **B0M0** then **SC2** for fully correct answer

Question			Answer	Marks	Guidance	
7			$\cos A = \dfrac{105^2 + 92^2 - 75^2}{2 \times 105 \times 92}$ oe	M1	or $\cos B = \dfrac{75^2 + 92^2 - 105^2}{2 \times 75 \times 92}$ oe	or $\cos C = \dfrac{105^2 + 75^2 - 92^2}{2 \times 105 \times 75}$ oe
			0.717598…soi	A1	0.2220289…soi	0.519746…soi
			A = 44.14345…° soi [0.770448553…]	A1	B = 77.1717719……° soi [1.346901422]	C = 58.6847827…° soi [1.024242678…] ignore minor errors due to premature rounding for second **A1** condone *A*, *B* or *C* wrongly attributed
			½ × 92 × 105 × sin (*their* A)	M1	or ½ × 75 × 92 × sin (*their* B)	or ½ × 75 × 105 × sin (*their* C)
			3360 or 3361 to 3365	A1		**or** **M3** for $\sqrt{136(136-75)(136-105)(136-92)}$ **A2** for correct answer 3360 or 3363 - 3364
				[5]		
8	**(i)**			M1	for curve of correct shape in both quadrants	**SC1** for curve correct in 1st quadrant and touching (0,1) or identified in commentary
				A1	through (0, 1) shown on graph or in commentary	
				[2]		

Question			Answer	Marks	Guidance	
8	(ii)		$5x - 1 = \dfrac{\log_{10} 500\,000}{\log_{10} 3}$	M1	or $5x - 1 = \log_3 500\,000$	condone omission of base 10 use of logs in other bases may earn full marks
			$x = (\dfrac{\log_{10} 500\,000}{\log_{10} 3} + 1) \div 5$	M1	$x = (\log_3 500000 + 1) \div 5$	
			[x =] 2.588 to 2.59	A1	oe; or **B3** www	if unsupported, **B3** for correct answer to 3 sf or more www
				[3]		
9	(i)		$\dfrac{(\dfrac{\sin\theta}{\cos\theta})}{\cos\theta} = 1$ oe	M1		
			$\sin\theta = \cos^2\theta$ and completion to given result	A1	www	
				[2]		
9	(ii)		$\sin^2\theta + \sin\theta - 1 [= 0]$	M1	allow 1 on RHS if attempt to complete square	condone $y^2 + y - 1 = 0$
			$[\sin\theta =] \dfrac{-1 \pm \sqrt{5}}{2}$ oe may be implied by correct answers	A1	may be implied by correct answers	mark to benefit of candidate ignore any work with negative root & condone omission of negative root with no comment eg **M1** for 0.618…
			[θ =] 38.17... ,or 38.2 and 141.83..., 141.8 or 142	A1	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**	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
				[3]		

Question			Answer	Marks	Guidance	
10	(i)		at A $y = 3$	B1		
			$\frac{dy}{dx} = 2x - 4$	B1		
			their $\frac{dy}{dx} = 2 \times 4 - 4$	M1*	must follow from attempt at differentiation	
			grad of normal = $^{-1}/_{\text{their }4}$	M1dep*		
			$y - 3 = (^{-1}/_4) \times (x - 4)$ oe isw	A1		
			substitution of $y = 0$ and completion to given result with at least 1 correct interim step www	A1	or substitution of $x = 16$ to obtain $y = 0$	correct interim step may occur before substitution
				[6]		
10	(ii)		at B, $x = 3$	B1	may be embedded	
			$F[x] = \frac{x^3}{3} - \frac{4x^2}{2} + 3x$	M1*	condone one error, must be three terms, ignore + c	
			F[4] – F[their 3]	M1* dep	dependent on integration attempted	
			area of triangle = 18 soi	B1		may be embedded in final answer
			area of region = $19\frac{1}{3}$ oe isw	A1	19.3 or better	
				[5]		

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*)	$\frac{50}{2}(2 \times their A + 49 \times their\ D)$ [= 60 625] or $\frac{20}{2}(2 \times their\ A + 19 \times their\ D)$ [= 9250] their "$S_{50} - S_{20}$" 51 375 cao	M1 M1 A1 **[3]**	or a = their $A + 20D$ $S_{30} = \frac{30}{2}(a + l)$ oe with l = their $A + 49D$	 $S_{30} = \frac{30}{2}(2 \times their 987.5 + 29 \times their 50)$

Question			Answer	Marks	Guidance	
11	(ii)		$\frac{a(r^2-1)}{r-1}=25$ or $\frac{a(r^4-1)}{r-1}=250$	B1		
			$\frac{a\frac{(r^4-1)}{r-1}}{a\frac{(r^2-1)}{(r-1)}}=\frac{250}{25}$ oe	M1		allow $a(1+r)$ as the denominator in the quadruple- decker fraction
			and completion to given result www		at least one correct interim step required	$r^2 = x$ oe may be used
			use of $r^4 - 1 = (r^2 - 1)(r^2 + 1)$ to obtain $r^2 + 1 = 10$ www	M1	or multiplication and rearrangement of quadratic to obtain $r^4 - 10r^2 + 9 = 0$ oe with all three terms on one side	or **M1** for valid alternative algebraic approaches eg using $a(1 + r) = 25$ <u>and</u> $ar^2 + ar^3 = ar^2 (1 + r) = 225$
			$r = \pm 3$	A1		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
			$a = 6.25$ or -12.5 oe	A1	or **A1** for one correct pair of values of r and a	
				[5]		
12	(i)		$\log_{10}p = \log_{10}a + \log_{10}10^{kt}$	M1	condone omission of base;	if unsupported, **B2** for correct equation
			$\log_{10}p = \log_{10}a + kt$ www	A1		
				[2]		
12	(ii)		2.02, 2.13, 2.23	B1	allow given to more sig figs	2.022304623…, 2.129657673, 2.229707433
			plots correct	B1f.t.	to nearest half square	
			ruled line of best fit	B1	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	ft their plots must cover range from $x = 9$ to 49
				[3]		

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

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GCE

Mathematics (MEI)

Advanced GCE **A2 7895-8**

Advanced Subsidiary GCE **AS 3895-8**

OCR Report to Centres

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4752 Concepts for Advanced Mathematics

General Comments

The majority of candidates seemed well prepared for this paper and some excellent work was seen. Solutions were often concise and clearly set out, although in some cases candidates wasted time by adopting convoluted methods: the number of marks available is usually a reliable pointer to the amount of work expected. Nevertheless, some candidates were defeated by routine work: solving the quadratic equation in question 9 (ii) proving to be beyond a surprising number.

Comments on Individual Questions

1 The majority of candidates scored full marks on this question. However, a significant minority omitted "+ *c*" and lost an easy mark. Similarly, some candidates failed to simplify $\frac{30}{5/2}$ correctly or didn't try to, and thus lost a mark. Occasionally $\frac{30^{5/2}}{5/2}$ was seen, which of course scored 0.

2 A considerable number of candidates ignored the request to state a reason, and therefore failed to score. Some simply wrote out the first few terms of each sequence and others made comments which were too vague to be credited, such as "decreasing, so converging". A few lost the mark in one or more parts because there was no statement of "convergent" or "neither" – even if a correct reason had been identified.

3(i) The majority obtained both marks. The usual errors were present: (20, −2), (4, −10) and (0.8, −0.4) being the most common, but (9, −2) and (0, −2) were also seen occasionally.

(ii) Surprisingly few candidates used the word "translate", and opted for their own terminology such as "move to the right" or "shift to the right". Many candidates identified 90 to the right or gave the appropriate vector form. A few gave ambiguous answers or gave the answer "90 to the left".

4(i) Almost all candidates achieved full marks on this question. Some converted to degrees and rounded prematurely, thus losing the accuracy mark for the final answer, and a few used the formula for the area of a sector.

(ii) This straightforward question defeated a surprisingly large number of candidates. Many of these misunderstood the question and used the Cosine Rule to calculate the length AB, or simply answered their own question and calculated the area of the sector or the segment. Many of the successful candidates used convoluted methods, such as finding AB and then using Pythagoras – premature rounding sometimes caused a mark to be lost; forgetting to halve AB cost both marks. The Sine Rule was sometimes used successfully – but this was sometimes spoiled by the use of $\sin\pi$ in conjunction with 3.5. A few candidates found the area of the triangle and then used ½ base × height. Surprisingly few were able to use the expected approach: $d = 3.5\cos 0.6$.

5 This was done very well. Some candidates lost the second mark through premature rounding or simply giving the answer as 0.6. Only a few calculated the reciprocal of the gradient (which didn't score) and nearly all gave an appropriate value for x_c. A few candidates differentiated and substituted values in the derivative.

6 Most candidates differentiated correctly and identified the correct values of x. The final mark was often lost, either due to a misunderstanding of what had been found – answer given as $–4 < x < 1$ or poor notation – answer given as $–4 > x > 1$. Those who used a graphical approach with the derivative generally scored full marks. A few candidates missed the last term out, converted the first plus sign to a minus sign or failed to multiply 2 by 3 correctly, and lost the first mark.

7 Nearly all candidates adopted the expected approach successfully and achieved full marks. A few rounded the angle prematurely and lost the final mark. Some lost the last two marks by using "cos" instead of "sin" in the area formula, and similarly a very few candidates used "sin" instead of "cos" in the Cosine Rule. Most candidates went on to use the correct sides with the angle that had been found. After using the Cosine Rule successfully a few candidates opted for ½ base × height and about half of these did so successfully. A tiny minority of candidates used Hero's formula successfully. Only a small number treated the triangle as right angled and failed to score.

8(i) This was tackled successfully by most. Most sketches were correct in both quadrants, and (0, 1) was often identified. A small number of candidates only sketched the curve in the first quadrant.

(ii) This was very well done. A correct initial step of $\log_3 500\,000$ or ${}^{\log 500\,000}/_{\log 3}$ was almost always present. The most common error was to then subtract 1 from each side. Occasionally only 1 term was divided by 5, and again some candidates rounded prematurely and lost the final mark.

9(i) Many candidates answered this question well, although there were a number of attempted fudges using $\tan\theta = {}^{\cos\theta}/_{\sin\theta}$. Some adopted a scattergun approach and it was not always possible to follow their method.

(ii) This defeated a significant minority of candidates. However, many obtained the correct quadratic equation. Most then went on to attempt factorisation, going wrong and failing to score. A minority successfully completed the square or used the formula. Many of these went on to score full marks, but some candidates missed the last mark because they presented extra values in the range, or because they didn't realise that further work was needed after obtaining the roots of the quadratic.

10(i) This was done extremely well, with the majority of even the weakest candidates scoring full marks. A few wrote $2x – 4 = 0$ to incorrectly obtain $m = 2$ and made no further progress, and a very small minority tried to answer the question without using calculus and working backwards.

(ii) Nearly all candidates identified the coordinates of B correctly. However, most – as if by rote – subtracted the equation of the line from the equation of the curve and then integrated. Some candidates integrated the equation of the curve correctly, but used the wrong limits (usually 3 to 16) and made no further progress, and of those that did adopt the correct approach, a large number were unable to find the area of the triangle correctly (½ × 12 × 4 was common).

11(i)(A) Most candidates formed the correct equations and went on to solve them successfully.

(i)(B) Many achieved full marks here. Of those who didn't, most candidates scored two marks for $S_{50} – S_{20}$ with their A and D. A few used S_{21} and just scored 1. Other candidates earned the first mark for u_{21} and about half then earned the second mark for a correct formula with $n = 30$. Fortunately hardly any candidates tried to sum all 30 terms individually.

(ii) Most earned the first mark, but then there was much toil for the second mark, which was often not earned due to wrong working or to leaving too much to the marker's imagination. Faced with solving the given statement, most opted for multiplying by $r^2 - 1$ and were then stumped by the quartic. Careless work led to $r^2 = 10$ or 11. A good number of candidates who successfully found r neglected to find a. A small number of candidates produced elegant work for full marks.

12(i) The correct equation was often seen, but in many cases it stemmed from wrong working and didn't score. Some candidates stopped at $\log p = \log a + kt\log 10$. $\log p = \log a \times kt$ was a common error; occasionally $\log p = \log a + k\log t$ or $\log p = \log a + \log kt$ were seen.

(ii) This was done very well indeed, with just a few candidates making slips with the plots (usually the middle point), and a few joining each point with a ruler or drawing a curve of best fit to lose the last mark. Only a few candidates lost an easy mark by drawing their line of best fit freehand.

(iii) Most were able to obtain values for the gradient and the y-intercept within the acceptable range, but not all knew what to do with these. For example, log 1.66 or $10^{1.66}$ were often seen in the equation for $\log p$. A surprising number of candidates neglected to include an equation for $\log p$ at all, and went straight to an equation for p. This was sometimes correct, even if the equation for $\log p$ was incorrect. However, a common error was (for example) $p = 45.7 + 10^{0.012t}$.

(iv) Although many candidates correctly identified the value of $\log a$ as crucial in their response, many of them neglected to include the word "million" and lost an easy mark.

(v) Most candidates had the sense to revert to their graph. Accurate plotting and a good line of best fit often rewarded them with full marks. However, most candidates used their answer to part (iii) and sometimes lost the final mark due to rounding. A few used 200 000 000 instead of 200 in one of their equations and failed to score.