OCR
RECOGNISING ACHIEVEMENT

Friday 17 May 2013 – 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

* 4 7 1 5 6 4 0 6 1 3 *

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 **16** 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.

Section A (36 marks)

1 Find $\frac{dy}{dx}$ when

(i) $y = 2x^{-5}$, **[2]**

(ii) $y = \sqrt[3]{x}$. **[3]**

2 The nth term of a sequence, u_n, is given by

$$u_n = 12 - \tfrac{1}{2}n.$$

(i) Write down the values of u_1, u_2 and u_3. State what type of sequence this is. **[2]**

(ii) Find $\sum_{n=1}^{30} u_n$. **[3]**

3 The gradient of a curve is given by $\frac{dy}{dx} = \frac{18}{x^3} + 2$. The curve passes through the point $(3, 6)$. Find the equation of the curve. **[5]**

4 **(i)** Starting with an equilateral triangle, prove that $\cos 30° = \frac{\sqrt{3}}{2}$. **[2]**

(ii) Solve the equation $2\sin\theta = -1$ for $0 \leqslant \theta \leqslant 2\pi$, giving your answers in terms of π. **[3]**

5

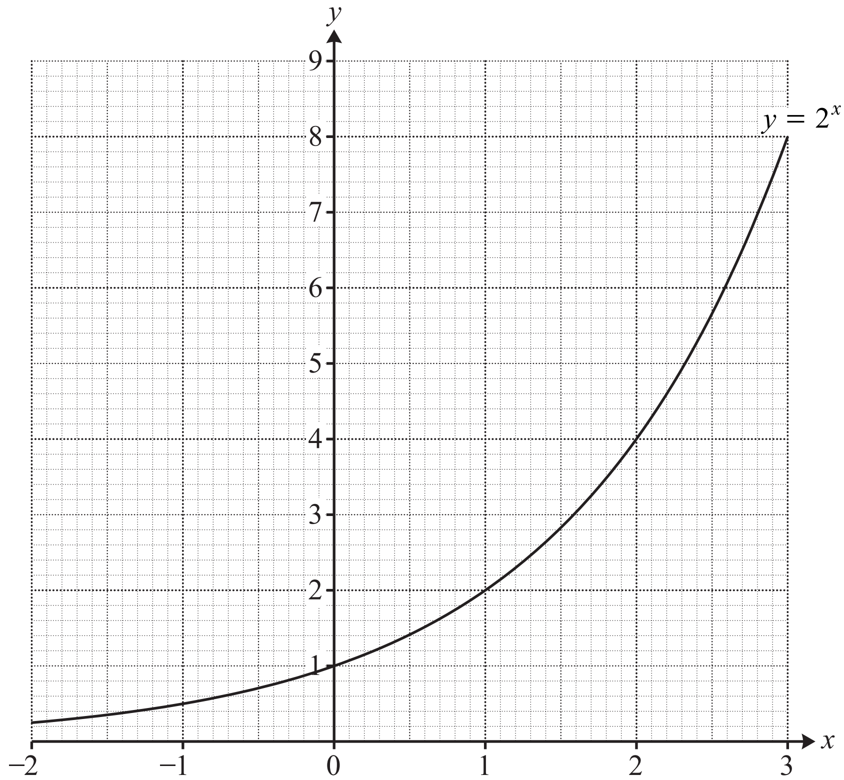


Fig. 5

Fig. 5 shows the graph of $y = 2^x$.

(i) On the copy of Fig. 5, draw by eye a tangent to the curve at the point where $x = 2$. Hence find an estimate of the gradient of $y = 2^x$ when $x = 2$. **[3]**

(ii) Calculate the y-values on the curve when $x = 1.8$ and $x = 2.2$. Hence calculate another approximation to the gradient of $y = 2^x$ when $x = 2$. **[2]**

6 S is the sum to infinity of a geometric progression with first term a and common ratio r.

(i) Another geometric progression has first term $2a$ and common ratio r. Express the sum to infinity of this progression in terms of S. **[1]**

(ii) A third geometric progression has first term a and common ratio r^2. Express, in its simplest form, the sum to infinity of this progression in terms of S and r. **[2]**

7 Fig. 7 shows a curve and the coordinates of some points on it.

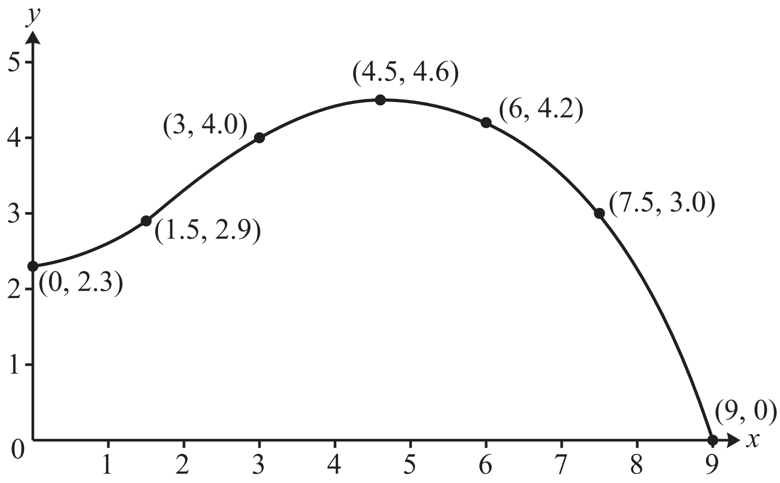


Fig. 7

Use the trapezium rule with 6 strips to estimate the area of the region bounded by the curve and the positive x- and y-axes. **[4]**

8 Fig. 8 shows the graph of $y = \mathrm{g}(x)$.

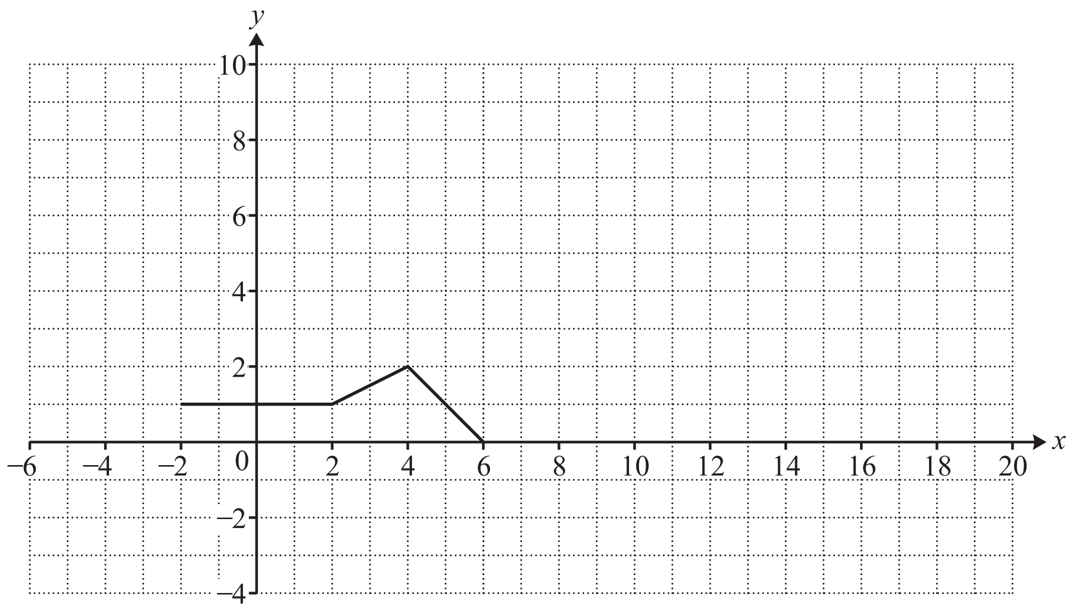


Fig. 8

Draw the graph of

(i) $y = \mathrm{g}(2x)$, **[2]**

(ii) $y = 3\mathrm{g}(x)$. **[2]**

Section B (36 marks)

9 Fig. 9 shows a sketch of the curve $y = x^3 - 3x^2 - 22x + 24$ and the line $y = 6x + 24$.

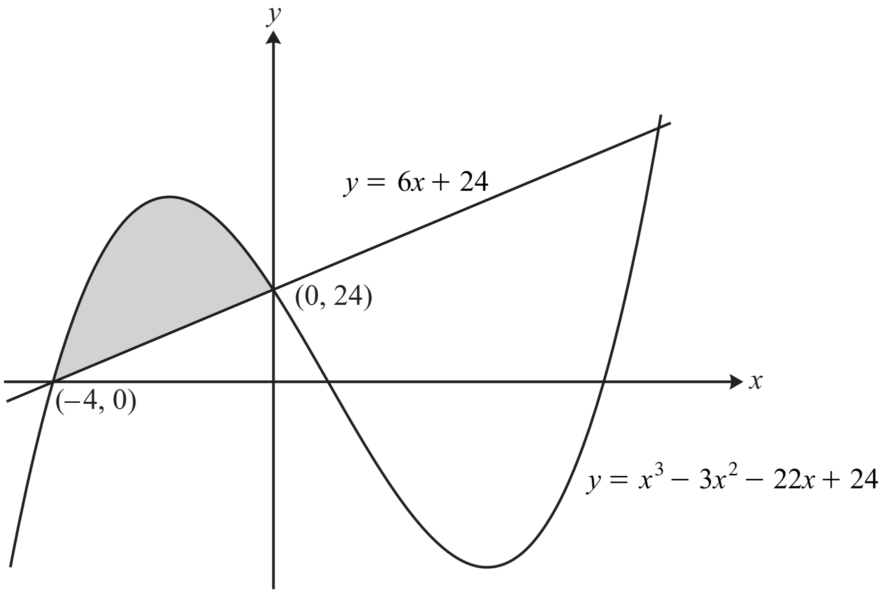


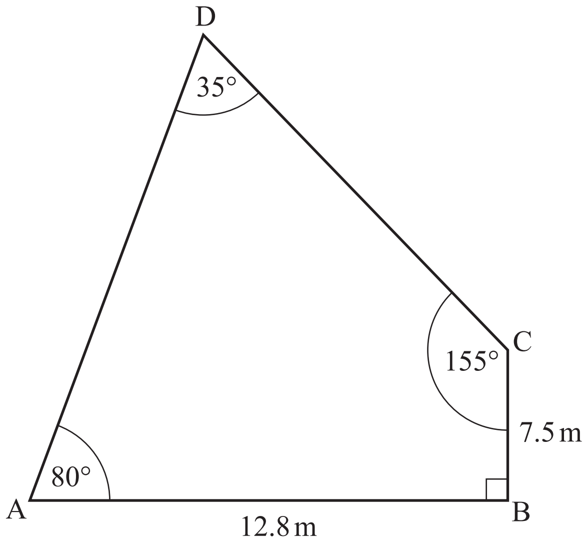
Fig. 9

(i) Differentiate $y = x^3 - 3x^2 - 22x + 24$ and hence find the x-coordinates of the turning points of the curve. Give your answers to 2 decimal places. **[4]**

(ii) You are given that the line and the curve intersect when $x = 0$ and when $x = -4$. Find algebraically the x-coordinate of the other point of intersection. **[3]**

(iii) Use calculus to find the area of the region bounded by the curve and the line $y = 6x + 24$ for $-4 \leqslant x \leqslant 0$, shown shaded on Fig. 9. **[4]**

10 Fig. 10.1 shows Jean's back garden. This is a quadrilateral ABCD with dimensions as shown.



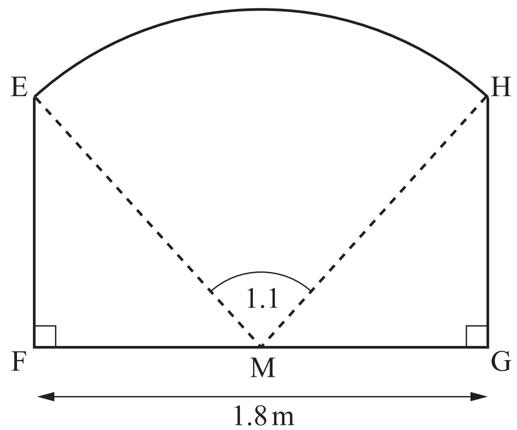
Not to scale

Fig. 10.1

(i) (*A*) Calculate AC and angle ACB. Hence calculate AD. **[6]**

(*B*) Calculate the area of the garden. **[3]**

(ii) The shape of the fence panels used in the garden is shown in Fig. 10.2. EH is the arc of a sector of a circle with centre at the midpoint, M, of side FG, and sector angle 1.1 radians, as shown. FG = 1.8 m.



Not to scale

Fig. 10.2

Calculate the area of one of these fence panels. **[5]**

11 A hot drink when first made has a temperature which is 65°C higher than room temperature. The temperature difference, d °C, between the drink and its surroundings decreases by 1.7% each minute.

(i) Show that 3 minutes after the drink is made, $d = 61.7$ to 3 significant figures. **[2]**

(ii) Write down an expression for the value of d at time n minutes after the drink is made, where n is an integer. **[1]**

(iii) Show that when $d < 3$, n must satisfy the inequality

$$n > \frac{\log_{10}3 - \log_{10}65}{\log_{10}0.983}.$$

Hence find the least integer value of n for which $d < 3$. **[4]**

(iv) The temperature difference at any time t minutes after the drink is made can also be expressed as $d = 65 \times 10^{-kt}$, for some constant k. Use the value of d for 1 minute after the drink is made to calculate the value of k. Hence find the temperature difference 25.3 minutes after the drink is made. **[4]**

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE.

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RECOGNISING ACHIEVEMENT

Friday 17 May 2013 – 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:
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- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

4715650613

475201

Candidate forename		Candidate surname	

Centre number						Candidate number				

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Section A (36 marks)

1 (i)	
1 (ii)	
2 (i)	
2 (ii)	

3	
4 (i)	
4 (ii)	

5 (i)

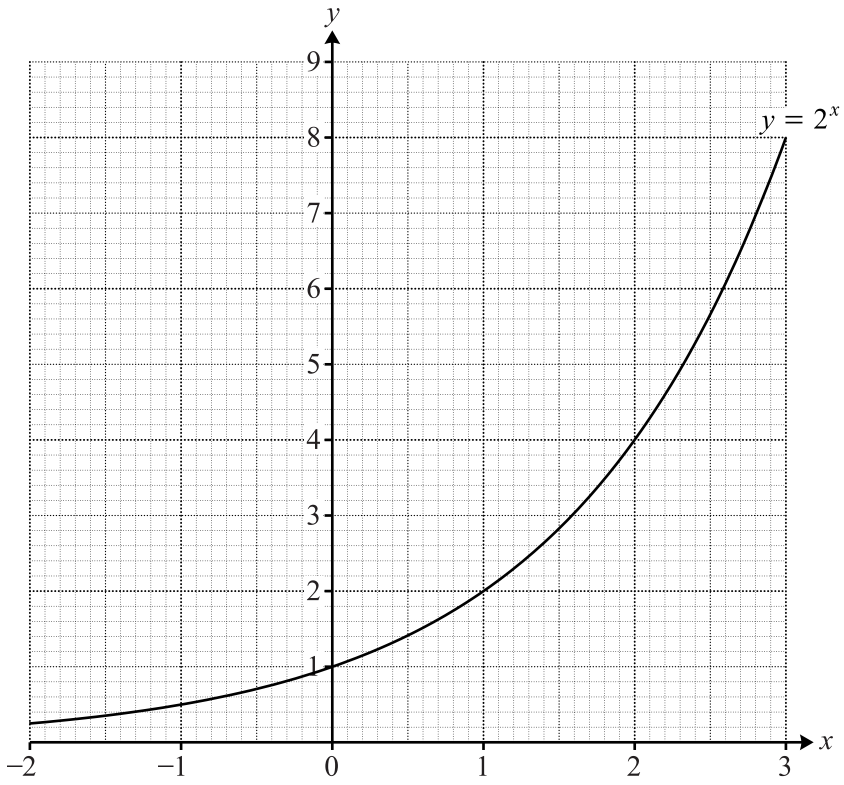
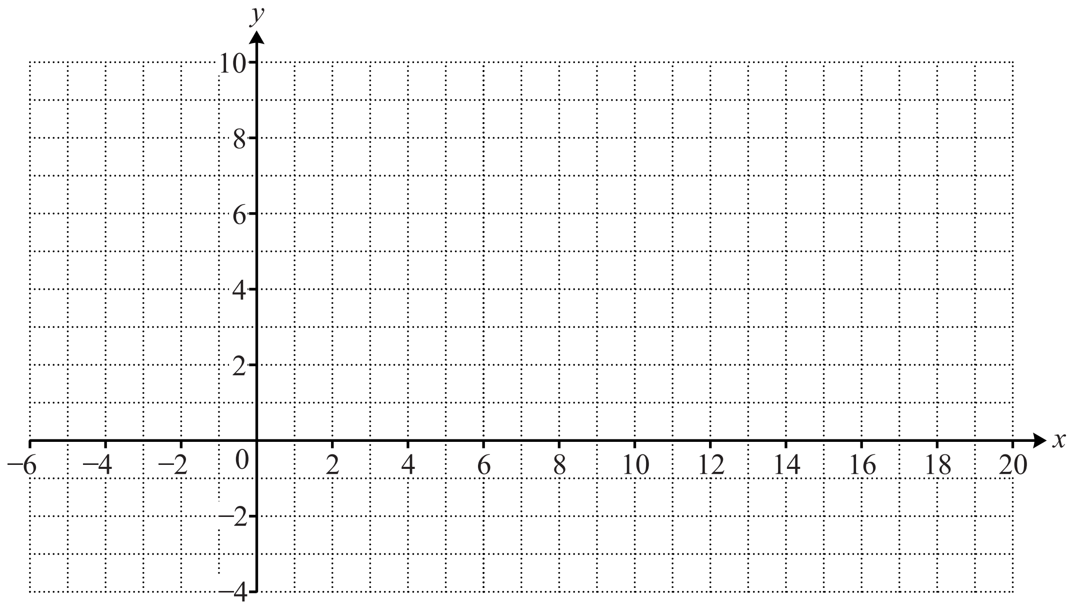


Fig. 5

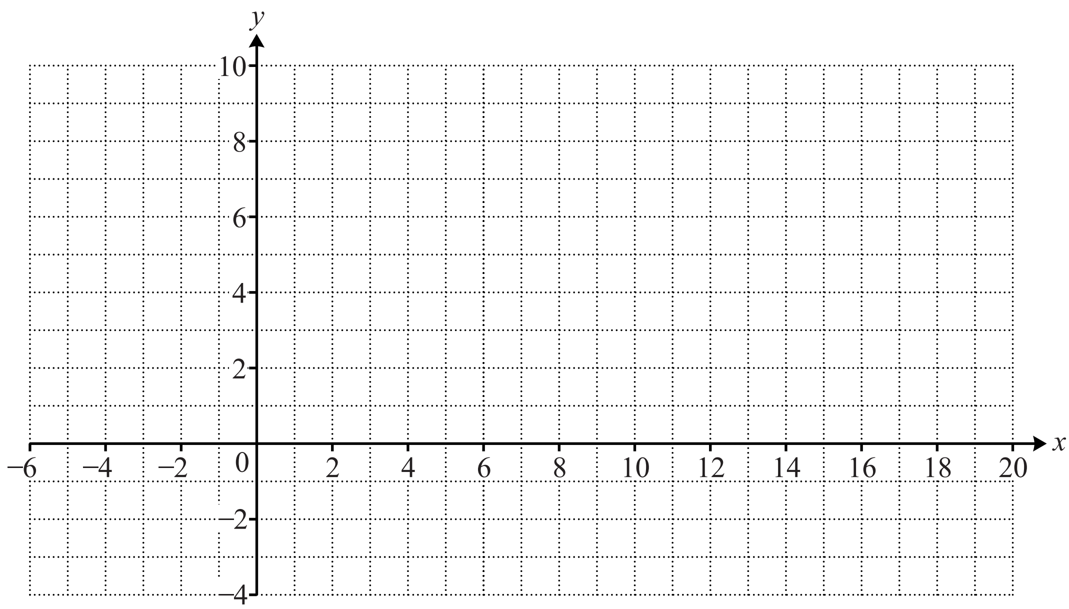
5 (ii)

6 (i)	
6 (ii)	
7	

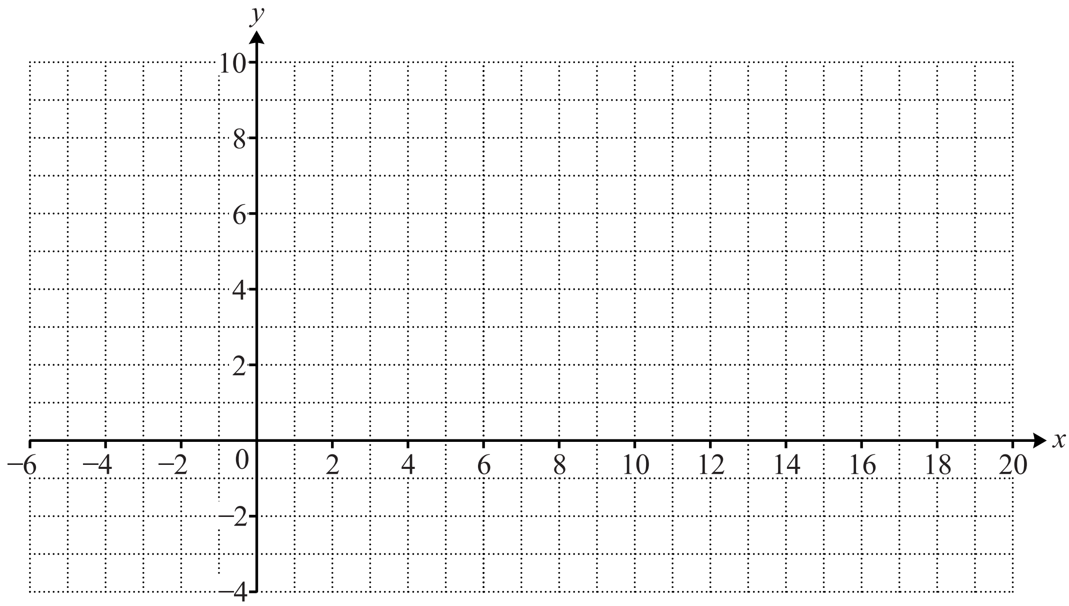
8 (i)



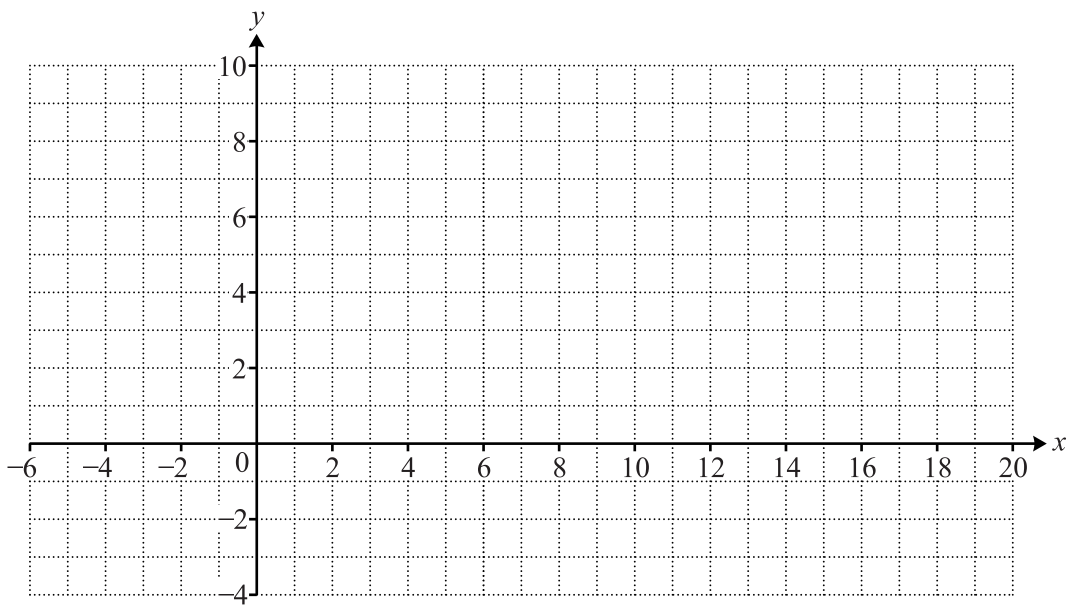
Spare copy of grid for Question 8(i)



8 (ii)



Spare copy of grid for Question 8(ii)



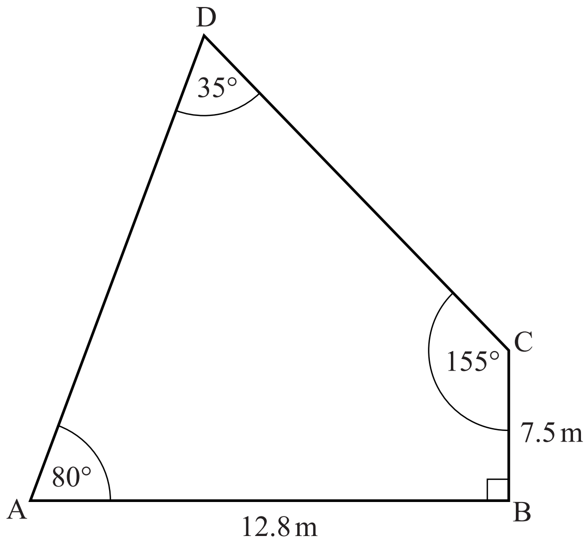
Turn over

Section B (36 marks)

9 (i)	
9 (ii)	

9 (iii)

10 (i) (*A*)

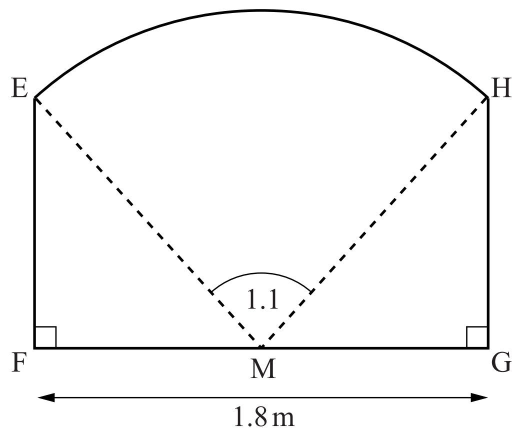


Not to scale

Fig. 10.1

10 (i) (*B*)

10 (ii)



Not to scale

Fig. 10.2

11 (i)	
11 (ii)	
11 (iii)	
	(answer space continued on next page)

11 (iii)	**(continued)**
11 (iv)	
	(answer space continued on next page)

11 (iv)	(continued)

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RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4752:** Concepts for Advanced Mathematics

Mark Scheme for June 2013

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.

1. **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

2. **Subject-specific Marking Instructions for GCE Mathematics (MEI) Pure strand**

a. Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c. The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep *’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g. Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

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

h. For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

Question			Answer	Marks	Guidance	
1	(i)		$-10x^{-6}$ isw	**B1** **B1** **[2]**	for – 10 for x^{-6} ignore + c and y =	if **B0B0** then **SC1** for $-5\times 2x^{-5-1}$ or better soi
1	(ii)		$y = x^{1/3}$ soi kx^{n-1} $\frac{1}{3}x^{-\frac{2}{3}}$ isw	**B1** **M1** **A1** **[3]**	condone $y' = x^{1/3}$ if differentiation follows ft their fractional n ignore + c and y =	 allow 0.333 or better
2	(i)		11.5, 11 and 10.5 oe arithmetic and/or divergent	**B1** **B1** **[2]**	 allow AP ignore references to a, d or n	ignore labelling incorrect embellishments such as converging arithmetic…, diverging geometric… do not score. **B0** if a choice is given eg AP/GP.
2	(ii)		$n = 30$ identified as number of terms in relevant AP $S_{30} = \frac{30}{2}(2\times 11.5 + (30-1)\times -0.5)$ 127.5 oe	**B1** **M1** **A1** **[3]**	 or $S_{30} = \frac{30}{2}(11.5 + -3)$ allow recovery from slip in working (eg omission of minus sign)	eg 1 + 2 + 3 + …+ 30 is not a relevant AP condone one error in a, d or n but do not condone $l = -½$ **SC3** if each term calculated and summed to correct answer or for 127.5 unsupported
3			kx^{-2} $-9x^{-2}$ $+ 2x + c$ substitution of $x = 3$ and $y = 6$ in their expression following integration $c = 1$	**M1*** **A1** **M1*** **M1dep** **A1** **[5]**	 may be awarded later c may appear at substitution stage on award of *either* of previous **M1**s **A0** if spoiled by further working	$k \neq 0$ no marks at all for responses based on "$mx + c$" eg $6 = k3^{-2} + 2\times 3 + c$ for full marks, **must** see "y =" at some stage

Question			Answer	Marks	Guidance	
4	(i)		clear diagram or explanation starting with equilateral triangle correctly showing 30 as half angle and sides 1 and 2 or multiples of these lengths	**B1**		units for sides and angle not required
			correct use of Pythagoras *and* adjacent and hypotenuse correctly identified to obtain given result $\cos 30° = \frac{\sqrt{3}}{2}$	**B1**	adjacent and hypotenuse may be identified on diagram	condone abbreviations
				[2]		
4	(ii)		$\pm\frac{\pi}{6}$ or $-\frac{5\pi}{6}$ soi	**M1**	may be implied by correct answer or ±0.523598775…, or may appear on quadrant diagram or graph	condone ±30° or − 150°
			$\frac{11\pi}{6}$	**A1**		ignore extra values outside the range
			$\frac{7\pi}{6}$	**A1**	if **A0A0**, **SC1** for 1.8333333π and 1.16666666π to 3 or more sf or **SC1** for 330° and 210° www	if full marks or **SC1** awarded, subtract 1 for extra values *in* the range
				[3]		
5	(i)		ruled line touching curve at $x = 2$	**M1**		intent to touch, but must not clearly cut curve
			their $\frac{y_2 - y_1}{x_2 - x_1}$ from their *tangent*	**M1**	may be on graph or in working; must use correct points from their line their tangent may be at another point	**M0** for reciprocal,
			answer in range 2.5 to 3.0 inclusive	**A1**	both **M1**s must be awarded	(value is approx 2.773)
				[3]		
5	(ii)		3.482202253... and 4.59479342... rot to 3 or more sf	**B1**		
			2.78 to 2.7815 or 2.8	**B1**	mark the final answer	2.781477917..
				[2]		

Question			Answer	Marks	Guidance	
6	(i)		$2S$ cao	**B1** **[1]**		
6	(ii)		$\frac{a}{1-r^2}$	**M1**	if **M0, SC1** for $\frac{1-r}{1-r^2}\times S$ oe	
			$\frac{S}{1+r}$ or $\frac{1}{1+r}S$	**A1** **[2]**		
7			$h = 1.5$	**B1**	$h = 1.5$	allow if used with 6 separate trapezia
			$\frac{1.5}{2}\times(2.3+2(2.9+4+4.6+4.2+3)+0)$	**M1**	basic shape of formula correct, omission of brackets may be recovered later	at least 4 y-values in middle bracket, eg $\frac{1.5}{2}\times(2.3+2(2.9+4+4.6+4.2)+3)$ **M0** if any x values used
			all y-values correct and correctly placed in formula	**B1**	condone omission of outer brackets and/or omission of 0	
			29.775 to 3 sf or better; isw	**A1** **[4]**	answer only does not score	or **B1** + **B3** if 6 separate trapezia calculated to give correct answer
8	(i)		graph from (–1, 1) to (1, 1) to (2, 2) to (3, 0)	2 **[2]**	**B1** for three points correct or for all four points correct but clearly not joined	points must be joined, but not always easy to see, so BOD if in doubt. Accept freehand drawing.
8	(ii)		graph from (–2, 3) to (2, 3) to (4, 6) to (6, 0)	2 **[2]**	**B1** for three points correct or for all four points correct but clearly not joined	points must be joined, but not always easy to see, so BOD if in doubt. Accept freehand drawing.

Question			Answer	Marks	Guidance	
9	(i)		$3x^2 - 6x - 22$	**M1**	condone one incorrect term, but must be three terms	condone "$y =$"
			their $y' = 0$ soi	**M1**	at least one term correct in their y'	may be implied by use of eg quadratic formula, completing square, attempt to factorise
			3.89 −1.89	**A1** **A1** **[4]**	if **A0A0**, **SC1** for $\frac{3 \pm 5\sqrt{3}}{3}$ or $1 \pm {}^{5}/_{\sqrt{3}}$ or better, or both decimal answers given to a different accuracy or from truncation	3.886751346 and −1.886751346
9	(ii)		$x^3 - 3x^2 - 22x + 24 = 6x + 24$ $x^3 - 3x^2 - 28x$ [= 0]	**M1** **M1**	may be implied by $x^3 - 3x^2 - 28x$ [= 0] may be implied by $x^2 - 3x - 28$[= 0]	
			other point when $x = 7$ isw	**A1** **[3]**	dependent on award of both **M** marks	ignore other values of x
9	(iii)		$\text{F}[x] = \frac{x^4}{4} - \frac{3x^3}{3} - \frac{22x^2}{2} + 24x$	**M1***	allow for three terms correct; condone $+c$	**alternative method** **M1** for $\int((x^3 - 3x^2 - 22x + 24) - (6x + 24))dx$ may be implied by 2nd **M1**
			F[0] – F[−4]	**M1dep**	allow 0 – F[−4], condone – F[−4], but do not allow F[−4] only	**M1*** for $\text{F}[x] = \frac{x^4}{4} - \frac{3x^3}{3} - \frac{28x^2}{2}$ condone one error in integration
			area of triangle = 48	**B1**		**M1dep** for F[0] – F[−4]
			area required = 96 from fully correct working	**A1** **[4]**	**A0** for – 96, ignore units,	no marks for 96 unsupported

Question			Answer	Marks	Guidance	
10	(i)	(*A*)	$AC^2 = 12.8^2 + 7.5^2$ oe	M1	allow correct application of cosine rule or from finding relevant angle and using trig	
			$AC = 14.83543056..$	A1	rot to 3 or more sf , or 15	**B2** for 14.8 or better unsupported
			$\tan C = {}^{12.8}/_{7.5}$ or $C = 90 - \tan^{-1}({}^{7.5}/_{12.8})$ oe	M1	or $\sin C = {}^{12.8}/_{\text{their}14.8}$ or $\cos C = {}^{7.5}/_{\text{their}14.8}$	or $\frac{\sin C}{12.8} = \frac{\sin 90}{\textit{their}14.8}$ or $\cos C = \frac{\textit{their}14.8^2 + 7.5^2 - 12.8^2}{2 \times 7.5 \times \textit{their}14.8}$
			59.6 to 59.64	A1		
			$\frac{AD}{\sin(155 - \textit{their}59.6)} = \frac{\textit{their}14.8}{\sin 35}$ oe	M1		
			25.69 to 25.8	A1 **[6]**	allow **B2** for $25.69 \le AD < 25.8$ unsupported…..but **B0** for 25.8 unsupported	**M0A0** for ${}^{14.8}/_{\cos 55} = 25.803...$

Question			Answer	Marks	Guidance	
10	(i)	(*B*)	area of *ABC* = 48 soi ½×their 14.8…×their 25.7…×sin(their 59.6 – 10) 192.8 to 194[m^2]	**B1** **M1** **A1** **[3]**	may be implied by correct final answer in range or by sight of ½ × 12.8 × 7.5 oe may be implied by 144.8 to 146	condone 48.0… **B3** for correct answer in range if unsupported
10	(ii)		angle *HMG* = $\frac{\pi - 1.1}{2}$ or *MHG* = 0.55 (31.5126°) *HM* = 1.7176 to 1.7225 ½ × 1.1 × *their* HM^2 or $\frac{\theta}{360} \times \pi \times theirHM^2$ area of triangle *EMF* = 0.652 to 0.662 2.95 to 2.952 [m^2] cao	**B1** **B1** **M1** **B1** **A1** **[5]**	or angle *EMF* or angle *MEF* 1.63(0661924…) θ =63(.025357…) or *MGH*	allow 1.02 to 1.021 *or* 58.487° to 58.5° may be implied by final answer check arithmetic if necessary their *HM* ≠ 0.9 or 1.8 may be implied by final answer or in double this (1.304 to 1.324) full marks may be awarded for final answer in correct range ie allow recovery of accuracy
11	(i)		65 ×$(1 - 0.017)^3$ oe 61.7410... showing more than 3 sf	**M1** **A1** **[2]**	may be longer method finding decrease year by year etc answer 61.7 given	NB use of 3×0.017 leads to 61.685, which doesn't score
11	(ii)		[*d* =] 65 × 0.983^n oe	**B1** **[1]**	eg 63.895 × 0.983^{n-1} or 61.7 × 0.983^{n-3}	

Question			Answer	Marks	Guidance	
11	(iii)		$65 \times 0.983^n < 3$ or $\log_{10}(65 \times 0.983^n) < \log_{10}3$ oe	M1*		condone omission of base 10 throughout
			$\log_{10}65 + \log_{10}0.983^n < \log_{10}3$ www	M1dep	may be implied by eg $\log_{10}65 + n\log_{10}0.983 < \log_{10}3$	if **M0M0**, **SC1** for $\log_{10}65 + n\log_{10}0.983 < \log_{10}3$ even if $<$ is replaced by eg $=$ or $>$ with no prior incorrect log moves
			[$\log_{10}65 + n\log_{10}0.983 < \log_{10}3$]		or [$\log_{10}0.983^n < \log_{10}3 - \log_{10}65$]	
			$n\log_{10}0.983 < \log_{10}3 - \log_{10}65$ and			NB watch for correct inequality sign at each step
			completion to $n > \dfrac{\log_{10}3 - \log_{10}65}{\log_{10}0.983}$ **AG** www	A1	inequality signs must be correct throughout	reason for change of inequality sign not required
			$n = 180$ cao	B1	**B0** for $n > 180$	$n > 179.38...$
				[4]		
11	(iv)		$63.895 = 65 \times 10^{-k}$ soi	B1	or $65 \times 0.983 = 65 \times 10^{-k}$	accept 63.895 rot to 3 or 4 sf; **B1** may be awarded for substitution of $t = 1$ after manipulation
			$\log_{10}$(their 63.895) $= \log_{10}65 - k$ or $-k = \log_{10}$(their 0.983)	M1	their 63.895 must be from attempt to reduce 65 by 1.7% at least once	**M1A1A1** may be awarded if other value of t with correct d is used
			[k =] 7.4×10^{-3} to 7.45×10^{-3}	A1	[k =] $-\log_{10}0.983$ isw	
			[d =] 42.1... to 42.123 [°C] isw	A1		NB **B1M1A0A1** is possible; unsupported answers for k and/or d do not score
				[4]		

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RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced GCE **A2 7895-8**

Advanced Subsidiary GCE **AS 3895-8**

OCR Report to Centres

June 2013

4752 Concepts for Advanced Mathematics (C2)

General Comments

Most candidates were well-prepared for the examination, and were able to demonstrate a good understanding of the specification content. However, even some high scoring candidates lost marks due to basic errors in routine algebra and arithmetic or poor notation, especially in calculus questions. For the most part, work was clearly presented, but in a few instances marks were lost because it was so badly set out that it was difficult for the examiner to decipher just what the candidate was trying to convey. Many candidates adopt the practice of working with calculator values and only rounding final answers to an appropriate accuracy when presenting the final answer. However, a significant proportion lost marks by working with rounded or truncated numbers at an early stage, and then presenting an over-specified answer which could not possibly be justified from the figures used.

Comments on Individual Questions

1) (i) The overwhelming majority of candidates scored full marks on this question. A few candidates omitted the minus sign, and others lost a mark because they calculated the power as – 5 – 1 = − 4. A small number of candidates integrated. Some of these did so incorrectly, obtaining the answer $\frac{-2x^{-6}}{-6}$.

1) (ii) Most candidates identified the correct power, and went on to differentiate correctly. However, a significant minority gave the new power as −⅓, and a few integrated instead of differentiating. In cases where candidates failed to identify ⅓ as the power, − 3 and $^3/_2$ were the most common errors.

2) (i) Nearly all candidates spotted the algebraic definition and correctly found the required terms. A few lost a mark by calculating the first, second and fourth term, and a few thought it was an inductive definition and substituted u_1 in the formula instead of n = 2. The most common description was “arithmetic”; a few candidates also earned the mark with “divergent”. However, a significant minority either omitted a description altogether, gave an incorrect answer (most commonly “convergent” or “geometric” and occasionally “periodic”) or spoiled their correct answer by hedging their bets: for example, “converging arithmetic” was fairly common.

2) (ii) A little over half of candidates scored full marks on this question. A surprising number either specifically identified *d* as ½, or omitted the minus sign when calculating the sum of the A.P., and ended up with an answer of 562.5. Very few of these candidates had the sense that something must have gone wrong. A few others mistakenly identified *a* as 12, but were still able to score 2 marks. Some candidates did not use the formula, instead writing out all the terms and calculating the sum directly: as often as not the arithmetic went astray and so only the first mark was earned. Approximately one fifth of candidates made no headway. The sigma notation proved insurmountable for a few, and others used the formula for the sum of a geometric progression or simply attempted to find the *n*th term. Others confused $\sum u_n$ with $\sum n$, and thus failed to score.

3) Most candidates recognised this standard question and integrated successfully; the majority went on to score full marks. A few dropped the minus sign on the first term and ended up losing both A marks, a few made arithmetic or substitution errors: c = − 1 and c = 81 were the most common wrong answers. In a small number of cases the final mark was withheld because at no point did the candidate write "y =" in their solution. A small number of candidates spoiled fully correct answers by reverting to an answer based on y = m*x* + c and an equally small number integrated successfully but used the original expression to evaluate c. Some candidates were unable to deal with the negative power successfully: variations of $\frac{18x}{x^3/3}$ and $\frac{18x^{-4}}{-4}$ were the most common errors. A significant minority of candidates (approximately 20%) failed to score because they multiplied by *x* and added c.

4) (i) Over half of candidates failed to score on this question. A surprising number drew "equilateral" triangles with unequal angles or sides, defined the cosine ratio incorrectly or not at all, or were unable to use Pythagoras correctly to obtain the third side of their right angled triangle. Generally, candidates did not set out their work rigorously; even those who understood what was required were minimalist in their approach and missed out on both marks.

4) (ii) Almost half of candidates obtained full marks on this question. Most obtained $\pm\frac{\pi}{6}$ or $\pm 30°$ to earn the first mark; some obtained the correct angles and left their answers in degrees or only found one of the angles and a few lost a mark by adding extra values, usually $\frac{\pi}{6}$ and / or $\frac{5\pi}{6}$. Over a quarter of candidates failed to score: the usual mistake was a first move of $2\theta = \sin^{-1}(\pm 1)$.

5) (i) More than half the candidates earned full marks; only a small minority failed to score at all. Almost all candidates drew a reasonable tangent, though it was occasionally at (1, 2) instead of (2, 4). A few lines were not tangents at all, the normal being the usual error, although occasionally curves were seen. Most candidates knew that they should draw a right-angled triangle, but many were very small, leading to a gradient which was outside the acceptable range. Some candidates clearly used two points taken from the curve which did not score, others tried (vainly) to differentiate the function, perhaps not understanding the word 'hence' in the question.

5) (ii) Approximately one third of candidates scored full marks and nearly all knew what was required. However, marks were commonly lost because of premature approximation. Candidates whose values for 2^x were 3.5 and 4.6 calculated a gradient of 2.75, outside the range and earned no marks. Candidates who stated the values 3.48 and 4.59 earned the first mark, but lost the second if they left their gradient as 2.775 rather than correcting it to 2.8 or 2.78, all that their values were qualified to give. Candidates who gave more figures (up to ten) usually earned the second mark. A few candidates calculated $\frac{\Delta x}{\Delta y}$; a few calculated the midpoint or calculated the gradient using the point (2, 4).

6) (i) Most candidates did not earn this mark: in spite of $\frac{2a}{1-r}$ being commonly seen, candidates were unable to make the connection to "S". Those who did, often left their answer embedded in irrelevant working.

6) (ii) Approximately three quarters of candidates made the correct initial move of $\frac{a}{1-r^2}$. A few then recognised that factorising the denominator was relevant, but only a tiny minority went on to earn the second mark.

7) A majority of candidates scored full marks, nearly always through correct application of the formula; although a few successfully used individual trapezia (the majority of those who adopted the latter approach were unsuccessful). Some slipped up by omitting the outer brackets and taking 3.0 (or occasionally 9) as the final *y*-value or by using an incorrect value for *h* (usually 1, occasionally 9 and rarely from incorrectly calculating 9÷6). Only a very small minority failed to score at all.

8) (i) The majority of candidates scored full marks. A few lost a mark by extending their function to the left or the right or by misplacing (2, 2) or (3, 0). Approximately 30% of candidates failed to score. A translation of $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$ or a stretch in the *x*-direction scale factor 2 were the most common errors; a few candidates gave the end point as (2, 0) and the adjacent vertex as (1.5, 2).

8) (ii) There was an even better response to this part with almost 70% of candidates obtaining full marks. As in part (i), a few lost a mark by extending their function to the left or the right or by misplacing (4, 6) or (more often) (6, 0). Approximately one quarter of candidates failed to score. A translation of $\begin{pmatrix} 0 \\ 3 \end{pmatrix}$ or a stretch in the *x*-direction scale factor 3 were common; occasionally (4, 6) and (6, 0) were correct, but the other two points were simply left unaltered.

9) (i) Nearly all candidates differentiated successfully and set their derivative to zero. Over 60% of candidates went on to score full marks, although a few candidates made an error (usually $2x^2$ but occasionally + 24 was retained). However, a significant minority attempted unsuccessfully to factorise the quadratic and then gave up and a surprising number were unable to use the quadratic formula correctly. Very few candidates appeared to check their answers. Some candidates lost an easy mark by leaving their answers in an exact form or by quoting a different precision. Occasionally, candidates found the second derivative and set this equal to zero. A significant minority wasted time either by finding the associated *y*-values or by determining the nature of the turning points, neither of which were required.

9) (ii) This was very well answered by most candidates. Well over 80% earned the first mark and most went on to score full marks. Occasionally, candidates slipped up when collecting like terms and a few made a sign error when factorising. The minority who failed to score either omitted the question altogether, or set $6x + 24$ equal to the derivative.

9)(iii) This question was accessible to most candidates, although a significant minority scored zero. Many candidates found the area of the triangle using ½×base×height. Most of those who used a base of −4 realised that a negative area was impossible and so removed the minus sign. Some used integration and more often than not were successful – sometimes after 'losing' a minus sign. Most candidates also integrated successfully, but some made no further progress, as they ignored the upper limit and then 'airbrushed' the minus sign. A good proportion of those who did integrate successfully then made errors with the arithmetic. Some candidates earned two marks by combining the equations and integrating correctly, but a similar proportion ignored the upper limit or made arithmetical slips.

10)(i)(A) Nearly all candidates used Pythagoras to obtain *AC* correctly. A few used the Cosine Rule instead: most were successful. However, those who did calculate $\arctan\left(\frac{12.8}{7.5}\right)$ were in the minority; most used the Sine or Cosine Rule and often lost the A mark having worked with rounded or truncated values. A few used the Cosine Rule wrongly obtaining an answer close to 90° and yet failed to spot that something must be wrong. A small minority of candidates assumed that *AC* bisects angle *ACB* and a similar sized group stopped at this point. However, most went on successfully to use the Sine Rule and obtain a value within the specified range.

10)(i) (B) Most candidates successfully found the area of *ABC*, although some used convoluted methods and lost accuracy or made errors with the arithmetic. Many candidates adopted the anticipated approach of ½×*AC*×*AD*×sin*DAC* and went on to present a final answer within range. However, some candidates omitted to add the two areas together and some used angle *DCA* in the formula. A small minority used convoluted methods involving the vertical height of triangle *ADC* or calculated *DC* and worked with that length instead. Accuracy was often lost, but about half of these candidates were successful.

10(ii) Approximately a quarter of candidates failed to score on this question. Either no response was made, or initial assumptions such as *MH* = *MG* or *HMG* = 45° were made and no progress was made. However, most were able to obtain one of the required angles correctly and many went on to use this to find *MH* or *HG* successfully. Far too many candidates then worked with truncated values or values which were approximated too severely. The method mark for finding the area of the sector was often earned, although a few candidates used the formula for arc length, found the area of the segment or selected something more exotic from the formula booklet. A small minority converted to degrees: sometimes this was successful, but it was disappointing to see calculations such as $\frac{1}{2}\times 1.72^2\times 63$ on occasion. In some cases, this was added to a correct value for the triangular sections, apparently without any awareness that the numbers generated couldn't possibly match up. A number of candidates found *HG* successfully and then used Pythagoras incorrectly to obtain a value for *MH* which was smaller. Again, this was usually ignored. Approximately 20% of candidates scored full marks, but a further 7% or 8% lost the last mark either by combining their answers incorrectly or by working with rounded or truncated figures and then over-specifying their final answer.

11) (i) A surprising number of candidates failed to score any marks. Many of these candidates adopted a 'simple interest' approach and evaluated $65 - 3\times0.017\times65$. A few candidates evaluated $65 - 3\times0.017$ or wrote $0.017^3\times65 = 61.7$. About two thirds of candidates did understand what was required but failed to appreciate the need to show more than 3 significant figures in their answer to 'show that' the value is 61.7 to this precision. $65\times0.983^3 = 61.7$ was quite common. A significant minority of candidates adopted a long-winded approach, showing each stage of the change, and were no more successful.

11) (ii) Fewer than 40% of candidates earned this mark. $65\times0.983^{n-1}$ was quite common, but more often than not the response was either non-existent or irrelevant.

11) (iii) This was inaccessible to most candidates, at least partly due to lack of success in the first two parts. It was surprising how few took advantage of the mark for obtaining n = 180: this request was either ignored, or a decimal answer was presented – although a few wrote $n > 180$. Very few scored all 3 marks for finding the given result. Most who did, had a correct formula from (ii) but had the inequality sign incorrect or used "=". Very few started off correctly, of those who did start correctly, a high proportion lost the third mark for reversing the sign too early. $\log_{10}(65 \times 0.983^n) < \log_{l0}3$ very often incorrectly led straight to $\log_{10}(65) \times \log(0.983^n) < \log_{l0}3$ which then became $\log_{10}65 + \log_{10}0.983^n < \log_{10}3$. It was pleasing that many of the successful candidates who did score full marks were justifying the reversal of the inequality sign, even though this was not required.

11) (iv) This proved more accessible than part (iii). A little under half of candidates were able to correctly substitute the appropriate value for d in conjunction with t = 1. However, $63.895 = 65 \times10^{-k}$ leading to $\log 63.895 = \log65 \times \log10^{-k}$ was quite common, so the remaining marks were inaccessible. Some candidates went on to earn the method mark, but lost at least one of the accuracy marks due to premature approximation - some candidates lost a mark by omitting to give an explicit statement of the value of *k.* Some lost both A marks because they divided by log65 instead of subtracting. A significant minority omitted the question altogether. In cases where there was an attempt which scored zero, the most common error was to begin with d = 1.

Unit level raw mark and UMS grade boundaries June 2013 series

AS GCE / Advanced GCE / AS GCE Double Award / Advanced GCE Double Award

		Max Mark	a	b	c	d	e	u
GCE Mathematics (MEI)								
4751/01 (C1) MEI Introduction to Advanced Mathematics	Raw	72	62	56	51	46	41	0
	UMS	100	80	70	60	50	40	0
4752/01 (C2) MEI Concepts for Advanced Mathematics	Raw	72	54	48	43	38	33	0
	UMS	100	80	70	60	50	40	0
4753/01 (C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	58	52	46	40	33	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
4753 (C3) MEI Methods for Advanced Mathematics with Coursework	UMS	100	80	70	60	50	40	0
4754/01 (C4) MEI Applications of Advanced Mathematics	Raw	90	66	59	53	47	41	0
	UMS	100	80	70	60	50	40	0
4755/01 (FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	63	57	51	45	40	0
	UMS	100	80	70	60	50	40	0
4756/01 (FP2) MEI Further Methods for Advanced Mathematics	Raw	72	61	54	48	42	36	0
	UMS	100	80	70	60	50	40	0
4757/01 (FP3) MEI Further Applications of Advanced Mathematics	Raw	72	60	52	44	36	28	0
	UMS	100	80	70	60	50	40	0
4758/01 (DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	62	56	51	46	40	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
4758 (DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01 (M1) MEI Mechanics 1	Raw	72	57	49	41	33	25	0
	UMS	100	80	70	60	50	40	0
4762/01 (M2) MEI Mechanics 2	Raw	72	50	43	36	29	22	0
	UMS	100	80	70	60	50	40	0
4763/01 (M3) MEI Mechanics 3	Raw	72	64	56	48	41	34	0
	UMS	100	80	70	60	50	40	0
4764/01 (M4) MEI Mechanics 4	Raw	72	56	49	42	35	29	0
	UMS	100	80	70	60	50	40	0
4766/01 (S1) MEI Statistics 1	Raw	72	55	48	41	35	29	0
	UMS	100	80	70	60	50	40	0
4767/01 (S2) MEI Statistics 2	Raw	72	58	52	46	41	36	0
	UMS	100	80	70	60	50	40	0
4768/01 (S3) MEI Statistics 3	Raw	72	61	55	49	44	39	0
	UMS	100	80	70	60	50	40	0
4769/01 (S4) MEI Statistics 4	Raw	72	56	49	42	35	28	0
	UMS	100	80	70	60	50	40	0
4771/01 (D1) MEI Decision Mathematics 1	Raw	72	58	52	46	40	35	0
	UMS	100	80	70	60	50	40	0
4772/01 (D2) MEI Decision Mathematics 2	Raw	72	58	52	46	41	36	0
	UMS	100	80	70	60	50	40	0
4773/01 (DC) MEI Decision Mathematics Computation	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	44	38	31	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
4776 (NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01 (NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
	UMS	100	80	70	60	50	40	0
4798/01 (FPT) Further Pure Mathematics with Technology	Raw	72	57	49	41	33	26	0
	UMS	100	80	70	60	50	40	0
GCE Statistics (MEI)		**Max Mark**	**a**	**b**	**c**	**d**	**e**	**u**
G241/01 (Z1) Statistics 1	Raw	72	55	48	41	35	29	0
	UMS	100	80	70	60	50	40	0
G242/01 (Z2) Statistics 2	Raw	72	55	48	41	34	27	0
	UMS	100	80	70	60	50	40	0
G243/01 (Z3) Statistics 3	Raw	72	56	48	41	34	27	0
	UMS	100	80	70	60	50	40	0