OCR
Oxford Cambridge and RSA

Wednesday 8 June 2016 – 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.** If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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.

Section A (36 marks)

1 **(i)** Find $\frac{dy}{dx}$ when $y = 6\sqrt{x}$. **[2]**

(ii) Find $\int \frac{12}{x^2} dx$. **[3]**

2 A sequence is defined as follows.

$u_1 = a$, where $a > 0$

To obtain u_{r+1}

- find the remainder when u_r is divided by 3,
- multiply the remainder by 5,
- the result is u_{r+1}.

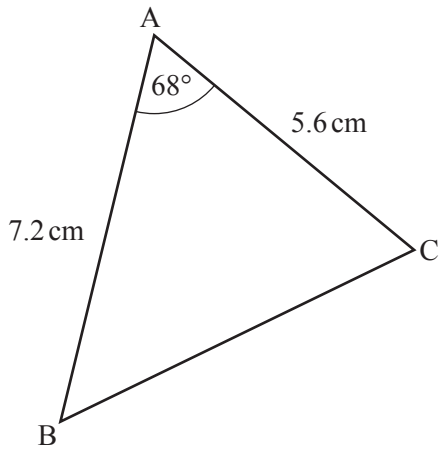
Find $\sum_{r=2}^{4} u_r$ in each of the following cases.

(i) $a = 5$

(ii) $a = 6$ **[3]**

3 An arithmetic progression (AP) and a geometric progression (GP) have the same first and fourth terms as each other. The first term of both is 1.5 and the fourth term of both is 12. Calculate the difference between the tenth terms of the AP and the GP. **[5]**

4



Not to scale

Fig. 4

Fig. 4 shows triangle ABC, where AB = 7.2 cm, AC = 5.6 cm and angle BAC = 68°.

Calculate the size of angle ACB. **[5]**

5 **(i)** Fig. 5 shows the graph of a sine function.

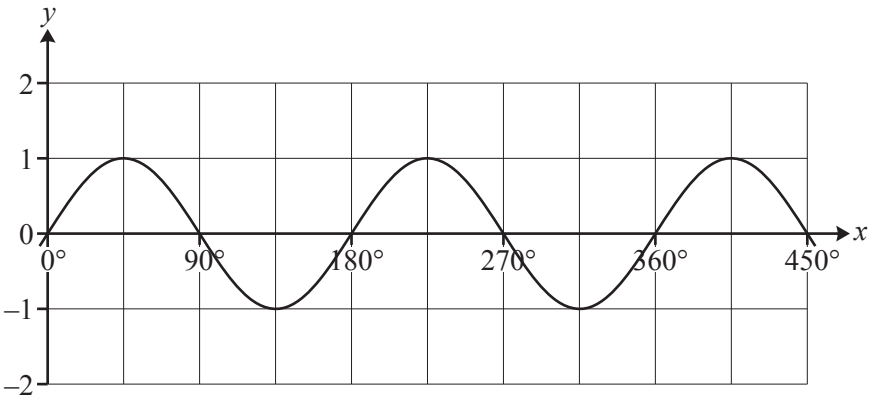
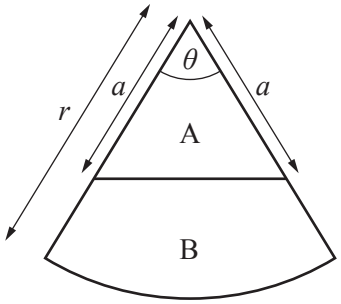


Fig. 5

State the equation of this curve. **[2]**

(ii) Sketch the graph of $y = \sin x - 3$ for $0° \leqslant x \leqslant 450°$. **[2]**

6 A sector of a circle has radius r cm and sector angle θ radians. It is divided into two regions, A and B. Region A is an isosceles triangle with the equal sides being of length a cm, as shown in Fig. 6.



Not to scale

Fig. 6

(i) Express the area of B in terms of a, r and θ. **[2]**

(ii) Given that $r = 12$ and $\theta = 0.8$, find the value of a for which the areas of A and B are equal. Give your answer correct to 3 significant figures. **[2]**

7 **(i)** Show that, when x is an acute angle, $\tan x \sqrt{1 - \sin^2 x} = \sin x$. **[2]**

(ii) Solve $4 \sin^2 y = \sin y$ for $0° \leqslant y \leqslant 360°$. **[3]**

8 **(i)** Simplify $\log_a 1 - \log_a (a^m)^3$. **[2]**

(ii) Use logarithms to solve the equation $3^{2x+1} = 1000$. Give your answer correct to 3 significant figures. **[3]**

Section B (36 marks)

9 Fig. 9 shows the cross-section of a straight, horizontal tunnel. The x-axis from 0 to 6 represents the floor of the tunnel.

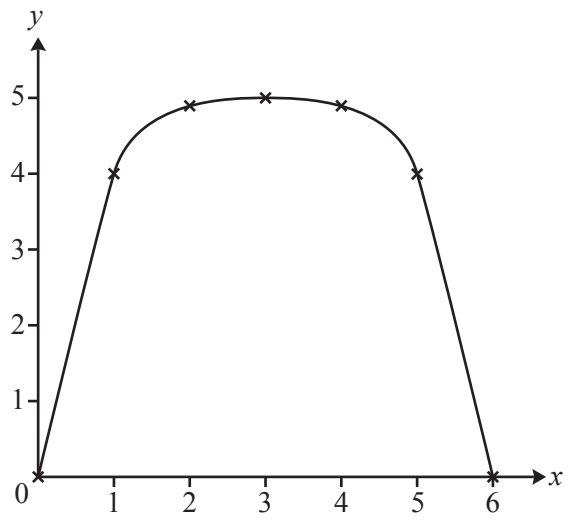


Fig. 9

With axes as shown, and units in metres, the roof of the tunnel passes through the points shown in the table.

x	0	1	2	3	4	5	6
y	0	4.0	4.9	5.0	4.9	4.0	0

The length of the tunnel is 50 m.

(i) Use the trapezium rule with 6 strips to estimate the area of cross-section of the tunnel. Hence estimate the volume of earth removed in digging the tunnel. **[4]**

(ii) An engineer models the height of the roof of the tunnel using the curve $y = \frac{5}{81}(108x - 54x^2 + 12x^3 - x^4)$. This curve is symmetrical about $x = 3$.

(*A*) Show that, according to this model, a vehicle of rectangular cross-section which is 3.6 m wide and 4.4 m high would not be able to pass through the tunnel. **[2]**

(*B*) Use integration to calculate the area of the cross-section given by this model. Hence obtain another estimate of the volume of earth removed in digging the tunnel. **[5]**

10 **(i)** Calculate the gradient of the chord of the curve $y = x^2 - 2x$ joining the points at which the values of x are 5 and 5.1. **[2]**

(ii) Given that $\mathrm{f}(x) = x^2 - 2x$, find and simplify $\dfrac{\mathrm{f}(5+h) - \mathrm{f}(5)}{h}$. **[4]**

(iii) Use your result in part (ii) to find the gradient of the curve $y = x^2 - 2x$ at the point where $x = 5$, showing your reasoning. **[2]**

(iv) Find the equation of the tangent to the curve $y = x^2 - 2x$ at the point where $x = 5$.

Find the area of the triangle formed by this tangent and the coordinate axes. **[5]**

11 There are many different flu viruses. The numbers of flu viruses detected in the first few weeks of the 2012–2013 flu epidemic in the UK were as follows.

Week	1	2	3	4	5	6	7	8	9	10
Number of flu viruses	7	10	24	32	40	38	63	96	234	480

These data may be modelled by an equation of the form $y = a \times 10^{bt}$, where y is the number of flu viruses detected in week t of the epidemic, and a and b are constants to be determined.

(i) Explain why this model leads to a straight-line graph of $\log_{10} y$ against t. State the gradient and intercept of this graph in terms of a and b. **[3]**

(ii) Complete the values of $\log_{10} y$ in the table, draw the graph of $\log_{10} y$ against t, and draw by eye a line of best fit for the data.

Hence determine the values of a and b and the equation for y in terms of t for this model. **[8]**

During the decline of the epidemic, an appropriate model was

$$y = 921 \times 10^{-0.137w},$$

where y is the number of flu viruses detected in week w of the decline.

(iii) Use this to find the number of viruses detected in week 4 of the decline. **[1]**

END OF QUESTION PAPER

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Duration: 1 hour 30 minutes

4752

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	
5 (i)	
5 (ii)	

6 (i)	
6 (ii)	
7 (i)	

7 (ii)	
8 (i)	
8 (ii)	

Section B (36 marks)

9 (i)

x	0	1	2	3	4	5	6
y	0	4.0	4.9	5.0	4.9	4.0	0

9 (ii) (*A*)

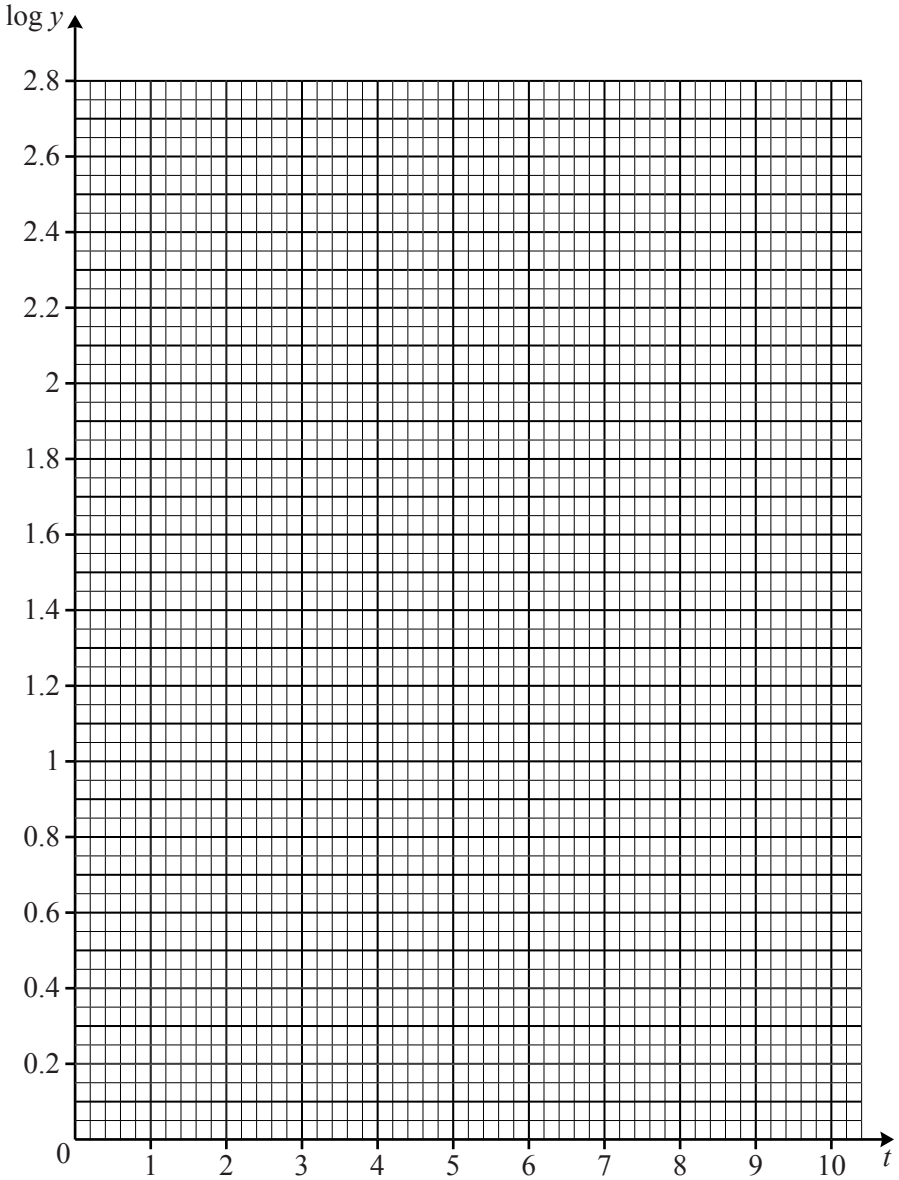
9 (ii) (*B*)	

10 (i)	
10 (ii)	
10 (iii)	

10 (iv)	

11 (i)

11 (ii) **First complete the copy of the table on the next page.**



The work space for this part is continued on the next page.

11 (ii) **continued**

t	1	2	3	4	5	6	7	8	9	10
y	7	10	24	32	40	38	63	96	234	480
$\log_{10} y$	0.85	1	1.38	1.51	1.60					

11 (iii)

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4752**: Concepts for Advanced Mathematics

Advanced Subsidiary GCE

Mark Scheme for June 2016

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

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

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations and abbreviations

Annotation in 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)		$kx^{\frac{1}{2}-1}$ or $kx^{-\frac{1}{2}}$ seen $3x^{-\frac{1}{2}}$ or $\frac{3}{\sqrt{x}}$ isw	**M1** **A1** **[2]**	$k > 0$ **A0** for eg $3x^{-\frac{1}{2}} + c$	**B2** for correct answer unsupported
1	(ii)		kx^{-2+1} or kx^{-1} oe seen $-12x^{-1}$ or $-\frac{12}{x}$ or $\frac{-12}{x}$ isw $+ c$	**M1** **A1** **A1** **[3]**	for any non-zero k seen at least once following integration	**SC0** for $\frac{12}{2x}$ or $\frac{6}{x}$ **A0** for $\frac{12}{-x}$ or $\frac{12x^{-1}}{-1}$ do not allow MR for integration of $12x^2$
2	(i)		(i) [5], 10, 5, [10] [10 + 5 + 10 =] 25 (ii) 0	**M1** **A1** **B1** **[3]**	ignore extra terms not from wrong working	condone wrongly attributed terms **B2** for 25 unsupported
3			1.5 + (4 – 1)d = 12 or better d = 3.5 r = 2 1.5 × their 2^9 – (1.5 + 9 × their 3.5) oe difference = 735	**M1** **A1** **B1** **M1** **A1** **[5]**	or 1.5 × $r^{(4-1)}$ = 12 or better r = 2 d = 3.5 **M0** for use of their S_{10} in either term	if first **M0 B0** allow **B3** for d = 3.5 **and** r = 2; **B2** for one of these; may be embedded in calculation of difference **NB** 768 – 33 allow –735

Question			Answer	Marks	Guidance	
4			$5.6^2 + 7.2^2 - 2 \times 5.6 \times 7.2 \times \cos 68$ seen	**M1**	may be implied by 53 or BC in range	
			53 or 53.0	**M1**	may be implied by BC in range	**NB** 52.9917243; (allow 47.7 to 47.71 from calculator in radian mode; may be implied by 6.90 to 6.91)
			[BC =] 7.3 or 7.27 to 7.28	**A1**	**NB** 7.27954…	
			$\sin C = \dfrac{7.2 \times \sin 68}{\text{their } BC}$	**M1**	or $[\cos C] = \dfrac{\text{their } BC^2 + 5.6^2 - 7.2^2}{2 \times 5.6 \times \text{their } BC}$	
			66 or awrt 66.5	**A1**	allow 1.2 or awrt 1.16 (radians); **A0** for eg 1.2 degrees	**NB** sin C = 0.917053… cos C = 0.398766…
				[5]		
			Alternatively eg if the perpendicular from B to AC, BX, is used			eg if perpendicular from C to AB, CY, is used, mark as follows
			7.2 × cos 68 seen	**M1***	if unsupported, **B2** for 2.70 or better	5.6 × cos 68 seen
			2.7 or 2.697 to 2.70	**A1**		2.1 or 2.097 to 2.10
			XC = 5.6 – their AX	**M1dep***	**NB** 2.902832527	BY = 7.2 – their AY
			$\tan C = \left[\dfrac{\text{BX}}{\text{XC}}\right] = \dfrac{7.2 \times \sin 68}{\text{their XC}}$	**M1**		$\tan B = \left[\dfrac{\text{CY}}{\text{BY}}\right] = \dfrac{5.6 \times \sin 68}{\text{their BY}}$
			66 or awrt 66.5	**A1**	allow 1.2 or awrt 1.19 (radians); **A0** for eg 1.2 degrees	C [= 90 – B] = 66 or awrt 66.5
				[5]		

Question			Answer	Marks	Guidance	
5	(i)		sin kx y = sin 2x	**M1** **A1** **[2]**	$k > 0$ and $k \neq 1$ must see "$y =$" at some stage for **A1**	condone use of other variable condone f(x) = sin 2x
5	(ii)		sketch of sine curve with period 360° and amplitude 1 sine curve centred on $y = -3$ and starting at (0, –3)	**B1** **B1** **[2]**	for $0 \leq x \leq 450$; ignore curve outside this range; do not allow sketch of y = cos x or $y = -\sin x$ for either mark	amplitude, period and centring on $y = -3$ must be clear from correct numerical scale, numerical labelling or comment; strokes on axes insufficient to imply scale: mark intent allow full marks if y = sin x and y = sin x – 3 seen on same diagram
6	(i)		$\frac{1}{2}r^2\theta$ or $\frac{1}{2}a^2\sin\theta$ or $a^2\sin\frac{1}{2}\theta\cos\frac{1}{2}\theta$ seen $\frac{1}{2}r^2\theta - \frac{1}{2}a^2\sin\theta$ isw oe	**M1** **A1** **[2]**	do not allow use of variable other than θ	allow eg $\frac{\theta}{2\pi}\times\pi r^2$ or $\frac{1}{2}a^2\sin\left(\frac{180\theta}{\pi}\right)$ seen oe
6	(ii)		$\frac{1}{2}a^2\sin 0.8 = \frac{1}{2}\times 12^2\times 0.8 - \frac{1}{2}a^2\sin 0.8$ oe [a =] 8.96 cao; mark the final answer	**B1** **B1** **[2]**	or eg $\frac{1}{2}a^2\sin 0.8 = \frac{1}{4}\times 12^2\times 0.8$ [= 28.8] or equivalent in degrees NB $\theta = 45.8366236\ldots^\circ$ if unsupported, allow **B2** for 8.96 or allow **B1** for 9.0 or 8.96074…to 4 sf or more	**NB** $a^2 = \frac{57.6}{0.717356}$ = 80.29485 **NB** $\theta = 45.83662361\ldots^\circ$ **NB** $\frac{1}{2}\sin 0.8 = 0.35867..$

Question			Answer	Marks	Guidance	
7	(i)		substitution of $\tan x = \frac{\sin x}{\cos x}$ or $\sqrt{1-\sin^2 x} = \sqrt{\cos^2 x}$ or $\cos x$ in given LHS both substitutions seen and completion to $\sin x$ as final answer	**M1** **A1** **[2]**	if no substitution, statements must follow a logical order and the argument must be clear; if one substitution made correctly, condone error in other part of LHS **NB AG**; answer must be stated allow consistent use of other variable eg θ for both marks	condone omission of variable throughout for **M1** only **,** but allow recovery from omission of variable at end **M0** if first move is to square one or both sides Simply stating eg $\tan x = \frac{\sin x}{\cos x}$ is insufficient *Alternatively* **SC2** for complete argument eg $\tan x = \frac{\sin x}{\cos x}$ [$\tan x \times \cos x = \sin x$] $\sin^2 x + \cos^2 x = 1$ $\cos x = \sqrt{1-\sin^2 x}$ $\tan x = \frac{\sin x}{\sqrt{1-\sin^2 x}}$ $\tan x \times \sqrt{1-\sin^2 x} = \sin x$ oe
7	(ii)		0, 180, 360 14 or 14.47 to 14.5 166 or awrt 165.5	**B1** **B1** **B1** **[3]**	all 3 required radians: mark as scheme but deduct one from total 0, π, 2π; 0.25 or 0.253 or awrt 0.2527; 2.89 or 2.889 or awrt 2.8889	**NB** $\sin y = 0$ or ¼ ignore extra values outside range if **B3,** deduct 1 mark for extra values within range

Question			Answer	Marks	Guidance	
8	(i)		$\log_a 1 = 0$ soi or $3m\log_a a$ or $\log_a a^{-3m}$ seen $-3m$ cao	**M1** **A1** **[2]**	do not condone $3m\log a$	do not allow MR for $(\log_a a^m)^3$
8	(ii)		$(2x+1)\log_3 3 = \log_3 1000$ or $2x+1 = \log_3 1000$ oe $[x =]\dfrac{\log_3 1000 - 1}{2}$ oe 2.64 cao; mark the final answer	**M1** **M1** **A1** **[3]**	Or $(2x+1)\log_{10} 3 = \log_{10} 1000$ [= 3] or $[x =]\dfrac{\dfrac{3}{\log_{10} 3} - 1}{2}$ oe not from wrong working	condone omission of brackets; allow omission of base 10 or consistent use of other base allow one sign error and / or omission of brackets allow recovery from bracket error for **A1** 0 if unsupported or for answer obtained by trial and error on $3^{2x+1} = 1000$
9	(i)		$\frac{h}{2} \times (0 + 0 + 2[4 + 4.9 + 5 + 4.9 + 4])$ oe all non-zero y-values correctly placed $h = 1$ used in formula or consistently with two triangles and four trapezia area = 22.8 **and** volume = 1140 isw cao	**M1** **M1** **B1** **A1** **[4]**	correct formula used with 4, 5 or 6 strips and numerical value for h; condone omission of zeros or omission of outer brackets for both **M** marks **M0M0** if 1, 2, 3 or 6 used as y-values (these are x-values) if **M0M0** allow **B1** for $h = 1$ and **B2** for 22.8 from area of 4 trapezia and 2 triangles and **B1** for 1140 ignore units	allow eg ½ × 1 × (4 + 4 + 2[4.9 + 5 + 4.9]) ½ × 1 × (4 + 0 + 2[4 +4.9 + 5 + 4.9]) (**NB** may be implied by 18.8 & 20.8 respectively) if **M0M0B0** allow **SC4** for 22.8 and 1140 obtained correctly by other method

Question			Answer	Marks	Guidance	
9	(ii)	A	substitution of x = 1.2 or 4.8 to find y y = 4.35 or 4.352 and correct comparison with 4.4 isw	**M1** **A1** **[2]**	allow substitution of $1.2 \leq x \leq 1.234$ or $4.766 \leq x \leq 4.8$	or **M1** for y = 4.4, x = 1.234 [or 4.766] and **A1** for comparison of 1.234 with 1.2 or 4.766 with 4.8 [so gap less than 3.6]
9	(ii)	B	$F[x] = \frac{5}{81}\left(\frac{108}{2}x^2 - \frac{54}{3}x^3 + \frac{12}{4}x^4 - \frac{x^5}{5}\right)$ oe eg $\frac{10}{3}x^2 - \frac{10}{9}x^3 + \frac{5}{27}x^4 - \frac{1}{81}x^5$ F[6] – F[0] or 2 × (F[3] – F[0]) 24 1200	**M2** **M1** **A1** **B1** **[5]**	**M1** for 3 correct terms; ignore +c allow coefficients 3.333333…, 1.11111…, 0.185185.., 0.01234567…r.o.t to 2 sf or better or decimal equivalents in numerator: 6.6666…, 3.333333…, 0.74074…, 0.061728… r.o.t to 2 sf or better dependent on at least two terms correctly integrated in bracket; condone omission of – F(0)	condone omission of $\frac{5}{81}$; **M0** if $\frac{5}{81}x$ seen outside bracket but next **M1** is still available; ignore subsequent attempt to evaluate c for first **M2** **M0** for non-zero lower limit 24 unsupported does not score ignore units
10	(i)		$\frac{\left(5.1^2 - 10.2\right) - \left(5^2 - 10\right)}{5.1 - 5}$ oe 8.1	**M1** **A1** **[2]**	condone omission of brackets	0 for 8.1 unsupported

Question			Answer	Marks	Guidance	
10	(ii)		$\frac{(5+h)^2 - 2(5+h) - \text{ their } 15}{h}$ oe	**M1**	condone omission of brackets	
			$25 + 10h + h^2 - 10 - 2h$ oe seen	**M1**	allow one sign error	
			numerator is $8h + h^2$	**A1**		
			$8 + h$ isw	**A1** **[4]**		
10	(iii)		$h \to 0$	**M1**	may be embedded; allow eg "tends to 0"	**M0** for differentiation of $x^2 - 2x$ **M0** for following from part (i) **M0** for $h = 0$
			their 8	**A1** **[2]**	**FT** their $k + h$ from part (ii)	
10	(iv)		$y = 8x - 25$ isw	**B1**	or $y - 15 = 8(x - 5)$ isw or $y = 8x + c$ and $c = -25$ stated isw	
			non-zero numerical value for x-intercept on their straight line found	**M1**		
			[x =] 3.125 oe	**A1**	may be embedded in calculation for area	
			$\frac{1}{2} \times$ their non-zero y-intercept $\times$ their $\frac{25}{8}$	**M1**	condone arithmetic slips in finding values of intercepts	or integration and evaluation of their $\int_0^{25/8} (8x - 25)\mathrm{d}x$; lower limit must be 0
			$\frac{625}{16}$ or $39\frac{1}{16}$ or 39.0625 isw	**A1** **[5]**	accept rounded to 1 dp or better for **A1**; but **A0** if **final** answer negative	

Question			Answer	Marks	Guidance	
11	(i)		$\log_{10} y = \log_{10} a + bt$ www	B1	**B0** for just $\log_{10} y = \log_{10} a + bt \log_{10} 10$	allow omission of base throughout question
			gradient is b, intercept is $\log_{10} a$ cao	B2	**B1** for one correct; award independently of their equation; must be stated – linking by arrows etc is insufficient; condone $m = b$ and $c = \log a$	ignore t-intercept is $\frac{-\log_{10} a}{b}$ **B0** for gradient is bt
				[3]		
11	(ii)		1.58, 1.8[0], 1.98, 2.37, 2.68	B1	allow values which round to these numbers to 2 dp;	all values must be correct
			all values correct and all plotted accurately	B1	within tolerance on overlay;	
			ruled line of best fit for at least $1 \le t \le 10$	B1	within tolerance on overlay: must not cut red or green line; line between (1, 0.6) and (1, 1.05) at lower limit and between (10, 2.3) and (10, 2.75) at upper limit;	use ruler tool to check if line is ruled where necessary; tolerance: one small square horizontally at each end; not dependent on correct plots
			evaluation of $\frac{\log y_2 - \log y_1}{t_2 - t_1}$ or substitution of $(t_1,\ \log y_1)$ and $(t_2,\ \log y_2)$ in $\log y = bt + \log a$ to obtain a numerical value for the gradient	M1	$(t_1,\ \log y_1)$ and $(t_2,\ \log y_2)$ are points on their line; gradient must be identified as b for **A1**	condone use of values from table
			$0.14 \le b \le 0.24$	A1		
			$2.5 \le a \le 6.3$	B1	must be identified as a ; not from wrong working	if **M0A0B0M0** allow **SC3** for substitution directly into given formula to obtain $y = a10^{bt}$ with a **and** b in acceptable range
			y = their $a \times 10^{\text{their}b \times t}$ or $y = 10^{\text{their}bt + \text{their log}a}$ or $10^{\text{their log } a} \times 10^{\text{their}b \times t}$ oe	M1		
			a and b or log a and b both in acceptable range	A1	$0.4 \le \log a \le 0.8$	
				[8]		
11	(iii)		260 **or** 261	B1	**B0** for non-integer answer	
				[1]		

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4752 Concepts for Advanced Mathematics (C2)

General Comments:

The paper was accessible to most candidates, but a small number were clearly ill-prepared and scored very poorly. A significant minority of candidates demonstrated a fair degree of understanding of Core 2 material, but failed to do themselves justice in the examination because of poor (GCSE level) algebra (bracket errors were especially common), careless arithmetical slips and failing to read the question correctly.

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.

Centres are advised that using a graphical calculator to avoid a demand to use calculus, for example in question 9(iv), or to solve an equation for example in question 8(ii) will earn no credit unless the relevant working is presented.

Comments on Individual Questions:

Question No. 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. Occasionally $3^{-½}$ was seen as a final answer.
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
Many candidates had difficulty with this question. In some cases it would seem that this was due to a failure to read the question properly, but it was also apparent that a significant minority did not understand how to generate the terms of the sequence. Even many of those who did generate the terms successfully then either ignored the sigma notation or summed an incorrect number of terms.

Question 3
This was done very well indeed, with many candidates scoring full marks. A few slipped up with the arithmetic and lost the accuracy marks, but the method was very well understood.

Question 4
This was very well done; the majority of candidates obtained full marks and almost all achieved at least 4 marks. A few worked with rounded numbers and then over-specified their final answer, thus losing the final accuracy mark, and a few left their calculator in radian mode and usually lost both accuracy marks.

Question 5
Part (i)
One or two easy marks were lost in a surprising variety of ways. Many candidates gave the answer as $y = \sin x$, $y = 2\sin x$ or $y = \sin ½x$ and some omitted "$y =$".
Part (ii)
Only a few candidates presented good sketches with the key points clearly identified. Too much was often left to the imagination of the marker. Candidates are reminded of the need to indicate amplitude, period and centring by clear scales and labelling. Unnumbered strokes on the axes, for instance, are insufficient.

A variety of misunderstandings was evident. $y = \sin(x - 3)$ was a common error, and occasionally $y = 3\sin x$ or $y = -\sin x$ were seen.

Question 6
Part (i)
This was generally very well done, but some candidates gave the area of the triangle as $\frac{1}{2}a^2$ and a few gave the area of the sector as $r\theta$.
Part (ii)
A significant minority were unable to make progress with this part due to incorrect work in part 9(i). Many others set the area of the sector equal to the area of the triangle and failed to score. A few needlessly converted to degrees, and often went wrong either by losing the accuracy mark or making a method error in the formula for the sector.
A surprising number of candidates ignored their correct work in part (i) and began again with incorrect expressions.

Question 7
Part (i)
A significant minority of candidates chose to work backwards, but few were successful. Many candidates "started at both ends" and tried to meet in the middle – sometimes a method mark was achieved.
A good number of candidates earned the first method mark with one of the correct substitutions, but either failed to complete the argument or tried to show something else.

Part (ii)
Most candidates solved the quadratic successfully and went on to find 14.5 and 166. A surprising number omitted one or more of the three other roots, however.

Question 8
Part (i)
Most candidates achieved a method mark from $\log_a 1 = 0$, but were often unable to resolve the second term. Surprisingly, a few candidates dealt successfully with $\log_a (a^m)^3$, but not with the first term.
Part (ii)
This was done very well indeed. A small number of candidates slipped up in making x the subject, and a few lost the final mark by giving the answer correct to three decimal places.

Question 9
Part (i)
Most candidates used the Trapezium rule correctly and went on to score full marks. A few made bracket errors or misplaced the y-values. Even fewer successfully found the correct value for the area by splitting the area into separate triangles and rectangles. This approach is not recommended – most go wrong and fail to score.

Part (ii) (*A*)
A minority worked out what to do here and used a correct value of x to find y, which was usually correctly compared with 4.4. However, many candidates misunderstood what was required, substitution of 3 or 3.6 were common errors. A few unsuccessfully tried to compare cross-sectional areas.

Part (ii)(*B*)
Most candidates integrated successfully and substituted the correct limits to find the correct area. However, some made an error in one of the terms, and some omitted the factor of $^5/_{81}$, which cost the later accuracy marks A few candidates lost marks by substituting incorrect limits.

Question 10

Part (i)
The majority of candidates gained full marks on this question. A significant minority differentiated and substituted in the midpoint, or the endpoints of the chord and found the mean. Whilst these approaches do achieve the correct numerical answer, they nevertheless went unrewarded.

Part (ii)
Many candidates clearly didn't understand the notation, and either produced expressions involving x and h, or "expanded brackets" and worked with $5f + fh$.
A good number of candidates did understand what this question was about, and successfully substituted to obtain correct expressions. Some made sign errors or slips in arithmetic: $h + 12$ was a common wrong answer, and a few knew what the answer was supposed to be and "back-engineered" their incorrect work accordingly.

Part (iii)
Only a few candidates used the correct terminology or notation here. Some worked with $h = 0$ and a good number ignored part (ii) and differentiated. Neither approach scored.

Part (iv)
Many candidates found the correct equation and went on to achieve full marks. Some didn't read the question carefully and used $(5, 15)$ with $(3.125, 0)$. A small number of candidates found the equation of the normal and were thus only able to access two method marks.

Question 11

Part (i)
Many scored full marks in this part, but of those who derived the equation, a significant minority did so incorrectly, thus losing the first mark. "bt" was sometimes quoted as the gradient, and "a = intercept" was a common error. Some candidates failed to state the gradient or the intercept, simply drawing lines to their equation or linking with $y = mx + c$. This is insufficient.

Part (ii)
Most completed the table successfully, and went on to plot the points and draw a suitable line of best fit. A few lost an easy first mark through poor calculator skills (2.34 instead of 2.37 was quite common) and some rounded to 1 decimal place. A few candidates drew a curve of best fit, or failed to use a ruler.
Most were able to find the gradient of the line for an easy mark, but many failed to link this to b. Similarly, the instruction to find the value of a was often disregarded. Surprisingly, many candidates simply stopped when they had found a and b, thus losing the last two marks.

Part (iii)
The majority of candidates successfully obtained the correct value, but a significant minority lost an easy mark by failing to give the answer in context as an integer.

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GCE Mathematics (MEI)

				Max Mark	a	b	c	d	e	u
4751	01	C1 – MEI Introduction to advanced mathematics (AS)	Raw	72	63	57	52	47	42	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – MEI Concepts for advanced mathematics (AS)	Raw	72	56	49	42	35	29	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	47	42	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	64	57	51	45	39	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – MEI Further concepts for advanced mathematics (AS)	Raw	72	59	53	48	43	38	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – MEI Further methods for advanced mathematics (A2)	Raw	72	60	54	48	43	38	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – MEI Further applications of advanced mathematics (A2)	Raw	72	60	54	49	44	39	0
			UMS	100	80	70	60	50	40	0
4758	01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	67	61	55	49	43	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	58	50	43	36	29	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – MEI Mechanics 2 (A2)	Raw	72	59	53	47	41	36	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – MEI Mechanics 3 (A2)	Raw	72	60	53	46	40	34	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – MEI Mechanics 4 (A2)	Raw	72	55	48	41	34	27	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – MEI Statistics 1 (AS)	Raw	72	59	52	46	40	34	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – MEI Statistics 2 (A2)	Raw	72	60	55	50	45	40	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – MEI Statistics 3 (A2)	Raw	72	60	54	48	42	37	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	48	43	38	34	30	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – MEI Decision mathematics 2 (A2)	Raw	72	55	50	45	40	36	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	55	49	44	39	33	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

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241	01 Statistics 1 MEI (Z1)	Raw	72	59	52	46	40	34	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	59	52	46	40	34	0
		UMS	100	80	70	60	50	40	0
G246	01 Decision 1 MEI	Raw	72	48	43	38	34	30	0
		UMS	100	80	70	60	50	40	0

Level 3 Certificate and FSMQ raw mark grade boundaries June 2016 series

For more information about results and grade calculations, see www.ocr.org.uk/ocr-for/learners-and-parents/getting-your-results

Level 3 Certificate Mathematics for Engineering

		Max Mark	a*	a	b	c	d	e	u
H860	01 Mathematics for Engineering	This unit has no entries in June 2016							
H860	02 Mathematics for Engineering								

Level 3 Certificate Mathematical Techniques and Applications for Engineers

			Max Mark	a*	a	b	c	d	e	u
H865	01 Component 1	Raw	60	48	42	36	30	24	18	0

Level 3 Certificate Mathematics - Quantitative Reasoning (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H866	01 Introduction to quantitative reasoning	Raw	72	55	47	39	31	23	0
H866	02 Critical maths	Raw	60	47	41	35	29	23	0
		Overall	132	111	96	81	66	51	0

Level 3 Certificate Mathematics - Quantitive Problem Solving (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H867	01 Introduction to quantitative reasoning	Raw	72	55	47	39	31	23	0
H867	02 Statistical problem solving	Raw	60	40	34	28	23	18	0
		Overall	132	103	88	73	59	45	0

Advanced Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6993	01 Additional Mathematics	Raw	100	59	51	44	37	30	0

Intermediate Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6989	01 Foundations of Advanced Mathematics (MEI)	Raw	40	35	30	25	20	16	0

Version	Details of change
1.1	Correction to Overall grade boundaries for H866
	Correction to Overall grade boundaries for H867