OCR
Oxford Cambridge and RSA

Wednesday 6 June 2018 – 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

7309796670

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 barcodes.
- 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

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

(ii) Find $\int 35x^{\frac{5}{2}} dx$. **[3]**

2 **(i)** An arithmetic progression (AP) has first term 3.5. The sum of the first 50 terms of the AP is 910. Find the value of the common difference. **[2]**

(ii) A geometric progression (GP) has first term 25 and common ratio 1.6. Find the sum of the first 12 terms of the GP, giving your answer correct to the nearest integer. **[2]**

3 A sequence has nth term $\sin\left(\frac{n\pi}{6}\right)$.

(i) Evaluate each of the first four terms of this sequence, giving your answers in exact form. **[2]**

(ii) Show that this sequence is periodic, stating the number of terms after which the sequence repeats. **[2]**

4 A sector OAB of a circle centre O has arc length 12 cm and area 45 cm^2. Find the radius of the circle in centimetres and the sector angle in radians. Hence find the area of the segment bounded by the chord AB and the arc AB. **[5]**

5 Fig. 5.1 shows the cross-section of a bus shelter, with measurements of the height, in metres, taken at 0.5 m intervals from O. O is at the front of the shelter.

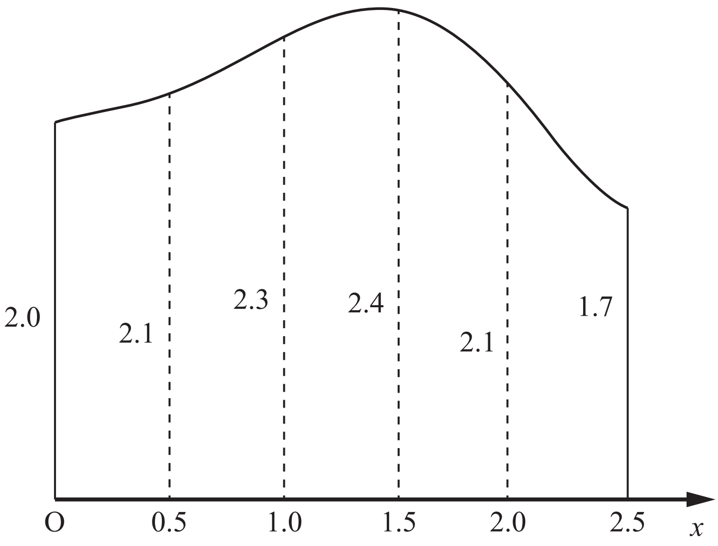

Fig. 5.1

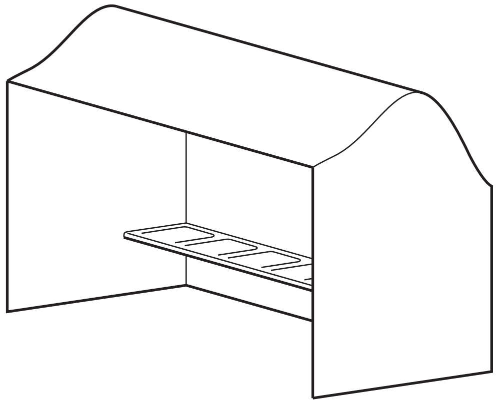

Fig. 5.2

Fig. 5.2 shows a sketch of the shelter, which has two identical side walls and a back wall but no front wall. The length of the shelter is 3.5 m. The outsides of the walls are to be painted. A litre of the type of paint to be used covers $15\,\text{m}^2$. Use the trapezium rule with 5 strips to calculate an estimate of the area of a side wall. Hence find the amount of paint that will be needed. **[5]**

6 You are given that $\cos\theta + 5 = 6\sin^2\theta$ and that $0 \leqslant \theta \leqslant 2\pi$. Show that $6\cos^2\theta + \cos\theta - 1 = 0$ and hence find the values of θ satisfying this equation. **[5]**

7 Use logarithms to solve the equation $5^{x+2} = 3^x$, showing your method and giving your answer correct to 3 significant figures. **[3]**

8 An arithmetic progression (AP) and geometric progression (GP) both have the same second term, which is 40. They also have the same fourth term, 250.

(i) Find the first term of the AP. **[2]**

(ii) Find the possible values of the first term of the GP. **[3]**

Section B (36 marks)

9

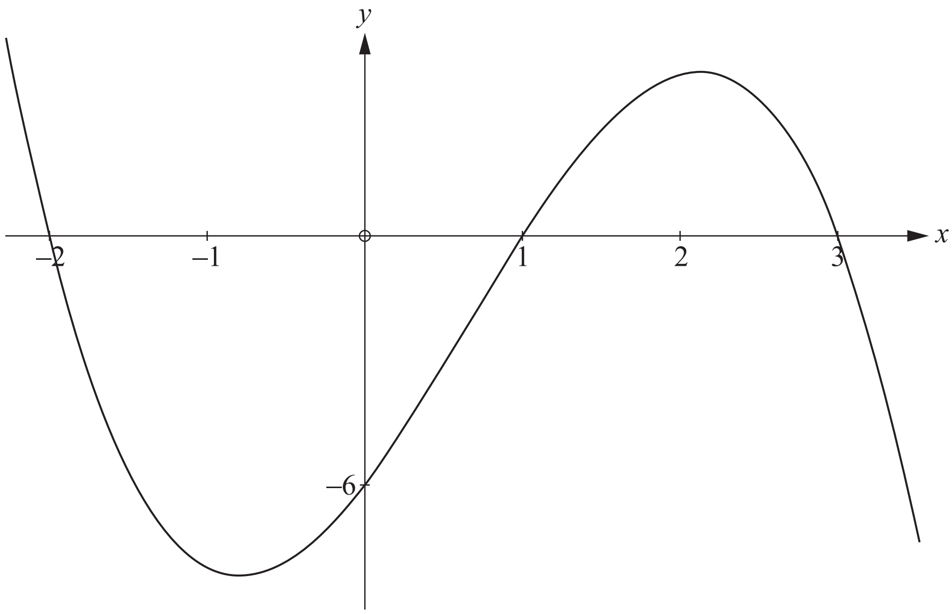

Fig. 9

Fig. 9 shows the curve $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = -x^3 + 2x^2 + 5x - 6$.

(i) Use calculus to find $\int_{-2}^{1} (-x^3 + 2x^2 + 5x - 6)\,\mathrm{d}x$ and state what this represents. **[5]**

(ii) Find the x-coordinates of the turning points of the curve $y = \mathrm{f}(x)$, giving your answers in exact form. Hence state the set of values of x for which $\mathrm{f}(x)$ is a decreasing function. **[5]**

(iii) You are given that $\mathrm{g}(x) = \mathrm{f}(2x)$. State the x-coordinates of the turning points of the curve $y = \mathrm{g}(x)$ and also the coordinates of the curve's intersection with the y-axis. **[2]**

10

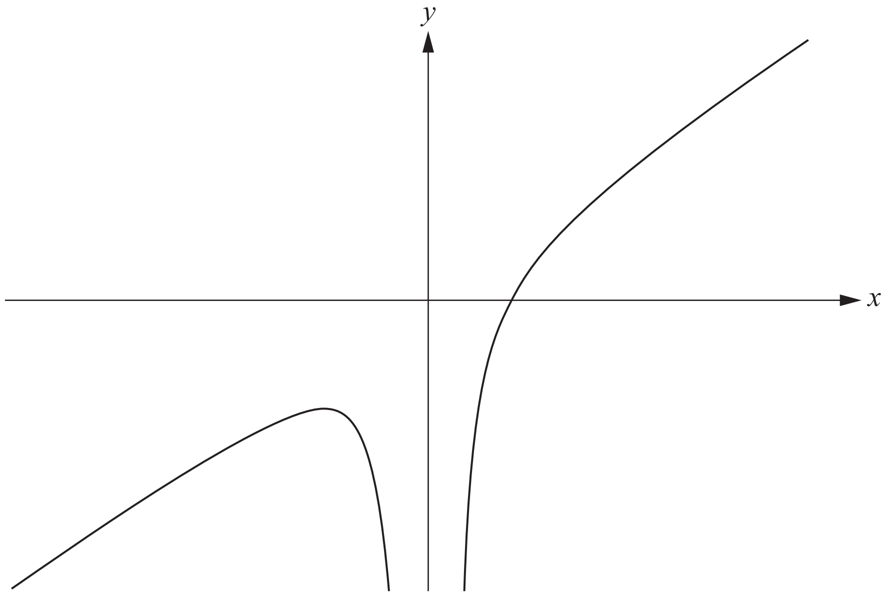

Fig. 10

Fig. 10 is a sketch of the graph of $y = x - \frac{1}{2x^2}$.

(i) Find $\frac{dy}{dx}$ and show that $\frac{d^2y}{dx^2} = -\frac{3}{x^4}$. **[2]**

(ii) Show that this curve has only one turning point and verify that it is a maximum. **[3]**

(iii) (*A*) Show that the equation of the tangent to the curve at the point where $x = 1$ is $y = 2x - 1.5$. **[3]**

(*B*) Show that where this tangent meets the curve, $2x^3 - 3x^2 + 1 = 0$. Hence find the coordinates of the point where this tangent meets the curve again. **[4]**

11 This question is about the Gross Domestic Product (GDP) of China. G, in billions of US dollars, is the GDP in year t after 2010. So, for example, $t = 5$ gives the year 2015.

Year	2011	2012	2013	2014	2015
t	1	2	3	4	5
GDP (G billion US$)	7573	8561	9607	10482	11010

G can be modelled by the equation

$G = 6100 \times \left(1 + \frac{r}{100}\right)^t$, where $r\%$ is a constant representing the average annual growth rate of the GDP.

(i) What does the 6100 in this equation represent? **[1]**

(ii) Use logarithms to show that, using this model, a graph of $\log_{10} G$ against t will be a straight line. **[2]**

(iii) Complete the table in the answer book and plot the points on the grid provided. Draw by eye a line of best fit. **[3]**

(iv) Use your line of best fit to estimate the value of r. **[4]**

(v) Hence estimate the GDP of China in 2018, showing your method. Comment on the reliability of this estimate. **[2]**

END OF QUESTION PAPER

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Wednesday 6 June 2018 – Morning

AS GCE MATHEMATICS (MEI)

4752/01 Concepts for Advanced Mathematics (C2)

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Duration: 1 hour 30 minutes

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 (i)	
3 (ii)	

4	
5	

6

7

8 (i)	
8 (ii)	

Section B (36 marks)

9 (i)

9 (ii)	
9 (iii)	

10(i)	
10(ii)	

10(iii)(*A*)	
10(iii)(*B*)	

11(i)

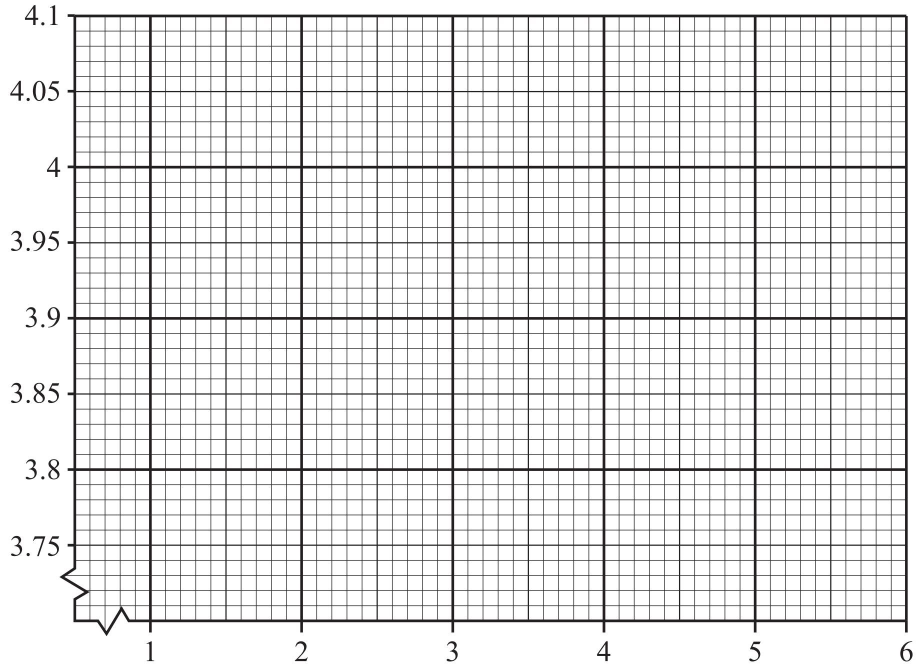
11 (ii)

11 (iii)

Year	2011	2012	2013	2014	2015
t	1	2	3	4	5
GDP (G billion US$)	7573	8561	9607	10482	11010
$\log_{10} G$					

grid on next page

11 (iii) and (iv)



11 (v)

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 2018

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.

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)**		$kx^{\frac{1}{2}-1}$	M1	k is any non-zero constant, ignore + c	**B2** for correct answer unsupported
			$3x^{-\frac{1}{2}}$ oe simplified form isw	A1 **[2]**	**A0** for e.g. $3x^{-\frac{1}{2}}+c$	
1	**(ii)**		$kx^{\frac{5}{2}+1}$	M1	k is any non-zero constant	
			$10x^{\frac{7}{2}}$ isw	A1		allow any equivalent exact, simplified form
			+ c	A1 **[3]**	seen at least once following integration	
2	**(i)**		$910 = \dfrac{50}{2}(2\times3.5+(50-1)d)$ oe	M1	if $u_{50}=32.9$ found first, **M1** for $32.9=3.5+(50-1)d$ oe	**B2** for correct answer unsupported
			0.6 or $\dfrac{3}{5}$	A1 **[2]**		
2	**(ii)**		for correct substn. into formula for sum of GP e.g. $S=\dfrac{25(1.6^{12}-1)}{1.6-1}$	M1	**B1** for 11686.457 unsupported **B2** for 11686 unsupported	
			11686 cao	A1 **[2]**		
3	**(i)**		$\dfrac{1}{2},\dfrac{\sqrt{3}}{2},1,\dfrac{\sqrt{3}}{2}$	B2 **[2]**	**B1** for two terms correct	**NB** exact form required

Question			Answer	Marks	Guidance	
3	(ii)		e.g. period of sin $x = 2\pi$ so sequence repeats each time a multiple of 2π is reached	B1	or **B1** for at least the <u>next</u> 9 terms: $\frac{1}{2}, 0, -\frac{1}{2}, -\frac{\sqrt{3}}{2}, -1, -\frac{\sqrt{3}}{2}, -\frac{1}{2}, 0, \frac{1}{2}$... to show repetition **SC1** if they have worked with decimals: at least the next 9 terms following the first 4, all rot to 3sf or better	Alternative acceptable statements for **B1**: $\sin\theta$ is periodic so $\sin(\frac{n\pi}{6})$ must also be periodic; $\sin\left(\frac{n\pi}{6}+2\pi\right)=\sin\left(\frac{n\pi}{6}\right)$ (so $\sin\left(\frac{n\pi}{6}\right)$ is periodic)
			12	B1 **[2]**	Repeats after 12 terms or <u>on</u> the 13th term	
4			$r\theta = 12$ **and** $\frac{1}{2}r^2\theta = 45$ oe	M1*	or $12 = \frac{2\pi r\theta}{360°}$ **and** $45 = \frac{\pi r^2\theta}{360°}$	
			eliminating a variable e.g. $\frac{1}{2}r = \frac{45}{12}$ or $\frac{1}{2}\times 12\times r = 45$	M1dep*	e.g. $\frac{45}{12} = \frac{1}{2}r$ or $45 = \frac{1}{2}\times 12\times r$	
			$r = 7.5$ [cm] **and** $\theta = 1.6$	A1		**NB** angle in degrees: 91.67…
			$45 - \frac{1}{2}\textit{their } r^2 \times \sin \textit{their } \theta$	M1		or **M1** for $45 - \frac{1}{2}\textit{their } AB \times \textit{their perp ht}$ ft *their* r and *their* θ **NB** $AB = 10.76034…$ *perp ht* $= 5.2253…$
			area of segment = 16.8 to 16.9 [cm^2]	A1 **[5]**		

Question			Answer	Marks	Guidance	
5			$H = 0.5$ soi	B1		
			$\frac{h}{2}\times\left[2.0+1.7+2\left(2.1+2.3+2.4+2.1\right)\right]$	M1	correct formula used with 3,4 or 5 strips and numerical value for h; condone omission of outer brackets for M marks, allow recovery	
			all y values placed correctly	M1	**M0** if any x values used	**NB** 5 trapezia areas are: 1.025, 1.1, 1.175, 1.125, 0.95
			5.375 oe to 2 sf or more	A1	if **M0M0** allow **B3** for 5.375 and **B1** 1.11 to 1.12	
			[amount of paint] = 1.11 to 1.12 isw	A1		
				[5]		
6			$\sin^2\theta = 1 - \cos^2\theta$ used	M1		or $\cos^2\theta = 1 - \sin^2\theta$ substituted in $6\cos^2\theta + \cos\theta - 1 = 0$
			eg $\cos\theta + 5 = 6(1 - \cos^2\theta)$ or better		at least one correct intermediate step to obtain **given** answer	to obtain $\cos\theta + 5 = 6\sin^2\theta$ with at least one correct intermediate step
			$6\cos^2\theta + \cos\theta - 1 = 0$ www	A1		
			$-\frac{1}{2}$ and $\frac{1}{3}$ found	B1	both required; allow 0.33 or better	
			$\theta = \frac{2\pi}{3}, \frac{4\pi}{3}, 1.23, 5.05$ correctly rot to 2 dp or more isw	B2	**B1** for 2 correct, to 2 dp or more if **B0** allow **SC1** for all four answers in degrees correctly rot to 2dp or more with no extras: 120, 240, 70.528…,289.47…	if **B2** deduct 1 mark for extra values in range; ignore extra values outside range **NB** 2.094395…, 4.18879…, 1.230959…, 5.052225…
				[5]		

Question			Answer	Marks	Guidance	
7			$(x + 2)\log_{10} 5 = x\log_{10} 3$ $(\log_{10} 5 - \log_{10} 3)x = -2\log_{10} 5$ oe −6.30 cao www	M1 M1 A1 **[3]**	**M1** for $x + 2 = x\log_5 3$ or **M1** $(x + 2)\log_3 5 = x$ for correct rearrangement to $kx = c$ in either exact or decimal form **M1** $(\log_5 3 - 1)x = 2$ oe or **M1** $(1 - \log_3 5)x = 2\log_3 5$ oe	condone omission of base 10 throughout accept decimal equivalents to 2sf allow recovery of omission of brackets in later working
8	**(i)**		$a + d = 40$ **and** $a + 3d = 250$ oe $a = -65$	M1 A1 **[2]**	or for $2d = 250-40$ oe **and** use of one of $a + their\ d = 40$ or $a + 3\times their\ d = 250$	**B2** for $a = -65$ unsupported **NB** $d = 105$
	(ii)		For GP , $ar = 40$ **and** $ar^3 = 250$ oe $a = \pm 16$ isw	M1 A2 **[3]**	**A1** for one value of a correct or **B1** for both values of r found: ± 2.5	if **M0** **B2** for one of $a = \pm 16$, **B3** for both

Question			Answer	Marks	Guidance	
9	(i)		(F[x]) = $-\frac{x^4}{4}+\frac{2x^3}{3}+\frac{5x^2}{2}-6x$ oe	M2	**M1** for 3 correct terms ignore + c for **M** marks	**NB** accept coeff to 3sf or better -0.25, 0.667, 2.5
			evidence of F[1] - F[-2] used: e.g $-\frac{37}{12}-\frac{38}{3}$ or -3.0833… - 12.666…	M1	dep at least two terms correctly integrated	**M0** if they have differentiated
			−15.75 oe isw	A1	if -15.75 seen after fully correct integral function obtained, award **M1A1** **A0** for -15.75 + c	-15.75 unsupported does not score
			The area between the curve and the x-axis, from $x = -2$ to $x = 1$(is 15.75)	B1 **[5]**		Can extend the argument further, e.g. area between curve and x-axis from $x = -2$ to $x = 1$, region is below axis, hence negative
9	(ii)		$\frac{dy}{dx}=-3x^2+4x+5$	M1	All correct	
			'*their*' $\frac{dy}{dx}=0$ soi	M1	ft provided attempt at differentiation	
			valid method for solving *their* 3 term quadratic	M1		can be implied by 2.1196… , -0.78629…
			$[x=]\frac{4\pm\sqrt{76}}{6}, \frac{2}{3}\pm\frac{\sqrt{19}}{3}$ oe exact	A1		
			$x<\frac{4-\sqrt{76}}{6}$, $x>\frac{4+\sqrt{76}}{6}$ oe exact	A1ft **[5]**	allow ≤ and ≥ used ft their exact roots	A0 for $\frac{4-\sqrt{76}}{6}>x>\frac{4+\sqrt{76}}{6}$ oe
9	(iii)		$\frac{4\pm\sqrt{76}}{12}$ oe	B1ft	ft *their* roots, to 3sf or better	can be implied by 1.0598… , - 0.3931…
			(0, −6) cao	B1 **[2]**		

Question			Answer	Marks	Guidance	
10	(i)		$\frac{dy}{dx} = 1 + \frac{1}{x^3}$ oe	M1		use of $\int \frac{d^2y}{dx^2} dx$ does not score
			$\frac{d^2y}{dx^2} = -3x^{-4} \left(= -\frac{3}{x^4} \right)$ www	A1	but not just $-\frac{3}{x^4}$ as **AG**	
				[2]		
10	(ii)		*their* $\frac{dy}{dx} = 0$ soi	M1	provided *their* $\frac{dy}{dx}$ is of the form $a + bx^n$	
			Solving to get $x = -1$ as the only solution	A1		
			$-\frac{3}{(\textit{their negative } x)^4}$ *their -3* < 0 (∴ maximum)	B1ft	or using negative x values to consider signs of gradient either side of $x = -1$, signs for gradients identified to verify maximum	accept a convincing argument that $\frac{d^2y}{dx^2}$ is always negative, ∴ any turning point must be a maximum
				[3]		
10	(iii)	(*A*)	$y = 0.5$ when $x = 1$	B1		
			subst $x = 1$ into *their* $\frac{dy}{dx}$ **and** either of: y – *their* 0.5 = *their* $\frac{dy}{dx} \times (x - 1)$ or *their* 0.5= *their* $\frac{dy}{dx} \times 1 + c$	M1		
			and completion to given answer	A1		$y = 2x - 1.5$ **AG**
				[3]		

Question			Answer	Marks	Guidance	
10	**(iii)**	**(*B*)**	$2x-1.5=x-\frac{1}{2x^2}$ $2x^3-3x^2+1=0$ AG $x=-\frac{1}{2}$ oe $y=-\frac{5}{2}$ oe	M1 A1 B1 B1 **[4]**	and completion to given answer with at least one intermediate step	
11	**(i)**		GDP in 2010, in billions	B1 **[1]**	date and billions both required	
11	**(ii)**		$\log_{10} G=\log_{10} 6100+t\log_{10}\left(1+\frac{r}{100}\right)$ www clear comparison with equation of straight line	B1 B1 **[2]**	condone omission of log base e.g. in the form y = c + xm, consistent with their correct log equation; or this is in the form of a straight line with gradient = $\log_{10}\left(1+\frac{r}{100}\right)$ and y intercept = $\log_{10} 6100$	
11	**(iii)**		3.88, 3.93, 3.98, 4.02, 4.04 correctly rounded to 3sf or more all values correct and pts plotted accurately ruled line of best fit drawn from at least t=1 to t=5 inclusive	 B1 B1 B1 **[3]**	3.8792…, 3.9325…, 3.9825…, 4.0204…, 4.0417… Condone 1 error, see overlay (tolerance 1mm, 1/2 a square) Line must not go outside overlay between t=1 and t=5	 **NB** line between (1, 3.87) and (1, 3.89) at lower limit and between (5, 4.04) and (5, 4.06) at upper limit

Question			Answer	Marks	Guidance	
11	**(iv)**		correct method for gradient of line e.g. evaluation of $\frac{\log G_2 - \log G_1}{t_2 - t_1}$	M1	May be implied by e.g. *m* between 0.035 to 0.05 $(t_1,\ \log G_1)$ and $(t_2,\ \log G_2)$ are points on *their* line or **M1** for substitution of $(t_1,\ \log G_1)$ in $\log_{10} G = \log_{10} 6100 + t\log_{10}\left(1+\frac{r}{100}\right)$ **M1** for making $1+\frac{r}{100}$ the subject	condone use of values from table for either approach if **M0A0M0** allow **SC4** for using a pair of values from *their* line, finding *G* and using in: $G = 6100\left(1+\frac{r}{100}\right)^t$ and evaluating www to give *r* in range
			0.035 to 0.05	A1	**A1** for $1+\frac{r}{100}$ = 1.0839 to 1.1220	
			$1+\frac{r}{100} = 10^{\textit{their}\ \text{gradient}}$	M1		
			$9.14 \le r \le 11.7$	A1 **[4]**	**A1** $9.14 \le r \le 11.7$	
11	**(v)**		12300 to 14800	B1		
			Comment on: Reliability of continuing constant average annual growth rate unreliable as it is extrapolation exponential growth model for GDP which may be unreasonable	B1 **[2]**	e.g. unreliable as no guarantee that the growth rate will not vary significantly during the 3 years after 2015 no guarantee that pattern will continue outside the range of data	

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Examiners' report

MATHEMATICS (MEI)

3895-3898, 7895-7898

4752/01 Summer 2018 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 4752/01 series overview

4752 is one of the two Pure Mathematics components for the modular AS Mathematics specification. It builds upon the skills in 4751 and its purpose is to introduce candidates to a number of topics which are fundamental to the advanced study of mathematics.

The paper was accessible to the majority of candidates, with significantly fewer ill-prepared, low-scoring candidates than previous years. This is likely to be the nature of this year's cohort who in the main will have sat this paper before.

All questions were attempted, with fewer candidates than usual appearing to be short of time. Those who did struggle to complete the examination seemed to spend a disproportionate amount of time on low mark questions earlier on in the paper. This reflects on their examination performance more than their application of mathematical skills.

Candidate performance overview

Candidates who generally did well on this paper:

- Showed good algebraic structure and sound use of mathematical annotation and language.
- Considered the accuracy of their responses, choosing an appropriate degree of accuracy for the context or demands of the question, e.g. Q2(ii), Q3(i), Q7, Q9(ii).
- Showed insight into the processes they had carried out when asked to justify or explain the context of their answers, e.g. Q3(ii), Q9(i), Q11(i)(ii)(v).
- Produced responses to questions that showed they had prepared specifically for this paper, tackling familiar questions with confidence.
- Presented clear and complete mathematical arguments in 'show that' questions.

Candidates who generally did less well on this paper:

- Carried out algebraic manipulation poorly, especially in the use of brackets in Q5, Q7.
- Didn't answer all parts of a question, e.g. missing the requirement to find the area of the segment in question Q4.
- Struggled with the use of fractions and index notation in Q1, Q10i.
- Prematurely rounded in calculations, often leading to inaccuracies in final answers.
- Showed poor setting out of work in less structured questions, e.g. Q4, Q9(i), Q10(iii)(B).
- Struggled to explain things in appropriate terms when asked for explanations or interpretations.
- Missed steps or did not show complete working in 'show that' questions.

Section A

Question 1(i)

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

Question 1(ii)

(ii) Find $\int 35x^{\frac{5}{2}}dx$. **[3]**

This question was very well answered. A small minority of candidates did not score with most errors in changing the original function to index form correctly. A few others incorrectly simplified the coefficients. As always, a significant minority of candidates neglected to add "+ *c*" in (ii), thereby losing an easy mark.

Question 2(i)

2 **(i)** An arithmetic progression (AP) has first term 3.5. The sum of the first 50 terms of the AP is 910. Find the value of the common difference. **[2]**

This question was best attempted by using one of the formulae given in the formula book; successful candidates chose appropriately and rearranged competently to get the correct answer. Some candidates used the formula for the *n*th term instead of the sum to *n* terms which didn't give them a chance to score.

Question 2(ii)

(ii) A geometric progression (GP) has first term 25 and common ratio 1.6. Find the sum of the first 12 terms of the GP, giving your answer correct to the nearest integer. **[2]**

Most candidates approached this successfully, using the given sum formula. It wasn't uncommon though for candidates to miss the request to give their answer correct to the nearest integer thereby losing a mark.

Question 3(i)

3 A sequence has nth term $\sin\left(\frac{n\pi}{6}\right)$.

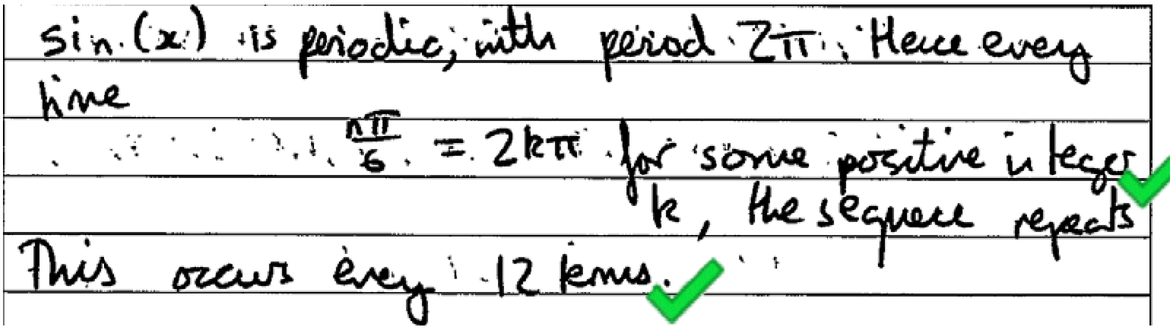
(i) Evaluate each of the first four terms of this sequence, giving your answers in exact form. **[2]**

Question 3(ii)

(ii) Show that this sequence is periodic, stating the number of terms after which the sequence repeats. **[2]**

This question brought together two familiar topics but in a more unfamiliar combination which caused a few problems in (ii). Most candidates were successful in evaluating the first 4 terms in (i), some missed the request for exact form, but many had more difficulty with the 'show that' in (ii). One approach used by the majority of successful candidates was to list the terms of the sequence until repetition happened but a mathematical argument based on the periodic nature of the sine function would have been more efficient. Whilst many candidates understood that 'periodic' had something to do with repetition, only a small proportion understood it in the context of this question.

Exemplar 1



sin(x) is periodic, with period 2π. Hence every time $\frac{n\pi}{6} = 2k\pi$ for some positive integer k, the sequence repeats. This occurs every 12 terms.

This response is excellent. It shows a good understanding of the periodic nature of the sine function and how that could be used in an argument to show why the sequence was periodic. It uses specifics to make the point effectively. Less successful responses just stated that sin*x* is periodic which didn't meet the requirement to *show* that the sequence was periodic.

Question 4

4 A sector OAB of a circle centre O has arc length 12 cm and area 45 cm^2. Find the radius of the circle in centimetres and the sector angle in radians. Hence find the area of the segment bounded by the chord AB and the arc AB. **[5]**

This question required candidates to form a pair of simultaneous equations from the given facts and then solve to find the radius and sector angle. Remembering the formulae for arc length and sector area gave an advantage and simplified working. Candidates are encouraged to work with radians rather than degrees in this type of question as the change of units can lead to loss of accuracy.

There were two stages to this question and the second one was often missed. Re-reading the question after answering may lead to this happening less often.

Question 5

5 Fig. 5.1 shows the cross-section of a bus shelter, with measurements of the height, in metres, taken at 0.5 m intervals from O. O is at the front of the shelter.

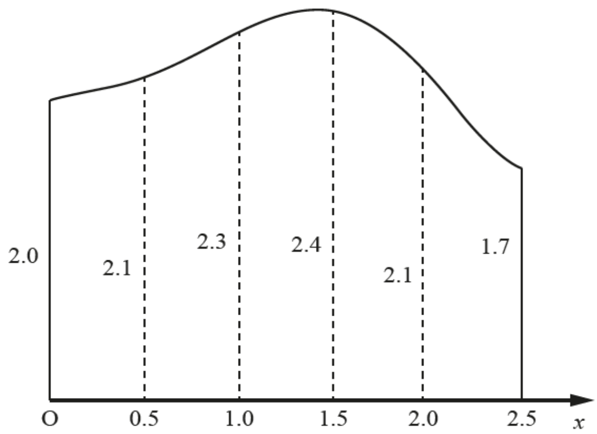


Fig. 5.1

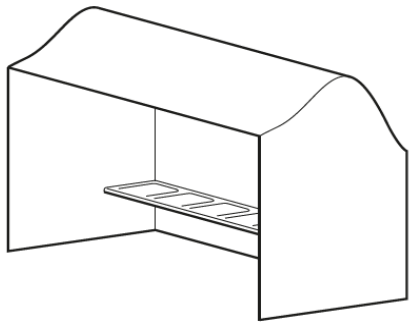


Fig. 5.2

Fig. 5.2 shows a sketch of the shelter, which has two identical side walls and a back wall but no front wall. The length of the shelter is 3.5 m. The outsides of the walls are to be painted. A litre of the type of paint to be used covers 15 m^2. Use the trapezium rule with 5 strips to calculate an estimate of the area of a side wall. Hence find the amount of paint that will be needed. **[5]**

The application of the trapezium rule was very successful in this question. Missing brackets were not uncommon but provided the working was consistent with brackets being present, candidates were able to gain marks. Excellent responses had clear structure and correct order of operations.

Finding the total amount of paint needed for the outsides of the walls proved a challenge. There were issues with finding the total area and sometimes confusion between surface area and volume of paint. For those that went on to calculate the volume of paint needed, many assumed they were being asked for the number of cans of paint which wasn't the case. Provided they had stated the answer to an appropriate degree of accuracy first, this was fine but not if the number of 1 litre cans was the only response given.

Question 6

6 You are given that $\cos\theta + 5 = 6\sin^2\theta$ and that $0 \leqslant \theta \leqslant 2\pi$. Show that $6\cos^2\theta + \cos\theta - 1 = 0$ and hence find the values of θ satisfying this equation. **[5]**

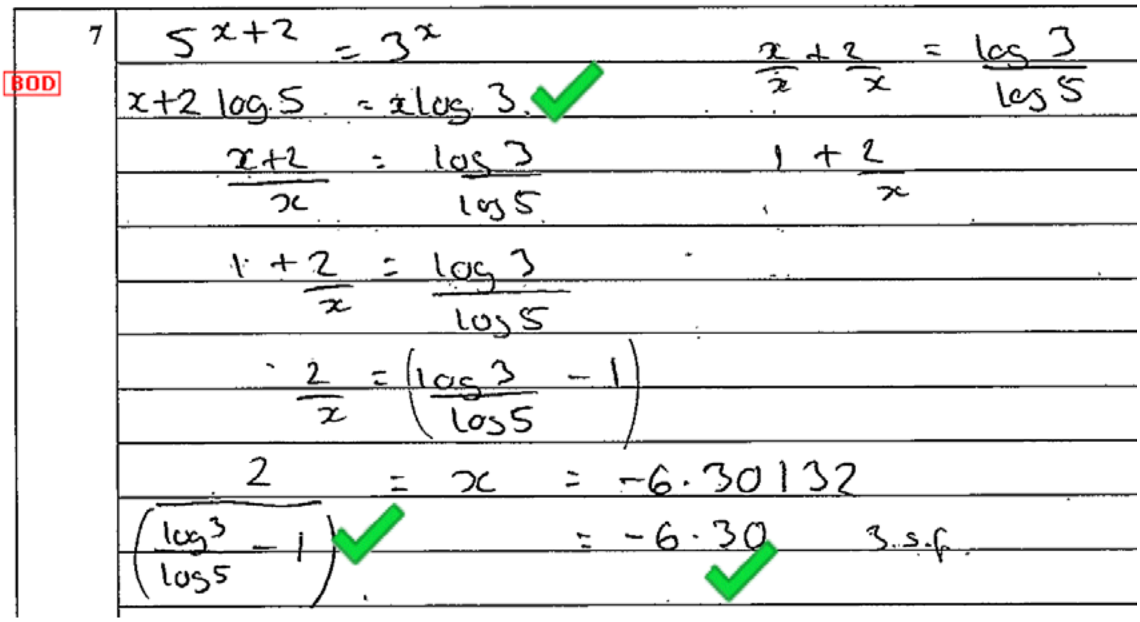
To gain full credit for the first stage of this question, candidates needed to be seen using the appropriate identity and showing at least one interim step to achieve the given result. This was generally very well done, as was solving the quadratic as the first step of finding the solutions. There are still some candidates who don't recognise they should be working in radians and some who work in degrees and then convert their answers which can lead to inaccuracies. A more useful approach would be to work with calculators in radian mode. Lower ability candidates have problems finding multiple solutions in range.

Question 7

7 Use logarithms to solve the equation $5^{x+2} = 3^x$, showing your method and giving your answer correct to 3 significant figures. **[3]**

To be successful with this question, candidates needed to bring together correct use of log laws, good algebraic skills and effective use of calculator functions. With a choice of which base to use, there were several different routes through to a correct answer. The majority of candidates used logs to the base 10 but there were many successful responses with using logs to the base 5, which gave a slightly shorter approach. As in Q5, missing brackets were not uncommon when using log laws and some struggled to make *x* the subject.

Exemplar 2


BOD

7
$5^{x+2} = 3^x$
$x+2 \log 5 = x \log 3$
$\frac{x+2}{x} = \frac{\log 3}{\log 5}$
$1 + \frac{2}{x} = \frac{\log 3}{\log 5}$
$\frac{2}{x} = \left(\frac{\log 3}{\log 5} - 1\right)$
$\frac{2}{\left(\frac{\log 3}{\log 5} - 1\right)} = x = -6.30132$
$= -6.30$ 3.s.f.

$\frac{x}{x} + \frac{2}{x} = \frac{\log 3}{\log 5}$
$1 + \frac{2}{x}$

This response illustrates a frequently seen example of missing brackets. This candidate's subsequent working indicates they knew they were working with a product so full marks were credited; many others didn't. Whilst the working of this candidate is correct, approaches that collected the terms in *x* on one side and then factorised offered fewer opportunities for error. A lot of the attempts to take the reciprocal of both sides after isolating $\frac{2}{x}$ went wrong.

Question 8(i)

8 An arithmetic progression (AP) and geometric progression (GP) both have the same second term, which is 40. They also have the same fourth term, 250.

(i) Find the first term of the AP. **[2]**

Question 8(ii)

(ii) Find the possible values of the first term of the GP. **[3]**

Parts (i) and (ii) shared the same information at the beginning of the question and this caused some overlap of working for the lower ability candidates. That aside, this question was successful for the majority of candidates and a variety of approaches was seen. The most successful ones used the formulae for *n*th terms and solved the pair of equations simultaneously in both parts. A significant minority of candidates lost sight of the objective in (ii) and gave values for *r* instead of *a*.

There were also some very successful approaches that were more deductive and less formally structured but candidates need to be aware that in these instances it is harder to gain partial credit if they are not entirely successful.

Section B

Question 9(i)

9

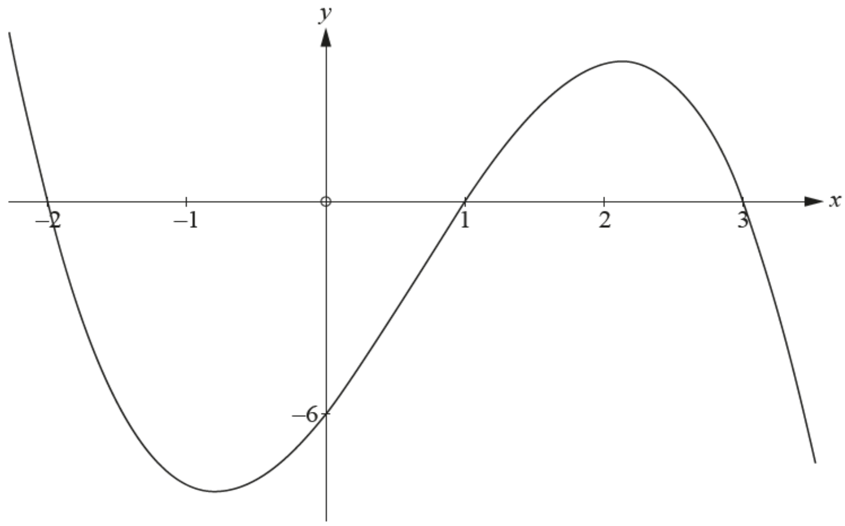


Fig. 9

Fig. 9 shows the curve $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = -x^3 + 2x^2 + 5x - 6$.

(i) Use calculus to find $\int_{-2}^{1} (-x^3 + 2x^2 + 5x - 6)\,\mathrm{d}x$ and state what this represents. **[5]**

This integration question was dealt with very competently by the majority of the candidates and the notation was usually sound. As calculators will evaluate definite integrals, candidates need to be aware that they must show sufficient working to support their answers. Whilst sight of the subtraction of correct values for F(1) and F(-2) is sufficient, if one or the other is incorrect then that can't imply a correct method. It is better to show the substitution into the integral function. The solution to the integral was negative but there was some confusion here when candidates thought they were being asked to find area at this stage, and lost an accuracy mark by giving the answer as + 15.75 only.

When asked to interpret the integral in the context of the graph, many were unable to give a precise explanation of what the answer represented and lost the final mark.

Question 9(ii)

(ii) Find the x-coordinates of the turning points of the curve $y = \mathrm{f}(x)$, giving your answers in exact form. Hence state the set of values of x for which $\mathrm{f}(x)$ is a decreasing function. **[5]**

This question was very well attempted by the majority of candidates. Most knew they had to differentiate, set equal to zero and solve. Any valid approach for solving a quadratic was acceptable but the answers needed to be in exact form, which was missed by a minority of candidates. Attempts at the set of values for which f(x) is decreasing were less successful. This part of the question was not attempted by some which could be due to not picking up on the 2nd demand of the question. Others tried to join the two separate regions together in a single inequality.

Question 9(iii)

(iii) You are given that $g(x) = f(2x)$. State the x-coordinates of the turning points of the curve $y = g(x)$ and also the coordinates of the curve's intersection with the y-axis. **[2]**

The most successful candidates realised they were being asked for a stretch parallel to the *x*-axis and correctly identified the scale factor. Follow through was allowed at this stage for non-exact solutions in part (ii). Less successful approaches included substituting 2*x* into f(*x*) and attempting to solve a quadratic. Being asked to *state* along with the number of marks allocated to this part of the question should be used to help determine the most appropriate approach. Candidates were asked for coordinates for the 2nd mark so a commonly seen answer of $y = -6$ only didn't score.

Question 10(i)

10

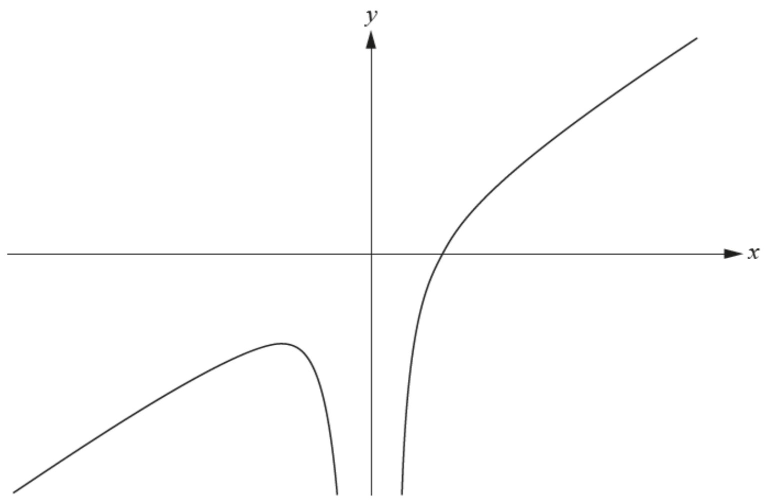


Fig. 10

Fig. 10 is a sketch of the graph of $y = x - \frac{1}{2x^2}$.

(i) Find $\frac{dy}{dx}$ and show that $\frac{d^2y}{dx^2} = -\frac{3}{x^4}$. **[2]**

Successful candidate responses to this question correctly rewrote the second term in index form, differentiated both terms correctly and then showed an interim step before achieving the given result for the 2nd derivative.

The second term caused the most problems, with most issues centred on how to deal with the 2.

Common mistakes included rewriting as either $2x^{-2}$ or $(2x)^{-2}$ and a small minority lost the first term in $\frac{dy}{dx}$.

Use of techniques taught in the second year of the A Level is obviously acceptable but candidates should note that they are likely to be approaching the question in a more complicated way than necessary. Those who rewrote the second term as $(2x^2)^{-1}$ and then used the chain rule could have been successful.

Having the second derivative given wasn't as much of a help as it should have been. Many candidates tried to get to $\frac{d^2y}{dx^2}$ from an incorrect $\frac{dy}{dx}$ which led to even more inaccuracies in their working. Others knew they weren't getting a correct 2nd derivative so tried to work back from that instead of differentiating to find $\frac{dy}{dx}$.

Question 10(ii)

(ii) Show that this curve has only one turning point and verify that it is a maximum. **[3]**

Candidates are encouraged to use all the evidence in front of them. The graph was given which showed the turning point occurring when $x < 0$ and an asymptote at $x = 0$. Candidates therefore should be expecting a negative solution to $\frac{dy}{dx} = 0$ and, if they had a single term $\frac{dy}{dx}$ from (i), know that a solution of x = 0 couldn't be correct which gave them an opportunity to correct this earlier.

Successful candidates set their $\frac{dy}{dx} = 0$ and solved to get a negative value of x. They then showed the substitution of their negative x into the second derivative, calculated it correctly and stated it was < 0, hence a maximum. Approaches that checked the gradient either side of the turning point were also successful.

Question 10(iii)(A)

(iii) (*A*) Show that the equation of the tangent to the curve at the point where $x = 1$ is $y = 2x - 1.5$. **[3]**

This was another 'show that' question so candidates need to be aware that they must show sufficient working to achieve the given result. Just stating that the gradient at $x = 1$ is 2 was insufficient, it needed to be calculated from their $\frac{dy}{dx}$. This part gave another opportunity to verify that their $\frac{dy}{dx}$ was correct but the chance was often missed. A small minority misread *normal* for *tangent* so ended up using the wrong gradient for their straight line.

Question 10(iii)(B)

(*B*) Show that where this tangent meets the curve, $2x^3 - 3x^2 + 1 = 0$. Hence find the coordinates of the point where this tangent meets the curve again. **[4]**

To show the given cubic, candidates needed to equate the given equations for the curve and the tangent and show sufficient working. Those that did this were generally very successful. The most common error was to equate the cubic and the equation of the tangent. Some bypassed the first part and went straight into solving the cubic equation with mixed results. This was a good question for testing algebraic manipulation; higher ability candidates could answer it correctly in a few lines whereas others took the whole page.

A significant number of candidates were unable to solve the cubic equation. One of the roots was already known, $x = 1$, but this wasn't often recognised or used to help factorise. Those who successfully found $x = -\frac{1}{2}$ usually went on to find the corresponding y value.

Question 11(i)

11 This question is about the Gross Domestic Product (GDP) of China. G, in billions of US dollars, is the GDP in year t after 2010. So, for example, $t = 5$ gives the year 2015.

Year	2011	2012	2013	2014	2015
t	1	2	3	4	5
GDP (G billion US$)	7573	8561	9607	10482	11010

G can be modelled by the equation

$$G = 6100 \times \left(1 + \frac{r}{100}\right)^t$$, where $r\%$ is a constant representing the average annual growth rate of the GDP.

(i) What does the 6100 in this equation represent? **[1]**

Very few gained this mark - the most common answer was to state that the GDP of China was $6100 in 2010, the fact that G was in billions of USD was generally lost. Often the 6100 was described as the initial GDP without referencing what initial meant in the context of the question.

Question 11(ii)

(ii) Use logarithms to show that, using this model, a graph of $\log_{10} G$ against t will be a straight line. **[2]**

If a candidate has worked through past papers, this is a very familiar request and there were a lot who found it accessible. Many successful attempts to use logs to form a correctly structured equation were seen but more had difficulty in justifying why this would be a straight line. Many approaches included incomplete or incorrect comparisons with $y = mx + c$. Candidates must indicate which part of their log equation is the gradient and which part is the y-intercept to gain the second mark.

Exemplar 3

$$\log_{10} G = \log_{10} 6100 \times \left(1 + \frac{r}{100}\right)^t$$

$$\log_{10} G = \log_{10} 6100 + \log_{10}\left(1 + \frac{r}{100}\right)^t$$

$$\log_{10} G = \log_{10} 6100 + t \log_{10}\left(1 + \frac{r}{100}\right)$$

$$y = c + m x$$

This response illustrates a typical problem with the comparison. The candidate shows good knowledge of the approach to this question and has taken the step to rearrange $y = mx + c$ to partially fit but hasn't gone far enough. As it currently is, they are implying that plotting $\log G$ against $\log\left(1 + \frac{r}{100}\right)$ will give a straight line with gradient t. If they had gone on to state that, e.g. $m = \log\left(1 + \frac{r}{100}\right)$, $x = t$, they would have been credited the mark. In this candidate's subsequent working they used t as the gradient which led to further loss of marks.

Question 11(iii)

(iii) Complete the table in the answer book and plot the points on the grid provided. Draw by eye a line of best fit. **[3]**

Candidates scored well here and frequently went on to achieve full marks. Most completed the table successfully, points were plotted accurately and lines of best fit were better than in previous examination series which was good to see. A few candidates drew a curve of best fit - after justifying in (ii) that they should get a straight line - but fewer than before. The choice of accuracy for values in the table was sometimes confusing. It would be good practice to look at the accuracy of values already given, along with the scales on the graph when making that decision.

Question 11(iv)

(iv) Use your line of best fit to estimate the value of r. **[4]**

Most successful candidates went down the route of finding the gradient from a pair of points and then equating to $\log\left(1+\frac{r}{100}\right)$ to find r. There was only one unknown to find so candidates could have substituted a single pair of values into their log equation which would have been more efficient. The instruction to use your line of best really should mean that the values used come from the line itself but use of values from the table was allowed. One point that wasn't valid was the intersection of their line with the vertical axis as representing when $t = 0$. Several missed the break in horizontal scale so this is something to look out for.

It was hard at times to follow the structure of the working in this section so candidates are reminded that good structure and annotation can help them gain marks.

Question 11(v)

(v) Hence estimate the GDP of China in 2018, showing your method. Comment on the reliability of this estimate. **[2]**

If their calculation for r in the previous part was accurate enough then most candidates achieved the first mark in this part. The 2^{nd} mark was trickier to achieve - the majority of successful candidates used an argument based on extrapolation. Less successful candidates got diverted into making extraneous comments on economic affairs rather than the parameters of the model itself. Others commented that their GDP was unreliable because their line of best fit was not good - this does not show good examination practice.

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				Max Mark	a	b	c	d	e	u
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			UMS	100	80	70	60	50	40	0
4722	01	C2 Core mathematics 2 (AS)	Raw	72	55	49	43	37	31	0
			UMS	100	80	70	60	50	40	0
4723	01	C3 Core mathematics 3 (A2)	Raw	72	55	48	41	34	28	0
			UMS	100	80	70	60	50	40	0
4724	01	C4 Core mathematics 4 (A2)	Raw	72	54	47	40	34	28	0
			UMS	100	80	70	60	50	40	0
4725	01	FP1 Further pure mathematics 1 (AS)	Raw	72	56	50	45	40	35	0
			UMS	100	80	70	60	50	40	0
4726	01	FP2 Further pure mathematics 2 (A2)	Raw	72	59	53	47	41	35	0
			UMS	100	80	70	60	50	40	0
4727	01	FP3 Further pure mathematics 3 (A2)	Raw	72	47	41	36	31	26	0
			UMS	100	80	70	60	50	40	0
4728	01	M1 Mechanics 1 (AS)	Raw	72	60	51	42	34	26	0
			UMS	100	80	70	60	50	40	0
4729	01	M2 Mechanics 2 (A2)	Raw	72	53	46	39	32	26	0
			UMS	100	80	70	60	50	40	0
4730	01	M3 Mechanics 3 (A2)	Raw	72	50	42	34	27	20	0
			UMS	100	80	70	60	50	40	0
4731	01	M4 Mechanics 4 (A2)	Raw	72	59	53	47	42	37	0
			UMS	100	80	70	60	50	40	0
4732	01	S1 – Probability and statistics 1 (AS)	Raw	72	57	50	43	36	29	0
			UMS	100	80	70	60	50	40	0
4733	01	S2 – Probability and statistics 2 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4734	01	S3 – Probability and statistics 3 (A2)	Raw	72	59	50	41	32	24	0
			UMS	100	80	70	60	50	40	0
4735	01	S4 – Probability and statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4736	01	D1 – Decision mathematics 1 (AS)	Raw	72	55	48	42	36	30	0
			UMS	100	80	70	60	50	40	0
4737	01	D2 – Decision mathematics 2 (A2)	Raw	72	58	53	48	44	40	0
			UMS	100	80	70	60	50	40	0

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AS & Advanced GCE Mathematics (MEI)

				Max Mark	a	b	c	d	e	u
4751	01	C1 – Introduction to advanced mathematics (AS)	Raw	72	60	55	50	45	40	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – Concepts for advanced mathematics (AS)	Raw	72	53	47	41	36	31	0
			UMS	100	80	70	60	50	40	0
4753	01	(C3) Methods for Advanced Mathematics (A2): Written Paper	Raw	72	61	56	51	46	40	0
4753	02	(C3) Methods for Advanced Mathematics (A2): Coursework	Raw	18	15	13	11	9	8	0
4753	82	(C3) Methods for Advanced Mathematics (A2): Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4754	01	C4 – Applications of advanced mathematics (A2)	Raw	90	63	56	49	43	37	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – Further concepts for advanced mathematics (AS)	Raw	72	55	51	47	43	40	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – Further methods for advanced mathematics (A2)	Raw	72	48	42	36	31	26	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – Further applications of advanced mathematics (A2)	Raw	72	63	56	49	42	35	0
			UMS	100	80	70	60	50	40	0
4758	01	(DE) Differential Equations (A2): Written Paper	Raw	72	61	54	48	42	35	0
4758	02	(DE) Differential Equations (A2): Coursework	Raw	18	15	13	11	9	8	0
4758	82	(DE) Differential Equations (A2): Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4761	01	M1 – Mechanics 1 (AS)	Raw	72	51	44	37	31	25	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – Mechanics 2 (A2)	Raw	72	59	53	47	41	35	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – Mechanics 3 (A2)	Raw	72	61	54	48	42	36	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – Mechanics 4 (A2)	Raw	72	59	51	44	37	30	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – Statistics 1 (AS)	Raw	72	59	53	47	42	37	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – Statistics 2 (A2)	Raw	72	54	47	41	35	29	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – Statistics 3 (A2)	Raw	72	61	54	47	41	35	0
			UMS	100	80	70	60	50	40	0
4769	01	S4 – Statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4771	01	D1 – Decision mathematics 1 (AS)	Raw	72	50	44	38	32	26	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – Decision mathematics 2 (A2)	Raw	72	55	51	47	43	39	0
			UMS	100	80	70	60	50	40	0
4773	01	DC – Decision mathematics computation (A2)	Raw	72	46	40	34	29	24	0
			UMS	100	80	70	60	50	40	0
4776	01	(NM) Numerical Methods (AS): Written Paper	Raw	72	57	52	48	44	39	0
4776	02	(NM) Numerical Methods (AS): Coursework	Raw	18	14	12	10	8	7	0
4776	82	(NM) Numerical Methods (AS): Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
			UMS	100	80	70	60	50	40	0
4777	01	NC – 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

AS GCE Statistics (MEI)

				Max Mark	a	b	c	d	e	u
G241	01	Statistics 1 MEI	Raw	72		No entry in June 2018				
			UMS	100	80	70	60	50	40	0
G242	01	Statistics 2 MEI	Raw	72		No entry in June 2018				
			UMS	100	80	70	60	50	40	0
G243	01	Statistics 3 MEI	Raw	72		No entry in June 2018				
			UMS	100	80	70	60	50	40	0

AS GCE Quantitative Methods (MEI)

				Max Mark	a	b	c	d	e	u
G244	01	Introduction to Quantitative Methods (Written Paper)	Raw	72	58	50	43	36	28	0
G244	02	Introduction to Quantitative Methods (Coursework)	Raw	18	14	12	10	8	7	0
			UMS	100	80	70	60	50	40	0
G245	01	Statistics 1	Raw	72	61	55	49	43	37	0
			UMS	100	80	70	60	50	40	0
G246	01	Decision Mathematics 1	Raw	72	50	44	38	32	26	0
			UMS	100	80	70	60	50	40	0

Level 3 Certificate, Level 3 Extended Project and FSMQ raw mark grade boundaries June 2018 series

For more information about results and grade calculations, see https://www.ocr.org.uk/students/getting-your-results/

Level 3 Certificate Mathematics - Quantitative Methods (MEI)

					Max Mark	a	b	c	d	e	u
G244	A	01	Introduction to Quantitative Methods with Coursework (Written Paper)	Raw	72	58	50	43	36	28	0
G244	A	02	Introduction to Quantitative Methods with Coursework (Coursework)	Raw	18	14	12	10	8	7	0
				UMS	100	80	70	60	50	40	0
				Overall	90	72	62	53	44	35	0

Level 3 Certificate Mathematics - Quantitative Reasoning (MEI)

				Max Mark	a	b	c	d	e	u
H866	01	Introduction to quantitative reasoning	Raw	72	56	49	42	35	28	0
H866	02	Critical maths	Raw	60	44	39	34	29	24	0
		*To create the overall boundaries, component 02 is weighted to give marks out of 72	Overall	144	109	96	83	70	57	0

Level 3 Certificate Mathematics - Quantitative Problem Solving (MEI)

				Max Mark	a	b	c	d	e	u
H867	01	Introduction to quantitative reasoning	Raw	72	56	49	42	35	28	0
H867	02	Statistical problem solving	Raw	60	40	36	32	28	24	0
		*To create the overall boundaries, component 02 is weighted to give marks out of 72	Overall	144	104	92	80	69	57	0

Advanced Free Standing Mathematics Qualification (FSMQ)

				Max Mark	a	b	c	d	e	u
6993	01	Additional Mathematics	Raw	100	56	50	44	38	33	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