



Thursday 13 June 2013 – Morning

A2 GCE MATHEMATICS (MEI)

4754/01A Applications of Advanced Mathematics (C4) Paper A

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

- Printed Answer Book 4754/01A
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

Duration: 1 hour 30 minutes



INSTRUCTIONS TO CANDIDATES

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

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

INFORMATION FOR CANDIDATES

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

- The number of marks is given in brackets [] at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **16** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.
- This paper will be followed by **Paper B: Comprehension**.

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) Express $\frac{x}{(1+x)(1-2x)}$ in partial fractions. [3]

(ii) Hence use binomial expansions to show that $\frac{x}{(1+x)(1-2x)} = ax + bx^2 + \dots$, where a and b are constants to be determined.

State the set of values of x for which the expansion is valid. [5]

2 Show that the equation $\operatorname{cosec} x + 5 \cot x = 3 \sin x$ may be rearranged as

$$3 \cos^2 x + 5 \cos x - 2 = 0.$$

Hence solve the equation for $0^\circ \leq x \leq 360^\circ$, giving your answers to 1 decimal place. [7]

3 Using appropriate right-angled triangles, show that $\tan 45^\circ = 1$ and $\tan 30^\circ = \frac{1}{\sqrt{3}}$.

Hence show that $\tan 75^\circ = 2 + \sqrt{3}$. [7]

4 (i) Find a vector equation of the line l joining the points $(0, 1, 3)$ and $(-2, 2, 5)$. [2]

(ii) Find the point of intersection of the line l with the plane $x + 3y + 2z = 4$. [3]

(iii) Find the acute angle between the line l and the normal to the plane. [3]

5 The points A, B and C have coordinates $A(3, 2, -1)$, $B(-1, 1, 2)$ and $C(10, 5, -5)$, relative to the origin O. Show that \overrightarrow{OC} can be written in the form $\lambda \overrightarrow{OA} + \mu \overrightarrow{OB}$, where λ and μ are to be determined.

What can you deduce about the points O, A, B and C from the fact that \overrightarrow{OC} can be expressed as a combination of \overrightarrow{OA} and \overrightarrow{OB} ? [6]

Section B (36 marks)

- 6 The motion of a particle is modelled by the differential equation

$$v \frac{dv}{dx} + 4x = 0,$$

where x is its displacement from a fixed point, and v is its velocity.

Initially $x = 1$ and $v = 4$.

- (i) Solve the differential equation to show that $v^2 = 20 - 4x^2$. [4]

Now consider motion for which $x = \cos 2t + 2 \sin 2t$, where x is the displacement from a fixed point at time t .

- (ii) Verify that, when $t = 0$, $x = 1$. Use the fact that $v = \frac{dx}{dt}$ to verify that when $t = 0$, $v = 4$. [4]

- (iii) Express x in the form $R \cos(2t - \alpha)$, where R and α are constants to be determined, and obtain the corresponding expression for v . Hence or otherwise verify that, for this motion too, $v^2 = 20 - 4x^2$. [7]

- (iv) Use your answers to part (iii) to find the maximum value of x , and the earliest time at which x reaches this maximum value. [3]

- 7 Fig. 7 shows the curve BC defined by the parametric equations

$$x = 5 \ln u, \quad y = u + \frac{1}{u}, \quad 1 \leq u \leq 10.$$

The point A lies on the x -axis and AC is parallel to the y -axis. The tangent to the curve at C makes an angle θ with AC, as shown.

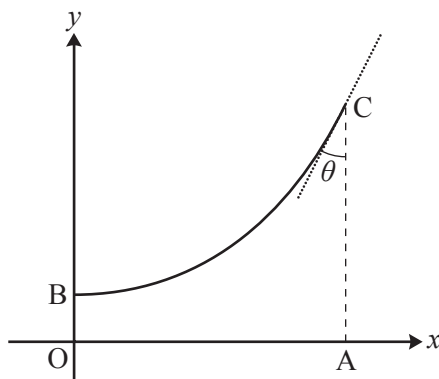


Fig. 7

- (i) Find the lengths OA, OB and AC. [5]
- (ii) Find $\frac{dy}{dx}$ in terms of u . Hence find the angle θ . [6]
- (iii) Show that the cartesian equation of the curve is $y = e^{\frac{1}{5}x} + e^{-\frac{1}{5}x}$. [2]

An object is formed by rotating the region OACB through 360° about Ox.

- (iv) Find the volume of the object. [5]

THERE ARE NO QUESTIONS WRITTEN ON THIS PAGE.



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

Thursday 13 June 2013 – Morning

A2 GCE MATHEMATICS (MEI)

4754/01B Applications of Advanced Mathematics (C4) Paper B: Comprehension
QUESTION PAPER

Candidates answer on the Question Paper.

OCR supplied materials:

- Insert (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator
- Rough paper

Duration: Up to 1 hour



Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.
- The Insert contains the text for use with the questions.
- 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.

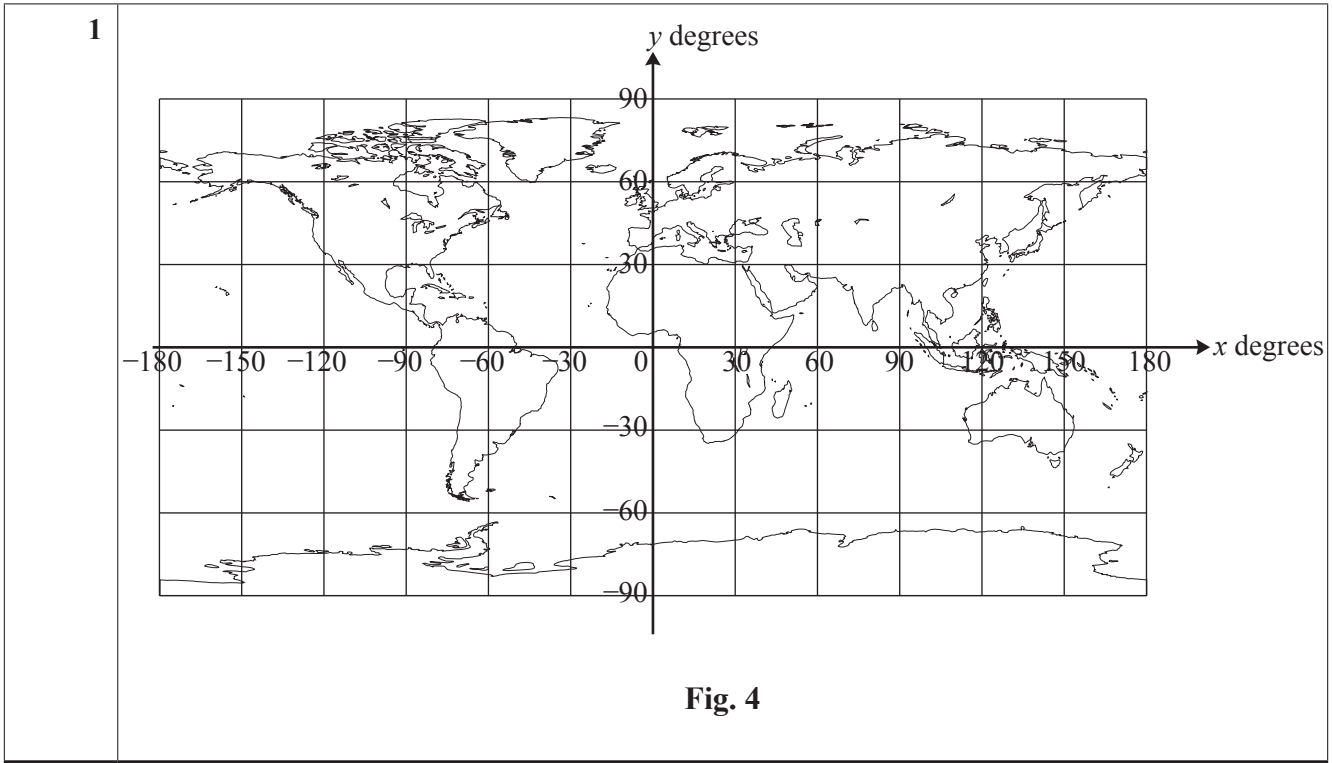
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You may find it helpful to make notes and to do some calculations as you read the passage.
- You are **not** required to hand in these notes with your 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 **18**.
- This document consists of **8** pages. Any blank pages are indicated.

1 The diagram is a copy of Fig. 4.

R is a place with latitude 45° north and longitude 60° west. Show the position of R on the diagram.

M is the sub-solar point. It is on the Greenwich meridian and the declination of the sun is $+20^\circ$. Show the position of M on the diagram. [2]



2 Use Fig. 8 to estimate the difference in the length of daylight between places with latitudes of 30° south and 60° south on the day for which the graph applies. [3]

2	
----------	--

3 The graph is a copy of Fig. 6.

The article says that it shows the terminator in the cases where the sun has declination 10° north, 1° north, 5° south and 15° south.

Identify which curve (A, B, C or D) relates to which declination.

[2]

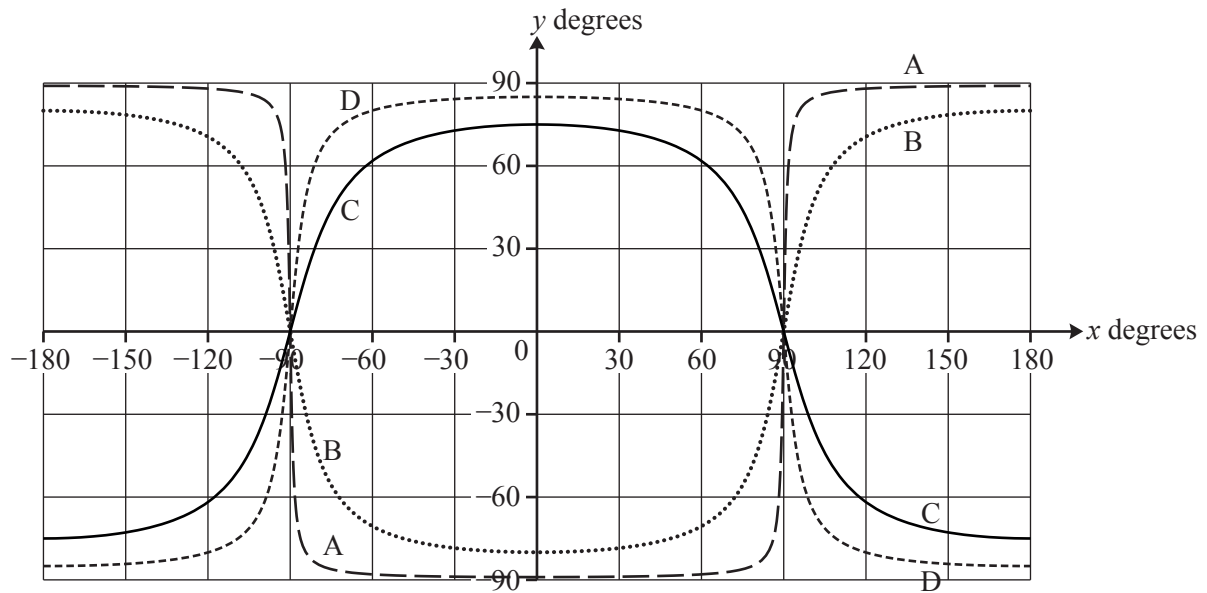


Fig. 6

3	10° north:
	1° north:
	5° south:
	15° south:

4 In lines 94 and 95 the article says

“Fig. 8 shows you that at latitude 60° north the terminator passes approximately through time +9 hours and -9 hours so that there are about 18 hours of daylight.”

Use Equation (4) to check the accuracy of the figure of 18 hours.

[4]

4	

5 (i) Use Equation (3) to calculate the declination of the sun on February 2nd. [3]

(ii) The town of Boston, in Lincolnshire, has latitude 53° north and longitude 0° .

Calculate the time of sunset in Boston on February 2nd.

Give your answer in hours and minutes using the 24-hour clock. [4]

5 (i)	
5 (ii)	

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.