

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 $\operatorname{cosec} x + 5 \operatorname{cot} x = 3 \sin x$ 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.

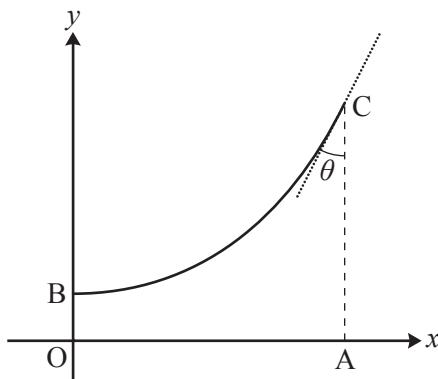


Fig. 7

(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.



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