OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

AS GCE MATHEMATICS (MEI)

4752/01   Concepts for Advanced Mathematics (C2)

QUESTION PAPER

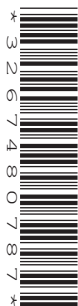Candidates answer on the Printed Answer Book.

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.** 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 **12** pages. The Question Paper consists of **4** 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.

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Turn over

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Section A (36 marks)

1   **(i)** Differentiate $12\sqrt[3]{x}$.   **[2]**

     (ii) Integrate $\dfrac{6}{x^3}$.   **[3]**

2   A sequence is defined by $u_1 = 2$ and $u_{k+1} = \dfrac{10}{u_k^2}$.

     Calculate $\displaystyle\sum_{k=1}^{4} u_k$.   **[3]**

3   An arithmetic progression has tenth term 11.1 and fiftieth term 7.1. Find the first term and the common difference. Find also the sum of the first fifty terms of the progression.   **[5]**

4   A sector of a circle has angle 1.5 radians and area $27\,\text{cm}^2$. Find the perimeter of the sector.   **[4]**

5   Use calculus to find the set of values of x for which $x^3 - 6x$ is an increasing function.   **[5]**

6   **(i)** On the same axes, sketch the curves $y = 3^x$ and $y = 3^{2x}$, identifying clearly which is which.   **[3]**

     (ii) Given that $3^{2x} = 729$, find in either order the values of 3^x and x.   **[2]**

7   Show that the equation $\sin^2 x = 3\cos x - 2$ can be expressed as a quadratic equation in $\cos x$ and hence solve the equation for values of x between 0 and 2π.   **[5]**

8   Fig. 8 shows the graph of $\log_{10} y$ against $\log_{10} x$. It is a straight line passing through the points $(2, 8)$ and $(0, 2)$.
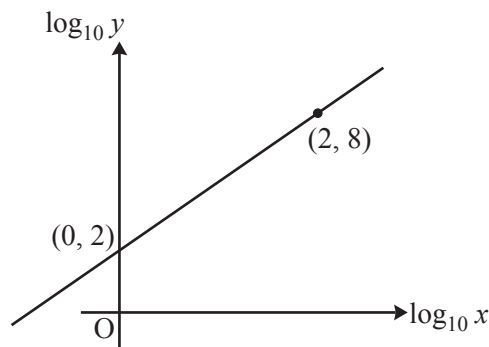

Fig. 8

Find the equation relating $\log_{10} y$ and $\log_{10} x$ and hence find the equation relating y and x.   **[4]**
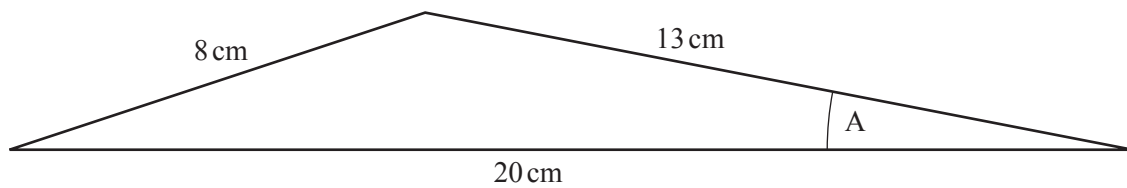
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Section B (36 marks)

9

Fig. 9.1

(i) Jean is designing a model aeroplane. Fig. 9.1 shows her first sketch of the wing's cross-section. Calculate angle A and the area of the cross-section. **[5]**

(ii) Jean then modifies her design for the wing. Fig. 9.2 shows the new cross-section, with 1 unit for each of x and y representing one centimetre.
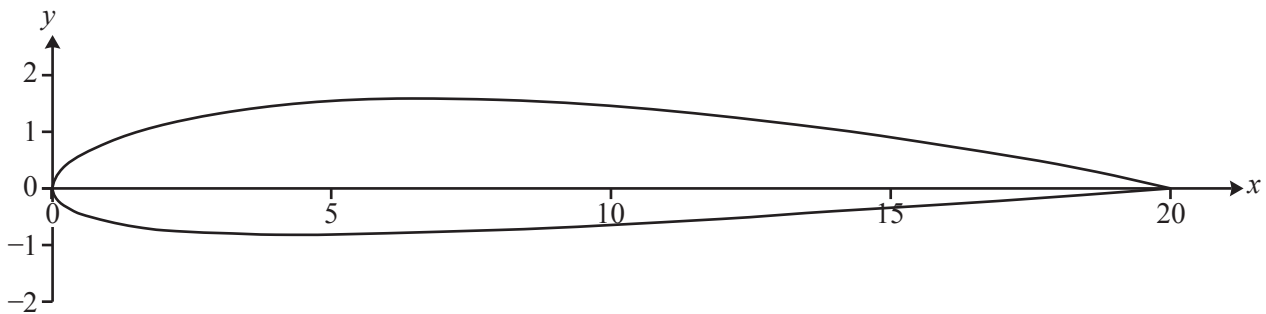

Fig. 9.2

Here are some of the coordinates that Jean used to draw the new cross-section.

Upper surface		Lower surface	
x	y	x	y
0	0	0	0
4	1.45	4	-0.85
8	1.56	8	-0.76
12	1.27	12	-0.55
16	1.04	16	-0.30
20	0	20	0

Use the trapezium rule with trapezia of width 4 cm to calculate an estimate of the area of this cross-section. **[6]**

10 The gradient of a curve is given by $\dfrac{dy}{dx} = 4x + 3$. The curve passes through the point $(2, 9)$.

   (i) Find the equation of the tangent to the curve at the point $(2, 9)$. **[3]**

  (ii) Find the equation of the curve and the coordinates of its points of intersection with the x-axis. Find also the coordinates of the minimum point of this curve. **[7]**

 (iii) Find the equation of the curve after it has been stretched parallel to the x-axis with scale factor $\frac{1}{2}$. Write down the coordinates of the minimum point of the transformed curve. **[3]**

11 Jill has 3 daughters and no sons. They are generation 1 of Jill's descendants.

Each of her daughters has 3 daughters and no sons. Jill's 9 granddaughters are generation 2 of her descendants. Each of her granddaughters has 3 daughters and no sons; they are descendant generation 3.

Jill decides to investigate what would happen if this pattern continues, with each descendant having 3 daughters and no sons.

   (i) How many of Jill's descendants would there be in generation 8? **[2]**

  (ii) How many of Jill's descendants would there be altogether in the first 15 generations? **[3]**

 (iii) After n generations, Jill would have over a million descendants altogether. Show that n satisfies the inequality
$$n > \frac{\log_{10} 2\,000\,003}{\log_{10} 3} - 1.$$

      Hence find the least possible value of n. **[4]**

  (iv) How many **fewer** descendants would Jill have altogether in 15 generations if instead of having 3 daughters, she and each subsequent descendant has 2 daughters? **[3]**

END OF QUESTION PAPER