OXFORD CAMBRIDGE AND RSA EXAMINATIONS

AS GCE

4755

MATHEMATICS (MEI)

Further Concepts for Advanced Mathematics (FP1)

QUESTION PAPER

FRIDAY 20 JANUARY 2012: Afternoon
DURATION: 1 hour 30 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the Printed Answer Book or any suitable paper provided by the centre. The Printed Answer Book may be enlarged by the centre.

OCR SUPPLIED MATERIALS:

Printed Answer Book 4755
MEI Examination Formulae and Tables (MF2)

OTHER MATERIALS REQUIRED:

Scientific or graphical calculator

READ INSTRUCTIONS OVERLEAF

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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.**
- **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.**
- **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.**

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 You are given that $\mathbf{A} = \begin{pmatrix} 2 & -1 & 1 \\ 0 & p & -4 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 0 & q \\ 2 & -2 \\ 1 & -3 \end{pmatrix}$.

(i) Find AB. [3]

(ii) Hence prove that matrix multiplication is not commutative. [2]

2 Find the values of A, B, C and D in the identity $2x^3 - 3 \equiv (x + 3)(Ax^2 + Bx + C) + D$. [5]

3 Given that $z = 6$ is a root of the cubic equation $z^3 - 10z^2 + 37z + p = 0$, find the value of p and the other roots. [6]

4 Using the standard summation formulae, find $\sum_{r=1}^{n} r^2(r - 1)$. Give your answer in a fully factorised form. [6]

5 The equation $z^3 - 5z^2 + 3z - 4 = 0$ has roots α, β and γ. Find the cubic equation whose roots are $\frac{\alpha}{2} + 1$, $\frac{\beta}{2} + 1$, $\frac{\gamma}{2} + 1$, expressing your answer in a form with integer coefficients. [6]

6 Prove by induction that $\sum_{r=1}^{n} r3^{r-1} = \frac{1}{4}[3^n(2n - 1) + 1]$. [8]

SECTION B (36 marks)

7 A curve has equation $y = \dfrac{(x + 1)(2x - 1)}{x^2 - 3}$.

(i) Find the coordinates of the points where the curve crosses the axes. [2]

(ii) Write down the equations of the three asymptotes. [3]

(iii) Determine whether the curve approaches the horizontal asymptote from above or from below for

(*A*) large positive values of x,

(*B*) large negative values of x. [3]

(iv) Sketch the curve. [3]

(v) Solve the inequality $\dfrac{(x + 1)(2x - 1)}{x^2 - 3} < 2$. [3]

8 **(i)** Sketch on an Argand diagram the locus, C, of points for which $|z - 4| = 3$. [3]

(ii) By drawing appropriate lines through the origin, indicate on your Argand diagram the point A on the locus C where arg z has its maximum value. Indicate also the point B on the locus C where arg z has its minimum value. [2]

(iii) Given that arg $z = \alpha$ at A and arg $z = \beta$ at B, indicate on your Argand diagram the set of points for which $\beta \leqslant \arg z \leqslant \alpha$ and $|z - 4| \geqslant 3$. [2]

(iv) Calculate the value of α and the value of β. [3]

9 The matrix R is $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

(i) Explain in terms of transformations why $R^4 = I$. [3]

(ii) Describe the transformation represented by R^{-1} and write down the matrix R^{-1}. [2]

(iii) S is the matrix representing rotation through 60° anticlockwise about the origin. Find S. [2]

(iv) Write down the smallest positive integers m and n such that $S^m = R^n$, explaining your answer in terms of transformations. [2]

(v) Find RS and explain in terms of transformations why RS = SR. [3]

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