Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments	Total Marks

FURTHER MATHEMATICS

AS LEVEL FURTHER PURE MATHEMATICS 2

CM

Bronze Set A (Edexcel Version)

Time allowed: 50 minutes

Instructions to candidates:

- In the boxes above, write your centre number, candidate number, your surname, other names and signature.
- Answer ALL of the questions.
- You must write your answer for each question in the spaces provided.
- You may use a calculator.

Information to candidates:

- Full marks may only be obtained for answers to ALL of the questions.
- The marks for individual questions and parts of the questions are shown in round brackets.
- There are 5 questions in this question paper. The total mark for this paper is 40.

Advice to candidates:

- You should ensure your answers to parts of the question are clearly labelled.
- You should show sufficient working to make your workings clear to the Examiner.
- Answers without working may not gain full credit.

AS/FM/F2

1 1 3 3 1 2 3 1 8 0 0 0 4

1 (a) Write down the value of 320 mod 2. **(1)**

(b) Write down a value of k such that

$$k \bmod 4 = -1$$ **(1)**

(c) Find a pair of integers u and v such that

$$1001u + 663v = d$$

where d is the highest common factor of 1001 and 663. **(4)**

Question 1 continued

TOTAL 6 MARKS

2 The matrix **A** is defined such that

$$\mathbf{A} = \begin{pmatrix} 1 & 3 \\ 3 & 1 \end{pmatrix}$$

(a) Write down the characteristic equation of **A**. **(2)**

(b) Show that $\mathbf{A}^3 = 12\mathbf{A} + 16\mathbf{I}$. **(2)**

(c) Calculate the eigenvalues and eigenvectors of the matrix **A**. **(4)**

(d) Hence, find matrices **P** and **D** such that

$$\mathbf{P}^{-1}\mathbf{A}\mathbf{P} = \mathbf{D}$$

where **P** is orthogonal. **(3)**

Question 2 continued

TOTAL 11 MARKS

3 The point P represents the complex number z on an Argand diagram, where

$$|z+2| = 4|z-3\mathrm{i}|$$

(a) Show that the locus of P is a circle and find the centre and radius of this circle. **(6)**

(b) Sketch the region on Argand diagram that satisfies

$$|z+2| \le 4|z-3\mathrm{i}|$$

(2)

Do not write outside the box

Question 3 continued

TOTAL 8 MARKS

Do not write outside the box

4 The set S is defined such that

$$S = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in \mathbb{R},\ x \neq 0 \right\}$$

In other words, S contains all 2×2 matrices with identical entries.

(a) Show that any matrix in S is singular. **(1)**

(b) Find the value of e such that

$$\begin{pmatrix} x & x \\ x & x \end{pmatrix}\begin{pmatrix} e & e \\ e & e \end{pmatrix} = \begin{pmatrix} x & x \\ x & x \end{pmatrix}$$

(2)

(c) Hence, find, in terms of x, the value of y such that

$$\begin{pmatrix} x & x \\ x & x \end{pmatrix}\begin{pmatrix} y & y \\ y & y \end{pmatrix} = \begin{pmatrix} e & e \\ e & e \end{pmatrix}$$

where e is the value found in (b). **(2)**

(d) Show that the set S forms a group under matrix multiplication.
(You may refer to parts (b) and (c) in your answer, but you must explain your reasoning. You may also assume that matrix multiplication is associative.) **(4)**

(e) Explain why the restriction that $x \neq 0$ is important for S to be a group. **(1)**

Question 4 continued

Question 4 continued

Question 4 continued

TOTAL 10 MARKS

5 A sequence of numbers is defined by

$$u_1 = 2$$
$$u_{n+1} = 2u_n + 4^{n+1}, \quad n \geq 1$$

Prove by induction that, for $n \in \mathbb{Z}^+$

$$u_n = 2^n\left(2^{n+1} - 3\right)$$

(5)

Do not write outside the box

Question 5 continued

END OF SECTION **TOTAL 5 MARKS**

TOTAL FOR SECTION IS 40 MARKS