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ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2014

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## Mathematics

Assessment Unit F1

*assessing*

Module FP1: Further Pure Mathematics 1

[AMF11]

TUESDAY 24 JUNE, MORNING

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### TIME

1 hour 30 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided.

Answer **all six** questions.

Show clearly the full development of your answers.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 75

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is  $\ln z$  where it is noted that  $\ln z \equiv \log_e z$

**Answer all six questions.**

**Show clearly the full development of your answers.**

**Answers should be given to three significant figures unless otherwise stated.**

**1** Let  $\mathbf{A} = \begin{pmatrix} 2 & -5 \\ -1 & 3 \end{pmatrix}$  and  $\mathbf{C} = \begin{pmatrix} 1 & 0 \\ 4 & 2 \end{pmatrix}$

Given that  $\mathbf{ABC} = \mathbf{I}$ , find the matrix  $\mathbf{B}$

[5]

**2** The equations of two circles  $C_1$  and  $C_2$  are

$$C_1 \quad x^2 + y^2 + 2x - 6y - 15 = 0$$

$$C_2 \quad x^2 + y^2 + 2y - 3 = 0$$

**(i)** Find the points of intersection of  $C_1$  and  $C_2$

[8]

A third circle  $C_3$  is defined as

$$C_3 \quad 4x^2 + 4y^2 - 4x - 16y - 127 = 0$$

**(ii)** Show that circle  $C_2$  lies entirely inside circle  $C_3$

[8]

**3** A binary operation  $*$  is defined on the set of all ordered pairs  $(x, y)$  of real numbers. The operation is given as

$$(a, b) * (c, d) = (ac, b + d + 2)$$

**(i)** Show that  $*$  is associative.

[4]

**(ii)** Find the identity element. Justify your answer.

[4]

4 (i) Show that the determinant of

$$\begin{pmatrix} 5 & -2 & -a \\ 4 & 2 & -6 \\ 1 & a & -4 \end{pmatrix}$$

is  $-4a^2 + 32a - 60$  [3]

Consider the system of linear equations

$$\begin{aligned} 5x - 2y - az &= 3 \\ 4x + 2y - 6z &= 2 \\ x + ay - 4z &= 0 \end{aligned}$$

where  $x, y$  and  $z$  are real numbers.

(ii) Determine the number of solutions for the above system of equations for **each** of the cases:

$$\begin{aligned} a &= 3 \\ \text{and } a &= 4 \end{aligned} \quad [7]$$

(iii) Find the general solution of this system of equations when  $a = 5$  [4]

5 (a) The transformation represented by the  $2 \times 2$  matrix  $\mathbf{M}$  maps the points  $(2, 3)$  and  $(5, -1)$  onto  $(7, 2)$  and  $(9, 5)$  respectively.

Find the matrix  $\mathbf{M}$  [5]

(b) The set of points which form the curve

$$x^2 + 5y^2 + 4xy - 6x - 8y = 0$$

is mapped by the matrix  $\mathbf{N} = \begin{pmatrix} 0 & -1 \\ 1 & 2 \end{pmatrix}$

Show that the curve formed by the image points is a circle with radius  $\sqrt{13}$  [9]

6 (a) Let  $z_1 = \sqrt{3} + i$  and  $z_2 = 1 - i$

(i) Find the modulus and argument of each of the complex numbers  $z_1$  and  $z_2$  [6]

(ii) Verify that  $|z_1 z_2| = |z_1| |z_2|$  [4]

(b) (i) Sketch on an Argand diagram the locus of those points  $u$  which satisfy

$$|u - (4 + 15i)| = |u + i| \quad [3]$$

(ii) On the same diagram sketch the locus of those points  $v$  which satisfy

$$\arg \{v - (2 + 7i)\} = \frac{\pi}{6} \quad [3]$$

(iii) On your diagram shade the region which represents the locus of those points  $w$ , where  $w$  satisfies both

$$|w - (4 + 15i)| \leq |w + i|$$
$$\text{and } \frac{\pi}{6} \leq \arg \{w - (2 + 7i)\} \leq \pi \quad [2]$$

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**THIS IS THE END OF THE QUESTION PAPER**

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