

Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2015

Mathematics

MFP4

Unit Further Pure 4

Wednesday 20 May 2015 9.00 am to 10.30 am

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



J U N 1 5 M F P 4 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** The points U , V and W have position vectors \mathbf{u} , \mathbf{v} and \mathbf{w} respectively relative to an origin O , where

$$\mathbf{u} = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}, \quad \mathbf{v} = \begin{bmatrix} 3 \\ -4 \\ 2 \end{bmatrix} \quad \text{and} \quad \mathbf{w} = \begin{bmatrix} a \\ 7 \\ -2 \end{bmatrix}$$

- (a) Find $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{w}$ in terms of a . **[2 marks]**
- (b) Given that \mathbf{u} , \mathbf{v} and \mathbf{w} are linearly dependent:
- (i) find the value of a ; **[1 mark]**
- (ii) express \mathbf{u} as a linear combination of \mathbf{v} and \mathbf{w} . **[3 marks]**

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2

The vectors \mathbf{a} , \mathbf{b} and \mathbf{c} are such that $\mathbf{c} \times \mathbf{a} = 2\mathbf{i}$ and $\mathbf{b} \times \mathbf{a} = 3\mathbf{j}$.

Simplify $(\mathbf{a} + 2\mathbf{b} - 6\mathbf{c}) \times (\mathbf{a} - \mathbf{b} + 3\mathbf{c})$, giving your answer in the form $\lambda\mathbf{i} + \mu\mathbf{j}$.

[5 marks]QUESTION
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3 (a) Factorise completely the determinant

$$\begin{vmatrix} a & b - c & -bc \\ b & a - c & -ca \\ -c & a + b & ab \end{vmatrix}$$

[6 marks]

(b) Hence, or otherwise, find the values of a for which the equations

$$ax + y - 6z = 0$$

$$3x + (a - 2)y - 2az = 0$$

$$-2x + (a + 3)y + 3az = 0$$

do not have a unique solution.

[3 marks]

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- 4 (a) Find the eigenvalues and corresponding eigenvectors of the matrix

$$\mathbf{M} = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}$$

[6 marks]

- (b) Given that $\mathbf{U} = \begin{bmatrix} 4 & b \\ a & -2 \end{bmatrix}$ and $\mathbf{U}^{-1}\mathbf{M}\mathbf{U} = \begin{bmatrix} 3 & 0 \\ 0 & 2 \end{bmatrix}$, find the values of a and b .

[3 marks]

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6 The line L has equation $\left(\mathbf{r} - \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix}\right) \times \begin{bmatrix} 3 \\ -1 \\ 2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$.

The plane Π contains the line L and the point $A(4, 1, -2)$.

- (a) Show that A does not lie on the line L . **[1 mark]**
- (b) Find an equation of the plane Π , giving your answer in the form $\mathbf{r} \cdot \mathbf{n} = c$. **[5 marks]**
- (c) The point D has coordinates $(8, -2, 6)$. Find the coordinates of the image of D after reflection in the plane Π . **[5 marks]**

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END OF QUESTIONS



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