

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
January 2013

Mathematics

MFP1

Unit Further Pure 1

Friday 18 January 2013 1.30 pm to 3.00 pm

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 A N 1 3 M F P 1 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

1 A curve passes through the point (1, 3) and satisfies the differential equation

$$\frac{dy}{dx} = \frac{x}{1 + x^3}$$

Starting at the point (1, 3), use a step-by-step method with a step length of 0.1 to estimate the value of y at $x = 1.2$. Give your answer to four decimal places.

(5 marks)

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QUESTION
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QUESTION
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Answer space for question 3

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4 Show that the improper integral $\int_{25}^{\infty} \frac{1}{x\sqrt{x}} dx$ has a finite value and find that value.
(4 marks)

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5 The roots of the quadratic equation

$$x^2 + 2x - 5 = 0$$

are α and β .

- (a) Write down the value of $\alpha + \beta$ and the value of $\alpha\beta$. (2 marks)
- (b) Calculate the value of $\alpha^2 + \beta^2$. (2 marks)
- (c) Find a quadratic equation which has roots $\alpha^3\beta + 1$ and $\alpha\beta^3 + 1$. (5 marks)

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6 (a) The matrix \mathbf{X} is defined by $\begin{bmatrix} 1 & 2 \\ 3 & 0 \end{bmatrix}$.

(i) Given that $\mathbf{X}^2 = \begin{bmatrix} m & 2 \\ 3 & 6 \end{bmatrix}$, find the value of m . (1 mark)

(ii) Show that $\mathbf{X}^3 - 7\mathbf{X} = n\mathbf{I}$, where n is an integer and \mathbf{I} is the 2×2 identity matrix. (4 marks)

(b) It is given that $\mathbf{A} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$.

(i) Describe the geometrical transformation represented by \mathbf{A} . (1 mark)

(ii) The matrix \mathbf{B} represents an anticlockwise rotation through 45° about the origin.

Show that $\mathbf{B} = k \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$, where k is a surd. (2 marks)

(iii) Find the image of the point $P(-1, 2)$ under an anticlockwise rotation through 45° about the origin, followed by the transformation represented by \mathbf{A} . (4 marks)

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7 The variables y and x are related by an equation of the form

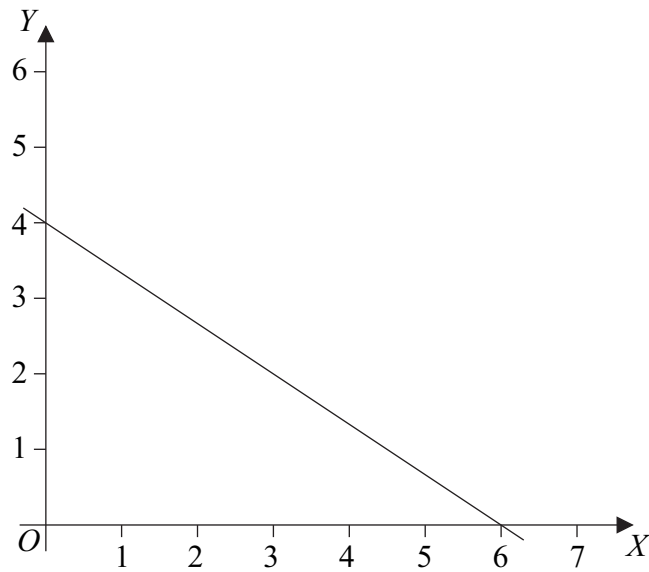
$$y = ax^n$$

where a and n are constants.

Let $Y = \log_{10}y$ and $X = \log_{10}x$.

(a) Show that there is a linear relationship between Y and X . (3 marks)

(b) The graph of Y against X is shown in the diagram.



Find the value of n and the value of a . (4 marks)

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8 (a) Show that

$$\sum_{r=1}^n 2r(2r^2 - 3r - 1) = n(n+p)(n+q)^2$$

where p and q are integers to be found.

(6 marks)

(b) Hence find the value of

$$\sum_{r=11}^{20} 2r(2r^2 - 3r - 1)$$

(2 marks)

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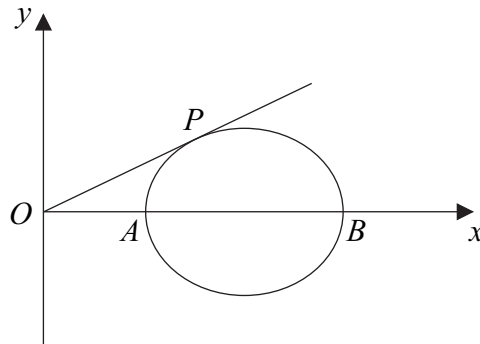
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9 An ellipse is shown below.



The ellipse intersects the x -axis at the points A and B . The equation of the ellipse is

$$\frac{(x - 4)^2}{4} + y^2 = 1$$

(a) Find the x -coordinates of A and B . (2 marks)

(b) The line $y = mx$ ($m > 0$) is a tangent to the ellipse, with point of contact P .

(i) Show that the x -coordinate of P satisfies the equation

$$(1 + 4m^2)x^2 - 8x + 12 = 0 \quad (3 \text{ marks})$$

(ii) Hence find the exact value of m . (4 marks)

(iii) Find the coordinates of P . (4 marks)

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END OF QUESTIONS



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