

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	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2015

Mathematics

MPC4

Unit Pure Core 4

Tuesday 9 June 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 P C 4 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

1 It is given that $f(x) = \frac{19x - 2}{(5 - x)(1 + 6x)}$ can be expressed as $\frac{A}{5 - x} + \frac{B}{1 + 6x}$, where A and B are integers.

(a) Find the values of A and B . **[3 marks]**

(b) Hence show that $\int_0^4 f(x) \, dx = k \ln 5$, where k is a rational number. **[6 marks]**

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2 (a) Express $2 \cos x - 5 \sin x$ in the form $R \cos(x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$, giving your value of α , in radians, to three significant figures.

[3 marks]

(b) (i) Hence find the value of x in the interval $0 < x < 2\pi$ for which $2 \cos x - 5 \sin x$ has its maximum value. Give your value of x to three significant figures.

[2 marks]

(ii) Use your answer to part **(a)** to solve the equation $2 \cos x - 5 \sin x + 1 = 0$ in the interval $0 < x < 2\pi$, giving your solutions to three significant figures.

[3 marks]

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3 (a) The polynomial $f(x)$ is defined by $f(x) = 8x^3 - 12x^2 - 2x + d$, where d is a constant. When $f(x)$ is divided by $(2x + 1)$, the remainder is -2 . Use the Remainder Theorem to find the value of d . **[2 marks]**

(b) The polynomial $g(x)$ is defined by $g(x) = 8x^3 - 12x^2 - 2x + 3$.

(i) Given that $x = -\frac{1}{2}$ is a solution of the equation $g(x) = 0$, write $g(x)$ as a product of three linear factors. **[3 marks]**

(ii) The function h is defined by $h(x) = \frac{4x^2 - 1}{g(x)}$ for $x > 2$.

Simplify $h(x)$, and hence show that h is a decreasing function. **[4 marks]**

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4 (a) Find the binomial expansion of $(1 + 5x)^{\frac{1}{5}}$ up to and including the term in x^2 . **[2 marks]**

(b) (i) Find the binomial expansion of $(8 + 3x)^{-\frac{2}{3}}$ up to and including the term in x^2 . **[3 marks]**

(ii) Use your expansion from part **(b)(i)** to find an estimate for $\sqrt[3]{\frac{1}{81}}$, giving your answer to four decimal places.

[2 marks]

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5 A curve is defined by the parametric equations $x = \cos 2t$, $y = \sin t$.

The point P on the curve is where $t = \frac{\pi}{6}$.

(a) Find the gradient at P .

[3 marks]

(b) Find the equation of the normal to the curve at P in the form $y = mx + c$.

[3 marks]

(c) The normal at P intersects the curve again at the point $Q(\cos 2q, \sin q)$.

Use the equation of the normal to form a quadratic equation in $\sin q$ and hence find the x -coordinate of Q .

[5 marks]

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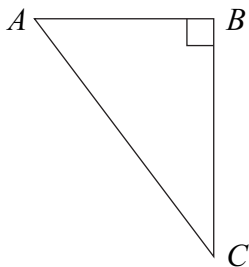


6 The points A and B have coordinates $(3, 2, 10)$ and $(5, -2, 4)$ respectively.

The line l passes through A and has equation $\mathbf{r} = \begin{bmatrix} 3 \\ 2 \\ 10 \end{bmatrix} + \lambda \begin{bmatrix} 3 \\ 1 \\ -2 \end{bmatrix}$.

(a) Find the acute angle between l and the line AB . **[4 marks]**

(b) The point C lies on l such that angle ABC is 90° .



Find the coordinates of C . **[4 marks]**

(c) The point D is such that BD is parallel to AC and angle BCD is 90° . The point E lies on the line through B and D and is such that the length of DE is half that of AC .

Find the coordinates of the two possible positions of E . **[4 marks]**

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7 A curve has equation $y^3 + 2e^{-3x}y - x = k$, where k is a constant.

The point $P\left(\ln 2, \frac{1}{2}\right)$ lies on this curve.

(a) Show that the exact value of k is $q - \ln 2$, where q is a rational number. **[1 mark]**

(b) Find the gradient of the curve at P . **[6 marks]**

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END OF QUESTIONS

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