

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	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
January 2011

Mathematics

MPC1

Unit Pure Core 1

Monday 10 January 2011 9.00 am to 10.30 am

<p>For this paper you must have:</p> <ul style="list-style-type: none"> the blue AQA booklet of formulae and statistical tables. <p>You must not use a calculator.</p>	
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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 the questions in the spaces provided. 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.
- The use of calculators is **not** permitted.

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.



J A N 1 1 M P C 1 0 1

Answer **all** questions in the spaces provided.

1 The curve with equation $y = 13 + 18x + 3x^2 - 4x^3$ passes through the point P where $x = -1$.

(a) Find $\frac{dy}{dx}$. *(3 marks)*

(b) Show that the point P is a stationary point of the curve and find the other value of x where the curve has a stationary point. *(3 marks)*

(c) (i) Find the value of $\frac{d^2y}{dx^2}$ at the point P . *(3 marks)*

(ii) Hence, or otherwise, determine whether P is a maximum point or a minimum point. *(1 mark)*

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2 (a) Simplify $(3\sqrt{3})^2$. (1 mark)

(b) Express $\frac{4\sqrt{3} + 3\sqrt{7}}{3\sqrt{3} + \sqrt{7}}$ in the form $\frac{m + \sqrt{21}}{n}$, where m and n are integers. (4 marks)

QUESTION
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3 The line AB has equation $3x + 2y = 7$. The point C has coordinates $(2, -7)$.

(a) (i) Find the gradient of AB . (2 marks)

(ii) The line which passes through C and which is parallel to AB crosses the y -axis at the point D . Find the y -coordinate of D . (3 marks)

(b) The line with equation $y = 1 - 4x$ intersects the line AB at the point A . Find the coordinates of A . (3 marks)

(c) The point E has coordinates $(5, k)$. Given that CE has length 5, find the two possible values of the constant k . (3 marks)

QUESTION
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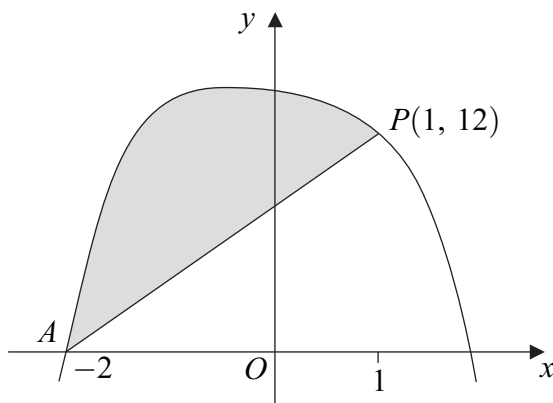
QUESTION
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4 The curve sketched below passes through the point $A(-2, 0)$.



The curve has equation $y = 14 - x - x^4$ and the point $P(1, 12)$ lies on the curve.

- (a) (i)** Find the gradient of the curve at the point P . *(3 marks)*
- (ii)** Hence find the equation of the tangent to the curve at the point P , giving your answer in the form $y = mx + c$. *(2 marks)*
- (b) (i)** Find $\int_{-2}^1 (14 - x - x^4) dx$. *(5 marks)*
- (ii)** Hence find the area of the shaded region bounded by the curve $y = 14 - x - x^4$ and the line AP . *(2 marks)*

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5 (a) (i) Sketch the curve with equation $y = x(x - 2)^2$. *(3 marks)*

(ii) Show that the equation $x(x - 2)^2 = 3$ can be expressed as

$$x^3 - 4x^2 + 4x - 3 = 0 \quad (1 \text{ mark})$$

(b) The polynomial $p(x)$ is given by $p(x) = x^3 - 4x^2 + 4x - 3$.

(i) Find the remainder when $p(x)$ is divided by $x + 1$. *(2 marks)*

(ii) Use the Factor Theorem to show that $x - 3$ is a factor of $p(x)$. *(2 marks)*

(iii) Express $p(x)$ in the form $(x - 3)(x^2 + bx + c)$, where b and c are integers. *(2 marks)*

(c) Hence show that the equation $x(x - 2)^2 = 3$ has only one real root and state the value of this root. *(3 marks)*

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6 A circle has centre $C(-3, 1)$ and radius $\sqrt{13}$.

(a) (i) Express the equation of the circle in the form

$$(x - a)^2 + (y - b)^2 = k \quad (2 \text{ marks})$$

(ii) Hence find the equation of the circle in the form

$$x^2 + y^2 + mx + ny + p = 0$$

where m , n and p are integers. (3 marks)

(b) The circle cuts the y -axis at the points A and B . Find the distance AB . (3 marks)

(c) (i) Verify that the point $D(-5, -2)$ lies on the circle. (1 mark)

(ii) Find the gradient of CD . (2 marks)

(iii) Hence find an equation of the tangent to the circle at the point D . (2 marks)

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7 (a) (i) Express $4 - 10x - x^2$ in the form $p - (x + q)^2$. (2 marks)

(ii) Hence write down the equation of the line of symmetry of the curve with equation $y = 4 - 10x - x^2$. (1 mark)

(b) The curve C has equation $y = 4 - 10x - x^2$ and the line L has equation $y = k(4x - 13)$, where k is a constant.

(i) Show that the x -coordinates of any points of intersection of the curve C with the line L satisfy the equation

$$x^2 + 2(2k + 5)x - (13k + 4) = 0 \quad (1 \text{ mark})$$

(ii) Given that the curve C and the line L intersect in two distinct points, show that

$$4k^2 + 33k + 29 > 0 \quad (3 \text{ marks})$$

(iii) Solve the inequality $4k^2 + 33k + 29 > 0$. (4 marks)

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Area with horizontal dotted lines for writing answers.

END OF QUESTIONS

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