

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><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>the blue AQA booklet of formulae and statistical tables.</li> </ul> <p>You must <b>not</b> 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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**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)

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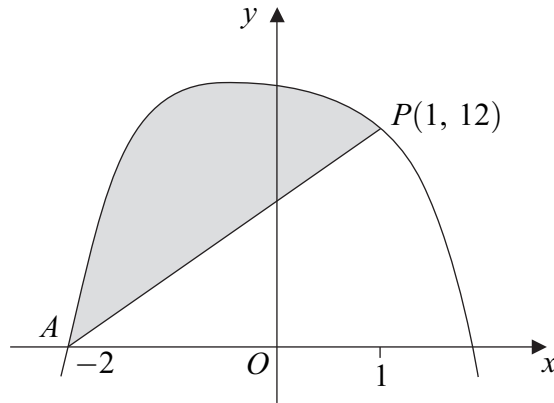








4 The curve sketched below passes through the point  $A(-2, 0)$ .



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

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

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

**(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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