

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	
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7	
8	
TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2014

# Mathematics

# MPC1

## Unit Pure Core 1

Monday 19 May 2014 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 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.
  - 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.
- You do not necessarily need to use all the space provided.



J U N 1 4 M P C 1 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** The point  $A$  has coordinates  $(-1, 2)$  and the point  $B$  has coordinates  $(3, -5)$ .
- (a) (i)** Find the gradient of  $AB$ . **[2 marks]**
- (ii)** Hence find an equation of the line  $AB$ , giving your answer in the form  $px + qy = r$ , where  $p, q$  and  $r$  are integers. **[3 marks]**
- (b)** The midpoint of  $AB$  is  $M$ .
- (i)** Find the coordinates of  $M$ . **[1 mark]**
- (ii)** Find an equation of the line which passes through  $M$  and which is perpendicular to  $AB$ . **[3 marks]**
- (c)** The point  $C$  has coordinates  $(k, 2k + 3)$ . Given that the distance from  $A$  to  $C$  is  $\sqrt{13}$ , find the two possible values of the constant  $k$ . **[4 marks]**

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QUESTION  
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2

A rectangle has length  $(9 + 5\sqrt{3})$  cm and area  $(15 + 7\sqrt{3})$  cm<sup>2</sup>.

Find the width of the rectangle, giving your answer in the form  $(m + n\sqrt{3})$  cm, where  $m$  and  $n$  are integers.

[4 marks]

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3 A curve has equation  $y = 2x^5 + 5x^4 - 1$ .

(a) Find:

(i)  $\frac{dy}{dx}$

[2 marks]

(ii)  $\frac{d^2y}{dx^2}$

[1 mark]

(b) The point on the curve where  $x = -1$  is  $P$ .

(i) Determine whether  $y$  is increasing or decreasing at  $P$ , giving a reason for your answer.

[2 marks]

(ii) Find an equation of the tangent to the curve at  $P$ .

[3 marks]

(c) The point  $Q(-2, 15)$  also lies on the curve. Verify that  $Q$  is a maximum point of the curve.

[4 marks]

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**4 (a) (i)** Express  $16 - 6x - x^2$  in the form  $p - (x + q)^2$  where  $p$  and  $q$  are integers. **[2 marks]**

**(ii)** Hence write down the maximum value of  $16 - 6x - x^2$ . **[1 mark]**

**(b) (i)** Factorise  $16 - 6x - x^2$ . **[1 mark]**

**(ii)** Sketch the curve with equation  $y = 16 - 6x - x^2$ , stating the values of  $x$  where the curve crosses the  $x$ -axis and the value of the  $y$ -intercept. **[3 marks]**

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**5** The polynomial  $p(x)$  is given by

$$p(x) = x^3 + cx^2 + dx + 3$$

where  $c$  and  $d$  are integers.

**(a)** Given that  $x + 3$  is a factor of  $p(x)$ , show that

$$3c - d = 8$$

**[2 marks]**

**(b)** The remainder when  $p(x)$  is divided by  $x - 2$  is 65.

Obtain a further equation in  $c$  and  $d$ .

**[2 marks]**

**(c)** Use the equations from parts **(a)** and **(b)** to find the value of  $c$  and the value of  $d$ .

**[3 marks]**

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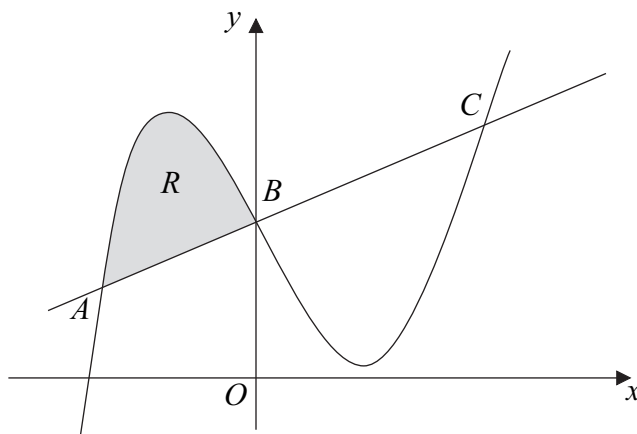
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6 The diagram shows a curve and a line which intersect at the points  $A$ ,  $B$  and  $C$ .



The curve has equation  $y = x^3 - x^2 - 5x + 7$  and the straight line has equation  $y = x + 7$ . The point  $B$  has coordinates  $(0, 7)$ .

(a) (i) Show that the  $x$ -coordinates of the points  $A$  and  $C$  satisfy the equation

$$x^2 - x - 6 = 0$$

[2 marks]

(ii) Find the coordinates of the points  $A$  and  $C$ .

[3 marks]

(b) Find  $\int (x^3 - x^2 - 5x + 7) dx$ .

[3 marks]

(c) Find the area of the shaded region  $R$  bounded by the curve and the line segment  $AB$ .

[4 marks]

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**7** A circle with centre  $C$  has equation  $x^2 + y^2 - 10x + 12y + 41 = 0$ . The point  $A(3, -2)$  lies on the circle.

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

$$(x - a)^2 + (y - b)^2 = k$$

**[3 marks]**

**(b) (i)** Write down the coordinates of  $C$ .

**[1 mark]**

**(ii)** Show that the circle has radius  $n\sqrt{5}$ , where  $n$  is an integer.

**[2 marks]**

**(c)** Find the equation of the tangent to the circle at the point  $A$ , giving your answer in the form  $x + py = q$ , where  $p$  and  $q$  are integers.

**[5 marks]**

**(d)** The point  $B$  lies on the tangent to the circle at  $A$  and the length of  $BC$  is 6. Find the length of  $AB$ .

**[3 marks]**

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8 Solve the following inequalities:

(a)  $3(1 - 2x) - 5(3x + 2) > 0$

[2 marks]

(b)  $6x^2 \leq x + 12$

[4 marks]

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**END OF QUESTIONS**



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