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| Centre Number       |  |  |  |  |  | Candidate Number |  |  |  |  |
| Surname             |  |  |  |  |  |                  |  |  |  |  |
| Other Names         |  |  |  |  |  |                  |  |  |  |  |
| Candidate Signature |  |  |  |  |  |                  |  |  |  |  |

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



General Certificate of Education  
Advanced Subsidiary Examination  
June 2012

# Mathematics

# MPC1

## Unit Pure Core 1

Wednesday 16 May 2012 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> |  |
|---|--|

**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.



Answer **all** questions.

Answer each question in the space provided for that question.

**1** Express  $\frac{5\sqrt{3} - 6}{2\sqrt{3} + 3}$  in the form  $m + n\sqrt{3}$ , where  $m$  and  $n$  are integers. (4 marks)

QUESTION  
PART  
REFERENCE

**Answer space for question 1**



QUESTION  
PART  
REFERENCE

Answer space for question 1

Area for writing the answer to question 1, featuring horizontal dotted lines.

Turn over ►



- 2 The line  $AB$  has equation  $4x - 3y = 7$ .
- (a) (i) Find the gradient of  $AB$ . (2 marks)
- (ii) Find an equation of the straight line that is parallel to  $AB$  and which passes through the point  $C(3, -5)$ , giving your answer in the form  $px + qy = r$ , where  $p, q$  and  $r$  are integers. (3 marks)
- (b) The line  $AB$  intersects the line with equation  $3x - 2y = 4$  at the point  $D$ . Find the coordinates of  $D$ . (3 marks)
- (c) The point  $E$  with coordinates  $(k - 2, 2k - 3)$  lies on the line  $AB$ . Find the value of the constant  $k$ . (2 marks)

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3 The polynomial  $p(x)$  is given by

$$p(x) = x^3 + 2x^2 - 5x - 6$$

- (a) (i) Use the Factor Theorem to show that  $x + 1$  is a factor of  $p(x)$ . (2 marks)
- (ii) Express  $p(x)$  as the product of three linear factors. (3 marks)
- (b) Verify that  $p(0) > p(1)$ . (2 marks)
- (c) Sketch the curve with equation  $y = x^3 + 2x^2 - 5x - 6$ , indicating the values where the curve crosses the  $x$ -axis. (3 marks)

QUESTION  
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Answer space for question 3



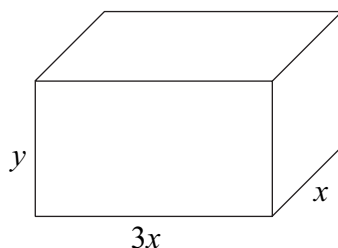
QUESTION  
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**Answer space for question 3**

A large rectangular area with horizontal dotted lines for writing an answer.



- 4 The diagram shows a solid cuboid with sides of lengths  $x$  cm,  $3x$  cm and  $y$  cm.



The total surface area of the cuboid is  $32 \text{ cm}^2$ .

- (a) (i) Show that  $3x^2 + 4xy = 16$ . (2 marks)

- (ii) Hence show that the volume,  $V \text{ cm}^3$ , of the cuboid is given by

$$V = 12x - \frac{9x^3}{4} \quad (2 \text{ marks})$$

- (b) Find  $\frac{dV}{dx}$ . (2 marks)

- (c) (i) Verify that a stationary value of  $V$  occurs when  $x = \frac{4}{3}$ . (2 marks)

- (ii) Find  $\frac{d^2V}{dx^2}$  and hence determine whether  $V$  has a maximum value or a minimum value when  $x = \frac{4}{3}$ . (2 marks)

QUESTION  
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### Answer space for question 4





QUESTION  
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REFERENCE

**Answer space for question 4**

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**Turn over** ▶

QUESTION  
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REFERENCE

**Answer space for question 4**

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QUESTION  
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**Answer space for question 4**

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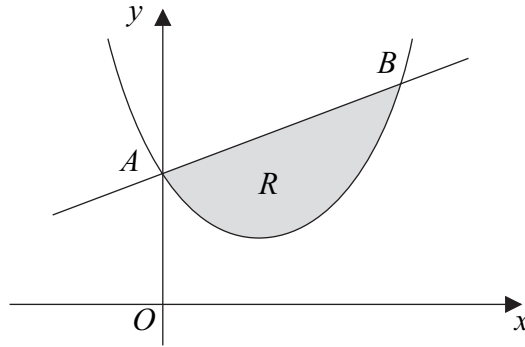
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**5 (a) (i)** Express  $x^2 - 3x + 5$  in the form  $(x - p)^2 + q$ . (2 marks)

**(ii)** Hence write down the equation of the line of symmetry of the curve with equation  $y = x^2 - 3x + 5$ . (1 mark)

**(b)** The curve  $C$  with equation  $y = x^2 - 3x + 5$  and the straight line  $y = x + 5$  intersect at the point  $A(0, 5)$  and at the point  $B$ , as shown in the diagram below.



**(i)** Find the coordinates of the point  $B$ . (3 marks)

**(ii)** Find  $\int (x^2 - 3x + 5) dx$ . (3 marks)

**(iii)** Find the area of the shaded region  $R$  bounded by the curve  $C$  and the line segment  $AB$ . (4 marks)

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QUESTION  
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**Answer space for question 5**

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QUESTION  
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**Answer space for question 5**

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QUESTION  
PART  
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**Answer space for question 5**

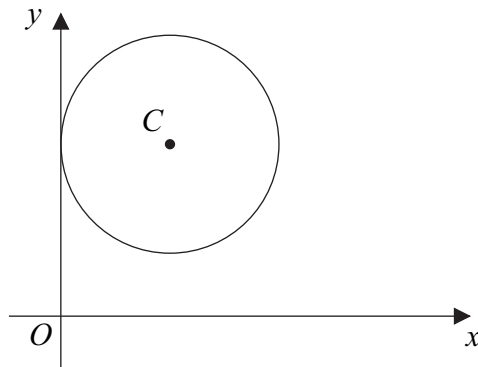
Dotted lines for writing the answer.



1 5

Turn over ►

- 6 The circle with centre  $C(5, 8)$  touches the  $y$ -axis, as shown in the diagram.



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

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

- (b) (i) Verify that the point  $A(2, 12)$  lies on the circle. (1 mark)

- (ii) Find an equation of the tangent to the circle at the point  $A$ , giving your answer in the form  $sx + ty + u = 0$ , where  $s$ ,  $t$  and  $u$  are integers. (5 marks)

- (c) The points  $P$  and  $Q$  lie on the circle, and the mid-point of  $PQ$  is  $M(7, 12)$ .

- (i) Show that the length of  $CM$  is  $n\sqrt{5}$ , where  $n$  is an integer. (2 marks)

- (ii) Hence find the area of triangle  $PCQ$ . (3 marks)

QUESTION  
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**Answer space for question 6**





QUESTION  
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**Answer space for question 6**

A large rectangular area with horizontal dotted lines for writing the answer.



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7 The gradient,  $\frac{dy}{dx}$ , of a curve  $C$  at the point  $(x, y)$  is given by

$$\frac{dy}{dx} = 20x - 6x^2 - 16$$

(a) (i) Show that  $y$  is increasing when  $3x^2 - 10x + 8 < 0$ . (2 marks)

(ii) Solve the inequality  $3x^2 - 10x + 8 < 0$ . (4 marks)

(b) The curve  $C$  passes through the point  $P(2, 3)$ .

(i) Verify that the tangent to the curve at  $P$  is parallel to the  $x$ -axis. (2 marks)

(ii) The point  $Q(3, -1)$  also lies on the curve. The normal to the curve at  $Q$  and the tangent to the curve at  $P$  intersect at the point  $R$ . Find the coordinates of  $R$ . (7 marks)

QUESTION  
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REFERENCE

Answer space for question 7



QUESTION  
PART  
REFERENCE

**Answer space for question 7**

A large rectangular area with horizontal dotted lines for writing an answer.

**Turn over ►**



QUESTION  
PART  
REFERENCE

**Answer space for question 7**

A large rectangular area with horizontal dotted lines for writing an answer.

**END OF QUESTIONS**

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