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



General Certificate of Education
Advanced Subsidiary Examination
June 2011

Mathematics

MPC1

Unit Pure Core 1

Wednesday 18 May 2011 9.00 am to 10.30 am

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.
- You must **not** use a 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 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.

| For Examiner's Use | |
|---------------------|------|
| Examiner's Initials | |
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| TOTAL | |



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

1 The line AB has equation $7x + 3y = 13$.

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

(b) The point C has coordinates $(-1, 3)$.

(i) Find an equation of the line which passes through the point C and which is parallel to AB . (2 marks)

(ii) The point $(1\frac{1}{2}, -1)$ is the mid-point of AC . Find the coordinates of the point A . (2 marks)

(c) The line AB intersects the line with equation $3x + 2y = 12$ at the point B . Find the coordinates of B . (3 marks)

QUESTION
PART
REFERENCE



QUESTION
PART
REFERENCE

Turn over ►



2 (a) (i) Express $\sqrt{48}$ in the form $k\sqrt{3}$, where k is an integer. (1 mark)

(ii) Simplify $\frac{\sqrt{48} + 2\sqrt{27}}{\sqrt{12}}$, giving your answer as an integer. (3 marks)

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

QUESTION
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QUESTION
PART
REFERENCE

Turn over ►



- 3** The volume, $V \text{ m}^3$, of water in a tank after time t seconds is given by

$$V = \frac{t^3}{4} - 3t + 5$$

- (a)** Find $\frac{dV}{dt}$. (2 marks)
- (b) (i)** Find the rate of change of volume, in $\text{m}^3 \text{s}^{-1}$, when $t = 1$. (2 marks)
- (ii)** Hence determine, with a reason, whether the volume is increasing or decreasing when $t = 1$. (1 mark)
- (c) (i)** Find the positive value of t for which V has a stationary value. (3 marks)
- (ii)** Find $\frac{d^2V}{dt^2}$, and hence determine whether this stationary value is a maximum value or a minimum value. (3 marks)

QUESTION
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QUESTION
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Turn over ►



- 4 (a)** Express $x^2 + 5x + 7$ in the form $(x + p)^2 + q$, where p and q are rational numbers. (3 marks)
- (b)** A curve has equation $y = x^2 + 5x + 7$.
- (i)** Find the coordinates of the vertex of the curve. (2 marks)
- (ii)** State the equation of the line of symmetry of the curve. (1 mark)
- (iii)** Sketch the curve, stating the value of the intercept on the y -axis. (3 marks)
- (c)** Describe the geometrical transformation that maps the graph of $y = x^2$ onto the graph of $y = x^2 + 5x + 7$. (3 marks)

QUESTION
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QUESTION
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Turn over ►



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

(a) Use the Remainder Theorem to find the remainder when $p(x)$ is divided by $x - 3$.
(2 marks)

(b) Use the Factor Theorem to show that $x + 1$ is a factor of $p(x)$. (2 marks)

(c) (i) Express $p(x) = x^3 - 2x^2 + 3$ in the form $(x + 1)(x^2 + bx + c)$, where b and c are integers. (2 marks)

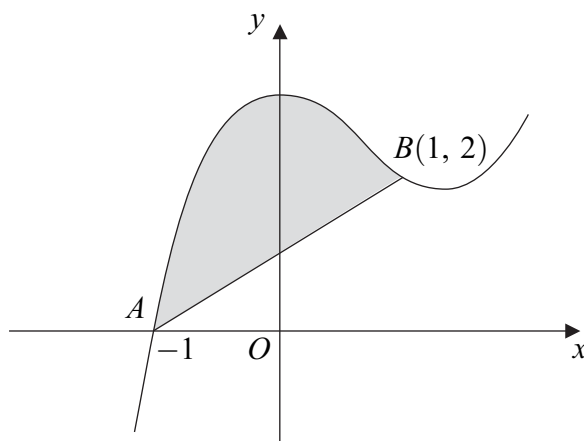
(ii) Hence show that the equation $p(x) = 0$ has exactly one real root. (2 marks)

QUESTION
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The curve with equation $y = x^3 - 2x^2 + 3$ is sketched below.



The curve cuts the x -axis at the point $A(-1, 0)$ and passes through the point $B(1, 2)$.

- (a)** Find $\int_{-1}^1 (x^3 - 2x^2 + 3) \, dx$. (5 marks)
- (b)** Hence find the area of the shaded region bounded by the curve $y = x^3 - 2x^2 + 3$ and the line AB . (3 marks)

| QUESTION | PART | REFERENCE |
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7 Solve each of the following inequalities:

(a) $2(4 - 3x) > 5 - 4(x + 2);$ *(2 marks)*

(b) $2x^2 + 5x \geq 12.$ *(4 marks)*

QUESTION
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8 A circle has centre $C(3, -8)$ and radius 10.

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

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

(b) Find the x -coordinates of the points where the circle crosses the x -axis. (3 marks)

(c) The tangent to the circle at the point A has gradient $\frac{5}{2}$. Find an equation of the line CA , giving your answer in the form $rx + sy + t = 0$, where r , s and t are integers. (3 marks)

(d) The line with equation $y = 2x + 1$ intersects the circle.

(i) Show that the x -coordinates of the points of intersection satisfy the equation

$$x^2 + 6x - 2 = 0 \quad (3 \text{ marks})$$

(ii) Hence show that the x -coordinates of the points of intersection are of the form $m \pm \sqrt{n}$, where m and n are integers. (2 marks)

QUESTION
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ANSWER IN THE SPACES PROVIDED**

