



General Certificate of Education
Advanced Subsidiary Examination
June 2013

Mathematics

MPC1

Unit Pure Core 1

Monday 13 May 2013 1.30 pm to 3.00 pm

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 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.

- 1** The line AB has equation $3x - 4y + 5 = 0$.
- (a)** The point with coordinates $(p, p + 2)$ lies on the line AB . Find the value of the constant p . (2 marks)
- (b)** Find the gradient of AB . (2 marks)
- (c)** The point A has coordinates $(1, 2)$. The point $C(-5, k)$ is such that AC is perpendicular to AB . Find the value of k . (3 marks)
- (d)** The line AB intersects the line with equation $2x - 5y = 6$ at the point D . Find the coordinates of D . (3 marks)
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- 2 (a) (i)** Express $\sqrt{48}$ in the form $n\sqrt{3}$, where n is an integer. (1 mark)

- (ii)** Solve the equation

$$x\sqrt{12} = 7\sqrt{3} - \sqrt{48}$$

giving your answer in its simplest form. (3 marks)

- (b)** Express $\frac{11\sqrt{3} + 2\sqrt{5}}{2\sqrt{3} + \sqrt{5}}$ in the form $m - \sqrt{15}$, where m is an integer. (4 marks)
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- 3** A circle C has equation

$$x^2 + y^2 - 10x + 14y + 25 = 0$$

- (a)** Write the equation of C in the form

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

where a , b and k are integers. (3 marks)

- (b)** Hence, for the circle C , write down:

(i) the coordinates of its centre; (1 mark)

(ii) its radius. (1 mark)

- (c) (i)** Sketch the circle C . (2 marks)

(ii) Write down the coordinates of the point on C that is furthest away from the x -axis. (2 marks)

- (d)** Given that k has the same value as in part **(a)**, describe geometrically the transformation which maps the circle with equation $(x + 1)^2 + y^2 = k$ onto the circle C . (3 marks)



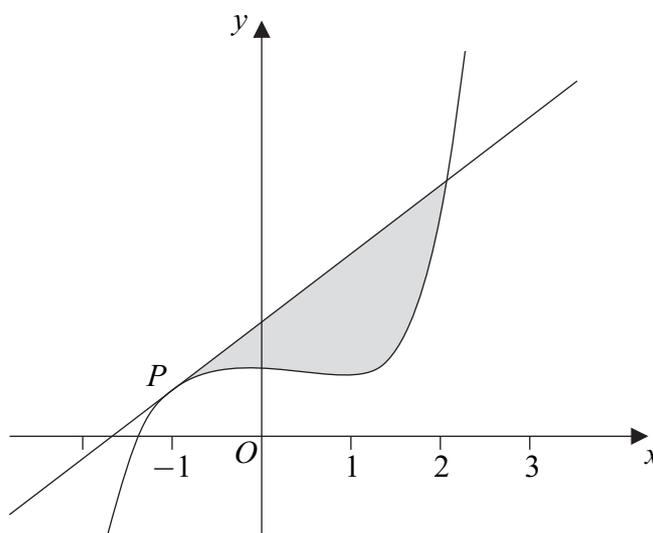
- 4 (a)** The polynomial $f(x)$ is given by $f(x) = x^3 - 4x + 15$.
- (i) Use the Factor Theorem to show that $x + 3$ is a factor of $f(x)$. (2 marks)
- (ii) Express $f(x)$ in the form $(x + 3)(x^2 + px + q)$, where p and q are integers. (2 marks)
- (b)** A curve has equation $y = x^4 - 8x^2 + 60x + 7$.
- (i) Find $\frac{dy}{dx}$. (3 marks)
- (ii) Show that the x -coordinates of any stationary points of the curve satisfy the equation
- $$x^3 - 4x + 15 = 0 \quad (1 \text{ mark})$$
- (iii) Use the results above to show that the only stationary point of the curve occurs when $x = -3$. (2 marks)
- (iv) Find the value of $\frac{d^2y}{dx^2}$ when $x = -3$. (3 marks)
- (v) Hence determine, with a reason, whether the curve has a maximum point or a minimum point when $x = -3$. (1 mark)
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- 5 (a) (i)** Express $2x^2 + 6x + 5$ in the form $2(x + p)^2 + q$, where p and q are rational numbers. (2 marks)
- (ii) Hence write down the minimum value of $2x^2 + 6x + 5$. (1 mark)
- (b)** The point A has coordinates $(-3, 5)$ and the point B has coordinates $(x, 3x + 9)$.
- (i) Show that $AB^2 = 5(2x^2 + 6x + 5)$. (3 marks)
- (ii) Use your result from part **(a)(ii)** to find the minimum value of the length AB as x varies, giving your answer in the form $\frac{1}{2}\sqrt{n}$, where n is an integer. (2 marks)

Turn over ►



- 6** A curve has equation $y = x^5 - 2x^2 + 9$. The point P with coordinates $(-1, 6)$ lies on the curve.
- (a)** Find the equation of the tangent to the curve at the point P , giving your answer in the form $y = mx + c$. *(5 marks)*
- (b)** The point Q with coordinates $(2, k)$ lies on the curve.
- (i)** Find the value of k . *(1 mark)*
- (ii)** Verify that Q also lies on the tangent to the curve at the point P . *(1 mark)*
- (c)** The curve and the tangent to the curve at P are sketched below.



- (i)** Find $\int_{-1}^2 (x^5 - 2x^2 + 9) dx$. *(5 marks)*
- (ii)** Hence find the area of the shaded region bounded by the curve and the tangent to the curve at P . *(3 marks)*

- 7** The quadratic equation

$$(2k - 7)x^2 - (k - 2)x + (k - 3) = 0$$

has real roots.

- (a)** Show that $7k^2 - 48k + 80 \leq 0$. *(4 marks)*
- (b)** Find the possible values of k . *(4 marks)*

