



General Certificate of Education
Advanced Subsidiary Examination
January 2013

Mathematics

MPC1

Unit Pure Core 1

Monday 14 January 2013 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 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.

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- 1 The point A has coordinates $(-3, 2)$ and the point B has coordinates $(7, k)$.
The line AB has equation $3x + 5y = 1$.
- (a) (i) Show that $k = -4$. (1 mark)
(ii) Hence find the coordinates of the midpoint of AB . (2 marks)
- (b) Find the gradient of AB . (2 marks)
- (c) A line which passes through the point A is perpendicular to the line AB . Find an equation of this line, giving your answer in the form $px + qy + r = 0$, where p , q and r are integers. (3 marks)
- (d) The line AB , with equation $3x + 5y = 1$, intersects the line $5x + 8y = 4$ at the point C . Find the coordinates of C . (3 marks)
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- 2 A bird flies from a tree. At time t seconds, the bird's height, y metres, above the horizontal ground is given by

$$y = \frac{1}{8}t^4 - t^2 + 5, \quad 0 \leq t \leq 4$$

- (a) Find $\frac{dy}{dt}$. (2 marks)
- (b) (i) Find the rate of change of height of the bird in metres per second when $t = 1$. (2 marks)
(ii) Determine, with a reason, whether the bird's height above the horizontal ground is increasing or decreasing when $t = 1$. (1 mark)
- (c) (i) Find the value of $\frac{d^2y}{dt^2}$ when $t = 2$. (2 marks)
(ii) Given that y has a stationary value when $t = 2$, state whether this is a maximum value or a minimum value. (1 mark)
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- 3 (a) (i) Express $\sqrt{18}$ in the form $k\sqrt{2}$, where k is an integer. (1 mark)
(ii) Simplify $\frac{\sqrt{8}}{\sqrt{18} + \sqrt{32}}$. (3 marks)
- (b) Express $\frac{7\sqrt{2} - \sqrt{3}}{2\sqrt{2} - \sqrt{3}}$ in the form $m + \sqrt{n}$, where m and n are integers. (4 marks)



- 4 (a) (i)** Express $x^2 - 6x + 11$ in the form $(x - p)^2 + q$. (2 marks)
- (ii)** Use the result from part (a)(i) to show that the equation $x^2 - 6x + 11 = 0$ has no real solutions. (2 marks)
- (b)** A curve has equation $y = x^2 - 6x + 11$.
- (i)** Find the coordinates of the vertex of the curve. (2 marks)
- (ii)** Sketch the curve, indicating the value of y where the curve crosses the y -axis. (3 marks)
- (iii)** Describe the geometrical transformation that maps the curve with equation $y = x^2 - 6x + 11$ onto the curve with equation $y = x^2$. (3 marks)
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- 5** The polynomial $p(x)$ is given by

$$p(x) = x^3 - 4x^2 - 3x + 18$$

- (a)** Use the Remainder Theorem to find the remainder when $p(x)$ is divided by $x + 1$. (2 marks)
- (b) (i)** Use the Factor Theorem to show that $x - 3$ is a factor of $p(x)$. (2 marks)
- (ii)** Express $p(x)$ as a product of linear factors. (3 marks)
- (c)** Sketch the curve with equation $y = x^3 - 4x^2 - 3x + 18$, stating the values of x where the curve meets the x -axis. (3 marks)
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- 6** The gradient, $\frac{dy}{dx}$, of a curve at the point (x, y) is given by

$$\frac{dy}{dx} = 10x^4 - 6x^2 + 5$$

The curve passes through the point $P(1, 4)$.

- (a)** Find the equation of the tangent to the curve at the point P , giving your answer in the form $y = mx + c$. (3 marks)
- (b)** Find the equation of the curve. (5 marks)

Turn over ►



- 7 A circle with centre $C(-3, 2)$ has equation

$$x^2 + y^2 + 6x - 4y = 12$$

- (a) Find the y -coordinates of the points where the circle crosses the y -axis. (3 marks)
- (b) Find the radius of the circle. (3 marks)
- (c) The point $P(2, 5)$ lies outside the circle.
- (i) Find the length of CP , giving your answer in the form \sqrt{n} , where n is an integer. (2 marks)
- (ii) The point Q lies on the circle so that PQ is a tangent to the circle. Find the length of PQ . (2 marks)
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- 8 A curve has equation $y = 2x^2 - x - 1$ and a line has equation $y = k(2x - 3)$, where k is a constant.

- (a) Show that the x -coordinate of any point of intersection of the curve and the line satisfies the equation

$$2x^2 - (2k + 1)x + 3k - 1 = 0 \quad (1 \text{ mark})$$

- (b) The curve and the line intersect at two distinct points.

- (i) Show that $4k^2 - 20k + 9 > 0$. (3 marks)
- (ii) Find the possible values of k . (4 marks)

