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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.



Examiner's Initials Question Mark 1 2 3 4 5 6 7 TOTAL

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 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 mari |
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| 2 (a) (l) | Express $\sqrt{48}$ in the form $n\sqrt{3}$, where n is an integer. | (1 m |

(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)
- 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.

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- 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

$$x^3 - 4x + 15 = 0 (1 mark)$$

- (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. | al (2 marks) |
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| | (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 AE x varies, giving your answer in the form $\frac{1}{2}\sqrt{n}$, where n is an integer. | 3 as (2 <i>marks</i>) |
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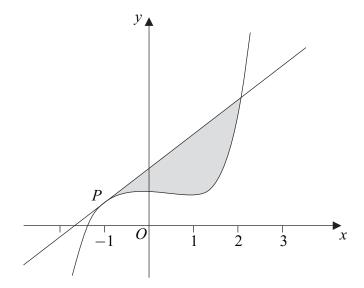
- A curve has equation $y = x^5 2x^2 + 9$. The point P with coordinates (-1, 6) lies on the curve.
 - (a) Find the equation of the tangent to the curve at the point P, giving your answer in the form y = mx + c. (5 marks)
 - **(b)** The point Q with coordinates (2, k) lies on the curve.
 - (i) Find the 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)

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7 The quadratic equation

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

has real roots.

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

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