General Certificate of Education
June 2004
Advanced Subsidiary Examination

MATHEMATICS AND STATISTICS **MBP1**
(SPECIFICATION B)
Unit Pure 1

Monday 24 May 2004 Morning Session

In addition to this paper you will require:
- an 8-page answer book;
- the AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed: 1 hour 15 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is MBP1.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.

Advice
- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 A curve has equation $y = x^4 - 32x + 7$.

(a) Find $\dfrac{dy}{dx}$. *(2 marks)*

(b) Find the x-coordinate of the stationary point of the curve. *(2 marks)*

(c) State, with a reason, whether the stationary point is a maximum or minimum point. *(2 marks)*

2 (a) Write each of the following as a power of 2:

(i) $\sqrt{2}$; *(1 mark)*

(ii) 8^x. *(1 mark)*

(b) Hence solve the equation $8^x \times 2^{x+1} = \sqrt{2}$. *(3 marks)*

3 The functions f and g are defined for $x > 0$ by

$$f(x) = \frac{5}{x} \qquad g(x) = x^2 + 1$$

(a) Find $fg(x)$. *(1 mark)*

(b) When $fg(x) = x$, show that $x^3 + x - 5 = 0$. *(2 marks)*

(c) Show that the equation $x^3 + x - 5 = 0$ has a root which lies between 1.5 and 1.6. *(2 marks)*

4 The points A and B have coordinates (5, 3) and (9, 9) respectively.
The line AC has equation $2x - 3y = 1$.

(a) (i) Find the gradient of AB. *(1 mark)*

(ii) Determine whether the lines AC and AB are perpendicular. *(3 marks)*

(b) (i) Given that $2x^2 + 3y = 11$

and $2x - 3y = 1$

show that $x^2 + x - 6 = 0$. *(2 marks)*

(ii) Hence find the coordinates of the points of intersection of the curve with equation $2x^2 + 3y = 11$ and the line AC. *(4 marks)*

5 (a) (i) Express $x^2 - 6x + 10$ in the form $(x-p)^2 + q$, where p and q are integers. *(2 marks)*

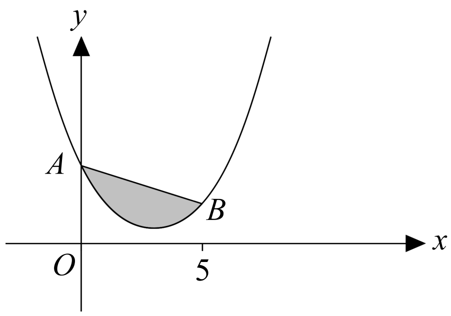
(ii) Describe in detail the geometrical transformation that maps the graph of $y = x^2$ onto the graph of $y = x^2 - 6x + 10$. *(3 marks)*

(b) Prove that the quadratic equation $x^2 - 6x + 10 = 0$ has no real solutions. *(3 marks)*

(c) (i) Find $\int (x^2 - 6x + 10)\,\mathrm{d}x$. *(2 marks)*

(ii) Hence find $\int_0^5 (x^2 - 6x + 10)\,\mathrm{d}x$. *(2 marks)*

(iii) The curve with equation $y = x^2 - 6x + 10$ is sketched below.



The curve crosses the y-axis at the point A, and the x-coordinate of the point B on the curve is 5.

The region bounded by the curve and the line AB, shaded in the diagram, is R. Determine the area of R. *(3 marks)*

(d) The points P and Q lie on the curve with equation $y = x^2 - 6x + 10$. The x-coordinate of P is 1 and the x-coordinate of Q is $1 + h$.

(i) Show that the gradient of the chord PQ is $h - 4$. *(3 marks)*

(ii) Deduce the value of the gradient of the curve at the point P. *(1 mark)*

Turn over ▶

6 (a) Find the value of $\sum_{r=1}^{29} r^2$. *(2 marks)*

(b) (i) The first two terms of an arithmetic series are 3 and 7 respectively.

Write down the rth term of the series, giving your answer in its simplest form. *(3 marks)*

(ii) Express the sum of the following arithmetic series in sigma notation

$$3 + 7 + 11 + \ldots + 799$$

(*You are not required to evaluate this sum.*) *(2 marks)*

7 (a) Solve the quadratic equation $2y^2 - 3y - 2 = 0$. *(2 marks)*

(b) (i) Show that the equation

$$3\tan x + 2\cos x = 0$$

can be written in the form

$$3\sin x + 2\cos^2 x = 0$$ *(1 mark)*

(ii) Show further that the equation

$$3\sin x + 2\cos^2 x = 0$$

can be written in the form

$$2\sin^2 x - 3\sin x - 2 = 0$$ *(2 marks)*

(c) Use the results from parts (a) and (b) to find all the values of x in the interval $0° \leqslant x \leqslant 360°$ for which

$$3\tan x + 2\cos x = 0$$ *(3 marks)*

END OF QUESTIONS

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