Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
9	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2011

Mathematics MPC2

Unit Pure Core 2

Monday 10 January 2011 9.00 am to 10.30 am

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics 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.

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.

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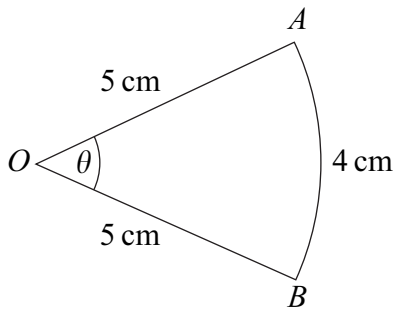
Answer **all** questions in the spaces provided.

1 The diagram shows a sector OAB of a circle with centre O and radius 5 cm.



The angle between the radii OA and OB is θ radians.

The length of the arc AB is 4 cm.

(a) Find the value of θ. *(2 marks)*

(b) Find the area of the sector OAB. *(2 marks)*

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2 (a) Write down the values of p, q and r given that:

(i) $8 = 2^p$; *(1 mark)*

(ii) $\frac{1}{8} = 2^q$; *(1 mark)*

(iii) $\sqrt{2} = 2^r$. *(1 mark)*

(b) Find the value of x for which $\sqrt{2} \times 2^x = \frac{1}{8}$. *(2 marks)*

QUESTION PART REFERENCE

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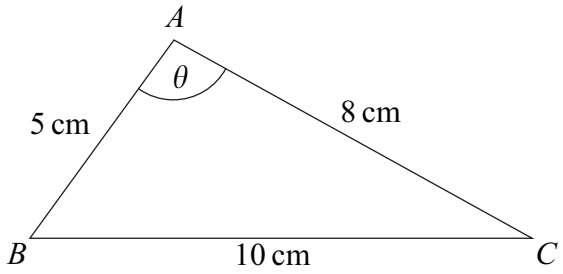
3 The triangle ABC, shown in the diagram, is such that $AB = 5\,\text{cm}$, $AC = 8\,\text{cm}$, $BC = 10\,\text{cm}$ and angle $BAC = \theta$.



(a) Show that $\theta = 97.9°$, correct to the nearest 0.1°. *(3 marks)*

(b) (i) Calculate the area of triangle ABC, giving your answer, in cm^2, to three significant figures. *(2 marks)*

(ii) The line through A, perpendicular to BC, meets BC at the point D. Calculate the length of AD, giving your answer, in cm, to three significant figures. *(3 marks)*

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4 (a) Use the trapezium rule with four ordinates (three strips) to find an approximate value for $\int_0^{1.5} \sqrt{27x^3 + 4}\, dx$, giving your answer to three significant figures. *(4 marks)*

(b) The curve with equation $y = \sqrt{27x^3 + 4}$ is stretched parallel to the x-axis with scale factor 3 to give the curve with equation $y = g(x)$. Write down an expression for $g(x)$. *(2 marks)*

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5 (a) Using the binomial expansion, or otherwise, express $(1-x)^3$ in ascending powers of x. *(2 marks)*

(b) Show that the expansion of

$$(1+y)^4 - (1-y)^3$$

is

$$7y + py^2 + qy^3 + y^4$$

where p and q are constants to be found. *(4 marks)*

(c) Hence find $\int \left[\left(1+\sqrt{x}\right)^4 - \left(1-\sqrt{x}\right)^3 \right] \mathrm{d}x$, expressing each coefficient in its simplest form. *(4 marks)*

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6 A geometric series has third term 36 and sixth term 972.

(a) (i) Show that the common ratio of the series is 3. *(2 marks)*

(ii) Find the first term of the series. *(2 marks)*

(b) The nth term of the series is u_n.

(i) Show that $\sum_{n=1}^{20} u_n = 2(3^{20} - 1)$. *(2 marks)*

(ii) Find the least value of n such that $u_n > 4 \times 10^{15}$. *(3 marks)*

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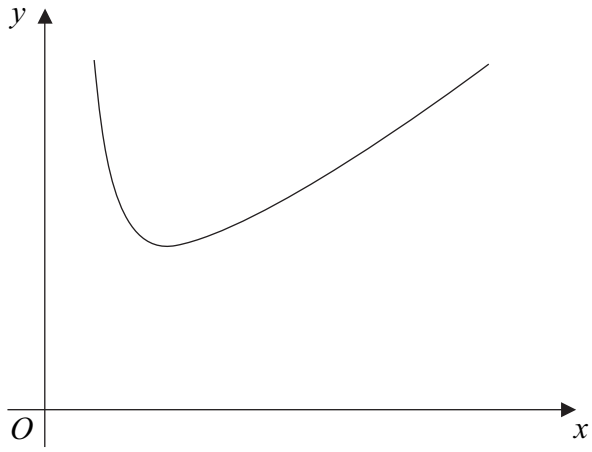
7 A curve C is defined for $x > 0$ by the equation $y = x + 3 + \frac{8}{x^4}$ and is sketched below.



(a) Given that $y = x + 3 + \frac{8}{x^4}$, find $\frac{dy}{dx}$. *(3 marks)*

(b) Find an equation of the tangent at the point on the curve C where $x = 1$. *(3 marks)*

(c) The curve C has a minimum point M. Find the coordinates of M. *(4 marks)*

(d) (i) Find $\int \left(x + 3 + \frac{8}{x^4} \right) dx$. *(3 marks)*

(ii) Hence find the area of the region bounded by the curve C, the x-axis and the lines $x = 1$ and $x = 2$. *(2 marks)*

(e) The curve C is translated by $\begin{bmatrix} 0 \\ k \end{bmatrix}$ to give the curve $y = f(x)$. Given that the x-axis is a tangent to the curve $y = f(x)$, state the value of the constant k. *(1 mark)*

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8 (a) Given that $2\log_k x - \log_k 5 = 1$, express k in terms of x. Give your answer in a form not involving logarithms. *(4 marks)*

(b) Given that $\log_a y = \frac{3}{2}$ and that $\log_4 a = b + 2$, show that $y = 2^p$, where p is an expression in terms of b. *(3 marks)*

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9 (a) Solve the equation $\tan x = -3$ in the interval $0° \leqslant x \leqslant 360°$, giving your answers to the nearest degree. *(3 marks)*

(b) (i) Given that

$$7\sin^2\theta + \sin\theta\cos\theta = 6$$

show that

$$\tan^2\theta + \tan\theta - 6 = 0$$ *(3 marks)*

(ii) Hence solve the equation $7\sin^2\theta + \sin\theta\cos\theta = 6$ in the interval $0° \leqslant \theta \leqslant 360°$, giving your answers to the nearest degree. *(4 marks)*

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END OF QUESTIONS

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