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General Certificate of Education Advanced Subsidiary Examination June 2010

Mathematics

MPC2

Unit Pure Core 2

Monday 24 May 2010 1.30 pm to 3.00 pm

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

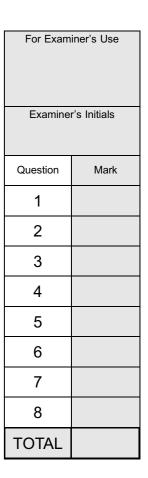
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer all questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write 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.

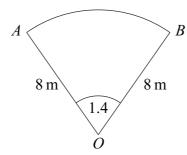
Advice

 Unless stated otherwise, you may quote formulae, without proof, from the booklet.



Answer all questions in the spaces provided.

1 The diagram shows a sector *OAB* of a circle with centre *O*.



The radius of the circle is 8 m and the angle AOB is 1.4 radians.

(a) Find the area of the sector OAB.

(2 marks)

(b) (i) Find the perimeter of the sector OAB.

(3 marks)

(ii) The perimeter of the sector OAB is equal to the circumference of a circle of radius x m. Calculate the value of x to three significant figures. (2 marks)

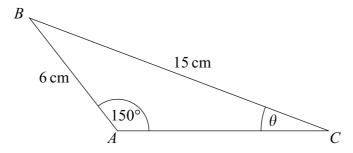
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2	The <i>n</i> th term of a sequence is u_n .
	The sequence is defined by
	$u_{n+1} = 6 + \frac{2}{5}u_n$
	The first term of the sequence is given by $u_1 = 2$.
(a	Find the value of u_2 and the value of u_3 . (2 marks)
(b	The limit of u_n as n tends to infinity is L .
	Write down an equation for L and hence find the value of L . (3 marks)
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The triangle ABC, shown in the diagram, is such that AB=6 cm, BC=15 cm, angle $BAC=150^{\circ}$ and angle $ACB=\theta$.



- (a) Show that $\theta = 11.5^{\circ}$, correct to the nearest 0.1° . (3 marks)
- (b) Calculate the area of triangle ABC, giving your answer in cm² to three significant figures. (3 marks)

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4 (a) The expression $\left(1 - \frac{1}{x^2}\right)^3$ ca	in be written in the form
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$$1 + \frac{p}{x^2} + \frac{q}{x^4} - \frac{1}{x^6}$$

Find the values of the integers p and q.

(2 marks)

(b) (i) Hence find
$$\int \left(1 - \frac{1}{x^2}\right)^3 dx$$
.

(4 marks)

(ii) Hence find the value of	$\int_{\frac{1}{2}}^{1} \left(1 \right)^{\frac{1}{2}} \left(1 \right)^{1$	$1-\frac{1}{x^2}$	$\frac{3}{dx}$
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(2 marks)

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5 ((a)	An infinite	e geometric	series has	common	ratio	r.
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The first term of the series is 10 and its sum to infinity is 50.

(i) Show that $r = \frac{4}{5}$.

(2 marks)

(ii) Find the second term of the series.

(2 marks)

- (b) The first and second terms of the geometric series in part (a) have the same values as the 4th and 8th terms respectively of an arithmetic series.
 - (i) Find the common difference of the arithmetic series.

(3 marks)

(ii) The *n*th term of the arithmetic series is u_n . Find the value of $\sum_{n=1}^{40} u_n$. (4 marks)

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6 A curve *C* has the equation

$$y = \frac{x^3 + \sqrt{x}}{x}, \quad x > 0$$

- (a) Express $\frac{x^3 + \sqrt{x}}{x}$ in the form $x^p + x^q$. (3 marks)
- **(b) (i)** Hence find $\frac{dy}{dx}$. (2 marks)
 - (ii) Find an equation of the normal to the curve C at the point on the curve where x=1.
- (c) (i) Find $\frac{d^2y}{dx^2}$. (2 marks)
 - (ii) Hence deduce that the curve C has no maximum points. (2 marks)

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- Sketch the graph of $y = \cos x$ in the interval $0 \le x \le 2\pi$. State the values of the intercepts with the coordinate axes. (2 marks)
 - (b) (i) Given that

$$\sin^2\theta = \cos\theta(2 - \cos\theta)$$

prove that $\cos \theta = \frac{1}{2}$. (2 marks)

(ii) Hence solve the equation

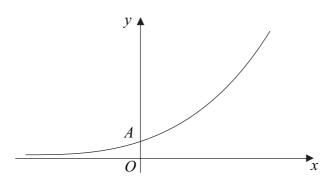
$$\sin^2 2x = \cos 2x(2 - \cos 2x)$$

in the interval $0 \le x \le \pi$, giving your answers in radians to three significant figures. (4 marks)

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8 The diagram shows a sketch of the curve $y = 2^{4x}$.



The curve intersects the y-axis at the point A.

(a) Find the value of the y-coordinate of A. (1 mark)

(b) Use the trapezium rule with six ordinates (five strips) to find an approximate value for $\int_0^1 2^{4x} dx$, giving your answer to two decimal places. (4 marks)

Describe the geometrical transformation that maps the graph of $y = 2^{4x}$ onto the graph of $y = 2^{4x-3}$.

(d) The curve $y = 2^{4x}$ is translated by the vector $\begin{bmatrix} 1 \\ -\frac{1}{2} \end{bmatrix}$ to give the curve y = g(x).

The curve y = g(x) crosses the x-axis at the point Q. Find the x-coordinate of Q.

(4 marks)

(e) (i) Given that

$$\log_a k = 3\log_a 2 + \log_a 5 - \log_a 4$$

show that k = 10. (3 marks)

(ii) The line $y = \frac{5}{4}$ crosses the curve $y = 2^{4x-3}$ at the point *P*. Show that the x-coordinate of *P* is $\frac{1}{4 \log_{10} 2}$.

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