

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2011

# Mathematics

# MPC2

## Unit Pure Core 2

Wednesday 18 May 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**

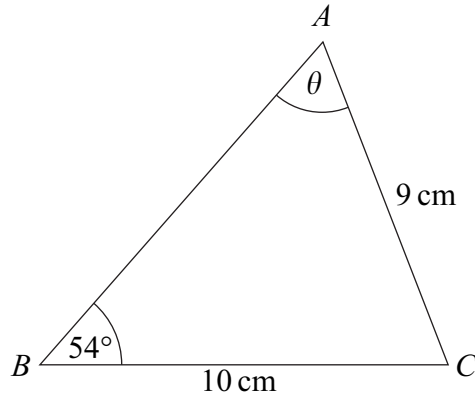
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.



J U N 1 1 M P C 2 0 1

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

- 1** The triangle  $ABC$ , shown in the diagram, is such that  $AC = 9$  cm,  $BC = 10$  cm, angle  $ABC = 54^\circ$  and the acute angle  $BAC = \theta$ .



- (a)** Show that  $\theta = 64^\circ$ , correct to the nearest degree. *(3 marks)*
- (b)** Calculate the area of triangle  $ABC$ , giving your answer to the nearest square centimetre. *(3 marks)*

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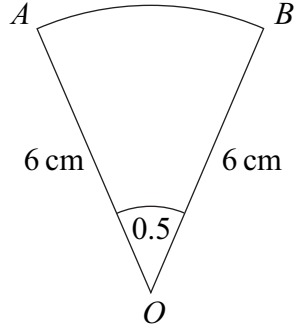
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**2** The diagram shows a sector  $OAB$  of a circle with centre  $O$ .



The radius of the circle is 6 cm and the angle  $AOB = 0.5$  radians.

- (a)** Find the area of the sector  $OAB$ . (2 marks)
- (b) (i)** Find the length of the arc  $AB$ . (2 marks)
- (ii)** Hence show that  
  
the perimeter of the sector  $OAB = k \times$  the length of the arc  $AB$   
  
where  $k$  is an integer. (2 marks)

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3 (a) The expression  $(2 + x^2)^3$  can be written in the form

$$8 + px^2 + qx^4 + x^6$$

Show that  $p = 12$  and find the value of the integer  $q$ . (3 marks)

(b) (i) Hence find  $\int \frac{(2 + x^2)^3}{x^4} dx$ . (5 marks)

(ii) Hence find the exact value of  $\int_1^2 \frac{(2 + x^2)^3}{x^4} dx$ . (2 marks)

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A large rectangular area containing horizontal dotted lines for writing the solution to the problems above.



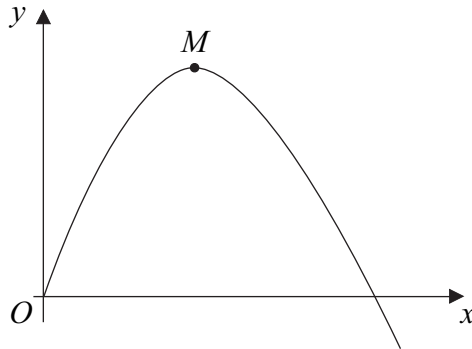








- 5 The diagram shows part of a curve with a maximum point  $M$ .



The curve is defined for  $x \geq 0$  by the equation

$$y = 6x - 2x^{\frac{3}{2}}$$

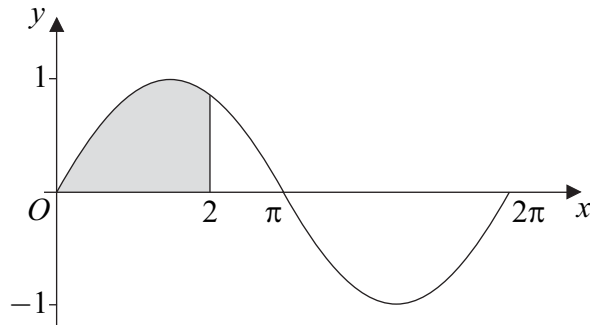
- (a) Find  $\frac{dy}{dx}$ . (3 marks)
- (b) (i) Hence find the coordinates of the maximum point  $M$ . (3 marks)
- (ii) Write down the equation of the normal to the curve at  $M$ . (1 mark)
- (c) The point  $P\left(\frac{9}{4}, \frac{27}{4}\right)$  lies on the curve.
- (i) Find an equation of the normal to the curve at the point  $P$ , giving your answer in the form  $ax + by = c$ , where  $a$ ,  $b$  and  $c$  are positive integers. (4 marks)
- (ii) The normals to the curve at the points  $M$  and  $P$  intersect at the point  $R$ . Find the coordinates of  $R$ . (2 marks)

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- 6** A curve  $C$ , defined for  $0 \leq x \leq 2\pi$  by the equation  $y = \sin x$ , where  $x$  is in radians, is sketched below. The region bounded by the curve  $C$ , the  $x$ -axis from 0 to 2 and the line  $x = 2$  is shaded.



- (a)** The area of the shaded region is given by  $\int_0^2 \sin x \, dx$ , where  $x$  is in radians.

Use the trapezium rule with five ordinates (four strips) to find an approximate value for the area of the shaded region, giving your answer to three significant figures.

(4 marks)

- (b)** Describe the geometrical transformation that maps the graph of  $y = \sin x$  onto the graph of  $y = 2 \sin x$ . (2 marks)

- (c)** Use a trigonometrical identity to solve the equation

$$2 \sin x = \cos x$$

in the interval  $0 \leq x \leq 2\pi$ , giving your solutions in radians to three significant figures.

(4 marks)

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Turn over ▶



7 The  $n$ th term of a sequence is  $u_n$ . The sequence is defined by

$$u_{n+1} = pu_n + q$$

where  $p$  and  $q$  are constants.

The first two terms of the sequence are given by  $u_1 = 60$  and  $u_2 = 48$ .

The limit of  $u_n$  as  $n$  tends to infinity is 12.

(a) Show that  $p = \frac{3}{4}$  and find the value of  $q$ . (5 marks)

(b) Find the value of  $u_3$ . (1 mark)

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- 9** The first term of a geometric series is 12 and the common ratio of the series is  $\frac{3}{8}$ .
- (a)** Find the sum to infinity of the series. *(2 marks)*
- (b)** Show that the sixth term of the series can be written in the form  $\frac{3^6}{2^{13}}$ . *(3 marks)*
- (c)** The  $n$ th term of the series is  $u_n$ .
- (i)** Write down an expression for  $u_n$  in terms of  $n$ . *(1 mark)*
- (ii)** Hence show that
- $$\log_a u_n = n \log_a 3 - (3n - 5) \log_a 2 \quad (4 \text{ marks})$$

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QUESTION  
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**END OF QUESTIONS**

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