

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 2013

# Mathematics

# MPC2

## Unit Pure Core 2

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 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 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.

### 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.



J U N 1 3 M P C 2 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** A geometric series has first term 80 and common ratio  $\frac{1}{2}$ .
- (a) Find the third term of the series. *(1 mark)*
  - (b) Find the sum to infinity of the series. *(2 marks)*
  - (c) Find the sum of the first 12 terms of the series, giving your answer to two decimal places. *(2 marks)*

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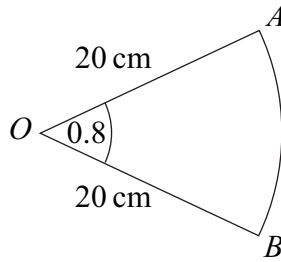
**Answer space for question 1**

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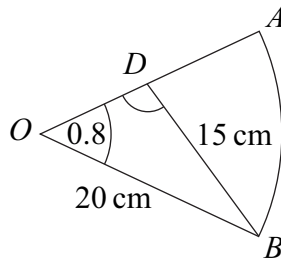


2 The diagram shows a sector  $OAB$  of a circle with centre  $O$ .



The radius of the circle is 20 cm and the angle  $AOB = 0.8$  radians.

- (a) Find the length of the arc  $AB$ . (2 marks)
- (b) Find the area of the sector  $OAB$ . (2 marks)
- (c) A line from  $B$  meets the radius  $OA$  at the point  $D$ , as shown in the diagram below.



The length of  $BD$  is 15 cm. Find the size of the **obtuse** angle  $ODB$ , in **radians**, giving your answer to three significant figures. (4 marks)

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- 3 (a) (i) Using the binomial expansion, or otherwise, express  $(2 + y)^3$  in the form  $a + by + cy^2 + y^3$ , where  $a$ ,  $b$  and  $c$  are integers. (2 marks)
- (ii) Hence show that  $(2 + x^{-2})^3 + (2 - x^{-2})^3$  can be expressed in the form  $p + qx^{-4}$ , where  $p$  and  $q$  are integers. (3 marks)
- (b) (i) Hence find  $\int [(2 + x^{-2})^3 + (2 - x^{-2})^3] dx$ . (2 marks)
- (ii) Hence find the value of  $\int_1^2 [(2 + x^{-2})^3 + (2 - x^{-2})^3] dx$ . (2 marks)

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- 4 (a) Sketch the graph of  $y = 9^x$ , indicating the value of the intercept on the  $y$ -axis. *(2 marks)*
  
- (b) Use logarithms to solve the equation  $9^x = 15$ , giving your value of  $x$  to three significant figures. *(2 marks)*
  
- (c) The curve  $y = 9^x$  is reflected in the  $y$ -axis to give the curve with equation  $y = f(x)$ . Write down an expression for  $f(x)$ . *(1 mark)*

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- 5 (a)** Use the trapezium rule with five ordinates (four strips) to find an approximate value for  $\int_0^2 \sqrt{8x^3 + 1} \, dx$ , giving your answer to three significant figures. *(4 marks)*
- (b)** Describe the single transformation that maps the graph of  $y = \sqrt{8x^3 + 1}$  onto the graph of  $y = \sqrt{x^3 + 1}$ . *(2 marks)*
- (c)** The curve with equation  $y = \sqrt{x^3 + 1}$  is translated by  $\begin{bmatrix} 2 \\ -0.7 \end{bmatrix}$  to give the curve with equation  $y = g(x)$ . Find the value of  $g(4)$ . *(3 marks)*

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**6** A curve has the equation

$$y = \frac{12 + x^2\sqrt{x}}{x}, \quad x > 0$$

(a) Express  $\frac{12 + x^2\sqrt{x}}{x}$  in the form  $12x^p + x^q$ . (3 marks)

(b) (i) Hence find  $\frac{dy}{dx}$ . (2 marks)

(ii) Find an equation of the normal to the curve at the point on the curve where  $x = 4$ . (4 marks)

(iii) The curve has a stationary point  $P$ . Show that the  $x$ -coordinate of  $P$  can be written in the form  $2^k$ , where  $k$  is a rational number. (3 marks)

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**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  $u_1 = 96$  and  $u_2 = 72$ .

The limit of  $u_n$  as  $n$  tends to infinity is 24.

- (a) Show that  $p = \frac{2}{3}$ . (4 marks)
- (b) Find the value of  $u_3$ . (2 marks)

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**8 (a)** Given that  $\log_a b = c$ , express  $b$  in terms of  $a$  and  $c$ . (1 mark)

**(b)** By forming a quadratic equation, show that there is only one value of  $x$  which satisfies the equation  $2 \log_2(x + 7) - \log_2(x + 5) = 3$ . (6 marks)

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9 (a) (i) On the axes given below, sketch the graph of  $y = \tan x$  for  $0^\circ \leq x \leq 360^\circ$ . (3 marks)

(ii) Solve the equation  $\tan x = -1$ , giving all values of  $x$  in the interval  $0^\circ \leq x \leq 360^\circ$ . (2 marks)

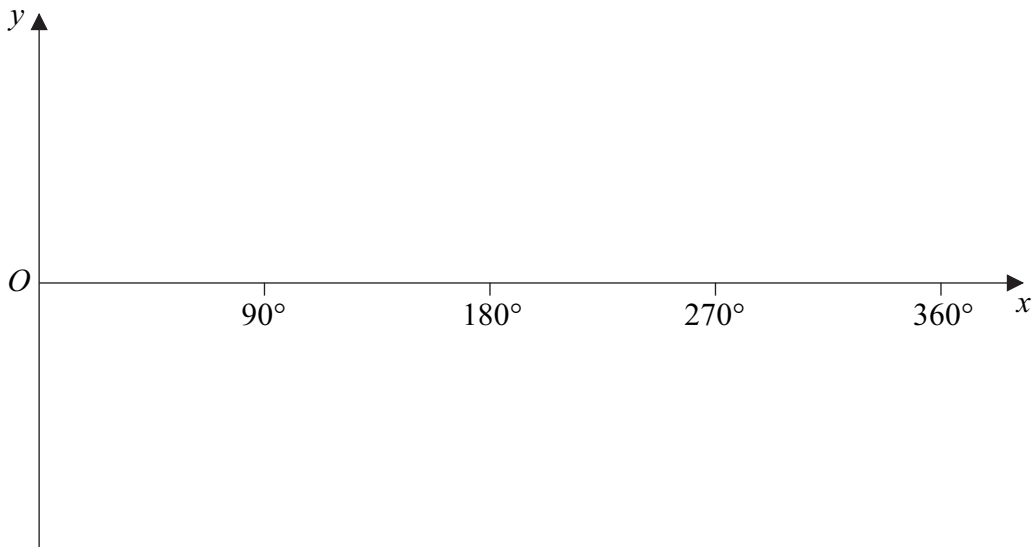
(b) (i) Given that  $6 \tan \theta \sin \theta = 5$ , show that  $6 \cos^2 \theta + 5 \cos \theta - 6 = 0$ . (3 marks)

(ii) Hence solve the equation  $6 \tan 3x \sin 3x = 5$ , giving all values of  $x$  to the nearest degree in the interval  $0^\circ \leq x \leq 180^\circ$ . (6 marks)

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**Answer space for question 9**

(a)(i)



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**Answer space for question 9**

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### Answer space for question 9

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**END OF QUESTIONS**

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