



General Certificate of Education
Advanced Subsidiary Examination
January 2010

Mathematics

MPC2

Unit Pure Core 2

Monday 11 January 2010 9.00 am to 10.30 am

For this paper you must have:

- an 8-page answer book
 - 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.
- Write the information required on the front of your answer book. The **Examining Body** for this paper is AQA. The **Paper Reference** is MPC2.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.

Information

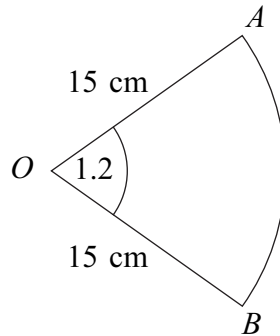
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

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

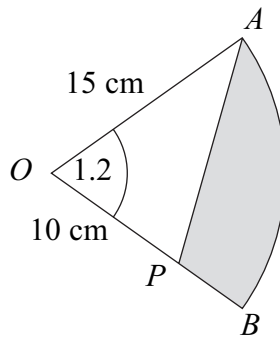
Answer **all** questions.

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



The radius of the circle is 15 cm and angle $AOB = 1.2$ radians.

- (a) (i) Show that the area of the sector is 135 cm^2 . (2 marks)
- (ii) Calculate the length of the arc AB . (2 marks)
- (b) The point P lies on the radius OB such that $OP = 10$ cm, as shown in the diagram below.



Calculate the perimeter of the shaded region bounded by AP , PB and the arc AB , giving your answer to three significant figures. (5 marks)

2 At the point (x, y) on a curve, where $x > 0$, the gradient is given by

$$\frac{dy}{dx} = 7\sqrt{x^5} - 4$$

(a) Write $\sqrt{x^5}$ in the form x^k , where k is a fraction. (1 mark)

(b) Find $\int (7\sqrt{x^5} - 4) dx$. (3 marks)

(c) Hence find the equation of the curve, given that the curve passes through the point $(1, 3)$. (3 marks)

3 (a) Find the value of x in each of the following:

(i) $\log_9 x = 0$; (1 mark)

(ii) $\log_9 x = \frac{1}{2}$. (1 mark)

(b) Given that

$$2 \log_a n = \log_a 18 + \log_a (n - 4)$$

find the possible values of n . (5 marks)

4 An arithmetic series has first term a and common difference d .

The sum of the first 31 terms of the series is 310.

(a) Show that $a + 15d = 10$. (3 marks)

(b) Given also that the 21st term is twice the 16th term, find the value of d . (3 marks)

(c) The n th term of the series is u_n . Given that $\sum_{n=1}^k u_n = 0$, find the value of k . (4 marks)

Turn over ►

- 5 A curve has equation $y = \frac{1}{x^3} + 48x$.
- (a) Find $\frac{dy}{dx}$. (3 marks)
- (b) Hence find the equation of each of the two tangents to the curve that are parallel to the x -axis. (4 marks)
- (c) Find an equation of the normal to the curve at the point $(1, 49)$. (3 marks)
- 6 (a) Sketch the curve with equation $y = 2^x$, indicating the coordinates of any point where the curve intersects the coordinate axes. (2 marks)
- (b) (i) Use the trapezium rule with five ordinates (four strips) to find an approximate value for $\int_0^2 2^x dx$, giving your answer to three significant figures. (4 marks)
- (ii) State how you could obtain a better approximation to the value of the integral using the trapezium rule. (1 mark)
- (c) Describe a geometrical transformation that maps the graph of $y = 2^x$ onto the graph of $y = 2^{x+7} + 3$. (3 marks)
- (d) The curve $y = 2^{x+k} + 3$ intersects the y -axis at the point $A(0, 8)$.
- Show that $k = \log_m n$, where m and n are integers. (2 marks)
- 7 (a) The first four terms of the binomial expansion of $(1 + 2x)^7$ in ascending powers of x are $1 + ax + bx^2 + cx^3$. Find the values of the integers a , b and c . (4 marks)
- (b) Hence find the coefficient of x^3 in the expansion of $\left(1 - \frac{1}{2}x\right)^2 (1 + 2x)^7$. (4 marks)

- 8 (a) Solve the equation $\tan(x + 52^\circ) = \tan 22^\circ$, giving the values of x in the interval $0^\circ \leq x \leq 360^\circ$. (3 marks)

- (b) (i) Show that the equation

$$3 \tan \theta = \frac{8}{\sin \theta}$$

can be written as

$$3 \cos^2 \theta + 8 \cos \theta - 3 = 0 \quad (3 \text{ marks})$$

- (ii) Find the value of $\cos \theta$ that satisfies the equation

$$3 \cos^2 \theta + 8 \cos \theta - 3 = 0 \quad (2 \text{ marks})$$

- (iii) Hence solve the equation

$$3 \tan 2x = \frac{8}{\sin 2x}$$

giving all values of x to the nearest degree in the interval $0^\circ \leq x \leq 180^\circ$. (4 marks)

END OF QUESTIONS

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