Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

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MATHEMATICS **9709/12**

Paper 1 Pure Mathematics 1 **(P1)** **May/June 2014**

1 hour 45 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 75.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

This document consists of **4** printed pages.

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1 Find the coordinates of the point at which the perpendicular bisector of the line joining (2, 7) to (10, 3) meets the x-axis. [5]

2 Find the coefficient of x^2 in the expansion of $(1+x^2)\left(\dfrac{x}{2}-\dfrac{4}{x}\right)^6$. [5]

3 The reflex angle θ is such that $\cos\theta = k$, where $0 < k < 1$.

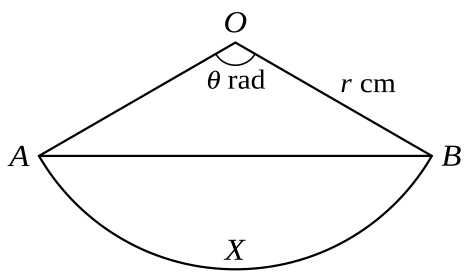
(i) Find an expression, in terms of k, for

(a) $\sin\theta$, [2]

(b) $\tan\theta$. [1]

(ii) Explain why $\sin 2\theta$ is negative for $0 < k < 1$. [2]

4



The diagram shows a sector of a circle with radius r cm and centre O. The chord AB divides the sector into a triangle AOB and a segment AXB. Angle AOB is θ radians.

(i) In the case where the areas of the triangle AOB and the segment AXB are equal, find the value of the constant p for which $\theta = p\sin\theta$. [2]

(ii) In the case where $r = 8$ and $\theta = 2.4$, find the perimeter of the segment AXB. [3]

5 **(i)** Prove the identity $\dfrac{1}{\cos\theta} - \dfrac{\cos\theta}{1+\sin\theta} \equiv \tan\theta$. [4]

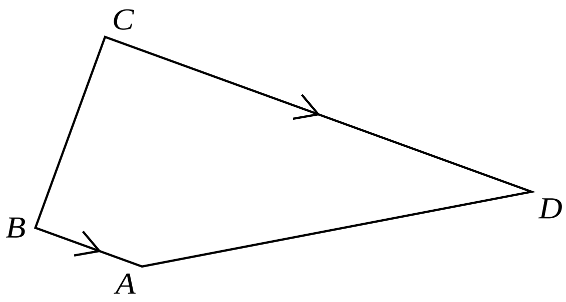
(ii) Solve the equation $\dfrac{1}{\cos\theta} - \dfrac{\cos\theta}{1+\sin\theta} + 2 = 0$ for $0° \leqslant \theta \leqslant 360°$. [3]

6 The 1st, 2nd and 3rd terms of a geometric progression are the 1st, 9th and 21st terms respectively of an arithmetic progression. The 1st term of each progression is 8 and the common ratio of the geometric progression is r, where $r \neq 1$. Find

(i) the value of r, [4]

(ii) the 4th term of each progression. [3]

7



The diagram shows a trapezium $ABCD$ in which BA is parallel to CD. The position vectors of A, B and C relative to an origin O are given by

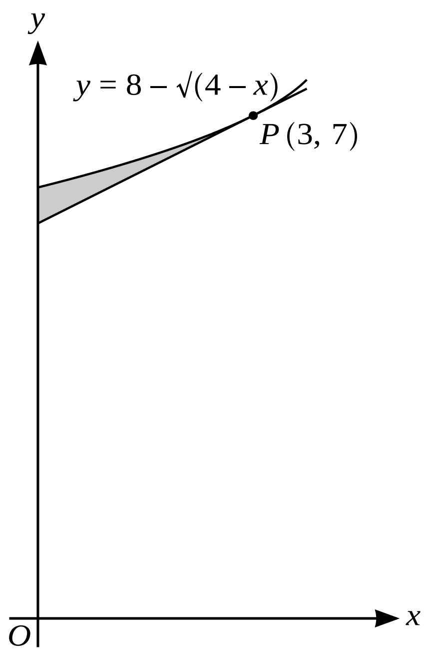
$$\overrightarrow{OA} = \begin{pmatrix} 3 \\ 4 \\ 0 \end{pmatrix}, \quad \overrightarrow{OB} = \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OC} = \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix}.$$

(i) Use a scalar product to show that AB is perpendicular to BC. [3]

(ii) Given that the length of CD is 12 units, find the position vector of D. [4]

8 The equation of a curve is such that $\dfrac{d^2y}{dx^2} = 2x - 1$. Given that the curve has a minimum point at $(3, -10)$, find the coordinates of the maximum point. [8]

9



The diagram shows part of the curve $y = 8 - \sqrt{(4 - x)}$ and the tangent to the curve at $P\,(3, 7)$.

(i) Find expressions for $\dfrac{dy}{dx}$ and $\displaystyle\int y\,dx$. [5]

(ii) Find the equation of the tangent to the curve at P in the form $y = mx + c$. [2]

(iii) Find, showing all necessary working, the area of the shaded region. [4]

10 Functions f and g are defined by

$$\mathrm{f} : x \mapsto 2x - 3, \quad x \in \mathbb{R},$$
$$\mathrm{g} : x \mapsto x^2 + 4x, \quad x \in \mathbb{R}.$$

(i) Solve the equation $\mathrm{ff}(x) = 11$. [2]

(ii) Find the range of g. [2]

(iii) Find the set of values of x for which $\mathrm{g}(x) > 12$. [3]

(iv) Find the value of the constant p for which the equation $\mathrm{gf}(x) = p$ has two equal roots. [3]

Function h is defined by $\mathrm{h} : x \mapsto x^2 + 4x$ for $x \geqslant k$, and it is given that h has an inverse.

(v) State the smallest possible value of k. [1]

(vi) Find an expression for $\mathrm{h}^{-1}(x)$. [4]

