



# Cambridge Pre-U

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**MATHEMATICS**

**9794/01**

Paper 1 Pure Mathematics 1

**May/June 2022**

**2 hours**

You must answer on the answer booklet/paper.

You will need: Answer booklet/paper  
Graph paper  
List of formulae (MF20)

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## INSTRUCTIONS

- Answer **all** questions.
- If you have been given an answer booklet, follow the instructions on the front cover of the answer booklet.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number on all the work you hand in.
- Do **not** use an erasable pen or correction fluid.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- At the end of the examination, fasten all your work together. Do **not** use staples, paper clips or glue.

## INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

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This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document has 4 pages. Any blank pages are indicated.



1 A sequence  $u_1, u_2, u_3, \dots$  is defined by  $u_1 = 1$  and  $u_{n+1} = \frac{4}{2 - u_n}$  for  $n \geq 1$ .

(a) Write down the values of  $u_2, u_3$  and  $u_4$ . [2]

(b) Find  $\sum_{n=1}^{50} u_n$ . [3]

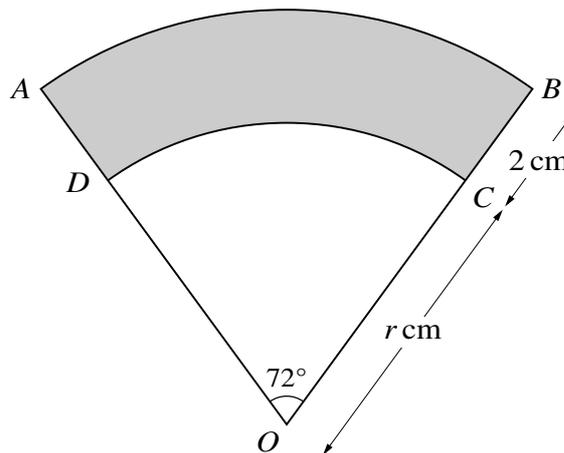
2 Solve the equation  $x^{\frac{1}{2}} - 6x^{\frac{1}{4}} + 8 = 0$ . [5]

3 A complex number  $z$  has modulus 4 and argument  $-\frac{1}{3}\pi$ . Giving your answers in the form  $x + iy$ , find

(a)  $z$ , [2]

(b)  $\frac{8}{iz}$ . [4]

4



The diagram shows a sector  $AOB$  of a circle with centre  $O$  and radius  $(r + 2)$  cm. Angle  $AOB$  is  $72^\circ$ . The points  $C$  and  $D$  lie on  $OB$  and  $OA$  respectively, and  $CD$  is an arc of a circle with centre  $O$  and radius  $r$  cm. The area of the shaded region  $ABCD$  is  $8\pi$  cm<sup>2</sup>.

(a) Express  $72^\circ$  in radians, giving your answer in an exact form. [1]

(b) Determine the value of  $r$ . [4]

5 The line  $L$  has equation  $\mathbf{r} = \begin{pmatrix} 3 \\ 10 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} -1 \\ 2 \\ 3 \end{pmatrix}$ . The point  $A$  has coordinates  $(1, -2, 1)$  and the point  $B$  has coordinates  $(8, 12, -6)$ . The line  $L$  intersects the line through  $A$  and  $B$  at the point  $C$ .

(a) Find the coordinates of  $C$ . [5]

(b) Determine the ratio  $AC : CB$ , giving the answer in its simplest form. [2]

- 6** The function  $f$  is defined for all real values of  $x$  by  $f(x) = (x - 14)^3 + 3$ .
- (a) Find  $ff(16)$ . [2]
- (b) Find  $f^{-1}(x)$ , stating its domain. [3]

The curve  $y = (x - 14)^3 + 3$  intersects the line  $y = x$  at the point  $P$ .

- (c) Use the Newton-Raphson method on  $(x - 14)^3 + 3 - x = 0$ , with  $x_0 = 20$ , to find the coordinates of the point  $P$ . Show the result of each iteration and give each coordinate correct to 4 significant figures. [3]
- (d) State how the point  $P$  is related to the curves  $y = f(x)$  and  $y = f^{-1}(x)$ . [1]
- 7** (a) Sketch, on a single diagram, the graphs of  $y = \operatorname{cosec} x$  and  $y = \tan x$  for  $0^\circ \leq x \leq 360^\circ$ . [4]
- (b) Solve the equation  $\operatorname{cosec} x = \tan x$  for  $0^\circ \leq x \leq 360^\circ$ . [5]
- 8** (a) (i) Show that  $(\sqrt{a} - \sqrt{a+b})(\sqrt{a} + \sqrt{a+b}) = -b$ . [1]
- (ii) Hence show that  $\frac{1}{\sqrt{a+b}} - \frac{1}{\sqrt{a}} = \frac{-b}{a\sqrt{a+b} + \sqrt{a}(a+b)}$ . [3]
- (b) Given that  $f(x) = x^{-\frac{1}{2}}$ , use differentiation from first principles to prove that  $f'(x) = -\frac{1}{2}x^{-\frac{3}{2}}$ . [3]

- 9** Find the solution of the differential equation  $\frac{dy}{dx} = y \ln(x+2)$ , given that  $y = 27$  when  $x = 1$ . Give your answer in the form  $f(y) = g(x)$ . [7]

- 10** The expansion of  $(1 + ax)^n$  contains the terms  $-\frac{2}{3}x$  and  $-\frac{112}{81}x^3$ .
- Find the possible values of  $a$  and  $n$ . [7]

- 11** (a) Show that  $\frac{d}{dx}(\sec x \tan x + \ln(\sec x + \tan x)) = 2 \sec^3 x$ . [7]
- [You may quote the derivatives of  $\sec x$  and  $\tan x$  from the list of formulae (MF20).]

- (b) The region bounded by the curve  $y = \frac{1}{1-x^2}$ , the  $x$ -axis and the lines  $x = 0$  and  $x = \frac{1}{2}$  is rotated completely around the  $x$ -axis. Use the substitution  $x = \sin u$  to show that the volume generated is given by  $\frac{1}{12}\pi(4 + 3 \ln 3)$ . [6]

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