Cambridge Pre-U

MATHEMATICS **9794/02**

Paper 2 Pure Mathematics 2 **For examination from 2020**

SPECIMEN PAPER **2 hours**

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You must answer on the answer booklet/paper.

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

INSTRUCTIONS

- Answer **all** questions.
- Follow the instructions on the front cover of the answer booklet. If you need additional answer paper, ask the invigilator for a continuation booklet.
- 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.

INFORMATION

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

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

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1 **(a)** Express each of the following as a single logarithm.

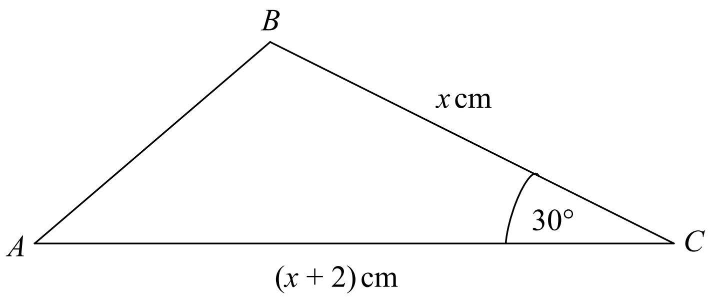
(i) $\log_a 5 + \log_a 3$ [1]

(ii) $5 \log_b 2 - 3 \log_b 4$ [3]

(b) Express $(9a^4)^{-\frac{1}{2}}$ as an algebraic fraction in its simplest form. [2]

(c) Show that $\dfrac{3\sqrt{3}-1}{2\sqrt{3}-3} = \dfrac{15+7\sqrt{3}}{3}$. [3]

2



The diagram shows a triangle ABC in which angle $C = 30°$, $BC = x\,\text{cm}$ and $AC = (x+2)\,\text{cm}$. Given that the area of triangle ABC is $12\,\text{cm}^2$, calculate the value of x. [5]

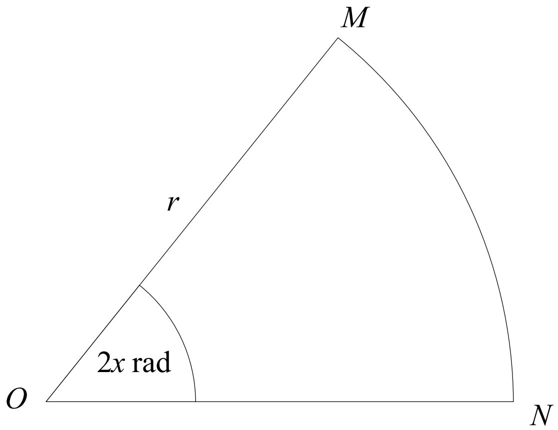
3 **(a)** The points A and B have coordinates $(-4, 4)$ and $(8, 1)$ respectively. Find the equation of the line AB. Give your answer in the form $y = mx + c$. [3]

(b) Determine, with a reason, whether the line $y = 7 - 4x$ is perpendicular to the line AB. [2]

4 **(a)** Show that $2x^2 - 10x - 3$ may be expressed in the form $a(x+b)^2 + c$ where a, b and c are real numbers to be found. Hence write down the coordinates of the minimum point on the curve. [4]

(b) Solve the equation $4x^4 - 13x^2 + 9 = 0$. [3]

5



The diagram shows a sector of a circle, OMN. The angle MON is $2x$ radians, the radius of the circle is r and O is the centre.

(a) Find expressions, in terms of r and x, for the area, A, and the perimeter, P, of the sector. [2]

(b) Given that $P = 20$, show that $A = \left(\frac{10}{1+x}\right)^2$. [2]

(c) Find $\frac{\mathrm{d}A}{\mathrm{d}x}$, and hence find the value of x for which the area of the sector is a maximum. [5]

6 Diane is given an injection that combines two drugs, Antiflu and Coldcure. At time t hours after the injection, the concentration of Antiflu in Diane's bloodstream is $3e^{-0.02t}$ units and the concentration of Coldcure is $5e^{-0.07t}$ units. Each drug becomes ineffective when its concentration falls below 1 unit.

(a) Show that Coldcure becomes ineffective before Antiflu. [3]

(b) Sketch, on the same diagram, the graphs of concentration against time for each drug. [3]

(c) 20 hours after the first injection, Diane is given a second injection. Determine the concentration of Coldcure 10 hours later. [2]

7 Solve the differential equation $x^2 \frac{\mathrm{d}y}{\mathrm{d}x} = \sec y$ given that $y = \frac{\pi}{6}$ when $x = 4$ giving your answer in the form $y = \mathrm{f}(x)$. [6]

8 The parametric equations of a curve are

$$x = e^{2t} - 5t, \quad y = e^{2t} - 3t.$$

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of t. [3]

(b) Find the equation of the tangent to the curve at the point when $t = 0$, giving your answer in the form $ay + bx + c = 0$ where a, b and c are integers. [5]

9 The points A and B have position vectors $\mathbf{a}$ and $\mathbf{b}$ relative to an origin O, where $\mathbf{a} = 5\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$ and $\mathbf{b} = -7\mathbf{i} + 3\mathbf{j} + \mathbf{k}$.

(a) Find the length of AB. [3]

(b) Use a scalar product to find angle OAB. [4]

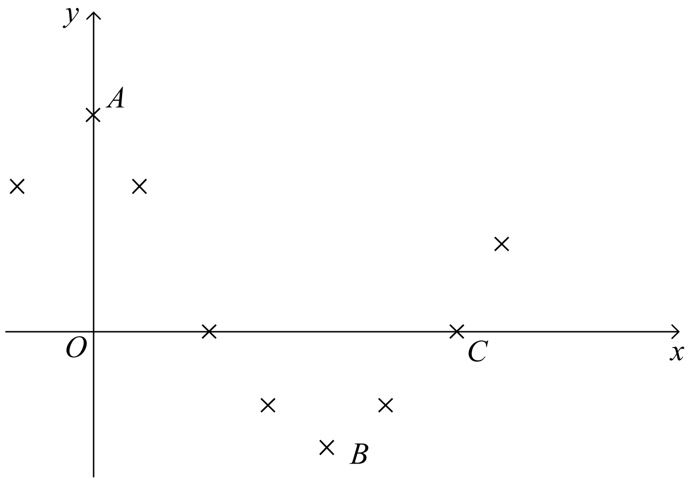
10 A curve has equation

$$y = \mathrm{e}^{ax} \cos bx$$

where a and b are constants.

(a) Show that, at any stationary points on the curve, $\tan bx = \dfrac{a}{b}$. [4]

(b)



Values of related quantities x and y were measured in an experiment and plotted on a graph of y against x, as shown in the diagram. Two of the points, labelled A and B, have coordinates (0, 1) and (0.2, –0.8) respectively. A third point labelled C has coordinates (0.3, 0.04). Attempts were then made to find the equation of a curve which fitted closely to these three points, and two models were proposed.

In the first model the equation is $y = \mathrm{e}^{-x} \cos 15x$.

In the second model the equation is $y = f\cos(\lambda x) + g$, where the constants f, λ, and g are chosen to give a maximum precisely at the point $A(0, 1)$ and a minimum precisely at the point $B(0.2, -0.8)$.

By calculating suitable values evaluate the suitability of the two models. [12]