Cambridge Assessment International Education

Cambridge Pre-U

MATHEMATICS **9794/01**

Paper 1 Pure Mathematics 1 **October/November 2020**

2 hours

* 3 5 8 7 3 7 0 5 8 4 *

You must answer on the answer booklet/paper.

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

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 [ ].

1 Two points A and B have coordinates (1, 2) and (7, 10) respectively. Given that AB is a diameter of a circle, find the equation of the circle. [4]

2 **(a)** Find the discriminant of $x^2 + kx + 2k - 3$, where k is a constant. [2]

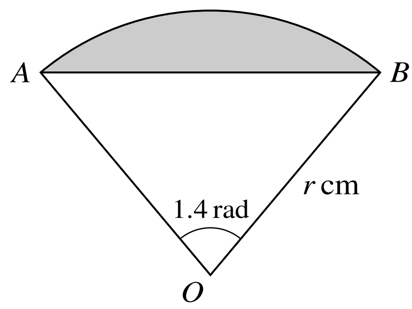
(b) The equation $x^2 + kx + 2k - 3 = 0$ has two distinct real roots. Find the set of possible values of k. [4]

3 Without using a calculator, express each of the following in the form $a + b\sqrt{3}$, where a and b are integers.

(a) $(4 + 5\sqrt{3})(2 + \sqrt{27})$ [3]

(b) $\dfrac{12}{3 + 2\sqrt{3}}$ [3]

4



The diagram shows a sector OAB of a circle, centre O and radius r cm. The angle AOB is 1.4 radians. The shaded segment enclosed by the arc AB and the chord AB has an area of 12 cm^2.

(a) Find the value of r, correct to 4 significant figures. [4]

(b) Find the perimeter of the shaded segment, correct to 3 significant figures. [3]

5 A curve has equation $y = e^{2x} + 1$. The region R is bounded by the curve, the x-axis, the y-axis and the line $x = 2$. Find the exact volume when R is rotated 360° around the x-axis. [5]

6 A sequence $u_1, u_2, u_3, \ldots$ is defined by $u_1 = 4$ and $u_{n+1} = u_n + 3$.

Another sequence $v_1, v_2, v_3, \ldots$ is defined by $v_1 = 1200$ and $v_{n+1} = 0.8v_n$.

(a) Find $u_{20} - v_{20}$, giving your answer correct to 3 significant figures. [3]

(b) Use an algebraic method to find the smallest value of N such that $\sum_{n=1}^{N} u_n > \sum_{n=1}^{\infty} v_n$. [6]

7 It is given that θ is the acute angle such that $\sin\theta = \frac{1}{4}$.

(a) Show that $\cos\theta = \dfrac{\sqrt{15}}{4}$. [2]

(b) Hence, using an appropriate formula in each case, find the exact values of

(i) $\cos(\theta - 30°)$, [2]

(ii) $\operatorname{cosec} 2\theta$. [3]

8 **(a)** Find the quotient when $3x^4 + 8x^3 - 24x^2 + 22x + 9$ is divided by $x^2 + 4x - 3$, and show that the remainder is $6x + 12$. [4]

(b) Hence find the exact value of $\displaystyle\int_1^3 \frac{3x^4 + 8x^3 - 24x^2 + 22x + 9}{x^2 + 4x - 3}\,\mathrm{d}x$. Give your answer in the form $a + b\ln c$, where a, b and c are integers. [5]

9 Two straight lines have equations

$$\mathbf{r} = \mathbf{i} + 4\mathbf{j} + 6\mathbf{k} + \lambda(2\mathbf{i} + a\mathbf{j} + \mathbf{k}) \quad \text{and} \quad \mathbf{r} = 4\mathbf{i} + 4\mathbf{j} + 9\mathbf{k} + \mu(\mathbf{i} + b\mathbf{j} + 2\mathbf{k}),$$

where a and b are constants.

(a) Given that the two lines intersect, show that $a + b = 0$. [4]

(b) Given also that the angle between the two lines is 60°, find the possible values of a and b. [5]

10 A population, P, of a certain species at time t is such that the rate of increase of P at any particular time is proportional to $(3P + 50)^{\frac{1}{3}}$. When $t = 0$, $P = 25$ and when $t = 13$, $P = 154$. Write down a differential equation for this situation and solve it to find P in terms of t. [7]

11 A curve has parametric equations $x = \dfrac{2}{t} - 1$, $y = \ln(3t - t^2)$, for $0 < t < 3$.

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ in terms of t, and hence find the exact coordinates of the stationary point on the curve. [6]

(b) Find $\dfrac{\mathrm{d}^2y}{\mathrm{d}x^2}$ in terms of t, and hence determine the nature of the stationary point. [5]

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