Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2417627705

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2021**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- 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 in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- 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 document has **16** pages. Any blank pages are indicated.

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\Delta = \frac{1}{2}bc\sin A$$

1 **DO NOT USE A CALCULATOR IN THIS QUESTION.**

Write $\dfrac{4-\sqrt{5}}{7-3\sqrt{5}}$ with a rational denominator, simplifying your answer. [3]

2 Given that $y = 2(7^{2x}) - 3(7^{x+1}) + 19$, find the value of x when $y = 30$. [4]

3 **(a)** Write $\dfrac{x(27xy^3)^{\frac{5}{3}}}{\sqrt[4]{81y^5}}$ in the form $3^a \times x^b \times y^c$ where a, b and c are constants. [3]

(b) **(i)** Find the value of a such that $2\log_a 8 = \dfrac{3}{2}$. [2]

(ii) Write $\log_{(a^2)} 3a$ as a single logarithm to base a. [2]

4 Variables x and y are such that $y = \frac{\sin x}{\cos x}$. Using differentiation, find the approximate change in y as x increases from $-\frac{\pi}{4}$ to $h - \frac{\pi}{4}$, where h is small. [4]

5 **(a)** Solve the inequality $2x^2 - 17x + 21 \leqslant 0$. [3]

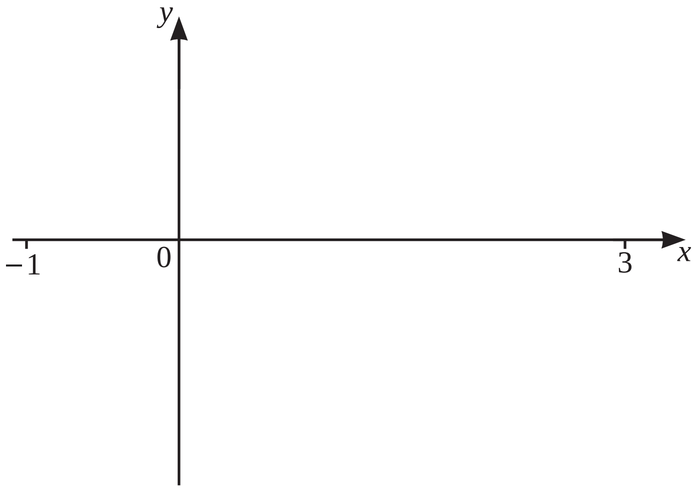
(b) Hence find the area enclosed between the curve $y = 2x^2 - 17x + 21$ and the x-axis. [3]

6 The polynomial p is given by $\mathrm{p}(x) = 36x^3 - 15x^2 - 2x + 1$.

(a) Show that $x = -0.25$ is a root of the equation $\mathrm{p}(x) = 0$. [1]

(b) Show that the equation $\mathrm{p}(x) = 0$ has a repeated root. [4]

7 **(a)** Sketch the graph of the curve $y = \ln(4x - 3)$ on the axes, stating the intercept with the x-axis. [2]



(b) Find the equation of the tangent to the curve $y = \ln(4x - 3)$ at the point where $x = 2$. [5]

8 **(a)** **(i)** Find $\int \sin\left(\frac{\phi + \pi}{3}\right) \mathrm{d}\phi$. [2]

(ii) Find $\int (5\sin^2\theta + 5\cos^2\theta)\,\mathrm{d}\theta$. [2]

(b) Show that $\int_1^{\mathrm{e}} \left(\left(1 + \frac{1}{x}\right)^2 - 1\right) \mathrm{d}x = \frac{3\mathrm{e} - 1}{\mathrm{e}}$. [4]

9 **(a)** The function f is defined, for all real x, by $\mathrm{f}(x) = 13 - 4x - 2x^2$.

(i) Write $\mathrm{f}(x)$ in the form $a + b(x+c)^2$, where a, b and c are constants. [3]

(ii) Hence write down the range of f. [1]

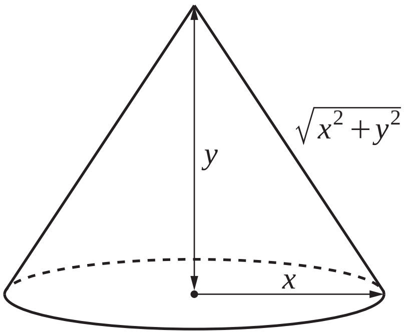
(b) The function g is defined, for $x \geqslant 1$, by $\mathrm{g}(x) = \sqrt{x^2 + 2x - 1}$.

(i) Given that $\mathrm{g}^{-1}(x)$ exists, write down the domain and range of g^{-1}. [2]

(ii) Show that $\mathrm{g}^{-1}(x) = -1 + \sqrt{px^2 + q}$, where p and q are integers. [4]

10 In this question all lengths are in centimetres.

The volume and curved surface area of a cone of base radius r, height h and sloping edge l are $\frac{1}{3}\pi r^2 h$ and πrl respectively.



The diagram shows a cone of base radius x, height y and sloping edge $\sqrt{x^2+y^2}$. The volume of the cone is 10π.

(a) Find an expression for y in terms of x and show that the curved surface area, S, of the cone is given by $S = \dfrac{\pi\sqrt{x^6+900}}{x}$. [3]

(b) Given that x can vary and that S has a minimum value, find the exact value of x for which S is a minimum. [5]

  [Turn over

11 **(a)** The first three terms of an arithmetic progression are $\frac{1}{p}$, $\frac{1}{q}$, $-\frac{1}{q}$.

(i) Show that the common difference can be written as $-\frac{2}{3p}$. [3]

(ii) The 10th term of the progression is $\frac{k}{p}$, where k is a constant. Find the value of k. [2]

(b) The sum to infinity of a geometric progression is 8. The second term of the progression is $\frac{3}{2}$. Find the two possible values of the common ratio. [5]

12 A particle moves in a straight line such that its displacement, s metres, from a fixed point O at time t seconds, is given by $s = 2 + t - 2\cos t$, for $t \geqslant 0$.

(a) Find the displacement of the particle from O at the time when it first comes to instantaneous rest. [5]

(b) Find the time when the particle next comes to rest. [1]

(c) Find the distance travelled by the particle for $0 \leqslant t \leqslant \frac{3\pi}{2}$. [2]

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