Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7011674582

ADDITIONAL MATHEMATICS **0606/12**

Paper 1 **February/March 2022**

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 Find the values of k such that the line $y = 9kx + 1$ does not meet the curve $y = kx^2 + 3x(2k+1) + 4$. [5]

2 DO NOT USE A CALCULATOR IN THIS QUESTION.

Solve the equation $(3-5\sqrt{3})x^2+(2\sqrt{3}+5)x-1=0$, giving your solutions in the form $a+b\sqrt{3}$, where a and b are rational numbers. [6]

3 The curve with equation $y = a\sin bx + c$, where a, b and c are constants, passes through the points $(4\pi, 11)$ and $\left(-\frac{4\pi}{3}, 5\right)$. It is given that $a\sin bx + c$ has period 16π.

(a) Find the exact values of a, b and c. [4]

(b) Using your answer to **part (a)**, find the coordinates of the minimum point on the curve for $0 \leqslant x \leqslant 16\pi$. [4]

4 **(a)** Show that $\dfrac{1}{2x-1}+\dfrac{4}{(2x-1)^2}$ can be written as $\dfrac{2x+3}{(2x-1)^2}$. [1]

(b) Find $\displaystyle\int_2^5 \frac{2x+3}{(2x-1)^2}\,\mathrm{d}x$, giving your answer in the form $a+\ln b$, where a and b are constants. [5]

5 Variables x and y are such that $y = \dfrac{\ln(2x^2 - 3)}{3x}$.

(a) Find $\dfrac{dy}{dx}$. [3]

(b) Hence find the approximate change in y when x increases from 2 to $2 + h$, where h is small. [2]

(c) At the instant when $x = 2$, y is increasing at the rate of 4 units per second. Find the corresponding rate of increase in x. [2]

6 The normal to the curve $y = 1 + \tan 3x$ at the point P with x-coordinate $\frac{\pi}{12}$, meets the x-axis at the point Q.

The line $x = \frac{\pi}{12}$ meets the x-axis at the point R. Find the area of the triangle PQR. [8]

7 A curve $y = \mathrm{f}(x)$ is such that $\dfrac{\mathrm{d}^2y}{\mathrm{d}x^2} = (2-3x)^{-\frac{1}{3}}$. The curve passes through the point $(-2, 10.2)$. The gradient of the tangent to the curve at $(-2, 10.2)$ is –6. Find $\mathrm{f}(x)$. [8]

8 In this question, all lengths are in metres and all times are in seconds.

A particle A is moving in the direction $\begin{pmatrix} -20 \\ 21 \end{pmatrix}$ with a speed of 58.

(a) Find the velocity vector of A. [1]

(b) Given that A is initially at the point with position vector $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$, write down the position vector of A at time t. [1]

A particle B starts to move such that its position vector at time t is $\begin{pmatrix} -35t+4 \\ 44t-2 \end{pmatrix}$.

(c) Find the displacement vector $\overrightarrow{AB}$ at time t. [2]

(d) Hence find the distance AB, at time t, in the form $\sqrt{pt^2+qt+r}$, where p, q and r are constants. [2]

(e) Find the value of t when the distance AB is $\sqrt{6}$, giving your answer correct to 2 decimal places. [2]

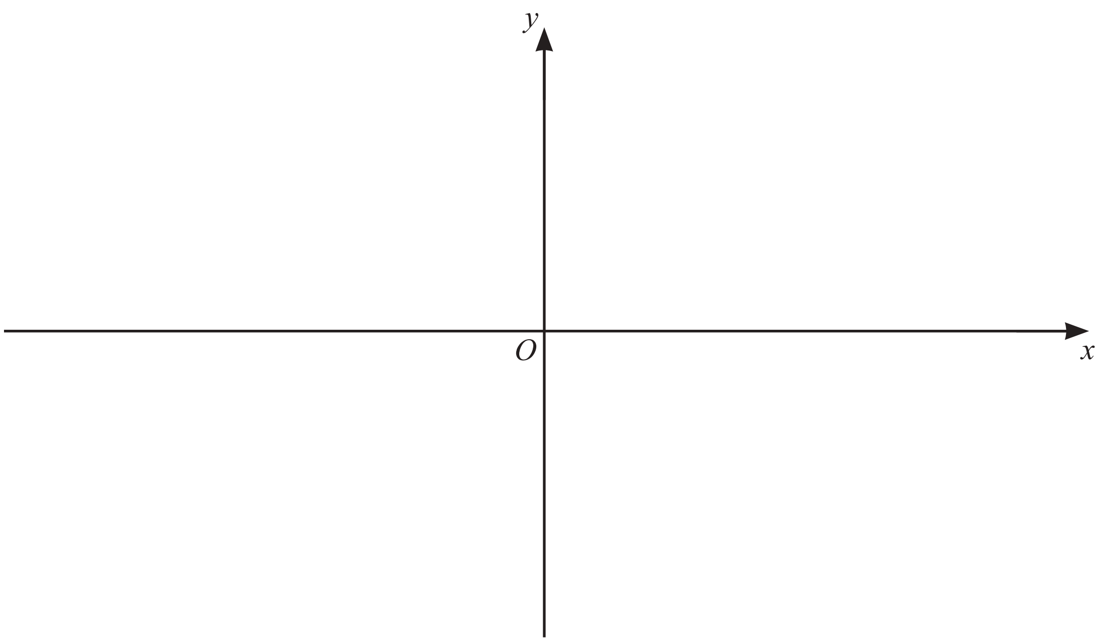
9 **(a)** The function f is such that $f(x) = \ln(5x+2)$, for $x > a$, where a is as small as possible.

(i) Write down the value of a. [1]

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

(iii) Find $f^{-1}(x)$, stating its domain. [3]

(iv) On the axes, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$, stating the exact values of the intercepts of the curves with the coordinate axes. [4]



(b) The function g is such that $g : x \mapsto x^{\frac{1}{2}} - 4$, for $x > 0$. Solve the equation $g^2(x) = -2$. [3]

10 **(a)** The first three terms of an arithmetic progression are $\sin 3x$, $5\sin 3x$, $9\sin 3x$. Find the exact values of x, where $0 \leqslant x \leqslant \frac{\pi}{2}$, for which the sum to twenty terms is equal to 390. [6]

(b) The first three terms of a geometric progression are $20\cos y,\ 10\cos^2 y,\ 5\cos^3 y$.

(i) Explain why this progression has a sum to infinity. [2]

(ii) Find the value of y, where y is in radians and $0 < y < 2$, for which the sum to infinity is 9. Give your answer correct to 2 decimal places. [4]