Cambridge Assessment International Education

# Cambridge IGCSE™

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| 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 $\binom{n}{r} = \dfrac{n!}{(n-r)!r!}$

*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 $\Delta ABC$*

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

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

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

**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 $16\pi$.

**(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]

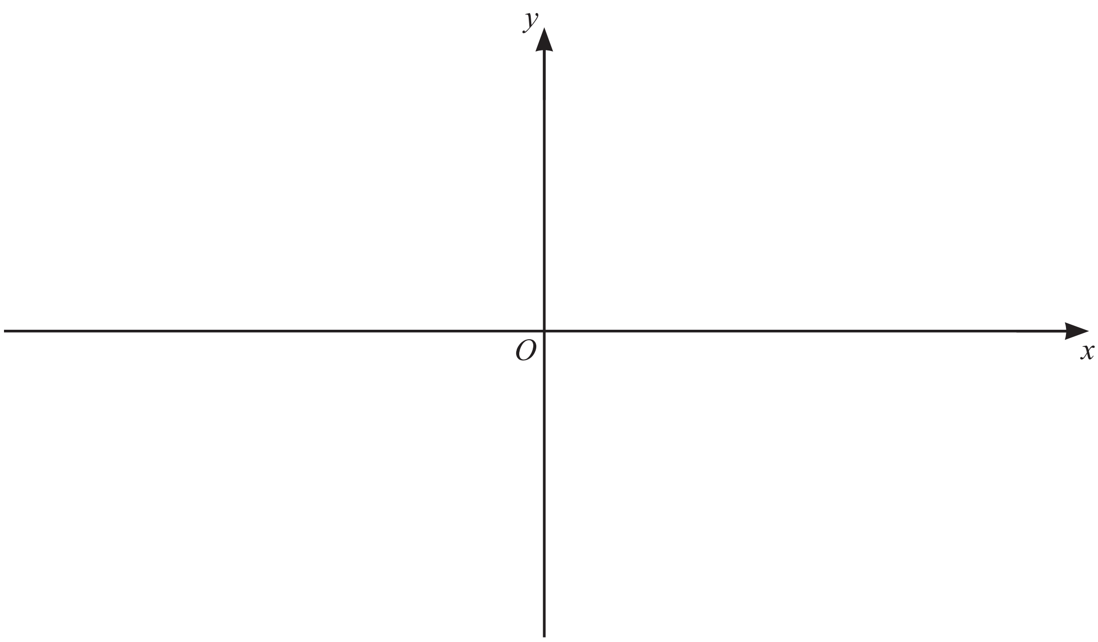
**9** **(a)** The function f is such that $f(x) = \ln(5x+2)$, for $x > a$, where $a$ is as small as possible.

**(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 $\mathrm{g} : x \mapsto x^{\frac{1}{2}} - 4$, for $x > 0$. Solve the equation $\mathrm{g}^2(x) = -2$. [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]

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