Cambridge Assessment International Education

# Cambridge IGCSE™

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| CANDIDATE NAME | | | |
| CENTRE NUMBER | | CANDIDATE NUMBER | |

*1799737130*

**ADDITIONAL MATHEMATICS** **0606/21**

Paper 2 **October/November 2023**

**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.

DC (CJ/JG) 317780/2

***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* $\Delta ABC$

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

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

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

**1** **(a)** Write $19 - 12x - 3x^2$ in the form $a(x+b)^2 + c$ where $a$, $b$ and $c$ are integers. [4]

**(b)** Hence find the maximum value of $19 - 12x - 3x^2$ and the value of $x$ at which this maximum occurs. [2]

**(c)** Use your answer to **part (a)** to solve the equation $19 - 12\sqrt{u} - 3u = 0$. [3]

**2** Solve the following simultaneous equations.

$$5x - 3\ln y = 2$$
$$x + \ln y = 1$$

[4]

**3** **(a)** Find $\int \left(4x+5-\frac{1}{2x+3}\right) dx$. [3]

**(b)** Hence find the exact value of $\int_1^3 \left(4x+5-\frac{1}{2x+3}\right) dx$, simplifying your answer. [3]

**4** In this question $a$ and $b$ are integers.

Three terms in the expansion of $(2+ax)^5(1+bx)$ are $32+112x-240x^2$. Find the values of $a$ and $b$. [7]

**5** In this question $p$ and $q$ are constants.

The normal to the curve $y = \frac{p}{x^2} + 5x - 2$, at the point where $x = 1$, has equation $y = -x + q$.

Find the values of $p$ and $q$. [6]

6 Find the value of the constant $a$ for which the line $y = (2a + 1)x - 10$ is a tangent to the curve $y = ax^2 - 5x + 2$. [6]

**7** A particle moves in a straight line. At time $t$ seconds after passing through a fixed point $O$, its velocity, $v\,\text{ms}^{-1}$, is given by $v = 10\sin 2t - 6\cos 2t$.

**(a)** Find an expression for the acceleration of the particle. [2]

**(b)** Find the acceleration when $t = \frac{\pi}{4}$. [1]

**(c)** Find the first time at which the acceleration is zero. [3]

**(d)** Find the displacement of the particle between $t = \frac{\pi}{4}$ and $t = \frac{\pi}{2}$. [4]

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

Solve the equation $(2-\sqrt{10})x^2+x+(2+\sqrt{10})=0$, giving your answers in the form $a+b\sqrt{10}$, where $a$ and $b$ are rational. [7]

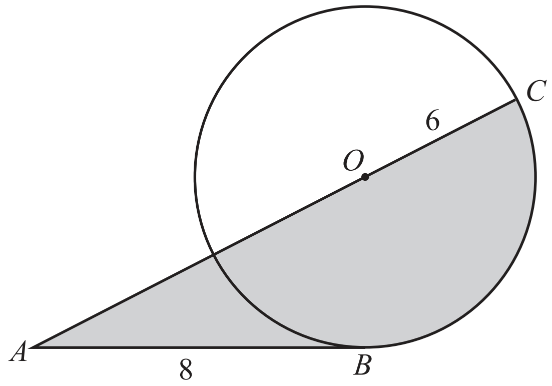
**9** The functions f and g are defined as follows, for all real values of $x$.

$$f(x) = 2x^2 - 1$$
$$g(x) = e^x + 1$$

**(a)** Solve the equation $fg(x) = 8$. [3]

**(b)** For each of the functions f and g, either explain why the inverse function does not exist or find the inverse function, stating its domain. [4]

**10** In this question all lengths are in centimetres.




The diagram shows a circle centre $O$ with radius 6. The line $AB$ is a tangent to the circle at the point $B$. The point $C$ lies on the circle such that $AOC$ is a straight line. $AB = 8$.

**(a)** Find the perimeter of the shaded region. [6]

**(b)** Find the area of the shaded region. [3]

**11** **(a)** Show that $\dfrac{1}{\sec x - \operatorname{cosec} x} + \dfrac{1}{\sec x + \operatorname{cosec} x} = \dfrac{2\cos x}{1 - \cot^2 x}$. [5]

**(b)** Solve the equation $3\tan^2\left(y+\frac{\pi}{4}\right)=1$ for $-2\pi < y < 0$. [4]

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