Cambridge Assessment International Education

# Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*7338070369*

**ADDITIONAL MATHEMATICS** **0606/13**

Paper 1 **May/June 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.

DC (NF/FC) 303987/4

## *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 $\Delta ABC$*

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

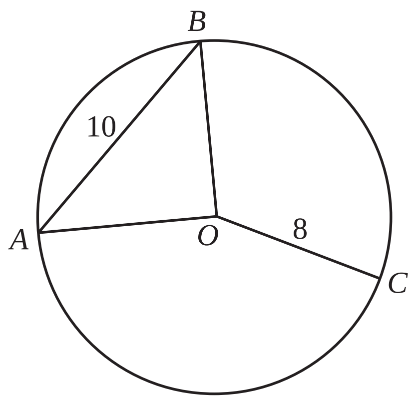
$$a^2 = b^2 + c^2 - 2bc\cos A$$

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

**1** **(a)** Find the rational numbers $a$, $b$ and $c$, such that the first three terms, in descending powers of $x$, in the expansion of $\left(3x^2 - \frac{1}{9x}\right)^5$ can be written in the form $ax^{10} + bx^7 + cx^4$. [3]

**(b)** Hence find the coefficient of $x^4$ in the expansion of $\left(3x^2 - \frac{1}{9x}\right)^5 \left(1 + \frac{1}{x^3}\right)^2$. [3]

**2** In this question, all lengths are in centimetres and all angles are in radians.




The diagram shows a circle, centre $O$, radius 8. The points $A$, $B$ and $C$ lie on the circumference of the circle. The chord $AB$ has length 10.

**(a)** Show that angle $BOA$ is 1.35 correct to 2 decimal places. [2]

**(b)** Given that the minor arc $BC$ has a length of 18, find angle $BOC$. [2]

**(c)** Find the area of the minor sector $AOC$. [3]

**3** **(a)** Find the exact solution of the equation $2e^{6x} - 3e^{3x} - 5 = 0$. [3]

**(b)** Solve the following simultaneous equations.

$$e^{4x-7} \div e^{5x+7y} = \frac{1}{e^2}$$

$$xy + 18 = 0$$ [5]

**4** Variables $x$ and $y$ are such that when $e^{4y}$ is plotted against $x$, a straight line of gradient $\frac{2}{5}$, passing through (10, 2), is obtained.

**(a)** Find $y$ in terms of $x$. [3]

**(b)** Find the value of $y$ when $x = 45$, giving your answer in the form $\ln p$. [2]

**(c)** Find the values of $x$ for which $y$ can be defined. [1]

**5** The velocity, $v\,\text{ms}^{-1}$, of a particle moving in a straight line, $t$ seconds after passing through a fixed point $O$, is given by $v = 6\sin 3t$.

**(a)** Find the time at which the acceleration of the particle is first equal to $-9\,\text{ms}^{-2}$. [4]

**(b)** Find the displacement of the particle from $O$ when $t = 5.6$. [4]

**6** **(a)** It is given that

$$f : x \to 2x^2 \quad \text{for } x \geqslant 0,$$

$$g : x \to 2x+1 \quad \text{for } x \geqslant 0.$$

Each of the expressions in the table can be written as one of the following.

$$f' \quad f'' \quad g' \quad g'' \quad fg \quad gf \quad f^2 \quad g^2 \quad f^{-1} \quad g^{-1}$$

Complete the table. The first row has been completed for you. [5]

| Expression | Function notation |
|---|---|
| $2$ | $g'$ |
| $0$ | |
| $4x$ | |
| $8x^2+8x+2$ | |
| $4x+3$ | |
| $\frac{x-1}{2}$ | |

**(b)** It is given that $h(x) = (x-1)^2 + 3$ for $x \geqslant a$. The value of $a$ is as small as possible such that $h^{-1}$ exists.

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

**(ii)** Write down the range of h. [1]

**(iii)** Find $h^{-1}(x)$ and state its domain. [3]

**7** A curve has equation $y = \dfrac{(2x+1)^{\frac{3}{2}}}{x+5}$ for $x \geqslant 0$.

**(a)** Show that $\dfrac{dy}{dx} = \dfrac{(2x+1)^{\frac{1}{2}}}{(x+5)^2}(Ax+B)$, where $A$ and $B$ are integers to be found. [4]

**(b)** Show that there are no stationary points on this curve. [1]

**(c)** Find the approximate change in $y$ when $x$ increases from 1 to $1+p$, where $p$ is small. [2]

**(d)** Given that when $x = 1$ the rate of change in $x$ is 2.5 units per second, find the corresponding rate of change in $y$. [2]

**8** **(a)** A 6-digit number is formed from the digits 0, 1, 2, 5, 6, 7, 8, 9. A number cannot start with 0 and each digit can be used at most once in any 6-digit number.

**(i)** Find how many 6-digit numbers can be formed if there are no further restrictions. [1]

**(ii)** Find how many of these 6-digit numbers are divisible by 5. [3]

**(iii)** Find how many of these 6-digit numbers are greater than 850 000. [3]

**(b)** A team of 8 people is to be chosen from 12 people. Three of the people are brothers who must not be separated. Find the number of different teams that can be chosen. [3]

**9** **(a)** Solve the equation $3\operatorname{cosec}^2\left(2\phi - \frac{\pi}{3}\right) = 4$, for $0 < \phi < \pi$. Give your solutions in terms of $\pi$. [4]

**(b)** Given that $2x - 1 = \operatorname{cosec}^2\theta$ and $y + 1 = \tan^2\theta$, find $y$ in terms of $x$. [4]

**10** **(a)** Show that $\dfrac{6}{2+3x}+\dfrac{4}{(x+1)^2}-\dfrac{2}{x+1}$ can be written as $\dfrac{14x+10}{(2+3x)(x+1)^2}$. [2]

**(b)** Hence find the exact value of $\displaystyle\int_0^2 \frac{14x+10}{(2+3x)(x+1)^2}\,dx$. Give your answer in the form $p+\ln q$, where $p$ and $q$ are rational numbers. [6]

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