Cambridge Assessment International Education

# Cambridge IGCSE™

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| CANDIDATE NAME | | | | | | | | | |
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*6562346474*

**ADDITIONAL MATHEMATICS** **0606/12**

Paper 1 **February/March 2020**

**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. Blank pages are indicated.


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## *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 $\Delta ABC$*

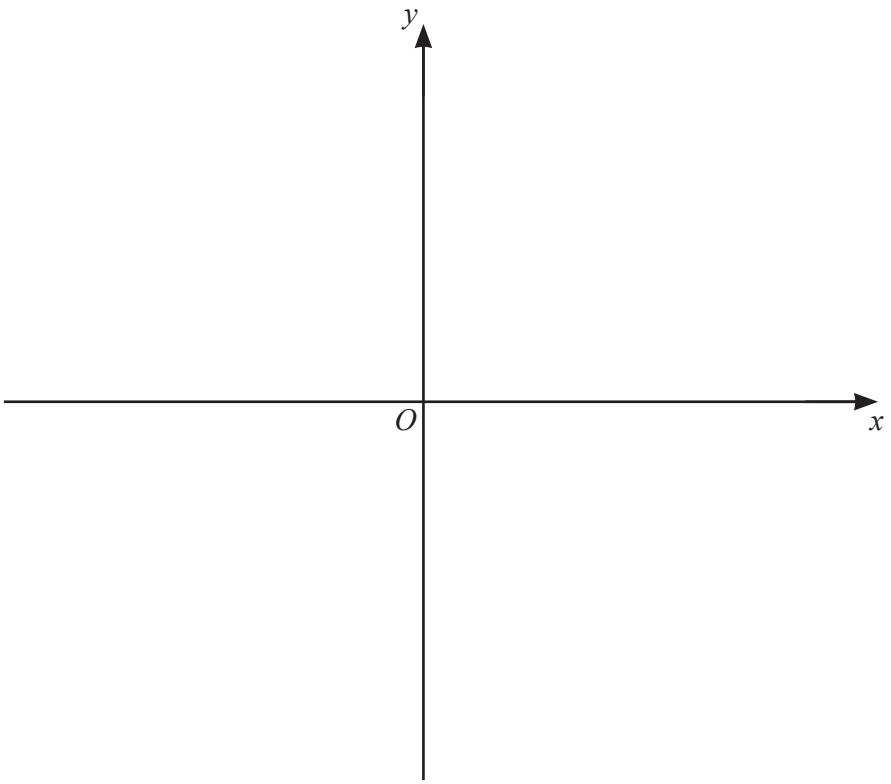
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

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**1** **(a)** On the axes below sketch the graph of $y = -3(x-2)(x-4)(x+1)$, showing the coordinates of the points where the curve intersects the coordinate axes. [3]




**(b)** Hence find the values of $x$ for which $-3(x-2)(x-4)(x+1) > 0$. [2]

**2** Find the values of $k$ for which the line $y = kx + 3$ is a tangent to the curve $y = 2x^2 + 4x + k - 1$. [5]

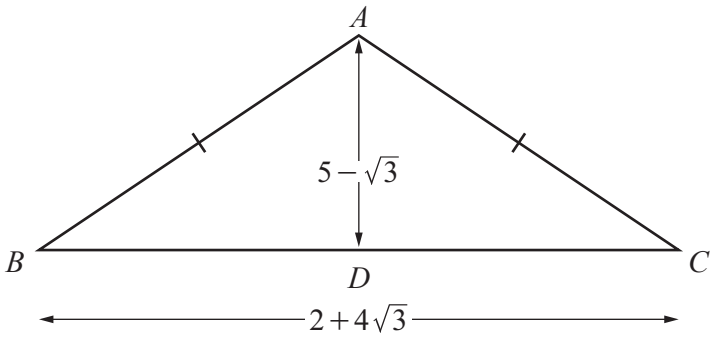
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**3** The first 3 terms in the expansion of $(3-ax)^5$, in ascending powers of $x$, can be written in the form $b-81x+cx^2$. Find the value of each of $a$, $b$ and $c$. [5]

**4** The tangent to the curve $y = \ln\left(3x^2 - 4\right) - \frac{x^3}{6}$, at the point where $x = 2$, meets the $y$-axis at the point $P$. Find the exact coordinates of $P$. [6]

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**5 DO NOT USE A CALCULATOR IN THIS QUESTION.**
In this question all lengths are in centimetres.




The diagram shows the isosceles triangle $ABC$, where $AB = AC$ and $BC = 2+4\sqrt{3}$. The height, $AD$, of the triangle is $5-\sqrt{3}$.

**(a)** Find the area of the triangle $ABC$, giving your answer in the form $a+b\sqrt{3}$, where $a$ and $b$ are integers. [2]

**(b)** Find $\tan ABC$, giving your answer in the form $c+d\sqrt{3}$, where $c$ and $d$ are integers. [3]

**(c)** Find $\sec^2 ABC$, giving your answer in the form $e+f\sqrt{3}$, where $e$ and $f$ are integers. [2]

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**[Turn over**

**6 Solutions by accurate drawing will not be accepted.**

The points $A$ and $B$ have coordinates $(-2, 4)$ and $(6, 10)$ respectively.

**(a)** Find the equation of the perpendicular bisector of the line $AB$, giving your answer in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers. [4]

The point $C$ has coordinates $(5, p)$ and lies on the perpendicular bisector of $AB$.

**(b)** Find the value of $p$. [1]

It is given that the line $AB$ bisects the line $CD$.

**(c)** Find the coordinates of $D$. [2]

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**7** $\mathrm{p}(x) = ax^3 + 3x^2 + bx - 12$ has a factor of $2x + 1$. When $\mathrm{p}(x)$ is divided by $x - 3$ the remainder is 105.

**(a)** Find the value of $a$ and of $b$. [5]

**(b)** Using your values of $a$ and $b$, write $\mathrm{p}(x)$ as a product of $2x + 1$ and a quadratic factor. [2]

**(c)** Hence solve $\mathrm{p}(x) = 0$. [2]

**8** In this question all distances are in km.

A ship $P$ sails from a point $A$, which has position vector $\begin{pmatrix}0\\0\end{pmatrix}$, with a speed of $52\,\text{kmh}^{-1}$ in the direction of $\begin{pmatrix}-5\\12\end{pmatrix}$.

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

**(b)** Write down the position vector of $P$ at a time $t$ hours after leaving $A$. [1]

At the same time that ship $P$ sails from $A$, a ship $Q$ sails from a point $B$, which has position vector $\begin{pmatrix}12\\8\end{pmatrix}$, with velocity vector $\begin{pmatrix}-25\\45\end{pmatrix}\text{kmh}^{-1}$.

**(c)** Write down the position vector of $Q$ at a time $t$ hours after leaving $B$. [1]

**(d)** Using your answers to **parts (b)** and **(c)**, find the displacement vector $\overrightarrow{PQ}$ at time $t$ hours. [1]

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**(e)** Hence show that $PQ = \sqrt{34t^2 - 168t + 208}$. [2]

**(f)** Find the value of $t$ when $P$ and $Q$ are first 2 km apart. [2]

**9** **(a)** **(i)** Find how many different 4-digit numbers can be formed using the digits 2, 3, 5, 7, 8 and 9, if each digit may be used only once in any number. [1]

**(ii)** How many of the numbers found in **part (i)** are divisible by 5? [1]

**(iii)** How many of the numbers found in **part (i)** are odd and greater than 7000? [4]

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**(b)** The number of combinations of $n$ items taken 3 at a time is $92n$. Find the value of the constant $n$. [4]

**10** **(a)** Solve $\tan(\alpha + 45°) = -\frac{1}{\sqrt{2}}$ for $0° \leqslant \alpha \leqslant 360°$. [3]

**(b)** **(i)** Show that $\frac{1}{\sin\theta - 1} - \frac{1}{\sin\theta + 1} = a\sec^2\theta$, where $a$ is a constant to be found. [3]

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**(ii)** Hence solve $\frac{1}{\sin 3\phi - 1} - \frac{1}{\sin 3\phi + 1} = -8$ for $-\frac{\pi}{3} \leqslant \phi \leqslant \frac{\pi}{3}$ radians. [5]

**Question 11 is on the next page.**

**11** Given that $\int_1^a \left(\frac{2}{2x+3} + \frac{3}{3x-1} - \frac{1}{x}\right) \mathrm{d}x = \ln 2.4$ and that $a > 1$, find the value of $a$. [7]

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