Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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.

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

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

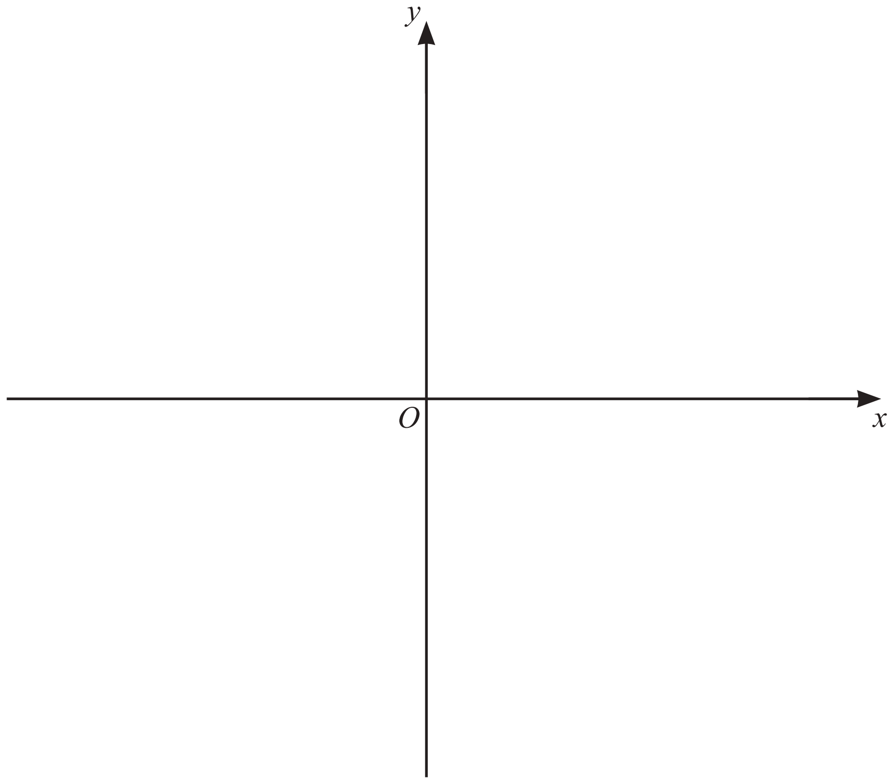
Formulae for ΔABC

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

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

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

1 **(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]



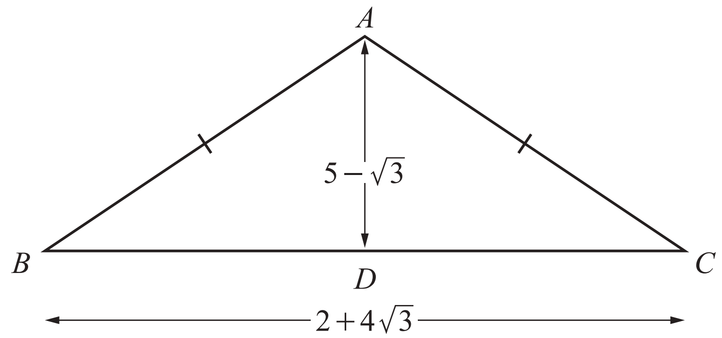
(b) Hence find the values of x for which $-3(x-2)(x-4)(x+1) > 0$. [2]

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]

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]

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]

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]

7 $p(x) = ax^3 + 3x^2 + bx - 12$ has a factor of $2x + 1$. When $p(x)$ 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 $p(x)$ as a product of $2x + 1$ and a quadratic factor. [2]

(c) Hence solve $p(x) = 0$. [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 $52\,\text{km h}^{-1}$ 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 $\begin{pmatrix} -25 \\ 45 \end{pmatrix}\text{km h}^{-1}$.

(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]

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

(f) Find the value of t when P and Q are first $2\,\text{km}$ 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]

(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 $\tan\left(\alpha+45°\right)=-\frac{1}{\sqrt{2}}$ 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]

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

Question 11 is on the next page.

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