Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5963414462

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 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.

DC (PQ/CB) 183935/5

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

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

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

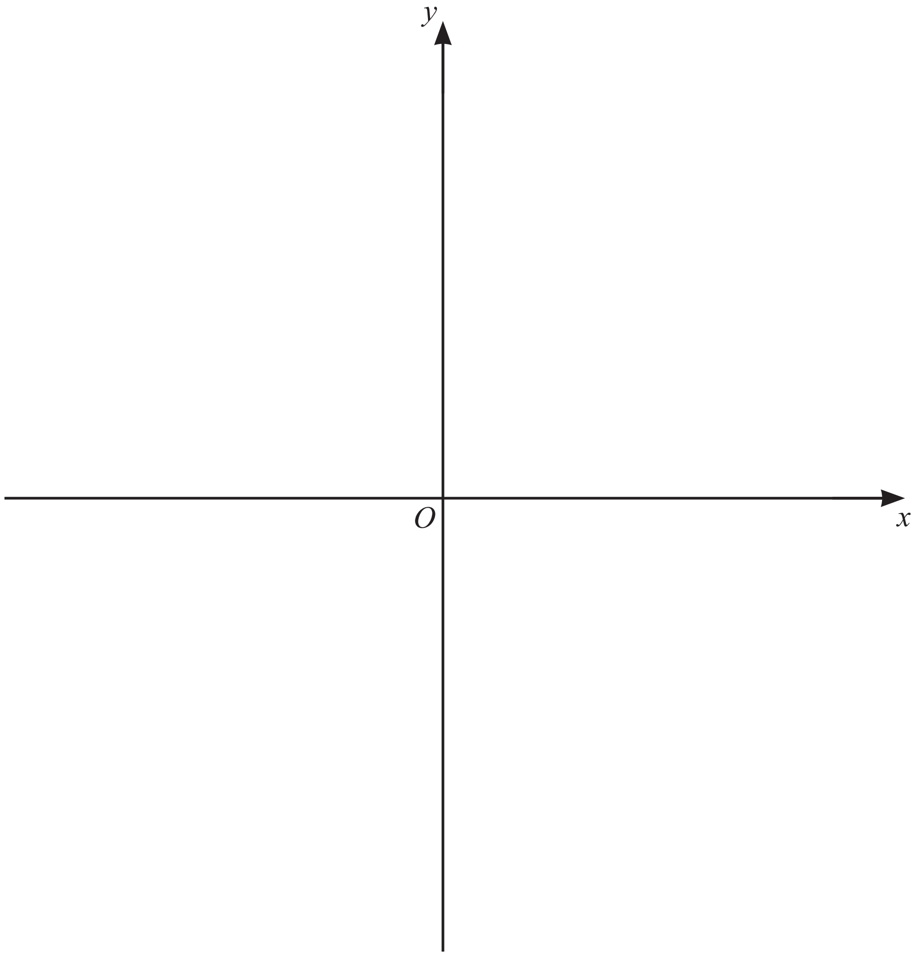
$$\Delta = \frac{1}{2}bc\sin A$$

1 **Solutions to this question by accurate drawing will not be accepted.**

Find the equation of the perpendicular bisector of the line joining the points $(4, -7)$ and $(-8, 9)$. [4]

2 Find the set of values of k for which $4x^2 - 4kx + 2k + 3 = 0$ has no real roots. [5]

3 **(a)** On the axes below, sketch the graph of $y = -(x+2)(x-1)(x-6)$, showing the coordinates of the points where the graph meets the coordinate axes.



[2]

(b) Hence solve $-(x+2)(x-1)(x-6) \leqslant 0$. [2]

4 **(a)** **(i)** Find how many different 5-digit numbers can be formed using five of the eight digits 1, 2, 3, 4, 5, 6, 7, 8 if each digit can be used once only. [2]

(ii) Find how many of these 5-digit numbers are greater than 60 000. [2]

(b) A team of 3 people is to be selected from 4 men and 5 women. Find the number of different teams that could be selected which include at least 2 women. [2]

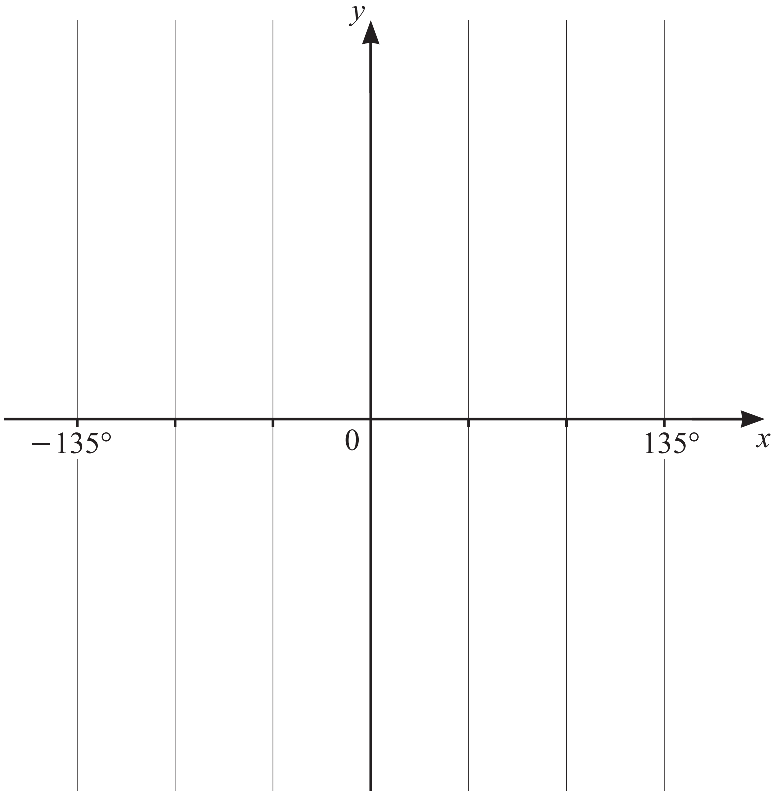
5 DO NOT USE A CALCULATOR IN THIS QUESTION.

(a) Simplify $\frac{\sqrt{128}}{\sqrt{72}}$. [2]

(b) Simplify $\frac{1}{1+\sqrt{3}} - \frac{\sqrt{3}}{3+2\sqrt{3}}$, giving your answer as a fraction with an integer denominator. [4]

6 **(a)** The curve $y = a\sin bx + c$ has a period of 180°, an amplitude of 20 and passes through the point (90°, −3). Find the value of each of the constants a, b and c. [3]

(b) The function g is defined, for $-135° \leqslant x \leqslant 135°$, by $\mathrm{g}(x) = 3\tan\frac{x}{2} - 4$. Sketch the graph of $y = \mathrm{g}(x)$ on the axes below, stating the coordinates of the point where the graph crosses the y-axis. [2]



7 Variables x and y are connected by the relationship $y = Ax^n$, where A and n are constants.

(a) Transform the relationship $y = Ax^n$ to straight line form. [2]

When $\ln y$ is plotted against $\ln x$ a straight line graph passing through the points (0, 0.5) and (3.2, 1.7) is obtained.

(b) Find the value of n and of A. [4]

(c) Find the value of y when $x = 11$. [2]

8 **(a)** Differentiate $y = \tan(x+4) - 3\sin x$ with respect to x. [2]

(b) Variables x and y are such that $y = \dfrac{\ln(2x+5)}{2e^{3x}}$. Use differentiation to find the approximate change in y as x increases from 1 to $1 + h$, where h is small. [6]

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

(a) Find the term independent of x in the binomial expansion of $\left(3x - \frac{1}{x}\right)^6$. [2]

(b) In the expansion of $\left(1 + \frac{x}{2}\right)^n$ the coefficient of x^4 is half the coefficient of x^6. Find the value of the positive constant n. [6]

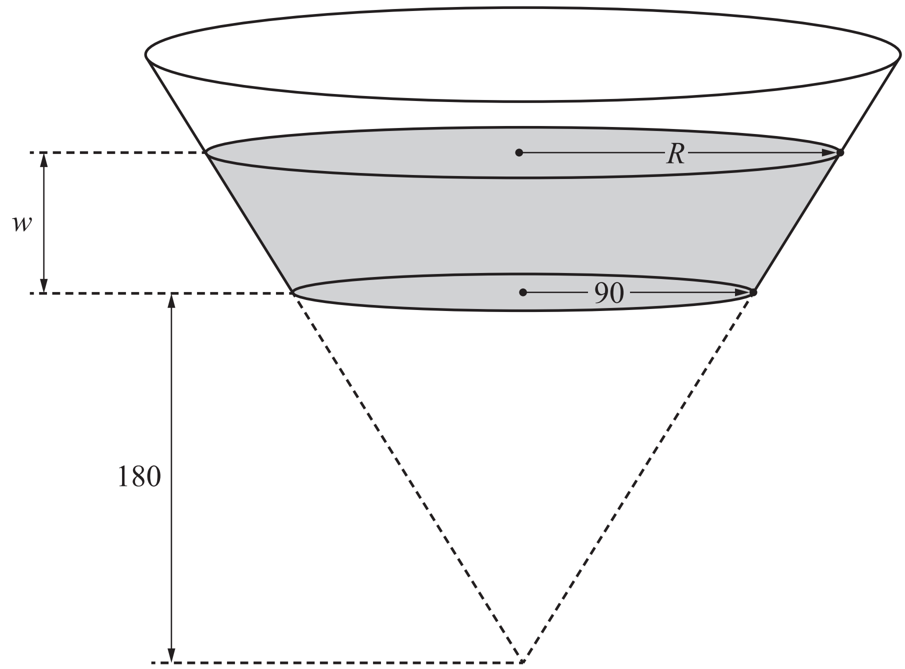
10 Solve the equation

(a) $5\sec^2 A + 14\tan A - 8 = 0$ for $0° \leqslant A \leqslant 180°$, [4]

(b) $5\sin\left(4B - \frac{\pi}{8}\right) + 2 = 0$ for $-\frac{\pi}{4} \leqslant B \leqslant \frac{\pi}{4}$ radians. [4]

11 In this question all lengths are in centimetres.

The volume, V, of a cone of height h and base radius r is given by $V = \frac{1}{3}\pi r^2 h$.



The diagram shows a large hollow cone from which a smaller cone of height 180 and base radius 90 has been removed. The remainder has been fitted with a circular base of radius 90 to form a container for water. The depth of water in the container is w and the surface of the water is a circle of radius R.

(a) Find an expression for R in terms of w and show that the volume V of the water in the container is given by $V = \frac{\pi}{12}(w+180)^3 - 486000\pi$. [3]

(b) Water is poured into the container at a rate of $10\,000\ \text{cm}^3\text{s}^{-1}$. Find the rate at which the depth of the water is increasing when $w = 10$. [4]

12 **(a)** **(i)** Given that $f(x) = \dfrac{1}{\cos x}$, show that $f'(x) = \tan x \sec x$. [3]

(ii) Hence find $\displaystyle\int \left(3 \tan x \sec x - \sqrt[4]{e^{3x}}\right) dx$. [3]

(b) Given that $\int_{2}^{5} \frac{p}{px+10}\,dx = \ln 2$, find the value of the positive constant p. [5]

BLANK PAGE