

Cambridge IGCSE[™]

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

5 9 6 3 4 1 4 4 6 2

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.

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

$$(a+b)^{n} = a^{n} + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^{2} + \dots + \binom{n}{r}a^{n-r}b^{r} + \dots + b^{n}$$

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

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1-r^n)}{1-r} \ (r \neq 1)$$

$$S_{\infty} = \frac{a}{1-r} \ (|r| < 1)$$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\csc^2 A = 1 + \cot^2 A$$

Formulae for $\triangle ABC$

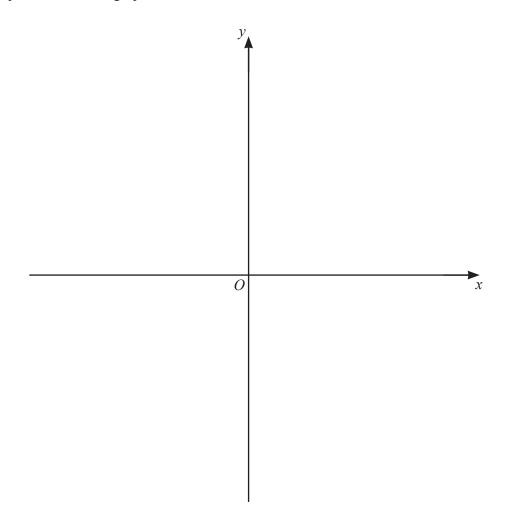
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$\Delta = \frac{1}{2}bc \sin A$$

1	Solutions to	this question	by accurate d	lrawing will not	t be accented.
1	Solutions to	, mis question	DY accurate u	11 a WIII 2 WIII 110	i 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.



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

[2]

4	(a)	(i)	Find how many different 5-digit numbers can be formed using five of the eight of 1, 2, 3, 4, 5, 6, 7, 8 if each digit can be used once only.	ligits [2]
		(ii)	Find how many of these 5-digit numbers are greater than 60 000.	[2]
	(b)		eam of 3 people is to be selected from 4 men and 5 women. Find the number of different to could be selected which include at least 2 women.	eams [2]

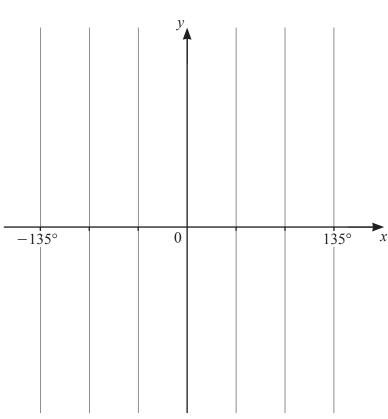
5 DO NOT USE A CALCULATOR IN THIS QUESTION.

(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 $(90^{\circ}, -3)$. Find the value of each of the constants a, b and c.

(b) The function g is defined, for $-135^{\circ} \le x \le 135^{\circ}$, by $g(x) = 3\tan\frac{x}{2} - 4$. Sketch the graph of y = 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 $y = \frac{\ln(2x+5)}{2e^{3x}}$. 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.

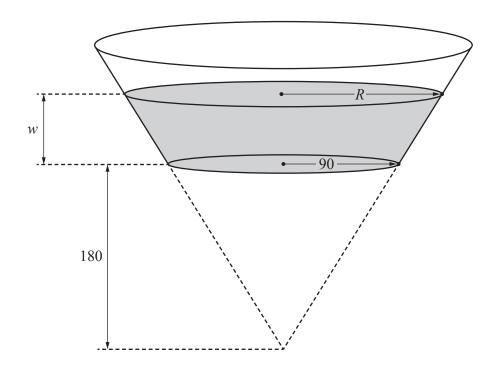
10 Solve the equation

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

(b)
$$5\sin(4B - \frac{\pi}{8}) + 2 = 0$$
 for $-\frac{\pi}{4} \le B \le \frac{\pi}{4}$ 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 $10\,000\,\mathrm{cm}^3\mathrm{s}^{-1}$. Find the rate at which the depth of the water is increasing when w=10.

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

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

(b) Given that $\int_2^5 \frac{p}{px+10} dx = \ln 2$, find the value of the positive constant p. [5]

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