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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER							CANDIDATE NUMBER					

* 6 0 1 4 4 8 2 5 3 5 *

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **October/November 2024**

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.

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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 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 Show that $\tan\theta + \cot\theta$ can be written as $\sec\theta\,\mathrm{cosec}\,\theta$. [3]

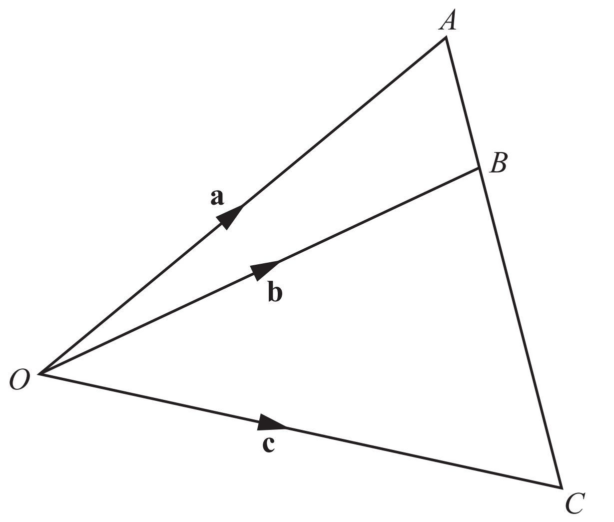
2 **(a)** Given that $y = \tan x - x$, find $\frac{dy}{dx}$. Write your answer in terms of $\tan x$. [2]

(b) Hence find $\int_0^{\frac{\pi}{4}} \tan^2 x \, dx$. Give your answer in exact form. [2]

3 **(a)** Solve the equation $8^{\frac{1}{x}} - 2 \times 8^{-\frac{1}{x}} = 1$. [4]

(b) It is given that $\left(a-\sqrt{3}\right)^2 = b + \left(3-b\right)\sqrt{3}$, where a and b are integers. Find the possible values of a and b. [6]

4



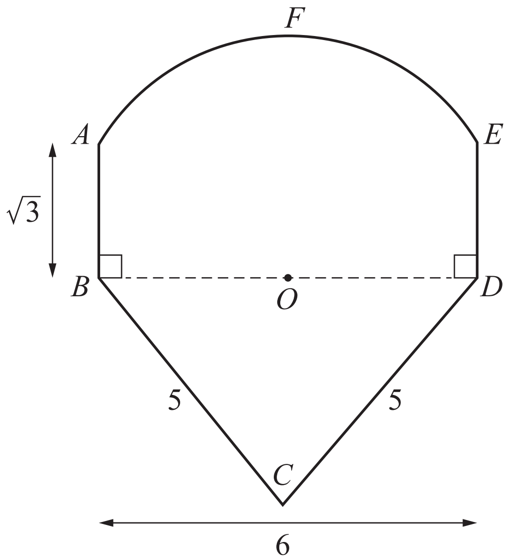
The diagram shows the triangle OAC. The point B lies on AC such that $AB:BC = p:q$, where p and q are constants $(p \neq -q)$.

$$\overrightarrow{OA} = \mathbf{a},\ \overrightarrow{OB} = \mathbf{b} \text{ and } \overrightarrow{OC} = \mathbf{c}.$$

Show that $\mathbf{b} = \dfrac{q\mathbf{a} + p\mathbf{c}}{q + p}$. [5]

5 Given that $\log_a(p+1)+\dfrac{1}{\log_p a}-\log_a(p+2)+\log_a 5=\log_a 12$, find the value of p. [5]

6 In this question all lengths are in metres.



The diagram shows a shape $ABCDEF$.
AB, BD and DE are three sides of a rectangle.
O is the mid-point of BD.
AFE is an arc of a circle whose centre is O.
$AB = \sqrt{3}$, $BC = CD = 5$ and $BD = 6$.

(a) Find the exact value of the perimeter of the shape, giving your answer in terms of π. [5]

(b) Find the exact value of the area of the shape, giving your answer in terms of π. [3]

7 A curve has equation $y = 2x\cos x$. The normal to the curve at $(\pi, -2\pi)$ meets the x-axis and y-axis at points P and Q. Find the exact area of triangle POQ. [7]

8 A particle moves in a straight line so that its displacement from a fixed point O at time t seconds is x metres, where $x = t^3 + t^2 - t + 8$ and $t \geqslant 0$.

(a) Find the time when the particle changes direction. [3]

(b) Show that the particle is moving towards O when $t = 0$. [3]

(c) Find the total distance travelled by the particle during the first 2 seconds of its motion. [4]

9 A curve has equation $y = x^2 - 8x + c$, where c is a constant.

(a) Find the value of c in each of the following cases.

(i) The curve crosses the x-axis at $x = 2$. [1]

(ii) The minimum value of y is 3. [3]

(b) Find the range of values of c for which y is always greater than 0. [2]

10 **(a)** A class contains 7 girls and 8 boys. A group of 6 is selected from the class. The group must contain at least 3 girls and at least 2 boys. Find the number of different groups that can be selected. [3]

(b) A 5-character code is to be formed from the following characters.

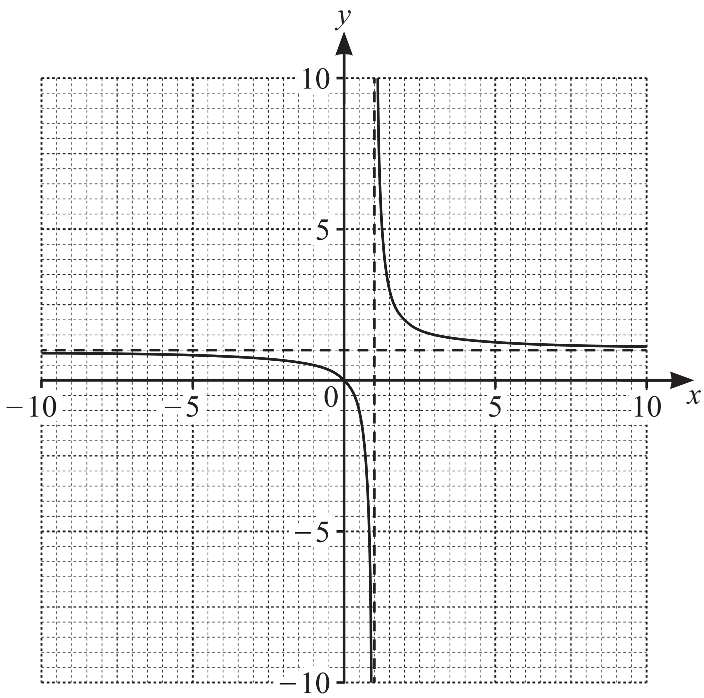
Letters	A	B	C	D	E	F
Numbers	1	2	3			

No character may be used more than once in any code. The characters may be arranged in any order.

Find the number of different codes that can be formed using 4 letters and 1 number. [3]

11 **(a)** $f(x) = \dfrac{x}{x-1}$ for $-10 \leqslant x \leqslant 10,\ x \neq 1$.

The diagram shows the graph of $y = f(x)$.



(i) Use the diagram to explain why f is a function. [1]

(ii) Find $ff(x)$, giving your answer in its simplest form. [2]

(iii) Using your answer to **part (ii)** state the relationship between the functions f and f^{-1}. [1]

(iv) Explain how the diagram shows the relationship between f and f^{-1}. [1]

(b) A function g is defined by $g(x) = \frac{x}{x-1}$ for $x \geqslant 2$. Find the range of g. [1]

(c) A function h is defined by $h(x) = \frac{2x}{3x+1}$ for the largest possible domain. State the domain of h. [1]

Question 12 is printed on the next page.

12 Two arithmetic progressions, A and B, each have 100 terms. Their terms are denoted by $a_1, a_2, a_3, a_4, \dots a_{100}$ and $b_1, b_2, b_3, b_4, \dots b_{100}$ respectively.

It is given that $a_1 = b_{100} = 1$ and $a_{100} = b_1 = 298$.

(a) Find n such that $a_n - b_n = 45$. [6]

(b) Find the smallest m such that $a_m > 2b_m$. [3]