

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

4037/23

October/November 2022

2 hours

You must answer on the question paper.

No additional materials are needed.

- 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.

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

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

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

2. TRIGONOMETRY*Identities*

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

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 Solve the following inequality.

$$(2x + 3)(x - 4) > (3x + 4)(x - 1)$$

[5]

- 2 The tangent to the curve $y = ax^2 - 5x + 2$ at the point where $x = 2$ has equation $y = 7x + b$. Find the values of the constants a and b . [5]

- 3 Solve the equation $\lg(2x - 1) + \lg(x + 2) = 2 - \lg 4$. [5]

4 The line $y = kx + 6$ intersects the curve $y = x^3 - 4x^2 + 3kx + 2$ at the point where $x = 2$.

(a) Find the value of k . [2]

(b) Show that, for this value of k , the line cuts the curve only once. [4]

5 (a) Show that $\frac{\cos x}{1 - \sin x} + \frac{1 - \sin x}{\cos x} = 2 \sec x$. [4]

(b) Hence solve the equation $\frac{\cos \frac{\theta}{2}}{1 - \sin \frac{\theta}{2}} + \frac{1 - \sin \frac{\theta}{2}}{\cos \frac{\theta}{2}} = 8 \cos^2 \frac{\theta}{2}$ for $-360^\circ < \theta < 360^\circ$. [4]

- 6 The first four terms in ascending powers of x in the expansion $(3 + ax)^4$ can be written as $81 + bx + cx^2 + \frac{3}{2}x^3$. Find the values of the constants a , b and c . [6]

- 7 Given that ${}^nC_4 = 13 \times {}^nC_2$, find the value of ${}^nC_8$. [5]

- 8 (a) Particle A starts from the point with position vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ and travels with speed 26 ms^{-1} in the direction of the vector $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$. Find the position vector of A after t seconds. [3]

- (b) At the same time, particle B starts from the point with position vector $\begin{pmatrix} 67 \\ -18 \end{pmatrix}$. It travels with speed 20 ms^{-1} at an angle of α above the positive x -axis, where $\tan \alpha = \frac{3}{4}$. Find the position vector of B after t seconds. [4]

- (c) Hence find the time at which A and B meet, and the position where this occurs. [3]

9 The equation of a curve is $y = kxe^{-2x}$, where k is a constant.

(a) Find $\frac{dy}{dx}$. [2]

(b) Find the coordinates of the stationary point on the curve $y = 10xe^{-2x}$. [3]

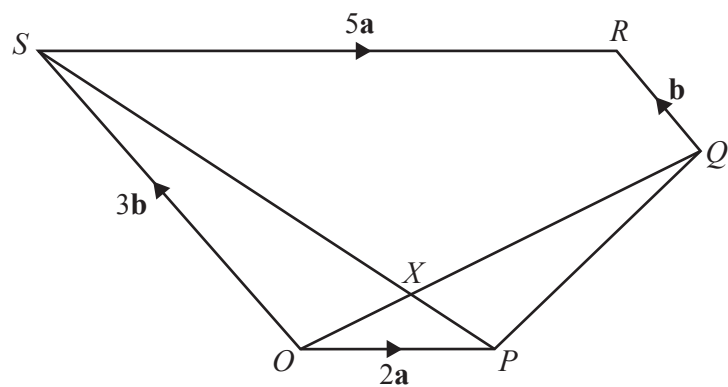
(c) Use your answer to **part (a)** to find $\int 4xe^{-2x} dx$. [3]

(d) Find the exact value of $\int_0^1 4xe^{-2x} dx$. [2]

- 10 (a)** The third term of an arithmetic progression is 10 and the sum of the first 8 terms is 116. Find the first term and common difference. [5]

- (b) Find the sum of nineteen terms of the progression, starting with the twelfth term. [4]

11



In the vector diagram, $\vec{OP} = 2\mathbf{a}$, $\vec{SR} = 5\mathbf{a}$, $\vec{OS} = 3\mathbf{b}$ and $\vec{QR} = \mathbf{b}$.

(a) Given that $\vec{PX} = \lambda \vec{PS}$, write $\vec{OX}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and λ .

[3]

(b) Given that $\vec{OX} = \mu \vec{OQ}$, write $\vec{OX}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and μ .

[2]

(c) Find the values of λ and μ .

[4]

(d) Write down the value of $\frac{OX}{OQ}$.

[1]

(e) Find the value of $\frac{PX}{XS}$.

[1]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.