

Surname	Centre Number	Candidate Number
First name(s)		2



GCE A LEVEL

1300U30-1



S24-1300U30-1

TUESDAY, 4 JUNE 2024 – MORNING

MATHEMATICS – A2 unit 3
PURE MATHEMATICS B

2 hours 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a Formula Booklet;
- a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The maximum mark for this paper is 120.

The number of marks is given in brackets at the end of each question or part-question.

Sufficient working must be shown to demonstrate the **mathematical** method employed.

Answers without working may not gain full credit.

Unless the degree of accuracy is stated in the question, answers should be rounded appropriately.

You are reminded of the necessity for good English and orderly presentation in your answers.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	11	
2	11	
3	7	
4	6	
5	4	
6	13	
7	7	
8	7	
9	9	
10	14	
11	10	
12	6	
13	3	
14	7	
15	5	
Total	120	

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- [4]



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- [5]



[6]

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- The diagram shows a circular sector with vertex O and radii OA and OB . The radius OA is labeled r . The arc length AB is labeled 5 cm . The region between the arc AB and the arc ADC is shaded gray. The points A and B are on the inner arc, and D and C are on the outer arc. The center of the circle is O .

[4]



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[3]



4. A function f is given by $f(x) = |3x + 4|$.

- (a) Sketch the graph of $y = f(x)$. Clearly label the coordinates of the point A , where the graph meets the x -axis, and the coordinates of the point B , where the graph cuts the y -axis. [3]

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- (b) On a separate set of axes, sketch the graph of $y = \frac{1}{2}f(x) - 6$, where the points A and B are transformed to the points A' and B' .
Clearly label the coordinates of the points A' and B' . [3]

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5. Prove by contradiction the following proposition:

When x is real and positive, $x + \frac{81}{x} \geq 18$.

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6. (a) Differentiate $\cos x$ from first principles.

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(b) Differentiate $e^{3x}\sin 4x$ with respect to x .

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7. Showing all your working, evaluate

(a) $\sum_{r=3}^{50} (4r + 5),$

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(b) $\sum_{r=2}^{\infty} \left(540 \times \left(\frac{1}{3} \right)^r \right).$

[3]



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(c) Explain why the Newton-Raphson method does not work if $x_0 = \frac{1}{3}$. [2]

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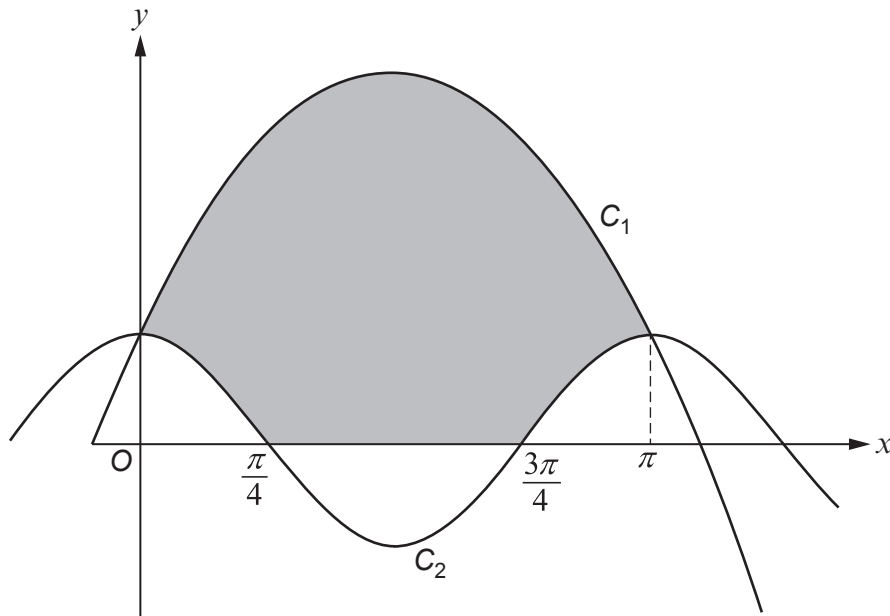
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9. The diagram below shows a sketch of the curve C_1 with equation $y = -x^2 + \pi x + 1$ and a sketch of the curve C_2 with equation $y = \cos 2x$. The curves intersect at the points where $x = 0$ and $x = \pi$.



Calculate the area of the shaded region enclosed by C_1 , C_2 and the x -axis. Give your answer in terms of π . [9]





$$f(x) = \frac{2(3x+1)}{x^2-2x-3} + \frac{x}{x+1}.$$


- (c) Find an expression for $f^{-1}(x)$ and write down the domain and range of f^{-1} . [4]

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- (d) Find the value of x when $f(x) = f^{-1}(x)$. [4]

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$$x = 2\theta + \sin 2\theta, \quad y = 1 + \cos 2\theta.$$

(a) Show that the gradient of the curve at the point with parameter θ is $-\tan \theta$. [6]



[4]

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

12. (a) Given that θ is small, show that $2\cos\theta + \sin\theta - 1 \approx 1 + \theta - \theta^2$.

[2]

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- (b) Hence, when θ is small, show that

$$\frac{1}{2\cos\theta + \sin\theta - 1} \approx 1 + a\theta + b\theta^2,$$

where a, b are constants to be found.

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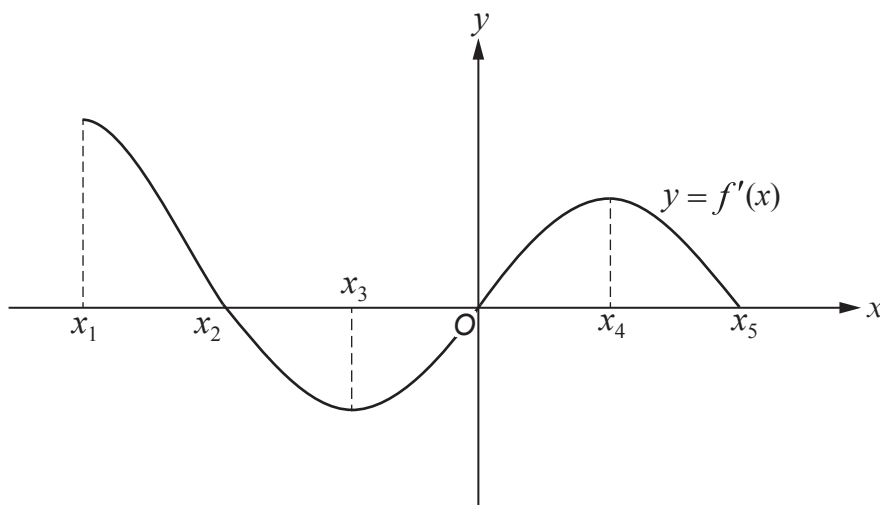
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13. The diagram below shows a sketch of the graph of $y = f'(x)$ for the interval $[x_1, x_5]$.



- (a) Find the interval on which $f(x)$ is both decreasing and convex. Give reasons for your answer. [2]

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- (b) Write down the x -coordinate of a point of inflection of the graph of $y = f(x)$. [1]

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14. (a) Given that $y = \frac{1 + \ln x}{x}$, show that $\frac{dy}{dx} = \frac{-\ln x}{x^2}$. [2]

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- (b) Hence, solve the differential equation

$$\frac{dx}{dt} = \frac{x^2 t}{\ln x},$$

given that $t = 3$ when $x = 1$.

Give your answer in the form $t^2 = g(x)$, where g is a function of x . [5]

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- After n years, account A is more profitable than account B . Find the smallest value of n . [5]



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