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Mathematics: analysis and approaches

Standard level

Paper 1

14 May 2026

Zone A afternoon | Zone B afternoon | Zone C afternoon

Session number

1 hour 30 minutes

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Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: analysis and approaches SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.



Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

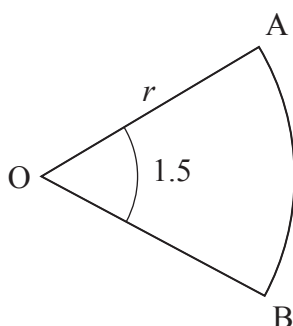
Section A

Answer **all** questions. Answers must be written within the answer boxes provided. Working may be continued below the lines, if necessary.

1. [Maximum mark: 6]

A sector AOB of radius r cm, where $\hat{AOB} = 1.5$ radians, is shown in the following diagram.

diagram not to scale



- (a) (i) Find an expression for the length of arc AB in terms of r .
- (ii) Hence, find an expression for the perimeter of sector AOB in terms of r . [2]
- (b) Given that the perimeter of the sector AOB is 14 cm, find the value of r . [2]
- (c) Hence, find the area of sector AOB. [2]

(This question continues on the following page)



(Question 1 continued)

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12EP03

Turn over

2. [Maximum mark: 5]

Consider the function $f(x) = x^2 + 6x + 25$, where $x \in \mathbb{R}$.

(a) Express $f(x)$ in the form $(x + p)^2 + q$, where $p, q \in \mathbb{Z}$. [2]

(b) Write down the coordinates of the vertex on the graph of $y = f(x)$. [2]

(c) Hence, determine the minimum value of $\sqrt{x^2 + 6x + 25}$. [1]

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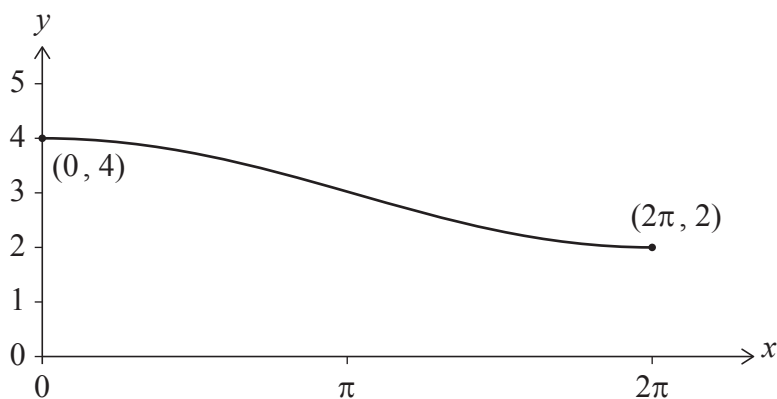
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3. [Maximum mark: 6]

Consider the function $f(x) = 3 + \cos bx$ for $0 \leq x \leq 2\pi$, where $b \in \mathbb{R}^+$.

The graph of $y = f(x)$ is shown in the following diagram.



The points $(0, 4)$ and $(2\pi, 2)$ are the maximum and minimum points, respectively, on the graph of $y = f(x)$.

(a) Show that $b = \frac{1}{2}$. [1]

(b) Find the area enclosed by the graph of $y = f(x)$, the coordinate axes and the line $x = 2\pi$. [5]

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4. [Maximum mark: 6]

The functions f and g are defined by

$$f(x) = x^2 + 5x, \quad x \in \mathbb{R}$$

$$g(x) = e^x - 10, \quad x \in \mathbb{R}.$$

(a) Show that $(f \circ g)(x) = e^{2x} - 15e^x + 50$. [2]

(b) Hence, find the value of x for which $(f \circ g)(x) = 50$. [4]

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Consider

(b) Hence, write down the value of $\sum_{n=2}^{2026} \ln \left(1 - \frac{1}{n} \right)$. [1]

[illegible]

6. [Maximum mark: 6]

Consider the function $g(x) = \sqrt{2x+5}$, where $x \geq -\frac{5}{2}$.

(a) Find $g'(x)$. [3]

The line L is a tangent to the graph of $y = g(x)$ at $x = -1$.

(b) Find the acute angle between the line L and the x -axis. [3]

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Do **not** write solutions on this page.

Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

7. [Maximum mark: 14]

The function f is defined by $f(x) = \frac{4x-9}{2x-5}$, where $x \in \mathbb{R}$, $x \neq \frac{5}{2}$.

- (a) Find the value of
 - (i) the y -intercept;
 - (ii) the x -intercept. [2]
- (b) Find the equations of all the asymptotes of the graph of $y = f(x)$. [2]
- (c) Sketch the graph of $y = f(x)$, clearly showing all features found in parts (a) and (b). [2]
- (d) Find the inverse function, $f^{-1}(x)$, and state its domain. [4]
- (e) Hence, find the value(s) of x that satisfy $f(x) = f^{-1}(x)$. [4]



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8. [Maximum mark: 16]

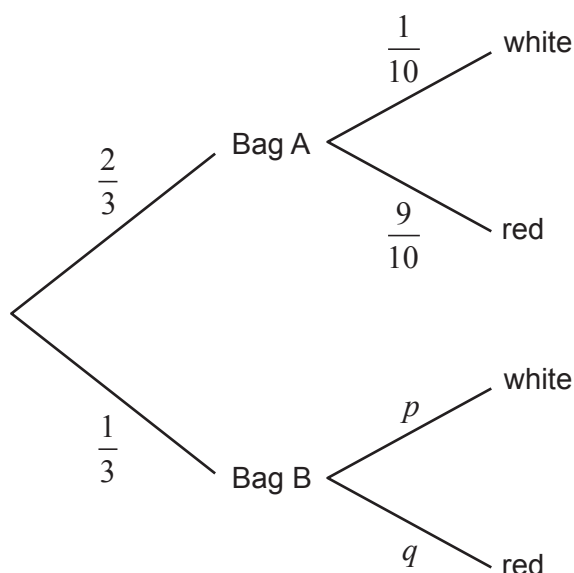
A game is played where a biased coin is tossed and then a ball is drawn from one of two bags. If the player obtains a head, then a ball is drawn from Bag A, otherwise a ball is drawn from Bag B.

The probability of obtaining a head is $\frac{2}{3}$.

Bag A contains 1 white ball and 9 red balls.

Bag B contains 4 white balls and 6 red balls.

This is shown in the following tree diagram.



- (a) Write down the value of p and the value of q . [2]
- (b) Show that the probability of drawing a white ball is $\frac{1}{5}$. [2]
- (c) Given that a white ball is drawn, calculate the probability that it came from Bag A. [3]

(This question continues on the following page)



Do **not** write solutions on this page.

(Question 8 continued)

Cayley plays three rounds of this game. In each round the colour of the ball is noted and replaced into the bag it came from.

In each round, Cayley scores 3 points if she draws a white ball and 1 point if she draws a red ball.

The random variable X denotes Cayley's total possible score after three rounds. The following table shows part of the probability distribution for X .

x	3	5	7	9
$P(X = x)$	$\frac{64}{125}$		$\frac{12}{125}$	

(d) (i) Find $P(X = 9)$.

(ii) Find $P(X = 5)$.

[4]

(e) Interpret in context the most likely outcome of X .

[1]

Cayley calculates that if she played three rounds of the game every day for n days her expected total score would be 105.

(f) Find the value of n .

[4]



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9. [Maximum mark: 15]

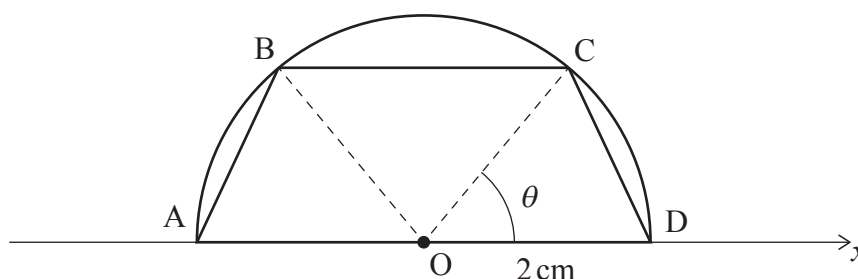
A trapezoid ABCD is inscribed in a semicircle centred at O, of radius 2 cm.

The longer parallel side [AD] is along the diameter of the semicircle.

The trapezoid is defined by the angle, θ , when the radius is rotated anticlockwise (counterclockwise) from the positive x -axis where $0 < \theta < \frac{\pi}{2}$.

This is shown in the following diagram.

diagram not to scale



The area of the trapezoid can be considered as the sum of the area of three triangles.

- (a) Find the area of the trapezoid when $\theta = \frac{\pi}{6}$. [4]
- (b) Find an expression for the area of the trapezoid $A(\theta)$, in terms of θ . Give your answer in the form $a \sin \theta + b \sin 2\theta$, where $a, b \in \mathbb{Z}^+$. [3]
- (c) (i) Find $A'(\theta)$.
(ii) Hence, find the maximum possible area of the trapezoid. [6]

Consider the case when θ approaches $\frac{\pi}{2}$.

- (d) (i) Describe the effect on the shape of ABCD.
(ii) The area of ABCD approaches the value k . Find the value of k . [2]

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