



Mathematics: analysis and approaches Standard level Paper 1

15 May 2025

Zone A afternoon | Zone B afternoon | Zone C afternoon

Candidate session number

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1 hour 30 minutes

Instructions to candidates

- 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]**.

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5. [Maximum mark: 6]

Consider events A and B such that $P(A') = P(A \cup B) = \frac{3}{4}$ and $P(B|A) = \frac{2}{3}$.

(a) Find $P(A \cap B)$. [3]

(b) Show that events A and B are independent. [3]

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Section B

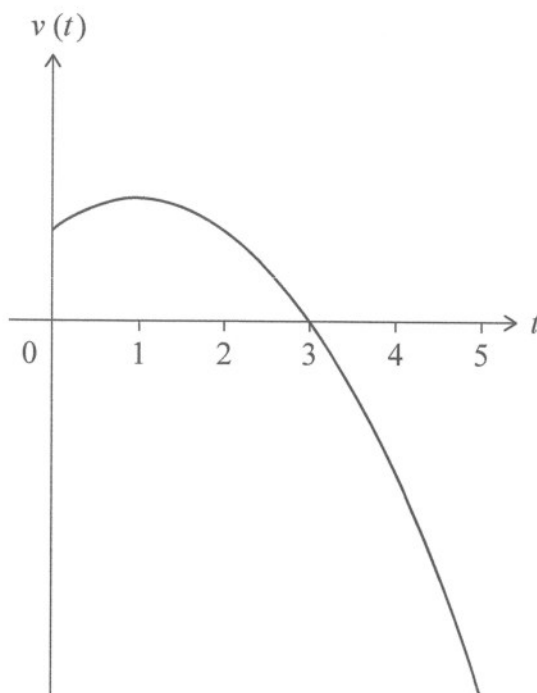
Answer **all** questions in the answer booklet provided. Please start each question on a new page.

7. [Maximum mark: 13]

An object moves in a straight line.

Its velocity $v \text{ m s}^{-1}$, at time t seconds, is given by $v(t) = 30 + 20t - 10t^2$ for $0 \leq t \leq 5$.

The graph of v is shown in the following diagram.



The graph of v has a local maximum point where $t = 1$ and intersects the t -axis at $t = 3$.

(a) Determine the object's

- (i) maximum velocity;
- (ii) maximum speed.

[4]

At $t = T$, the object changes direction.

(b) (i) Write down the value of T .

(ii) Find the distance travelled by the object in the first T seconds.

[5]

(c) Determine whether the object returns to its initial position during the time period $0 \leq t \leq 5$, justifying your answer.

[4]

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8. [Maximum mark: 15]

The function f is defined by $f(x) = 5(x + 1)(x + 3)$, where $x \in \mathbb{R}$.

- (a) Write $f(x)$ in the form $a(x - h)^2 + k$, where $a, h, k \in \mathbb{Z}$. [4]
- (b) Sketch the graph of $y = f(x)$, showing the values of any intercepts with the axes and the coordinates of the vertex. [4]
- (c) Solve the inequality $f(x) \leq 40$. [4]

The function g is defined by $g(x) = \ln x$, where $x \in \mathbb{R}, x > 0$.

- (d) (i) Write down an expression for $(f \circ g)(x)$.
- (ii) Solve the inequality $(f \circ g)(x) \leq 40$. [3]

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9. [Maximum mark: 17]

A solid cylinder has height h cm and base radius R cm.

The cylinder fits exactly inside a hollow sphere of radius r cm.

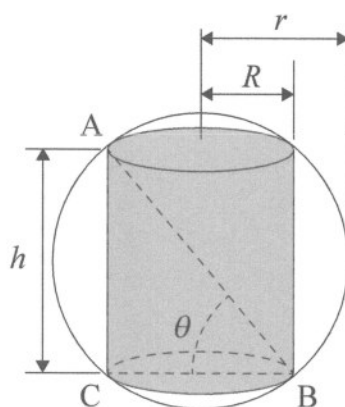
Points A, B and C are points where the surface of the cylinder touches the surface of the sphere.

The line segment [AB] is a diameter of the sphere.

The line segment [BC] is a diameter of the base of the cylinder and $\hat{A}BC = \theta$.

This information is shown on the following diagram.

diagram not to scale



- (a) (i) By considering triangle ABC, show that $R = r \cos \theta$.
- (ii) Find an expression for h in terms of r and θ . [4]

- (b) Hence or otherwise, show that the total surface area, S cm², of the cylinder is given by $S = 2\pi r^2(1 + 2 \sin \theta \cos \theta - \sin^2 \theta)$. [4]

The external surface area of the sphere is $2S$.

- (c) Show that $\tan \theta = 2$. [4]

The volume of the cylinder is V cm³.

- (d) Find V , giving your answer in the form $p\pi r^3\sqrt{5}$, where $p \in \mathbb{Q}^+$. [5]

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will not be marked.

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