Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics: analysis and approaches
Standard level
Paper 2

15 May 2026

Zone A morning | **Zone B** morning | **Zone C** morning

Session number

1 hour 30 minutes

Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required 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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Please **do not** write on this page.

Answers written on this page
will not be marked.

A001

Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Solutions found from a graphic display calculator should be supported by suitable working. For example, if graphs are used to find a solution, you should sketch these as part of your answer. 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: 5]

Eight students run a 400-metre race. Their race time, T, and the length, L, of their legs are shown in the table.

Leg length (L cm)	85	82	78	91	76	84	80	88
Race time (T seconds)	65.2	67.3	70.0	60.8	72.5	66.1	68.9	62.4

The equation of the regression line of T on L for this data can be written in the form $T = aL + b$.

(a) Find the value of a and the value of b. [2]

(b) Write down the value of the Pearson's product-moment correlation coefficient, r. [1]

(c) Use the equation of the regression line of T on L to predict the time of a student with a leg length of $79\,\text{cm}$. [2]

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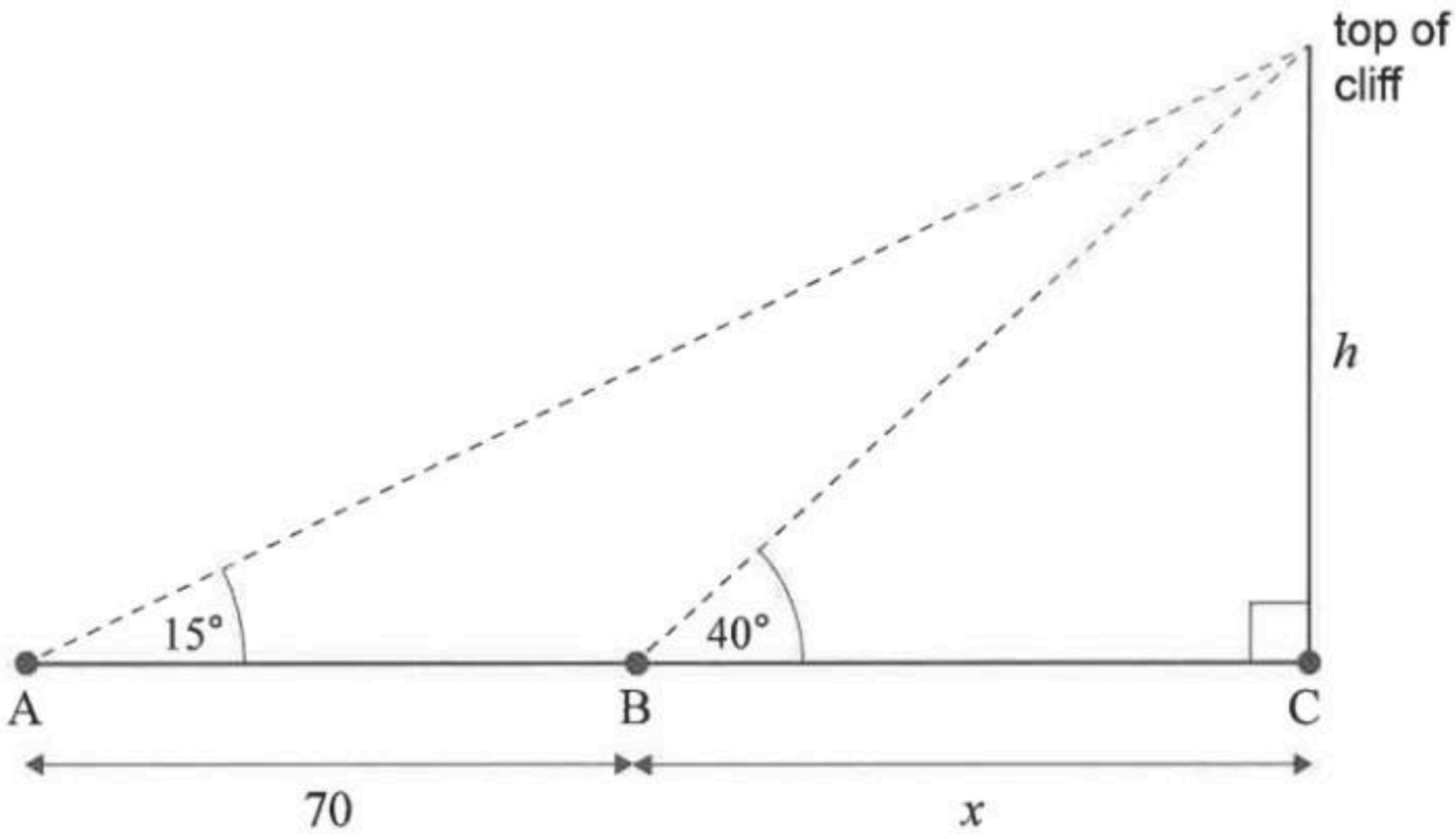
2. [Maximum mark: 6]

A ship is sailing directly towards a vertical cliff of height h metres.

diagram not to scale



When the ship is at point A, the angle of elevation to the top of the cliff is $15°$. After sailing a further 70 metres towards the cliff, the ship reaches point B, and the angle of elevation to the top of the cliff is $40°$.

Point C is at the base of the cliff, and $BC = x$ metres.

(a) Find an expression in terms of h and x for

(i) $\tan 40°$;

(ii) $\tan 15°$. [2]

(b) Hence, find the value of x. [2]

(c) Find the value of h. [2]

(This question continues on the following page)

(Question 2 continued)

3. [Maximum mark: 5]

The volume of air inside a balloon, V, measured in cubic metres, after t minutes is given by

$V = 5 + 20e^{-kt}$, where $t \geq 0$ and k is a positive constant.

(a) Write down the initial volume of air inside the balloon. [1]

After 4 minutes, the volume of air inside the balloon is half the initial volume.

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

(c) Find the time at which the volume of air inside the balloon is 8 cubic metres. [2]

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4. [Maximum mark: 6]

The following table shows the probability distribution of a discrete random variable X, for $1 \leq X \leq 6$, such that

$$\mathrm{P}(X=1)=k \text{ and } \mathrm{P}(X=r+1)=\frac{1}{2}\mathrm{P}(X=r),$$

where $r \in \mathbb{Z}^+$, $1 \leq r \leq 5$ and $k \in \mathbb{R}$.

x	1	2	3	4	5	6
$\mathrm{P}(X=x)$	k	a	$\frac{8}{63}$	$\frac{k}{8}$	b	$\frac{1}{63}$

(a) Write down an expression in terms of k for

(i) a;

(ii) b. [2]

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

(c) Hence, find the value of $\mathrm{E}(X)$. [2]

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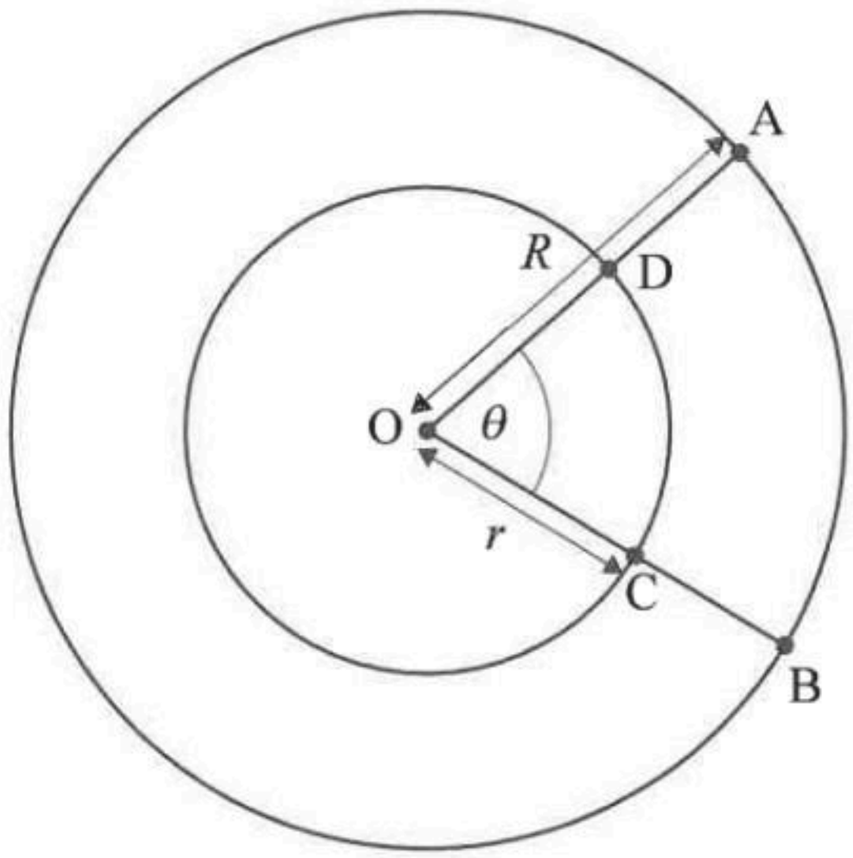
5. [Maximum mark: 7]

Two circles have a common centre, O. Points A and B lie on the circumference of the larger circle, which has radius $OA = R$. Points C and D lie on [OB] and [OA] respectively, and they also lie on the circumference of the smaller circle. The smaller circle has radius $OC = r$ and the acute angle $D\hat{O}C = A\hat{O}B = \theta$ radians.

This is shown in the following diagram.

diagram not to scale



The area of the sector OAB is $50\,\text{cm}^2$ and its perimeter is $40\,\text{cm}$. The area of the sector ODC is $18\,\text{cm}^2$.

(a) Find the value of θ. [5]

(b) Hence, find the value of r. [2]

6. [Maximum mark: 7]

A particle moves along a straight line with an initial displacement at O. Its velocity, $v\,\mathrm{m\,s^{-1}}$, at time t seconds is given by

$$v(t) = (3t^2 - 10t + 4)\mathrm{e}^{-0.5t} - 4\cos t, \text{ where } 0 \leq t \leq 6.$$

(a) Find the maximum displacement of the particle. [4]

(b) Determine the intervals of time when the acceleration of the particle is negative. [3]

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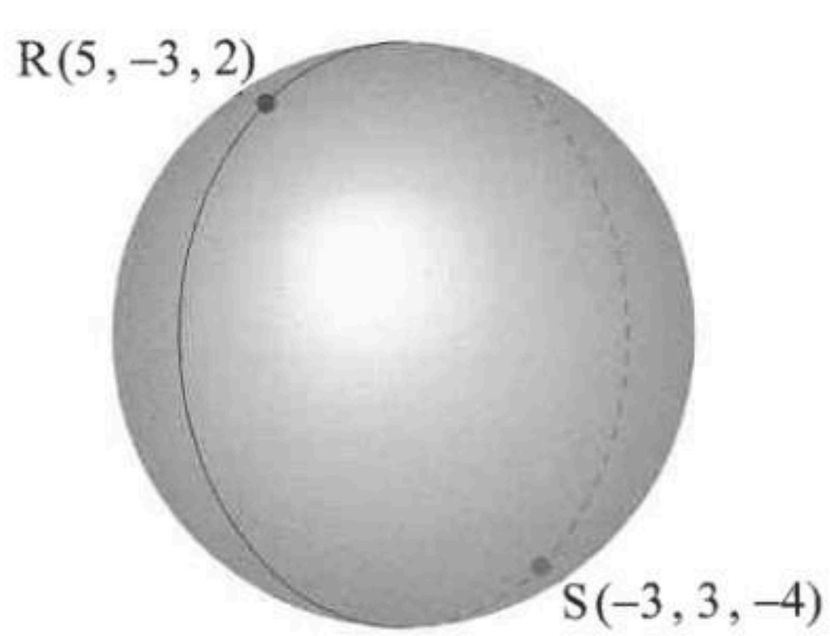
Section B

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

7. [Maximum mark: 15]

All lengths in this question are in metres.

A sphere has diameter $[RS]$, where $R(5, -3, 2)$ and $S(-3, 3, -4)$.



(a) Determine

(i) the coordinates of the centre of the sphere;

(ii) the radius of the sphere. [4]

(b) Find the volume of the sphere. [2]

A cuboid has a rectangular base of length x, width x^2 and height y. The cuboid has a volume of 1000 cubic metres and surface area A.

(c) (i) Write down an equation for the volume of the cuboid in terms of x and y.

(ii) Show that $A = 2\left(x^3 + \frac{1000}{x} + \frac{1000}{x^2}\right)$. [4]

The surface area has a minimum value when $x = k$.

(d) (i) Find the minimum value of A.

(ii) Find the value of $\frac{d^2A}{dx^2}$ when $x = k$.

(iii) Use your answer to part (d)(ii) to justify that A is a minimum when $x = k$. [5]

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

8. [Maximum mark: 14]

The waiting time, T minutes, of patients at a clinic can be modelled by a normal distribution with mean μ and standard deviation σ. The waiting times of all patients are independent of each other.

3.8% of the patients have a waiting time of less than 20 minutes, while 7.3% of the patients have a waiting time of more than 30 minutes.

(a) (i) Find the value of μ and the value of σ.

(ii) Hence, find the probability that a patient chosen at random has a waiting time of between 15 and 22 minutes. [7]

The doctor at the clinic only sees patients with an appointment.

Records show that 82.6% of patients attend their appointment.

The probability of a patient attending their appointment is independent of any other patient.

(b) On a particular day, 20 patients each made an appointment to see the doctor.

(i) Find the probability that at least 13 of these patients attended their appointment.

(ii) Given that at least 13 of these patients attended their appointment, find the probability that more than 2 patients did not attend their appointment. [7]

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

9. [Maximum mark: 15]

The geometric sequence $a_1, a_2, a_3, \ldots$ has common ratio r.
The sum to infinity, A_∞, of this sequence is 5.

(a) Find an expression for a_1 in terms of r. [1]

A second geometric sequence $a_1^2, a_2^2, a_3^2, \ldots$ has common ratio q.

(b) Show that $q = r^2$. [2]

The sum to infinity, B_∞, of this second sequence is 16.

(c) (i) Show that $41r^2 - 50r + 9 = 0$.

(ii) Find the value of r.

(iii) Hence, find the value of a_1. [5]

A third sequence has its nth term given by $c_n = \log_k(a_n) + k$, where $k \in \mathbb{Z}^+$, $k > 1$.

(d) Show that this third sequence is arithmetic. [4]

Let C_{20} denote the sum of the first 20 terms of the third sequence.

(e) Find the maximum value of k such that $C_{20} < 0$. [3]