

© International Baccalaureate Organization 2026

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2026

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2026

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Mathematics: analysis and approaches
Higher level
Paper 1

14 May 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Session number

2 hours

--	--	--	--	--	--	--	--	--	--

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 HL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[110 marks]**.



Section A

This image shows a full page of white paper with horizontal dotted lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

2. [Maximum mark: 5]

A particle P is travelling along a straight line, with displacement measured relative to a point O on the line. The velocity, $v \text{ m s}^{-1}$, of the particle at time t seconds is given by

$$v = \frac{1}{t+1} + e^{-t}, \text{ where } t \geq 0.$$

(a) Find $\int \left(\frac{1}{t+1} + e^{-t} \right) dt$. [2]

Initially the particle is at O .

(b) Find an expression for the displacement, s metres, in terms of t . [3]

[illegible]

3. [Maximum mark: 6]

Consider a geometric sequence, u_n , with common ratio r , where each term in the sequence is positive.

It is given that $u_6 = 1.6 \times 10^5$ and $u_8 = 6.4 \times 10^5$.

(a) Find the value of r . [3]

(b) Find the value of u_1 , giving your answer in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



4. [Maximum mark: 7]

(a) Show that $\log_{25}(81x^2) = \log_5 9 + \log_5 x$ for $x > 0$. [4]

(b) Hence, solve the equation $\log_5 \sqrt[3]{x} = \log_{25}(81x^2) - \log_5 4$, where $x > 0$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



Please **do not** write on this page.

Answers written on this page
will not be marked.



5. [Maximum mark: 9]

Consider two events, A and B .

It is given that $P(A \cap B') = \frac{5+x}{24}$, $P(A \cap B) = \frac{7-x}{12}$ and $P(A' \cap B) = \frac{1}{6}$, where $0 \leq x \leq 7$.

- (a) Show that $P(A) = \frac{19-x}{24}$. [3]

It is given that A and B are independent.

- (b) Find the possible values of x . [6]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

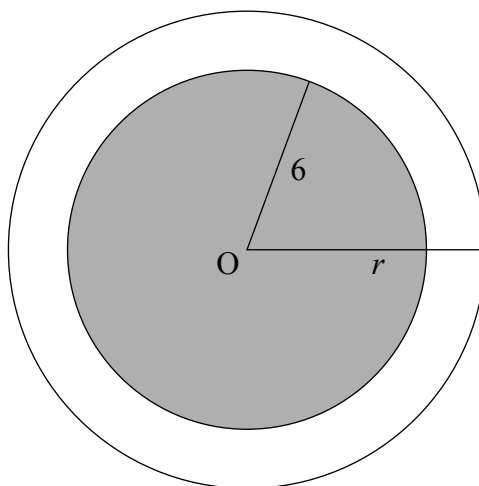
.....



6. [Maximum mark: 4]

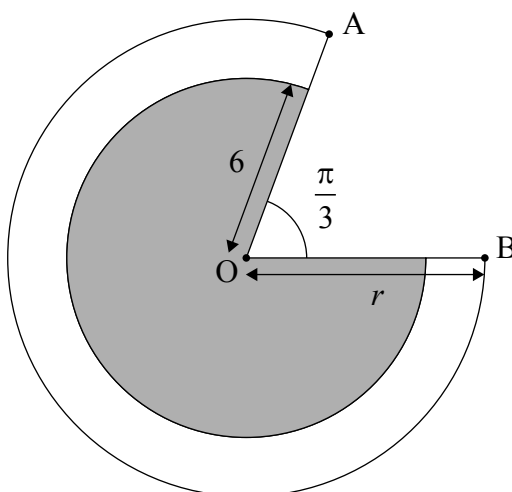
Consider a piece of paper in the shape of a circle with centre O and radius r cm, where $r > 6$. A second circle with centre O and radius 6 cm is drawn inside the first and shaded, as shown in the following diagram.

diagram not to scale



The points A and B are on the circumference of the larger circle such that the acute angle $\angle AOB = \frac{\pi}{3}$. The paper is cut along the lines AO and BO and the sector AOB with a central angle of $\frac{\pi}{3}$ is removed as shown on the following diagram.

diagram not to scale



(This question continues on the following page)



(Question 6 continued)

After removing the sector, it is now given that

$$\frac{\text{the area of the unshaded region}}{\text{the area of the shaded region}} = \frac{2}{3}.$$

Find the value of r , giving your answer in the form $\sqrt{k}$, where $k \in \mathbb{Z}$.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



7. [Maximum mark: 6]

Reyn is investigating the fertility of a group of adult female foxes.

He has developed a clinical test that aims to identify whether or not a given fox is pregnant, and he wants to evaluate the reliability of this test.

Reyn knows that

- 40% of the foxes in the group are pregnant
- if a fox is pregnant, the probability that it will test positive is 90%
- if a fox is not pregnant, the probability it will test positive is 20%.

(a) Find the probability that a randomly selected fox from the group will test positive. [3]

(b) Find the probability that a randomly selected fox from the group is pregnant, given that it tested positive. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



8. [Maximum mark: 8]

Consider the polynomial $p(z) = 3z^5 - 7z^4 + cz^3 + dz^2 + ez - 26$, where $z \in \mathbb{C}$ and $c, d, e \in \mathbb{R}$.

Three of the roots of $p(z)$ are $\frac{1}{3}$, $a - i$, $2 + bi$, where $a, b \in \mathbb{R}$, $b > 1$.

(a) By considering the sum and the product of the roots of $p(z)$,

(i) show that $a = -1$;

(ii) find the value of b .

[5]

(b) Show that $p(z) = (Az + B)(z^2 + Cz + D)(z^2 + Ez + F)$, where A, B, C, D, E, F are integers to be determined.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



9. [Maximum mark: 8]

Consider non-zero vectors $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$ in three-dimensional space.

The non-zero vector $\mathbf{v}$ is defined as $\mathbf{v} = (\mathbf{a} \cdot \mathbf{c})\mathbf{b} - (\mathbf{a} \cdot \mathbf{b})\mathbf{c}$.

- (a) Show that $\mathbf{v} \cdot \mathbf{a} = 0$. [2]

It is given that $\mathbf{b} \times \mathbf{c}$ and $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ are non-zero vectors.

- (b) (i) Justify why $\mathbf{b} \cdot (\mathbf{b} \times \mathbf{c}) = 0$.
 (ii) Show that $\mathbf{v} \cdot (\mathbf{b} \times \mathbf{c}) = 0$. [4]

- (c) Hence, state the geometrical relationship between $\mathbf{v}$ and $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$, briefly justifying your answer. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



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.

10. [Maximum mark: 15]

Consider the function $f(x) = ax^3 + bx^2 + cx + d$, where $x \in \mathbb{R}$ and where a, b, c and d are real constants.

The graph of f has a point of inflexion at $(-2, -2c + d + 24)$.

(a) Show that $a = \frac{3}{2}$ and $b = 9$. [6]

It is given that the tangents to the graph of f at $x = -3$ and $x = k$ are horizontal.

- (b) (i) Show that $c = \frac{27}{2}$.
 (ii) Find the value of k .
 (iii) State whether f has a local maximum or a local minimum at $x = k$, justifying your answer. [7]

The graph of f intersects the y -axis at the point P.

(c) Show that the tangent to the graph of f at $x = -3$ passes through P. [2]



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

11. [Maximum mark: 19]

(a) Prove the identity $\cot 2\theta \equiv \frac{1}{2} \left(\cot \theta - \frac{1}{\cot \theta} \right)$. [3]

(b) Hence, solve the equation

$$\cot 2\theta = \frac{3}{2} \cot \theta (\cot^2 \theta - 1) \text{ for } 0 < \theta < \pi \text{ where } \theta \neq \frac{\pi}{2}. \quad [6]$$

(c) By differentiating both sides of the identity in part (a), show that

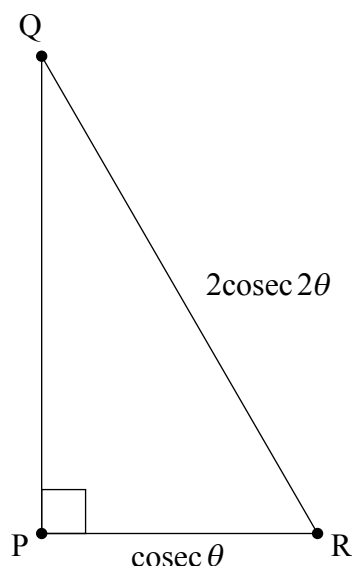
$$4\operatorname{cosec}^2 2\theta \equiv \operatorname{cosec}^2 \theta + \sec^2 \theta. \quad [5]$$

Consider the right-angled triangle $\triangle PQR$, where $\hat{R}PQ = \frac{\pi}{2}$.

$PR = \operatorname{cosec} \theta$, $QR = 2\operatorname{cosec} 2\theta$, where $0 < \theta < \frac{\pi}{2}$ and all lengths are given in metres.

This is shown in the following diagram.

diagram not to scale



QR has length L metres and $\triangle PQR$ has area A square metres.

(d) Calculate the ratio $L : A$ in the form $n : 1$, where $n \in \mathbb{Z}^+$. [5]



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

12. [Maximum mark: 18]

Rowan is investigating the spread of an infection through a population of rabbits.

He models N , the number (in thousands) of infected rabbits in the population, at time t days.

Rowan models the spread of the infection by the differential equation

$$\frac{dN}{dt} = k(-3 + 4N - N^2), \text{ where } t \geq 0 \text{ and } k \in \mathbb{R}^+.$$

Initially, 1500 rabbits are infected.

(a) Express $\frac{1}{-3 + 4x - x^2}$ in the form $\frac{A}{x-1} + \frac{B}{3-x}$, where $A, B \in \mathbb{R}$. [3]

(b) Hence, show that $\ln\left(\frac{N-1}{3-N}\right) = 2kt - \ln p$, where $p \in \mathbb{R}^+$ is a constant to be determined. [8]

(c) Find an expression for N in the form $N = \frac{a + be^{-2kt}}{1 + ce^{-2kt}}$, where $a, b, c \in \mathbb{Z}$. [5]

According to Rowan's model, the number of infected rabbits approaches a limit, L , over the long term.

(d) Find the value of L . [2]



Disclaimer:

Content used in IB assessments is often taken from authentic, third-party sources. The views expressed within them belong to their individual authors and/or publishers and do not necessarily reflect the views of the IB. Sometimes fictitious companies, products or individuals are included in assessments; any similarities with actual entities are purely coincidental. Any trademarks™ or registered® trademarks included are used for illustrative purposes only, and use does not imply any affiliation with or endorsement by the International Baccalaureate.



16EP16