

© International Baccalaureate Organization 2022

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 2022

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, 2022

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
Standard level
Paper 2

Tuesday 1 November 2022 (morning)

Candidate session number

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

1 hour 30 minutes

Instructions to candidates

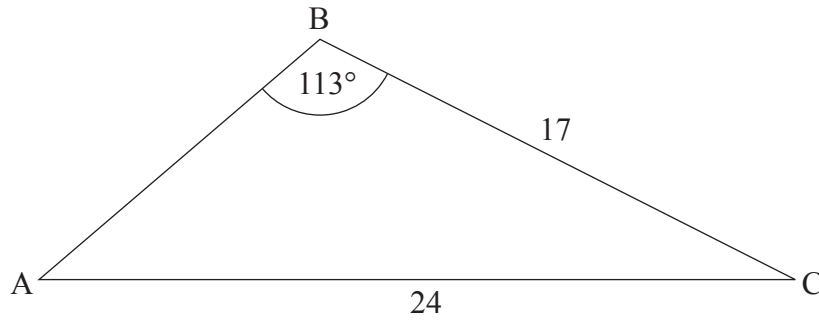
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions in 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 formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.



2. [Maximum mark: 6]

The following diagram shows triangle ABC, with $AC = 24$, $BC = 17$, and $\hat{A}BC = 113^\circ$.

diagram not to scale



(a) Find $\hat{B}AC$.

[3]

(b) Find AB.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

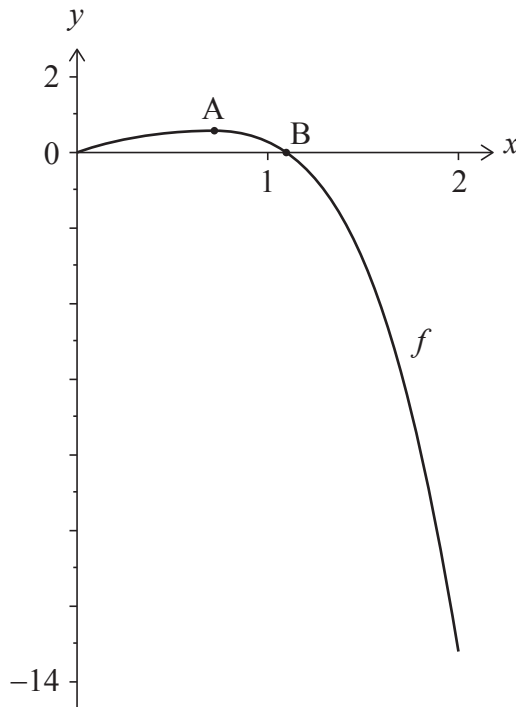
.....



Turn over

3. [Maximum mark: 6]

The function f is defined as $f(x) = \ln(xe^x + 1) - x^4$, for $0 \leq x \leq 2$. The graph of f is shown in the following diagram.



The graph of f has a local maximum at point A. The graph intersects the x -axis at the origin and at point B.

- (a) Find the coordinates of A. [2]
- (b) Find the x -coordinate of B. [1]
- (c) Find the total area enclosed by the graph of f , the x -axis and the line $x = 2$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



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

Answers written on this page
will not be marked.



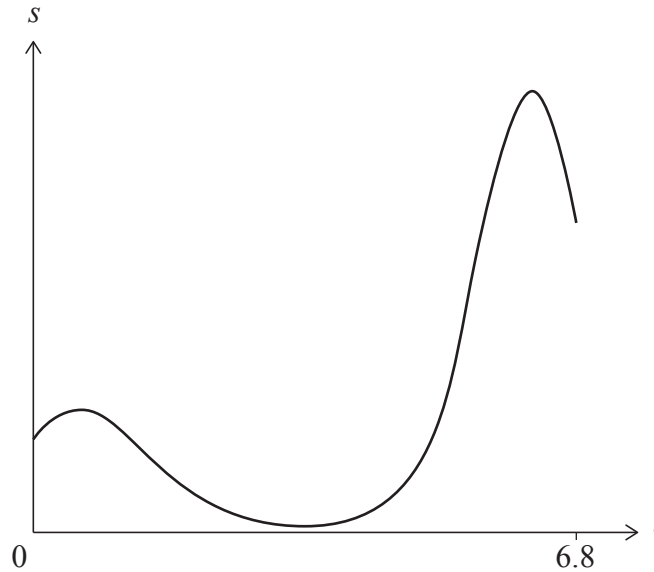
Do **not** write solutions on this page.

Section B

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

7. [Maximum mark: 16]

A particle moves in a straight line. Its displacement, s metres, from a fixed point P at time t seconds is given by $s(t) = 3(t + 2)^{\cos t}$, for $0 \leq t \leq 6.8$, as shown in the following graph.



- (a) Find the particle's initial displacement from the point P. [2]
 - (b) Find the particle's velocity when $t = 2$. [2]
 - (c) Determine the intervals of time when the particle is moving away from the point P. [5]
- The acceleration of the particle is zero when $t = b$ and $t = c$, where $b < c$.
- (d) Find the value of b and the value of c . [4]
 - (e) Find the total distance travelled by the particle for $b \leq t \leq c$. [3]



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

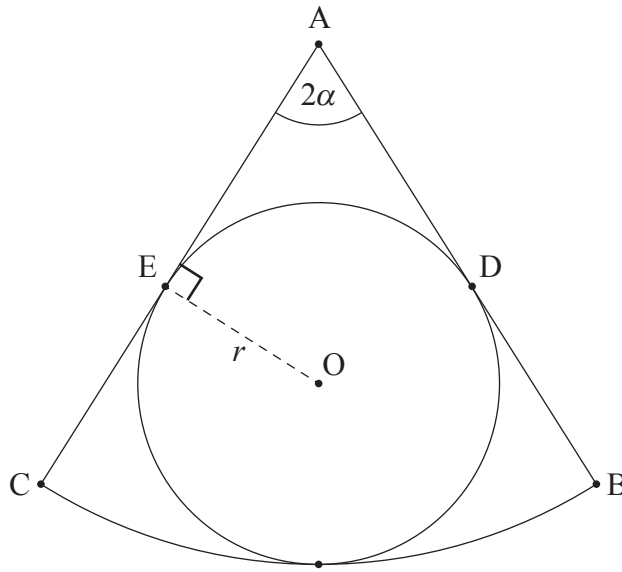
8. [Maximum mark: 13]

The following diagram shows a sector ABC of a circle with centre A . The angle $\widehat{BAC} = 2\alpha$, where $0 < \alpha < \frac{\pi}{2}$, and $\widehat{OEA} = \frac{\pi}{2}$.

A circle with centre O and radius r is inscribed in sector ABC .

AB and AC are both tangent to the circle at points D and E respectively.

diagram not to scale



(a) Show that the area of the quadrilateral $ADOE$ is $\frac{r^2}{\tan \alpha}$.

[4]

(This question continues on the following page)

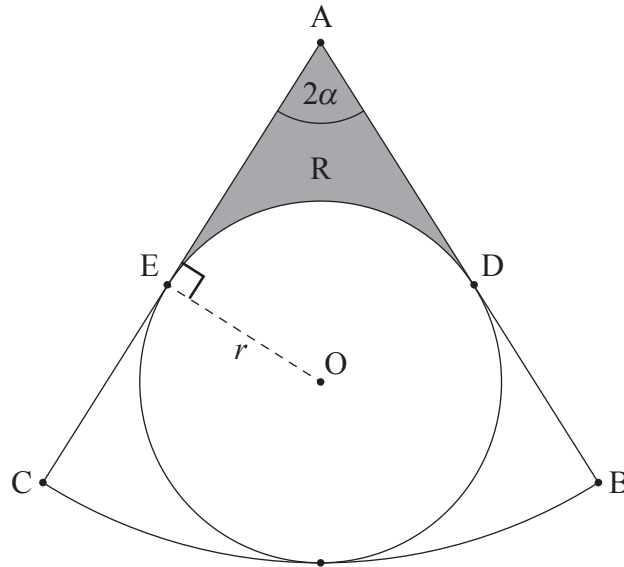


Do **not** write solutions on this page.

(Question 8 continued)

R represents the shaded region shown in the following diagram.

diagram not to scale



- (b) (i) Find \widehat{DOE} in terms of α .
- (ii) Hence or otherwise, find an expression for the area of R. [5]
- (c) Find the value of α for which the area of R is equal to the area of the circle of centre O and radius r . [4]



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

9. [Maximum mark: 16]

The time worked, T , in hours per week by employees of a large company is normally distributed with a mean of 42 and standard deviation 10.7.

(a) Find the probability that an employee selected at random works more than 40 hours per week. [2]

(b) A group of four employees is selected at random. Each employee is asked in turn whether they work more than 40 hours per week. Find the probability that the fourth employee is the only one in the group who works more than 40 hours per week. [3]

(c) A large group of employees work more than 40 hours per week.

(i) An employee is selected at random from this large group.

Find the probability that this employee works less than 55 hours per week.

(ii) Ten employees are selected at random from this large group.

Find the probability that exactly five of them work less than 55 hours per week. [7]

It is known that $P(a \leq T \leq b) = 0.904$ and that $P(T > b) = 2P(T < a)$, where a and b are numbers of hours worked per week. An employee who works fewer than a hours per week is considered to be a part-time employee.

(d) Find the maximum time, in hours per week, that an employee can work and still be considered part-time. [4]

References:

© International Baccalaureate Organization 2022

