

© International Baccalaureate Organization 2025

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 2025

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, 2025

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/>.

Physics
Higher level
Paper 1B

5 November 2025

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

Candidate session number

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

2 hours [Paper 1A and Paper 1B]

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for paper 1B is **[20 marks]**.
- The maximum mark for paper 1A and paper 1B is **[60 marks]**.



Answer **all** questions. Answers must be written within the answer boxes provided.

1. A group of students is trying to determine the density and the viscosity of a liquid.

To determine the density, they use a balance to read the mass m of a sphere in air and immersed in the liquid.

They use a sphere of volume $V = 1.827 \times 10^{-7} \text{ m}^3$.

The readings are $m_{\text{air}} = 1.427 \text{ g}$ in air and $m_{\text{Immersed}} = 1.208 \text{ g}$ in the liquid.

The readings are different due to buoyancy. The buoyancy force F_b is given by

$$F_b = \rho Vg,$$

where V is the volume of the sphere and ρ is the density of the liquid.

- (a) State the level of precision in the measurement of m . [1]

.....
.....

- (b) Show that F_b is about 2 mN. [1]

.....
.....

- (c) Calculate the density of the liquid. [2]

.....
.....
.....
.....

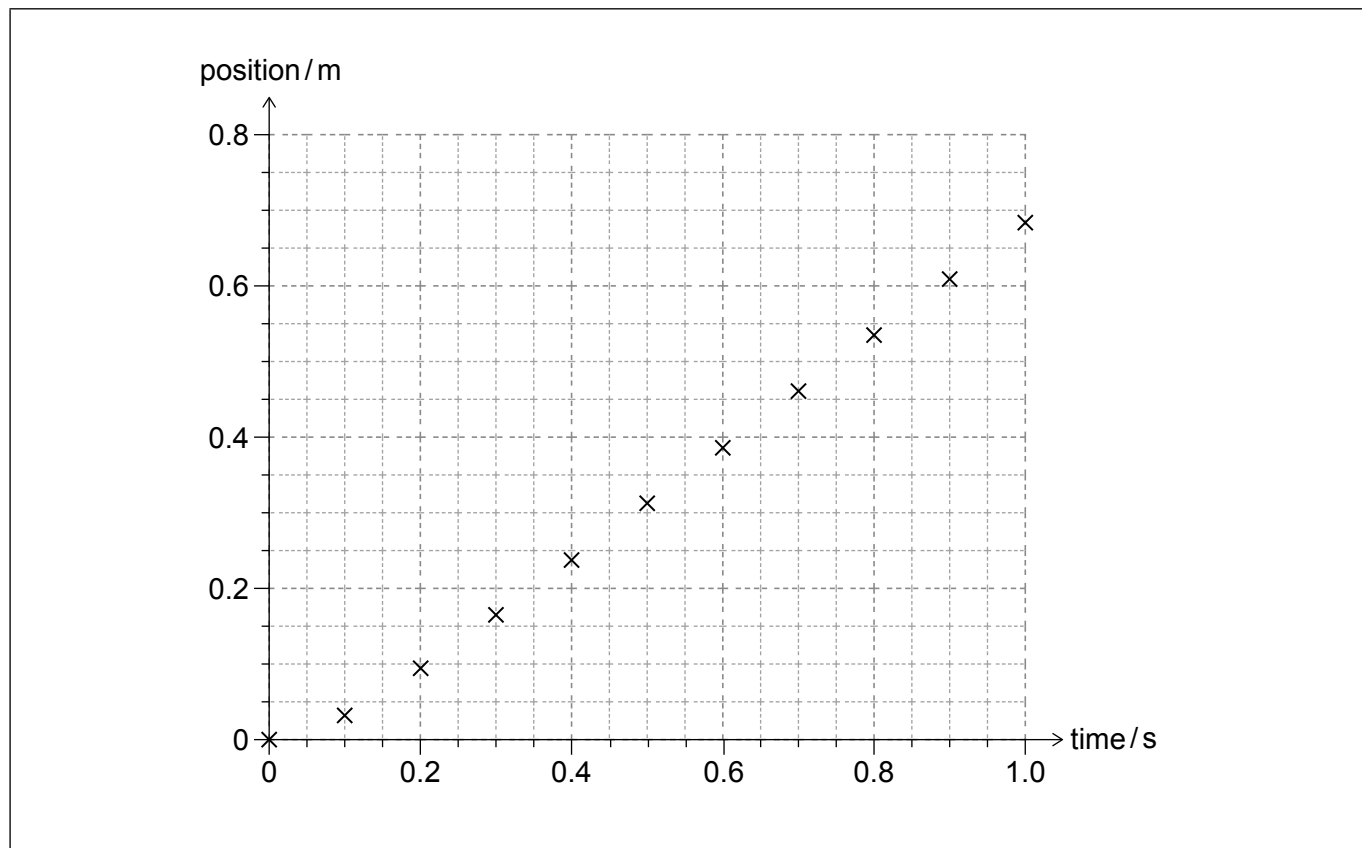
(This question continues on the following page)



(Question 1 continued)

To determine the viscosity, they immerse the sphere in the liquid and drop it from rest.

They collect values and plot a graph of the position d of the sphere from the moment they drop it. They verify that the sphere reaches terminal velocity v_t after 0.5 s.



(d) Draw the line of best fit on the graph. [2]

(e) Outline how the students may verify that the sphere reaches terminal velocity. [1]

.....

.....

(This question continues on page 5)



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

Answers written on this page
will not be marked.



08EP04

(Question 1 continued)

They repeat the experiment several times and estimate an average for

$$v_t = (0.71 \pm 0.05) \text{ m s}^{-1}.$$

They use the equation

$$\eta = \frac{m_{\text{air}}g - \rho Vg}{6\pi r v_t},$$

where

r = radius of the sphere,

v_t = terminal velocity of the sphere,

η = viscosity of the liquid.

The radius r of the sphere is 3.520 mm.

- (f) Calculate the viscosity of the liquid and its absolute uncertainty. Ignore uncertainties in the mass, radius and volume of the sphere. Give your answer in the form $\eta \pm \Delta\eta$, to an appropriate number of significant figures, including units. [4]

.....

.....

.....

.....

.....

.....

.....

.....

The students search literature values and find the viscosity of this liquid to be 0.24, when expressed in SI base units.

- (g) Suggest a conclusion reached by the students. [1]

.....

.....



2. A student investigates whether the Stefan–Boltzmann law, $L = 4\pi\sigma R^2T^4$, applies to stars.

L = luminosity of the star, in W

σ = Stefan–Boltzmann constant

R = radius of the star, in m

T = surface temperature of the star, in K

To verify the law, they obtain values from databases and manipulate the data as shown.

Star	L	R	T	$\frac{L}{R^2}$	$\log\left(\frac{L}{R^2}\right)$	$\log(T)$
10 Lacertae	3.92×10^{31}	5.75×10^9	3.62×10^4	1.19×10^{12}	12.1	4.56
σ -Orionis A	1.60×10^{31}	3.90×10^9	3.49×10^4	1.05×10^{12}	12.0	4.54
σ -Orionis B	6.08×10^{30}	3.48×10^9	2.91×10^4	5.02×10^{11}	11.7	4.46
Polaris B	1.50×10^{27}	9.60×10^8	6.90×10^3		9.21	
α -Centauri A	5.77×10^{26}	8.49×10^8	5.79×10^3	8.00×10^8	8.90	3.76
α -Centauri B	1.92×10^{26}	5.97×10^8	5.26×10^3	5.39×10^8	8.73	3.72
ε -Indi	8.08×10^{25}	4.95×10^8	4.65×10^3	3.30×10^8	8.52	3.67
Sun	3.85×10^{26}	6.96×10^8	5.78×10^3	7.95×10^8	8.90	3.76

- (a) Complete the table with the missing values for Polaris B.

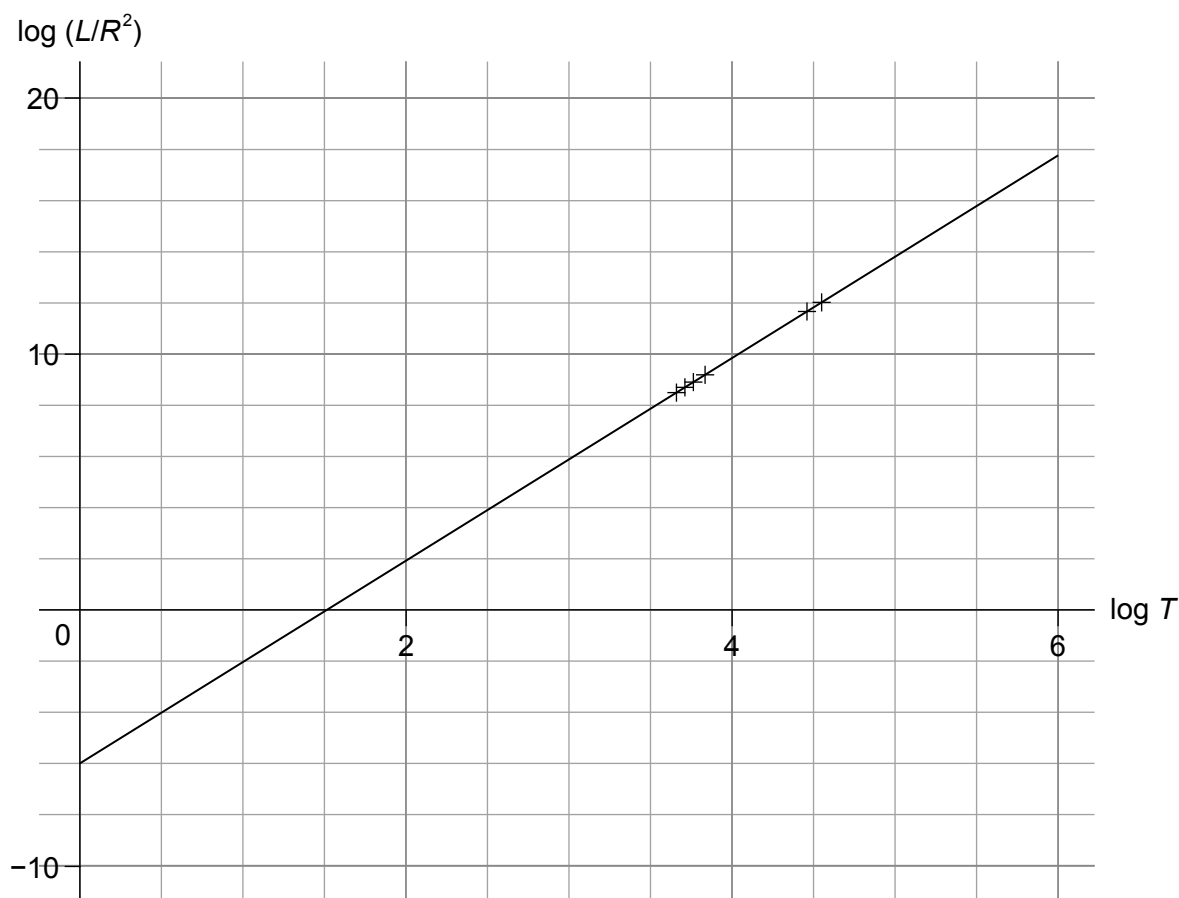
[2]

(This question continues on the following page)



(Question 2 continued)

The student plots the variation with $\log T$ of $\log \left(\frac{L}{R^2} \right)$ and draws the line of best fit.



The student uses a GDC (graphical display calculator) to determine the equation of the line of best fit as $y = 3.99x - 6.15$.

(b) Explain how the gradient of the line of best fit relates to the Stefan–Boltzmann law. [2]

.....

.....

.....

.....

(This question continues on the following page)



08EP07

Turn over

(Question 2 continued)

(c) Calculate the Stefan–Boltzmann constant obtained in this investigation. [2]

.....

.....

.....

.....

(d) Outline a conclusion for the investigation. [1]

.....

.....

(e) Suggest a possible improvement of the investigation, related to the range of the surface temperatures of the stars selected. [1]

.....

.....

