

Markscheme

November 2025

Physics

Standard level

Paper 2

© 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/>.

**Subject Details: Physics SL Paper 2 Markscheme
Mark Allocation**

Candidates are required to answer ALL questions. Maximum total = [50 marks].

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “max” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative wording is indicated in the “Answers” column by a slash (/). Either wording can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**” between the alternatives. Either answer can be accepted.
7. Words in angled brackets « » in the “Answers” column are not necessary to gain the mark.
8. Words that are underlined are essential for the mark.
9. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
10. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
11. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
12. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. “Allow ECF” will be displayed in the “Notes” column.
13. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.
14. CNA refers to a correct numerical answer.
15. Allow reasonable substitutions where in common usage, *eg* ° for rad.

Question			Answers	Notes	Total
1	a	i	$V = \frac{4}{3}\pi(3.5 \times 10^{-3})^3 = 1.8 \times 10^{-7} \text{ m}^3 \quad \checkmark$	<p><i>Do not award mark for solutions using the density of water ($V = 1.63 \times 10^{-7} \text{ m}^3$)</i></p> <p><i>Must see full substitution OR answer to 2 (or more) significant figures for MP</i></p>	[1]
1	a	ii	$F_b = \rho V g = (1000)(1.8 \times 10^{-7})(9.8) = 0.00176 \quad \checkmark$ $m = \frac{W}{g} = \frac{1.6 \times 10^{-3}}{9.8} = 1.63 \times 10^{-4} \text{ kg} \quad \checkmark$ $a = \frac{\sum F}{m} = \frac{F_b - F_g}{m} = \frac{1.6 \times 10^{-4} \text{ N}}{1.63 \times 10^{-4} \text{ kg}} = 0.98 \text{ m s}^{-2} \quad \checkmark$		[3]
1	b		<p>As the speed of the droplet increases, the drag force increases ✓ net force changes/decreases ✓</p>		[2]

Question			Answers	Notes	Total
1	c	i	net force/acceleration becomes zero ✓ weight and drag force cancel out buoyancy force ✓		[2]
1	c	ii	Use of $F_d = 6\pi\eta r v$ ✓ $\ll v = \frac{F_b - F_g}{6\pi\eta r} = \frac{(1.8 \times 10^{-3}) - (1.6 \times 10^{-3})}{6\pi(0.0011)(0.0035)} \gg = 2.2 \text{ms}^{-1} \checkmark$	Allow ECF from 1(a).	[2]

Question		Answers	Notes	Total
2	a	<p>«Changing the variable resistor» changes the current in the «circuit» ✓ $V = \varepsilon - Ir$, so as I changes, V changes ✓</p>	<p><i>Do not allow arguments based on Ohm's law.</i></p>	[2]
2	b	<p>ALTERNATIVE 1 Recognition that the gradient is internal resistance OR The attempt to use gradient ✓ $\left\langle r = \frac{6V}{8A} \right\rangle = 0.75 \Omega$ ✓</p> <p>ALTERNATIVE 2 Reads 24.7 ± 0.1 V from graph ✓ Use $r = \left(\frac{\varepsilon - V}{I} \right)$ and any data point to give $0.75 \pm 0.02 \Omega$ ✓</p>	<p><i>Must see full substitution OR answer to 2 (or more) significant figures for MP2.</i></p> <p><i>Candidates may use the y-intercept value or solve using two discrete data points from the graph.</i></p>	[2]

Question		Answers	Notes	Total
2	c	Use of $\varepsilon = I(R+r)$ OR Reference to y-intercept ($I = 0$) OR Line extrapolated back to y-axis ✓ 24.7 V ✓	Accept 24.6 - 25.2 V for MP2.	[2]

Question			Answers	Notes	Total
3	a	i	Elastic/Spring potential «energy» to kinetic «energy» OR Elastic/Spring potential «energy» decreases AND kinetic «energy» increases. ✓	<i>Must see elastic/spring potential energy specifically (and not just potential energy).</i> <i>Allow appropriate abbreviations (E_K, E_H or E_E) for energy names.</i>	[1]
3	a	ii	Kinetic «energy» to elastic/spring potential «energy» OR Kinetic «energy» decreases AND elastic/spring potential «energy» increases. ✓	<i>Must see elastic/spring potential energy specifically (and not just potential energy)</i> <i>Allow appropriate abbreviations (E_K, E_H or E_E) for energy names.</i>	[1]
3	b		Use of $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$ ✓ ratio = $\sqrt{3}$ OR 1.7 ✓	<i>Allow for use of $f = \frac{1}{T}$ solutions in MP1.</i> <i>Award [2] for CNA.</i>	[2]
3	c		«the spring» obeys Hooke's Law/has a fixed spring constant OR the force «exerted by the spring» must be proportional to the displacement ✓		[1]

Question			Answers	Notes	Total
4	a	i	$I = \frac{F}{BL} = \frac{0.084}{(1.2)(0.6)} = 0.117 \text{ A} \checkmark$	<i>Must see full substitution OR answer to 3 (or more) significant figures.</i>	[1]
4	a	ii	Down «the page» ✓		[1]
4	a	iii	current «in wire» creates a magnetic field OR Reference to hand rule ✓ «by hand rule» Field is out of page on right side of wire OR Field is into the page on left side of wire. ✓ therefore, field is smaller/weaker/opposite direction on right side of wire OR field is larger/stronger/same direction on left side of wire. ✓	<i>Allow ECF from 4aii for “upwards” current. For MP2 and MP3 we need to see specific sides mentioned. Allow ECF from MP2 if field directions are backwards.</i>	[3]
4	b	i	Force on wires is attractive/towards each other. OR Force on left wire to the right AND force on right wire to the left ✓		[1]

Question			Answers	Notes	Total
4	b	ii	<p>Use of $\frac{F}{L} = \mu_0 \frac{I^2}{2\pi r}$ ✓</p> <p>$\frac{F}{L} = \ll 4\pi \times 10^{-7} \times \frac{0.117^2}{2\pi(0.4)} \gg = 6.84 \times 10^{-9}$ ✓</p> <p>N m⁻¹ ✓</p>	<p><i>Award MP2 for use of L = 0.6 m leading to 4.1x10⁻⁹ (or 4.32x10⁻⁹)</i></p> <p><i>For MP3 accept other variations such as kg s⁻² or T A</i></p> <p><i>MP3 should be awarded for correct units regardless of value.</i></p>	[3]

Question			Answers	Notes	Total
5	a	i	The outward «radiation/thermal» pressure/force is balanced by the «inward» gravitational pressure/force ✓	<i>Need to see reference to gravitational force/pressure. Do not accept “gravity”.</i>	[1]
5	a	ii	Nuclei need to have sufficiently high speed/energy to overcome repulsive force ✓ Nuclei need to be sufficiently close for the strong nuclear force to cause attraction ✓		[2]
5	a	iii	The core of star A is at a much higher temperature than the surface ✓ Gas/plasma in the hot core becomes less dense and moves to the surface of the star OR Gas/plasma at the cool surface becomes more dense and moves toward the core ✓		[2]
5	b	i	$d = \left(\frac{1}{0.74}\right)(3.26)(9.46 \times 10^{15}) = 4.2 \times 10^{16} \text{ m}$ ✓	<i>Distance must be stated in metres.</i>	[1]

Question			Answers	Notes	Total
5	b	ii	$\frac{L_A}{L_S} = \left(\frac{0.9R_s}{R_s} \right)^2 \left(\frac{5200}{5800} \right)^4 = 0.52 \quad \checkmark$	<p>Must see full substitution OR answer to 2 (or more) significant figures.</p> <p>Allow the reverse fraction, leading to 1.92.</p>	[1]
5	b	iii	<p>Use of $b = \frac{L}{4\pi d^2} \quad \checkmark$</p> $b_A = \frac{0.52L_S}{4\pi(4.16 \times 10^{16})^2} \quad \checkmark$ $b_A = (2.4 \times 10^{-35})L_S \text{ Wm}^{-2} \quad \checkmark$	<p>Allow ECF from b(i) in denominator and b(ii) in numerator.</p> <p>Allow ECF for MP3.</p> <p>Allow $b_A = \frac{L_S}{4.35 \times 10^{34}}$ for MP3.</p>	[3]
5	c	i	$\lambda_{\max} = \frac{2.9 \times 10^{-3}}{5200} = 5.58 \times 10^{-7} \text{ m OR } 558 \text{ nm} \quad \checkmark$	<p>Must see full substitution OR answer to 3 (or more) significant figures.</p>	[1]

Question			Answers	Notes	Total
5	c	ii	Use of $c = f\lambda$ OR $E = \frac{hc}{\lambda}$ ✓ $E = \frac{(6.63 \times 10^{-34})(3 \times 10^8)}{5.57 \times 10^{-7}} = 3.6 \times 10^{-19} \text{ J}$ OR 2.25 eV ✓		[2]
5	c	iii	Star A is moving toward Earth ✓ Therefore the wavefronts are closer together «and the wavelength is reduced» ✓	MP1 must be correct to earn MP2 For MP2 we need to see the connection to wavefronts.	[2]
5	c	iv	$v = \frac{\Delta\lambda}{\lambda} c = \frac{0.007}{100} \times 3 \times 10^8 = 21000 \text{ ✓}$ 21 km s ⁻¹ ✓	Allow ECF for MP2. Do not award MP1 for use of the Doppler formulas for sound and mechanical waves.	[2]
5	d		Stellar gases absorb specific wavelengths of light ✓ «Absorption» spectrum is observed on Earth ✓ The observed spectral lines are compared to known chemical spectra ✓		[3]