

Markscheme

May 2026

Physics

Standard level

Paper 2

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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. An alternative markscheme is indicated in the “Answers” column under the heading **ALTERNATIVE 1** etc. Any alternative can be accepted.
8. Words in angled brackets « » in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. 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.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. 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.
14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.
15. Allow reasonable substitutions where in common usage, *eg* ° for rad.

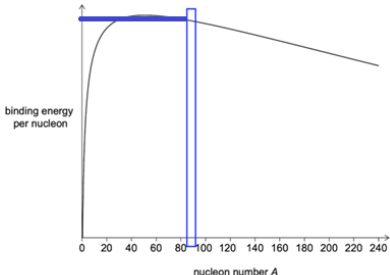
Question			Answers	Notes	Total
1	a		$1.3 \times 9.8 \times 1.6 \times \sin 25$ OR $8.6 \text{ J } \checkmark$	Accept use of $g = 10$ leading to 8.8. Do not penalize intermediate rounding of $1.6 \sin 25 = 0.7$ leading to answers in the range 8.7-9.1	[1]
	b	i	$E_k = \left\langle \frac{1}{2} \times 1.3 \times 2.4^2 \right\rangle = 3.7 \text{ J } \checkmark$		[1]
	b	ii	ALTERNATIVE 1 Work done = $8.6 - 3.7$ OR 4.9 OR $E_g - E_k$ $\checkmark$ $\left\langle W_f = \mu \times 1.3 \times 9.8 \times \cos 25 \times 1.6 \text{ so } \mu = 0.26 \right\rangle \checkmark$ ALTERNATIVE 2 $\left\langle v^2 = 2ad \text{ so } a = 1.8 \text{ ms}^{-2} \right\rangle \checkmark$ $\left\langle a = g(\sin 25 - \mu \cos 25) \text{ so } \mu = 0.26 \right\rangle \checkmark$	Accept in the range 0.25 - 0.29 due to rounding, use of $g = 10$ or use of given value of 9 J. For the work done, accept other consistent alternatives, e.g. $9 - 3.7$ Allow ECF from b) i) Allow ECF from MP1	[2]
	c		The product of force and distance is the same OR force and distance vary inversely with the angle OR shows an algebraic manipulation e.g. $m \times g \times \frac{h}{\sin \theta} \times \sin \theta$ OR $\left\langle \text{no friction} \right\rangle$ so no change in mechanical energy $\checkmark$	It is not enough to repeat the question, so “there is no friction” OR “angle is not important” OR the work does not depend on the angle” is not enough to award the mark. Answer like “ mgh the same for all angles” OR “weight is a conservative force” without some more details are not enough to award the mark.	[1]

Question			Answers	Notes	Total
2	a		« $220 \times 2 \times 30 = 13200$ » = 1.3×10^4 J ✓		[1]
	b		«average» velocity / speed / kinetic energy of the particles increases ✓ collisions «with the walls» produce a larger change in momentum OR frequency of collisions «with the walls» are increased ✓	<i>Do not allow MP2 if collisions explicitly refer to collision between particles only. Allow MP2 for a reference that the pressure arises from the rate of change in momentum. Accept “more collisions” for MP2.</i>	[2]

Question			Answers	Notes	Total
3	a		$\frac{\sin 45}{\sin r} = \frac{1450}{1480}$ ✓ $r = 46.2^\circ$ ✓	<i>Do not penalize intermediate rounding Accept CNA</i>	[2]
	b		« $\frac{\sin \theta}{1} = \frac{1450}{1480}$ so » $\theta = 78.4^\circ$ ✓		[1]
	c		sound refracts away from the normal ✓ continues bending away / curves ✓ «eventually» undergoes total internal reflection ✓ total internal reflection depends on the number of layers / speed increase on those layers ✓ propagates along a layer / within some layers ✓	MP2 to MP5 also scores MP1.	[3] max

Question			Answers	Notes	Total
4	a		force per unit charge ✓ on a positive / small / test / point charge ✓	Accept $E = \frac{F}{q}$ with symbols identified for MP1 .	[2]
	b		both are negative OR both are positive ✓	Accept both are the same	[1]
	c		ALTERNATIVE 1 (working where the field is zero) $\frac{Q_R}{0.02^2} = \frac{Q_S}{0.03^2} \checkmark$ $\frac{Q_S}{Q_R} = \frac{0.03^2}{0.02^2} \text{ OR } 2.25 \text{ OR } \frac{9}{4} \checkmark$ ALTERNATIVE 2 (assuming field is negligible from other charge at the extreme points) $\frac{Q_R}{1^2} = 4.5 \text{ AND } \frac{Q_S}{1^2} = 11 \checkmark$ $\frac{Q_S}{Q_R} = \frac{11}{4.5} \text{ OR } 2.4 \checkmark$ ALTERNATIVE 3 (use of simultaneous equations) $\frac{kQ_R}{0.01^2} - \frac{kQ_S}{0.04^2} = -4.5 \times 10^5 \text{ OR } \frac{kQ_R}{0.04^2} - \frac{kQ_S}{0.01^2} = 11 \times 10^5 \checkmark$ $\frac{Q_S}{Q_R} = 2.25 \text{ OR } Q_S = -1.3 \times 10^{-8} \text{ AND } Q_R = -5.8 \times 10^{-9} \checkmark$	Award [1] if not clear which charge is identified as larger. For ALT 2, accept any ratio between 11/4.1 to 11/4.5. Award [1] in ALT 2 if no working shown. For ALT 3, accept consistent work from the equations. Accept either convention, field is positive right or field is positive left.	[2]

Question			Answers	Notes	Total
5	a		$qvB = \frac{mv^2}{R}$ OR $R = \frac{mv}{qB}$ ✓ $R = 7.5 \times 10^{-8} \times v$ OR correct values of q , and m of proton seen OR R correctly calculated with any v given by the candidate ✓	In MP1 , accept $\sin(\theta)$ in the formula.	[2]
	b		(different radii imply) different mass / other particles / neutrons «in the nucleus» ✓		[1]
	c		$E = \frac{hc}{\lambda}$ seen ✓ $\ll 1.99 \times 10^{-25} \left(\frac{1}{656.296 \times 10^{-9}} - \frac{1}{656.478 \times 10^{-9}} \right) \gg = 8.4 \times 10^{-23} \text{ J}$ OR $5 \times 10^{-4} \text{ eV}$ ✓	Award [2] for CNA. Allow range 7×10^{-23} to $10 \times 10^{-23} \text{ J}$.	[2]

Question			Answers	Notes	Total
6	a		β^- / beta minus ✓		[1]
	b	i	Rb missing has become Sr / initial mass equals the sum of the masses / nucleon number remains unchanged ✓	Calculation without an attempt at explanation is not enough for the mark.	[1]
	b	ii	the half-life / decay constant «of Rb » ✓	Award [0] for half-life of the rock.	[1]
	c	i	X at about $A = 87$ on the vertical axis / on the curve ✓		[1]
	c	ii	ALTERNATIVE 1 $37 \times 1.007276 + 50 \times 1.008665 - 86.89 \quad \text{OR} \quad 0.812462 \quad \checkmark$ $\frac{0.812462 \times 931.5}{87} = 8.7 \text{ MeV / nucleon } \checkmark$ ALTERNATIVE 2 $37 \times 938 + 50 \times 940 - 86.89 \times 931.5 \quad \text{OR} \quad 767.965 \quad \checkmark$ $\frac{767.965}{87} = 8.8 \text{ MeV / nucleon } \checkmark$	Accept the inclusion of the electrons that leads to correct answers of 8.7 in ALT 1 and 8.8 in ALT 2. Allow ECF from MP1	[2]

Question			Answers	Notes	Total
7	a		$m = \langle \rho V \rangle = 1600 \times 41000 \times 0.021 \times 10^{-3} \text{ m}$ OR $m = 1380 \text{ kg}$ ✓	Actual value is 1378 kg.	[1]
	b		$n = \frac{PV}{RT}$ OR $n = \frac{102000 \times 3700}{8.31 \times 288}$ OR $n = 158000$ ✓ $n \times 0.004$ OR 158000×0.004 OR 631 kg ✓	Allow ECF from MP1 Accept equivalent use of $PV = NkT$	[2]
	c		Calculates $F_b = 1.2 \times 3700 \times g$ ✓ sets Newton's 2 nd law $F_b - mg = m \times 2.2$ OR $m = 3626 \text{ kg}$ ✓ subtracts to get $m_c = 1600$ ✓	Accept CNA Combined mass is 1626 if they use show that values., Allow ECF for MP3	[3]
	d	i	«at very low pressure» there are few molecules to transfer thermal energy / no transfer in vacuum ✓	Allow reference to air instead of vacuum. Accept no transfer as no contact	[1]
	d	ii	$P_{in} = P_{out}$ OR $P_{in} = \varepsilon \sigma AT^4$ ✓ $\varepsilon = \frac{120}{5.67 \times 10^{-8} \times 14 \times 243^4} = 0.043$ ✓	Accept CNA Award MP2 if they use $T = 288$ leading to final answer of 0.022.	[2]

e	i	$\frac{6400^2}{6439^2}$ seen ✓ 0.988g OR 9.68 ms ⁻² ✓	Allow backwards calculations to get <i>M</i> of Earth. Allow calculations where students recall and use the mass of the Earth. MP2 scores MP1	[2]
e	ii	$v^2 = 2gh$ ✓ $v = \sqrt{2 \times 9.7 \times 4000} = 279 \text{ ms}^{-1}$ ✓	Do not award MP2 if they use $g = 10$ or 9.8 Award [2] as CNA for an answer of 279. Award [1] for an answer of 280 unless this comes from rounding with correct procedure.	[2]
f	i	the positive area represents the increase in speed/velocity «from where he jumps from rest until max speed» ✓ the negative area represents the decrease in speed/velocity «until terminal velocity» ✓	Award [1] if they identify «change in» speed/velocity without any specific detail.	[2]
f	ii	positive area is larger «as the difference represents the terminal speed» ✓		[1]
g		«air resistance will increase» decelerating/slowing down the skydiver ✓ the skydiver keeps falling / reaches «a lower» terminal/constant speed/velocity ✓		[2]
h		λ in the range $10^{-6} - 10^{-4} \text{ m}$ (these are the limits given in the booklet) ✓ converted to frequency so f in the range $10^{12} - 3 \times 10^{14} \text{ Hz}$ ✓	Allow ECF for MP2 Allow other methods to estimate the frequency of infrared, e.g. using Wien's law for a temperature of 298 K (found in some scripts). Accept CNA for full marks, i.e accept a plain answer if in the range accepted.	[2]