8825 – 6724M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2025

Physics

Standard level

Paper 2

11 pages

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***". Either answer can be accepted.

7. An alternative markscheme is indicated in the "Answers" column under heading ***ALTERNATIVE 1*** *etc*. Either alternative can be accepted.

8. Words inside chevrons **« »** 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.

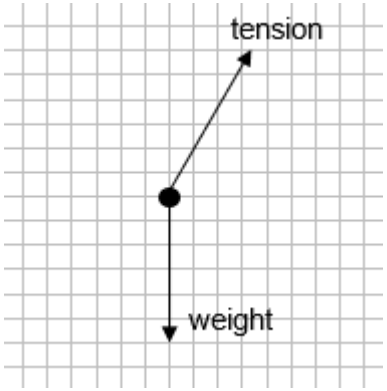
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

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. "ECF acceptable" will be displayed in the "Notes" column.

14. CNA refers to a correct numerical answer.

15. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Question			Answers	Notes	Total
1.	a		3 ✓		[1]
1.	b		Chooses 3->2 transition ✓ $\lambda = \frac{hc}{\Delta E}$ ✓ $\lambda = «\frac{1.24\times10^{-6}}{1.89} =» 6.56\times10^{-7}\,\text{m}$ ***OR*** $\lambda = «\frac{6.63\times10^{-34}\times3.0\times10^{8}}{1.89\times1.6\times10^{-19}} =» 6.58\times10^{-7}\,\text{m}$ ✓	*Ignore sign.* *Award [3] for CNA (correct numerical answer)* *Allow ECF from MP1 if they choose an incorrect transition* *Do not penalize 657 nm* *Award [1] max if they calculate a wavelength using a single energy level instead of a delta ΔE.*	[3]

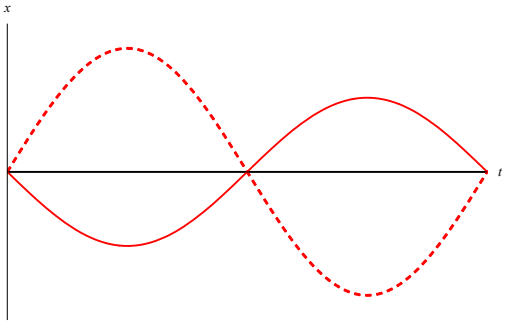
Question			Answers	Notes	Total
2.	a	i	 Labelled vertical weight / W / mg / F_g and tension / T / F_T in approximately correct direction ✓ With vertical *T* component equal to weight ✓	*Ignore other forces drawn for MP1*	**[2]**
2.	a	ii	$T\sin 30^\circ = ma$ **OR** $T\cos 30^\circ = mg$ ✓ $a = g\tan 30^\circ = 5.66 \approx 5.7$ m s^{-2} ✓	*Accept reversed trig functions if 60º used.* *Award [2] for CNA*	**[2]**
2.	b		The ball is in equilibrium / forces are balanced / net force is zero / no acceleration/ the vertical weight must be balanced by a vertical tension ✓ The angle is zero ✓	*For MP2, accept an answer of 10º if from the students' answer it can be understood that they interpreted the vertical as the perpendicular line to the ceiling of the truck, so that their answer of 10º implies that the string is vertically downwards.*	**[2]**

Question			Answers	Notes	Total
2.	c		$\mu mg = m\frac{v^2}{R}$ ✓ v = «$\sqrt{0.6 \times 9.8 \times 75}$» 21 ms^{-1} ✓	*Award [2] for a CNA.*	**[2]**
2.	d		**ALTERNATIVE 1** KE $\frac{1}{2}\times 1400\times 15^2$ **OR** 1.6×10^5 J ✓ Work done by drag force $520\times\pi\times 75$ **OR** 1.2×10^5 J ✓ This is less than the KE so the truck will make it ✓ **ALTERNATIVE 2** Truck decelerates at $\frac{520}{1400}$ **OR** 0.371ms^{-2} ✓ Speed at gas station is $\sqrt{15^2 - 2\times 0.371\times\pi\times 75}$ **OR** 7.0ms^{-1} ***OR*** truck stops after a distance « $\frac{15^2}{2 \text{ x } 0.371}$ =» $303\ m$ ✓ Speed is not zero ***OR*** 303 m > 75π **OR** 303 m > 236 m ✓	*Allow MP3 for a consistent conclusion if any previous calculation is wrong.*	**[3]**

Question			Answers	Notes	Total
3.	a		« $8.99\times10^{9}\times(\frac{9Q}{0.30^{2}}+\frac{Q}{0.06^{2}})=3.26\times10^{7}$ so » Q = 9.6x10^{-6} ✓ C ✓		[2]
3.	b	i	$qvB=m\frac{v^{2}}{R}$ ✓ Hence answer		[1]
3.	b	ii	Force is perpendicular to the velocity / F acts as centripetal / F does no work / F only changes direction of velocity ✓	*Do not accept reference to centripetal acceleration only*	[1]
3.	c		loss of energy / speed reduced ✓ so radius decreases ✓	*MP2 scores only if MP1 is scored.*	[2]

Question			Answers	Notes	Total
4.	**a**	**i**	600 «counts per hr »✓		**[1]**
4.	**a**	**ii**	**ALTERNATIVE 1** Subtract their background rate to 3000 to get the initial count rate e.g. initial count rate 2400 counts per h ✓ Attempt to read t for $\frac{1}{2}$, $\frac{1}{4}$ or $\frac{1}{8}$ this initial count rate plus their background rate ✓ Half-life is 10 h ✓ **ALTERNATIVE 2** Use of decay equation with A_0 = 3000 (their ai) and one point correctly read from graph ✓ calculate decay constant ✓ Use $half\ life = \frac{ln2}{\lambda}$ to get $T_{1/2}$ =10 h ✓	*Allow ECF from a i)* *Allow ECF from MP1, i.e.max [2] for answer of about 14 h if background rate not used* *Accept 9 to 11 hours for MP3*	**[3]**
4.	**a**	**iii**	The BE «per nucleon» is greater for $^{204}_{82}Pb$ ✓ Because $^{204}_{82}Pb$ is more stable/tightly bound than $^{204}_{83}Bi$ ✓	*Award [1] if they recognize Pb as more stable but conclude incorrectly.*	**[2]**
4.	**a**	**iv**	The alpha particles would be absorbed / have low penetration / short range / ✓		**[1]**
4.	**b**		$\Delta m = 203.932254 - (203.928034 + 0.000549) = 3.671\times10^{-3}$ u ✓ $Q = 3.671\times10^{-3}\times931.5 \approx 3.42$ MeV ✓	*Allow ECF from MP1* *Award [1] if electron mass is neglected and Q = 3.93 MeV or 6.30x10^{-13} J* *Award [2] for a CNA* *Accept final answer in J (5.48x10^{-13})*	**[2]**

Question			Answers	Notes	Total
5.	a	i	**ALTERNATIVE 1** One mole contains 6.02×10^{23} atoms and has mass 63.5 g ✓ Mass of one atom is $\frac{63.5\times10^{-3}}{6.02\times10^{23}}=1.055\times10^{-25}\approx1.1\times10^{-25}$ kg ✓ **ALTERNATIVE 2** The atom has mass 63.5 u ✓ I.e. $63.5\times1.661\times10^{-27}=1.055\times10^{-25}\approx1.1\times10^{-25}$ kg ✓	*Award full marks for a CNA* *Accept similar calculation for a mass of 0.4 kg (n = 6.3)*	**[2]**
5.	a	ii	Volume of copper = $\frac{0.0635}{8940}$ ✓ V = « $\frac{0.0635}{\left(8940\times6.02\times10^{23}\right)}$ » = $1.2\times10^{-29}\,\mathrm{m}^3$ ✓	*Award full marks for a CNA* *Accept similar calculation for a mass of 0.4 kg*	**[2]**
5.	a	iii	Side of cube $a=\sqrt[3]{1.180\times10^{-29}}=2.277\times10^{-10}\approx2\times10^{-10}$ m ✓	*Allow ECF from a ii* *Award the mark for the CNA*	**[1]**
5.	b		Q « = mL= 0.400 x 206 x 10^3 » = 82.4kJ ✓		**[1]**

Question			Answers	Notes	Total
5.	c		Internal energy is greater in the liquid phase ✓ in liquid the intermolecular potential energy is greater / the separation is greater / energy has been added✓ kinetic energy is unchanged / temperature is the same / internal energy is the sum of kinetic and potential energies✓		[3]
5.	d	i	wave «created by the hammer» is reflected / two «identical» waves in opposite directions✓ the right and left waves superpose / add up / interfere ✓	*Accept reference to constructive and destructive interference in MP2*	[2]
5.	d	ii	Antinodes at both ends, a node in the middle ✓	*Accept only one wave or wave and envelope, either solid or broken lines.*	[1]
5.	d	iii	Opposite line i.e. phase difference of π ✓ Smaller amplitude, ✓ 	*Labelling not necessary* MP2 only scores if MP1 scores	[2]
5.	e	i	The standing wave is longitudinal/sand moves horizontally / sand is pushed/vibrates **OR** there are nodes and antinodes ✓ « sand moves» away from antinodes/ to nodes ✓		[2]

Question			Answers	Notes	Total
5.	e	ii	**ALTERNATIVE 1** Wavelength in air is $2d$ (= 3.6 cm) ✓ Frequency of wave in copper is the same as that in the air in the tube ✓ $\frac{v_{Cu}}{2L} = \frac{v_{air}}{2d}$ ✓ $v_{Cu} = \frac{L}{d} \times v_{air} = \frac{34}{1.8} \times 330 = 6.2 \times 10^3$ m s^{-1} ✓ **ALTERNATIVE 2** Wavelength in air is $2d$ (= 3.6 cm) ✓ $f = \frac{330}{3.6 \times 10^{-2}} = 9.167 \times 10^3$ Hz ✓ $\lambda_{Cu} = 68$ cm ✓ $v_{Cu} = 9167 \times 0.68 = 6.2 \times 10^3$ m s^{-1} ✓	Award [4] for a CNA Allow ECF from wrong wavelengths	**[4]**