GCE AS MARKING SCHEME

SUMMER 2025

AS
PHYSICS – UNIT 1
2420U10-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE AS PHYSICS

UNIT 1 – MOTION, ENERGY AND MATTER

SUMMER 2025 MARK SCHEME

GENERAL INSTRUCTIONS

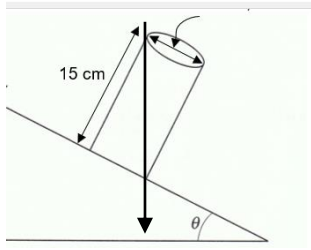
Recording of marks
Examiners must mark in red ink.
One tick must equate to one mark (except for the extended response question).
Question totals should be written in the box at the end of the question.
Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules
All work should be seen to have been marked.
Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.
Crossed out responses not replaced should be marked.
Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

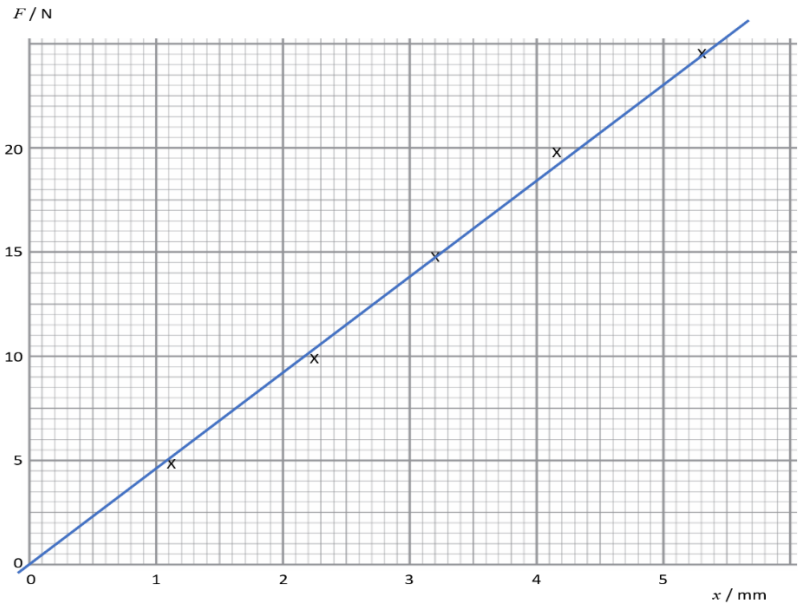
Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)		The centre of gravity of a body is the **point where the** [entire] {**weight / force of gravity}** of the body can [be considered to] **act.** (Bold - minimum required answer) Don't accept mass or gravity	1			1		
	(b)	(i)	 Arrow as shown (or line). Can originate at approximate CoG but must pass through bottom right corner. Accept vertical line.	1			1		
		(ii)	$\tan 18.7 = \frac{d}{15}$ or equivalent (1) d = 5.08 or 5.1 c[m] (1) **Alternative:** x or r = tan 18.7° × 7.5 (1) d = 2 × 2.54 = 5.08 or 5.1 c[m] (1) **Alternative:** $\frac{7.5}{r}$ = tan 71.3 (1) d = 2 × 2.54 = 5.08 or 5.1 c[m] (1) Accept working backwards from 5 cm to 18.4° **Don't accept** sin this leads to 4.8 [cm]		2		2	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	Volume = $\pi \times (2.54)^2 \times 15$ (= 304.0 cm^3 or 294.5 if r = 2.5 cm used) (1) Density = $\frac{2400}{304.0\ \textbf{ecf}}$ (1) Note 8.15 gains 1st and 2nd marks Density = 7.89 [g cm^{-3}] (or 8.15 [g cm^{-3}] if r = 2.5 cm used) **and** iron stated (1) **Alternative:** Volume = $\pi \times (2.54)^2 \times 15$ (= 304.0 cm^3 or 294.5 if r = 2.5 cm used) (1) Trial and error correctly carried out (1) 294.5 × 7.9 = 2326.7 **and** correct conclusion that metal is iron (1) Apply **ecf** if sin used in (b)(ii) leads to density of 8.84 [g cm^{-3}] accept brass or copper			3	3	3	
	(c)		**Any 1 from:** • Angle of toppling depends on diameter **and** length • Angle of toppling depends on dimensions or shape • Centre of gravity in same place **or** depends on centre of mass • Doesn't depend on density [So student is incorrect or angle will stay the same (or equivalent)]			1	1		
			Question 1 total	**2**	**2**	**4**	**8**	**5**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		F = 160 × 0.08 (substitution) (1) F = 12.8 [N] (1) Deduct 1 mark for power of 10 slip	1	1		2	1	
	(b)		Anti-clockwise: 12.8 **ecf** × 0.6 = [7.68] (1) Clockwise: F × 1.5 (1) F = 5.1(2) [N] **and** yes (reasonable comment) (1) **Alternative:** Clockwise: 5 × 1.5 = 7.5 (1) Anti-clockwise: F_C × 0.6 (1) $F_C = \frac{7.5}{0.6}$ = 12.5 ≈ 12.8 **and** yes (1)			3	3	3	
	(c)		½ mv^2 = ½ Fx (or ½ kx^2) **or** by implication (1) 0.3 × v^2 = 0.2 × 12.8 × 0.08 (or 0.2 × 160 × $(0.08)^2$) (1) (Can award 1st and 2nd marks if this is seen) v = 0.83 [m s^{-1}] (1) Award max 2 marks if 20% factor omitted i.e. 1.85 m s^{-1} Deduct 1 mark for new power of 10 slip	1	1 1		3	3	
			Question 2 total	**2**	**3**	**3**	**8**	**7**	**0**

<table>
<tr><th colspan="3" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>
<table>
<tr><td></td><td>In the horizontal direction</td><td>In the vertical direction</td></tr>
<tr><td>Velocity of cannonball</td><td>Constant [but not zero]</td><td>Increases</td></tr>
<tr><td>Acceleration of cannonball</td><td>Is zero</td><td>Constant [but not zero]</td></tr>
</table>
2 × 1 mark for each correct row.
</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Substitute into $= ut + ½\ at^2$ e.g. $3 = 0.5 \times 9.81 \times t^2$ or $x = 0.5 \times 9.81 \times 0.8^2$ (1)
u = 0 stated or implied (1)
t = 0.78 [s] seen or x = 3.14 [m] seen (1)
Alternative:
Use of $v^2 = u^2 + 2ax$ to find v (i.e. 7.67 m s^{-1}) (1)
Use of $t = \frac{2x}{(u+v)}$ i.e. $\frac{6}{7.67}$ (1)
t = 0.78 [s] seen (1)
Alternative:
Use of $v^2 = u^2 + 2ax$ to find v (i.e. 7.67 m s^{-1}) (1)
Use of $t = \frac{(v-u)}{a}$ i.e. $\frac{7.67}{9.81}$ (1)
t = 0.78 [s] seen (1)</td><td>1
1</td><td>1</td><td></td><td>3</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Substitution into $v^2 = u^2 + 2ax$ e.g. $v^2 = 2 \times 9.81 \times 7$ (1)
v = 11.7 [m s^{-1}] (1)</td><td>1</td><td>1</td><td></td><td>2</td><td>1</td><td></td></tr>
</table>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	$\frac{11.7}{v_H}$ = tan 10° (**ecf** on vertical velocity) (1) v_H = 66.4 [m s^{-1}] (1)	1	1		2	2	
		(iv)	D = 66.4 × 0.78 (**ecf** on v_H) (1) D = 51.8 [m] (1)	1	1		2	2	
	(c)		The angle will be less than 10° because ….. (1) Vertical velocity will be less (no need to mention horizontal velocity being same as other cannonball) (1) Accept shape of path argument if explained well. e.g. vertical component of 'flightpath' will be less			2	2		
			Question 3 total	**7**	**4**	**2**	**13**	**7**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Any changes in temperature **or** reference to environmental changes (1) will affect both wires equally (accept 'the same') (1)		2		2		2
	(b)	(i)	Suitable scale and both axes labelled correctly with appropriate units: **Load or F / N, Extension or e or x / mm** (1) All 5 points plotted correctly ± small square division (2) If 4 points plotted correctly ± small square division (1) If fewer than 4 points plotted correctly ± small square division (0) Appropriate line of best fit (1)  	1	3		4	2	4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)	I	[±] 0.01 [mm]		1		1		1
			II	$A = \pi \times (0.18 \times 10^{-3})^2$ (1) $A = 1.02 \times 10^{-7}$ [m^2] (1)	2			2	1	2
		(iii)		Good method for gradient with $\Delta x \geq 3$ mm determined in either $N\,m^{-1}$ or $N\,mm^{-1}$ e.g. $\frac{22.5}{4.9 \times 10^{-3}} = 4.59 \times 10^3$ [$N\,m^{-1}$] (1) **ecf** from line of best fit E = grad $\times \frac{l}{A}$ (or implied by substitution) (1) (**ecf** on gradient) $E = \frac{4.59 \times 10^3 \times 2.88}{1.02 \times 10^{-7}\ \textbf{ecf}}$ (1) E = 130 G [Pa] (1) (Accept 128 -132) Don't accept 130.7 Don't award any marks for using stress-strain approach apart from the final mark if within range		4		4	4	4
	(c)			To continue as elastic deformation / remain within elastic limit (or no plastic deformation detected) (1) To check that wire returns to original length (or to check that there is no permanent extension) (1)			2	2		2
				Question 4 total	**3**	**10**	**2**	**15**	**7**	**15**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		Area = 40 [N s] (1) $v = \frac{40}{19.0}$ = 2.1 [m s^{-1}] seen (1) **Alternative:** 0 to 2 s: correct use of $a = \frac{F_{mean}}{m} = \frac{5}{19}$ **and** correct use of $v = u + at$ to show v after 2 s = 0.53 [m s^{-1}] (1) 2 s to 5 s correct use of $a = \frac{F_{mean}}{m} = \frac{10}{19}$ (1) Correct use of $v = u + at$ to show v after 5 s = 2.1 [m s^{-1}] i.e. v = 0.53 **(ecf)** + $\frac{10}{19} \times 3$ (1)	1	1 1		3	2	
	(b)	(i)	Concept – ΔE_k attempted (1) ½ × 19 × (2)^2 – ½ × 19 × (1.2)^2 (1) Work done = 24.3 [J] or 28.2 [J] if 2.1 m s^{-1} used (1) Award 2 marks if W = 6.1 [J] seen – this due to (2 – 1.2)^2		3		3	2	
		(ii)	$F = \frac{24.3 \textbf{ ecf}}{8}$ (1) (substitute and re-arrange) F = 3 [N] (or 3.5 N if 28.2 J used) (1) **Alternative:** Using $v^2 = u^2 + 2as$ for a = 0.16 m s^{-2} (1) $F = ma$ = 3.04 [N] (1)		2		2	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	t calculated using $x = \frac{(u+v)t}{2}$ i.e. $8 = \frac{(2+1.2)t}{2}$ seen (1) t = 5 [s] (1) evidence of t calculation must be seen to award the 1st 2 marks Mean rate of energy transfer = $\frac{24.3}{5}$ (1) (**ecf** on both W and t) = 4.86 or 4.9 [J s^{-1} or W] or 5.8 [W] if 28.2 J used (i.e v = 2.1 m s^{-1} throughout) (1) **Alternative:** Use F and m to get a e.g. $a = \frac{3\ \textbf{ecf}}{19}$ (1) $t = \frac{v-u}{a}$ = 5 [s] (1) evidence of t calculation must be seen to award the 1st 2 marks Mean rate of energy transfer = $\frac{24.3}{5}$ (1) (**ecf** on both W and t) = 4.86 or 4.9 [J s^{-1} or W] or 5.8 [W] if 28.2 J used (i.e v = 2.1 m s^{-1} throughout) (1) **Alternative:** Mean speed = $\frac{u+v}{2}$ (1) Mean speed = 1.6 [m s^{-1}] (1) Use of $P = Fv$ **ecf** on F and mean v (1) P = 4.86 or 4.9 [J s^{-1} or W] (1)	1	1 1 1		4	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)	X = {contact / normal / reaction} force of {surface / ice / Earth} [on the stone] (1) Y = {gravitational force due to Earth / weight / mg}[on the stone] (1) Don't accept gravity by itself	2			2		
		(ii)	Forces act on the same body (1) accept forces {<u>should / must</u>} act on different bodies Forces are not of the same type (or equivalent explanation) (1) accept forces should be of the same type	2			2		
			Question 5 total	**6**	**10**	**0**	**16**	**9**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)		**Indicative content:** • A positive pion (pi-plus) decays into a positron and an electron neutrino. • The pion is a meson, while the positron and neutrino are leptons. • Charge **and** baryon number **and** lepton number are conserved (however **no details** given) [can award by implication] • Charge conservation shown: $+1 \rightarrow +1 + 0$ • Make up of charge on pion shown: $+\frac{2}{3} + (+\frac{1}{3}) = +1$ • Baryon conservation shown: $0 \rightarrow 0 + 0$ or quark number conservation: $(+\frac{1}{3} - \frac{1}{3}) \rightarrow 0 + 0$ • Lepton conservation shown: $0 \rightarrow (-1) + (+1)$ • Quark analysis: positive pion is made up of one quark and one antiquark $u\bar{d}$; positron and neutrino are fundamental particles and don't contain quarks. • This is a 'weak' interaction (or interaction involving the weak force)..... • **…..** because of relatively long lifetime and neutrino involvement and change in quark flavour. • Mass of pion is considerably larger than that of the positron so decay is possible.	4	2		6		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5-6 marks Detailed description with charge, baryon and lepton conservation considered. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Good description with 2 out of charge, baryon and lepton conservation considered or partial description of all 3. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Good description with 1 out of charge, baryon and lepton conservation considered or partial description of 2. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.* **0 marks** *No attempt made or no response worthy of credit.*						
	(b)	(i)	**No other (or only)** combination of three u and d can give +1 (1) [Overall charge must be +1 and] $(+\frac{2}{3})$ + $(+\frac{2}{3})$ + $(-\frac{1}{3})$ = +1 (1)			2	2		
		(ii)	Baryon **and** hadron identified	1			1		
			Question 6 total	**5**	**2**	**2**	**9**	**0**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Substitution into Wien equation: $\lambda_{max} = \frac{2.9 \times 10^{-3}}{5800}$ (1) = 500 nm **UNIT MARK** (1)	1	1		2	1	
	(b)	(i)	$1.8 \times 3.9 \times 10^{26} = 7.0[2] \times 10^{26}$ [W]		1		1	1	
		(ii)	Substitution: $A = 4 \times \pi \times (1.4 \times 7 \times 10^{8})^2$ (1) $A = 1.2 \times 10^{19}$ [m^2] (1) Accept correct application of Stefan's law for approximate values of T between 0.95 and 0.98 ($\times$ 5800) Don't accept use of Stefan's law with T = 5800 [K]	1	1		2	1	
		(iii)	Substitution into Stefan's Law: 7×10^{26} **ecf** = 1.2×10^{19} **(ecf)** $\times$ $5.67 \times 10^{-8} \times T_{new}^4$ (1) T_{new} = 5663 [K] (1) 5800 – 5663 = 136 [K] (approx. 100 K) verified (1)	1	1 1		3	2	
	(c)		Decrease in temperature (after 11 billion yrs) (1) Will lead to increase in λ_{max} (no further detail) (1) Sun will appear more orange / red (1) **Accept numerical attempt:** e.g. At 12 billion years $T \approx 0.85 \times 5800$ (= 4930) Be tolerant (1) New λ_{max} = 588 n[m] (1) Hence orange / red (1)			3	3		
			Question 7 total	**3**	**5**	**3**	**11**	**5**	**0**

AS UNIT 1: MOTION, ENERGY AND MATTER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	2	4	8	5	0
2	2	3	3	8	7	0
3	7	4	2	13	7	0
4	3	10	2	15	7	15
5	6	10	0	16	9	0
6	5	2	2	9	0	0
7	3	5	3	11	5	0
TOTAL	**28**	**36**	**16**	**80**	**40**	**15**