GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
PHYSICS – COMPONENT 1
A420U10-1

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 A LEVEL PHYSICS

COMPONENT 1 – NEWTONIAN PHYSICS

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

SECTION A

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)		v_V =18sin40 = 11.6 [m s^{-1}] (1) v_H = 18cos40 = 13.8 [m s^{-1}] (1)		2		2	2	
	(b)		Vertical motion involves constant acceleration / changing velocity (1) Horizontal motion involves constant {velocity / speed} (1)	2			2		
	(c)		Use of equation[s] of motion e.g. $v = u + at$ into $t = \frac{v-u}{a}$ **OR** manipulation of $v^2 = u^2 + 2ax$ into $x = \frac{v^2-u^2}{2a}$ and use of $x = \frac{1}{2}(u + v)t$ (1) $t_{1/2}$ = 1.2 [s] **OR** t_{whole}= 2.4 [s] (1) $x = vt$ =13.8 **ecf** × 1.2 **OR** $x = vt$ =13.8 **ecf** × 2.4 (1) Final answer = 33 [m] so pumpkin doesn't hit target (1) **Alternative:** If use approximation use of $v = \frac{x}{t}$ (1) Correct value of t = 2.8 [s] (1) Use of equations of motion (1) Calculation of vertical velocity = - 15.5 [m s^{-1}] **or** x = -5.3 [m] **or** t = 2.4 [s] **AND** suitable comment **Alternative** $x = \frac{2v\sin\theta}{g} v\cos\theta$ **OR** $\frac{u^2 sin2\theta}{g}$ (2) $x = \frac{2\times18\sin40}{9.81} \times 18\cos40$ **OR** $\frac{18^2\sin(2\times40)}{9.81}$ (1) Final answer = 33 [m] so pumpkin doesn't hit target (1)			4	4	3	
			Question 1 total	**2**	**2**	**4**	**8**	**5**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Substitution into $\Delta E = mg\Delta h$ i.e. 95 × 9.81 × 40sin18 [=11 520 J] (1) Substitution into $\Delta KE = {}^{1}/_{2}\,mv^2 - {}^{1}/_{2}\,mu^2$ [= 8313 J] (1) W = 11 520 **ecf** – 8313 **ecf** = [3207 J] (1) F = 80 [N] (1) **Alternative:** Use of $\frac{v-u}{t}$ **AND** $\Sigma F = ma$ i.e. $\Sigma F = 95 \times \frac{16-9}{3.2}$ = 208 [N] (1) $mg\sin\theta = 95 \times 9.81 \times \sin 18$ = 288 [N] (1) $mg\sin\theta - \Sigma F$ (1) **ecf** on 208 and 288 F = 80 [N] (1)	1 1	 1 1		4	3	
	(b)	(i)	Product of mass and [linear] velocity	1			1		
		(ii)	The rate of change of momentum of an object is proportional to the <u>resultant force</u> acting on it (1) accept net force and takes place in the direction of the force (1) Accept equation with named terms for 1 mark	2			2		
		(iii)	$F = \frac{m(v-u)}{t}$ used or equivalent (1) F = 208 [N] (1) **Alternative:** $mg\sin\theta$ = 288 [N] (1) 288 – 80 **ecf** = 208 [N] (1) **Alternative 2:** $\frac{\Delta KE}{x}$ i.e. $\frac{8313\ \mathbf{ecf}}{40}$ (1) F = 208 [N] (1)		2		2	2	
			Question 2 total	**5**	**4**	**0**	**9**	**5**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		Abs unc = 0.02 **AND** point correctly plotted with error bar (±4 squares with ±½ small square tolerance) (1)		1		1	1	1
	(b)		Max and min gradient lines drawn correctly with ±½ small square tolerance (1) Correct gradient calculations with {triangles drawn / points chosen} occupying more than half the lines (max = 0.51 ± 0.02 and min = 0.41 ± 0.02) (1) Mean gradient correct from candidate's max and min values (expect 0.46) (1) % uncertainty correct from candidate's max, min and mean values (expect 11%) (1) N.B. No sig fig penalties yet!			4	4	4	4
	(c)		$x = h, a = g, ut = 0$ (1) $x = ut + {}^{1}/_{2}\,at^2$ stated (1) Convincing algebra (1)	1	1 1		3	2	
	(d)		$\text{gradient} = \sqrt{\frac{2}{g}}$ or can be implied (1) g correctly calculated from mean gradient from part (b) (1) % uncertainty in g = 2 × % uncertainty in gradient (1) Accept correct upper and lower limits for g Absolute uncertainty **ecf** written to 1 or 2 sig figs with g to correct place value e.g. (9.5 ± 2.1) OR (10 ± 2) [m s^{-2}] (1)			4	4	4	4
	(e)		{Time delay between switch being pressed and ball being released / demagnetisation of sphere and / or electromagnet} **OR** time delay between ball hitting plate and timer stopping (1) Recorded time readings are [ever so slightly] larger than they should be (1) Value of g unaffected as gradient is unaffected (1)			3	3		3
			Question 3 total	**1**	**3**	**11**	**15**	**11**	**12**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Angle swept out [by radius] per unit time (1) Accept rate of change of angular {position / displacement} OWTTE Accept use of equation with terms clearly defined	1			1		
	(b)	(i)	$\times 2\pi$ and $\div 60$ (1) 147 seen (1)		2		2	2	
		(ii)	Substitution into $F = m\omega^2 r$ i.e. $0.15 \times 147^2 \times 19 \times 10^{-2}$ (1) 616 [N] **OR** $F = \frac{mv^2}{r}$ with $v = r\omega$ = 28 [m s^{-1}] (1) Accept 641 [N] if 150 rad s^{-1} used Towards centre of {drum / washing machine} (1)	1 1	1		3	2	
	(c)		Sock is accelerating (1) Resultant force needed so student is incorrect (1) **Alternative** With no resultant force (1) Sock would move in a straight line so student is incorrect (1) **Award 1 mark only for:** Second force acting on the sock which acts {downwards / weight} **and** doesn't effect the centripetal force			2	2		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)		**Indicative content:** • Driving force caused by rotation of unbalanced drum. • Drum undergoes forced oscillations at drum rotation frequency. • The frequency of the drum's free oscillations is the natural frequency. • If driving frequency is equal to natural frequency of the system… • …the amplitude of oscillation is large / builds up. • This is resonance. • Poor design if natural frequency coincides with rotation frequency of drum. • Damping is the dying away of oscillations due to resistive forces. • Effective shock absorbers/dampers would have reduced amplitude/energy of drum's oscillations. • Damping would also have reduced natural frequency. **5-6 marks** Comprehensive explanation with good coverage of forced vibrations, natural frequency, resonance and damping. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Reasonable explanation with some coverage of forced vibrations, natural frequency, resonance and damping. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Limited explanation with little coverage of forced vibrations, natural frequency, resonance and damping. *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.*	4	2		6		
			Question 4 total	**7**	**5**	**2**	**14**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	Straight line drawn from approx. (-5,310) through (0,0) to (5,-310) (1) Accept extended line beyond (-5,310) and (5,-310) Straight line through origin shows acceleration proportional to distance [from equilibrium] (1) - ve gradient shows acceleration acts towards equilibrium (1)	1 1	1		3	1	3
		(ii)	Calculate ω = 7.85 [rad s^{-1}] (1) Substitution into appropriate sine equation e.g. $v = A\omega\sin(\omega t + \varepsilon)$ with ε equal to zero so $v = 5[\times 10^{-2}] \times \frac{2\pi}{0.8}\sin(\frac{2\pi}{0.8} \times 0.32)$ (1) 23 cm s^{-1} **OR** 0.23 m s^{-1} **UNIT MARK** (1) N.B. 1.7 cm s^{-1} would score 2 marks (DEG mode incorrectly used) **Alternative 1** Suitable tangent drawn on x-t graph (1) Use of $\frac{\Delta x}{\Delta t}$ (1) 23 ± 5 cm s^{-1} **OR** 0.23 ± 0.05 m s^{-1} **UNIT MARK** (1) **Alternative 2** Substitution into $v = \omega\sqrt{A^2 - x^2}$ i.e. $v = \frac{2\pi}{0.8}\sqrt{5^2 - 4^2}$ (2) 24 cm s^{-1} **OR** 0.24 m s^{-1} **UNIT MARK** (1)	1	1 1		3	2	3
	(b)	(i)	[T] = s, [m] = kg, [A] = m^2 (1) [ρ] = kg m^{-3}, [g] = m s^{-2} (1) Convincing algebra (1)	1 1	1		3	1	
		(ii)	Manipulation of equation i.e. $m = \frac{T^2 A\rho g}{4\pi^2}$ (1) 0.029 [kg] (1) allow **ecf** on T		2		2	2	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)	Sub into $g = \frac{GM}{r^2}$ i.e. $g = \frac{6.67\times10^{-11}\times7.4\times10^{22}}{1740000^2}$ (1) 1.6 [N kg^{-1}] (1)	1	1		2	1	
		(ii)	$T_{\mathrm{M}} = 2\pi\sqrt{\frac{m}{A\rho g}}$ used on Moon i.e. $T = 2\pi\sqrt{\frac{\mathbf{0.029\ ecf}}{1.8\times10^{-4}\times997\times\mathbf{1.6\ ecf}}}$ (1) $T_{\mathrm{M}} = 2.0$ [s] (1) $\frac{T_{\mathrm{E}}}{T_{\mathrm{M}}} = \frac{0.8}{2.0} = 0.42$ (1) **Alternative** $T \propto \sqrt{\frac{1}{g}}$ can be implied (1) $\frac{T_{\mathrm{E}}}{T_{\mathrm{M}}} = \frac{\sqrt{\frac{1}{9.81}}}{\sqrt{\frac{1}{1.6}}}$ **OR** $\sqrt{\frac{\mathbf{1.6\ ecf}}{9.81}}$ (1) $= 0.40$ (1)	1	1 1		3	2	
			Question 5 total	**7**	**9**	**0**	**16**	**9**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)		$KE_{\text{molecule}} = \frac{3}{2}kT = \frac{3}{2} \times 1.38 \times 10^{-23} \times (20 + 273[.15])$ (1) 6.1×10^{-21} [J] (1)		2		2	2	
	(b)		$\overline{c^2} = \frac{2KE_{\text{molecule}}}{m}$ **OR** $\bar{c}^2 = \frac{3kT}{m}$ **OR** $\bar{c}^2 = \frac{3RT}{M_r}$ (1) Use of $\frac{M_r/1000}{N_A}$ i.e. $\frac{0.04}{6.02\times10^{23}}$ **OR** $40 \times 1.66 \times 10^{-27}$ [= 6.64×10^{-26} kg] (1) $\overline{c^2} = \frac{2\times6.1\times10^{-21}\ \textbf{ecf}}{6.64\times10^{-26}}$ = 184 000 [$m^2 s^{-2}$] (1) c_{rms} = 430 [$m s^{-1}$] (1)	1	1 1 1		4	3	
	(c)		Ne has same KE_{molecule} as Ar (1) Ne has greater c_{rms} than Ar (1) Ne has $c_{\text{rms}}\sqrt{2}$ times bigger than Ar (1)		3		3		
			Question 6 total	**1**	**8**	**0**	**9**	**5**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Energy transfer due to a temperature difference [between two systems] (1) Accept heat transfer instead of energy transfer Accept energy transfer from Al to brass Initially rate of heat flow will be greatest as temperature difference is greatest (1) Rate decreases [as temperature difference decreases] until zero heat flow [when equilibrium is reached] (1) To award full marks energy must be referenced correctly at least once	3			3		
	(b)		Substitution into $Q = mc\Delta\theta$ for Al **OR** brass (1) $Q_{\text{transferred from Al}} = Q_{\text{transferred to brass}}$ (1) 1.0 × 920 × (85 – θ) = 2.5 × 400 × (θ - 50) (1) θ = 66.8 [°C] (1)	1	1 1 1		4	2	
	(c)		**Benefits:** renewable / stores carbon / helps regulate humidity levels / {if compressed will not lose insulating properties / fibre glass settles losing some of its insulating ability} / does not use toxic substances (formaldehyde) to bind fibres / fibre glass not good for health if breathed in (1) Don't accept just environmentally friendly **Drawbacks:** {Untested / fibreglass is tried and tested} / {not fire retardant unless chemical added / may contain harmful chemicals (ammonium phosphate) as fire retardants} / more expensive than fibreglass / requires {space to grow / specific growing conditions / time to grow} / may attract vermin / may degrade over time (1)			2	2		
			Question 7 total	**4**	**3**	**2**	**9**	**2**	**0**

SECTION B

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		Data taken from graph i.e. 7.1±0.1, 2.9±0.1, 1.1±0.1 (1) Multiplying BE/N with N for at least one value e.g. 7.1 × 4 (1) Conversion to J seen at least once i.e. × 1.6 × 10^{-13} (1) Final answer correct i.e. 2.8 pJ (1)		4		4	4	
	(b)		Use of equation $F = \frac{kQq}{r^2}$ (1) Correct strategy e.g. using 200 N to obtain r **OR** inputting a distance i.e. 1 × 10^{-15} to obtain force (1) Correct calculation and comment (1) e.g. r = 1.1 fm – about right **OR** 230 N with 1 fm **AND** a comment of "close"			3	3	3	
	(c)		Conversion of 1 MeV to 1.6 × 10^{-13} [J] (1) $\frac{3}{2}kT$ used (1) 7.7 × 10^{9} K which is much bigger than 10^{8} K so correct (1)	1	1 1		3	2	
	(d)		Correct algebra e.g. $v^3 = \frac{2P}{0.35\rho\pi r^2}$ (1) Correct substitution including 35% (1) Speed = 11.4 [m s^{-1}] (1) Award 2 marks for 8.0 [m s^{-1}]	1	1 1		3	2	
	(e)		Arrow seen in opposite direction end-to-end (1) N3 force is towards the centre linked to implosion (1)		2		2		
	(f)		Substitute 400 MJ and 2.05 MJ into efficiency equation (1) $\frac{2.05}{400}$ × 100 = 0.51 [%] (1)	1	1		2	1	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(g)		$2 \times 10^9 \times 2 \times 10^{-3}$ seen i.e. 4×10^6 [W](1) Dividing 500×10^{12} by this (1) Correct answer = 125 million year and needs more time! (1) **Alternative for 2nd and 3rd marks** Multiply by 10 000 = 4×10^{10} [W] (1) 4×10^{10} [W] is much lower than 500×10^{12} [W] (1)			3	3	3	
			Question 8 total	**3**	**11**	**6**	**20**	**15**	**0**

A LEVEL COMPONENT 1: NEWTONIAN PHYSICS

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	2	4	8	5	0
2	5	4	0	9	5	0
3	1	3	11	15	11	12
4	7	5	2	14	4	0
5	7	9	0	16	9	6
6	1	8	0	9	5	0
7	4	3	2	9	2	0
8	3	11	6	20	15	0
TOTALS	**30**	**45**	**25**	**100**	**47**	**18**