



GCE AS MARKING SCHEME

SUMMER 2025

**AS
PHYSICS – UNIT 2
2420U20-1**

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 2 – ELECTRICITY AND LIGHT
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)	(i)		Number of {free / delocalised} <u>electrons</u> per {metre cubed / m ³ / unit volume} Accept free electron {concentration / density}	1			1		
		(ii)		Rate of flow of charge OR charge passing [through a cross section] per unit time (1) Don't accept current is flow of charge ACCEPT $I = \frac{[\Delta]Q}{[\Delta]t}$ with terms named $\therefore \frac{nAvt e}{t}$ or $It = nAvt e$ (1)	1	1		2		
	(b)	(i)		Rearrange and sub into $\rho = \frac{RA}{l}$ (1) condone power slips and factor of 2 errors $\rho = 4.9 \times 10^{-7} [\Omega \text{ m}]$ (1) can be implied Rearrange and sub into $l = \frac{RA}{\rho}$ (1) condone power slips and factor of 2 errors $l = 3.722$ OR 3.72 [m] (1) allow ecf on ρ Alternative Realising the resistivities are equal (1) Substituting into Griff's equation (1) Substituting into Gwen's equation (1) $l = 3.722$ OR 3.72 [m] (1) Alternative Halving the resistance means half the length (1) Doubling the diameter means 4 × the csa (1) so needs 4 × the length (1) [Combining both gives twice the length], i.e. 3.722 [m] (1)		4		4	4	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)	I	Clockwise	1			1		
			II	Current will be the same in both resistors as they are in <u>series</u> OR due to conservation of charge (1) Gwen's wire has larger [cross-sectional] area, so will have smaller drift velocity (1) $A \propto \frac{1}{v}$ [for constant current] (1)		3		3		
				Question 1 total	3	8	0	11	4	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Use of Ohm's law e.g. $V \propto I$ [temperature is constant] or $\frac{V}{I} = \text{a constant}$ or I-V graph is a straight line graph through the origin or $R = \frac{V}{I}$ (1) Use of values from 0 V to 2.0 V to prove proportionality or from 3.0 V to 10.0 V to prove not proportional (1) Conclusion that ohm's law is obeyed for lower voltages or not obeyed for higher voltages (1)			3	3	2	3
	(b)		Indicative content • pd causes force on [free] electrons • Force causes electrons to accelerate or to move to the positive terminal • This movement of electrons is an electric current • Electrons collide with {positive ions / atoms} • This gives rise to resistance • Electrons transfer kinetic energy to ions • Ions vibrate more / have greater vibrational / thermal energy • Temperature increases • Electrons move faster • Collisions {are more frequent / impart more force} • Electrons have less time to accelerate • Current increases at decreasing rate [hence higher resistance] 5-6 marks A comprehensive description is provided. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.</i>	6			6		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			3-4 marks A reasonable description is provided. <i>There is a line of reasoning that is partially coherent, largely relevant, supported by some evidence and with some structure.</i> 1-2 marks A limited description is provided. <i>A basic line of reasoning that is not coherent, largely irrelevant, supported by limited evidence and with very little structure.</i> 0 marks No attempt made or no response worthy of credit.						
	(c)		[When metal is cooled,] the temperature at which it loses all its electrical resistance (1) Transition temperature of a few Kelvin (1) Accept >0-50 K	2			2		
	(d)		Any 2 ×(1) from: • Repeat their own work • Ask scientific community to repeat the work / reproducibility comment • Produce report for small number within the science community to view / check OR publish findings to press to be passed by a referee • Check for errors in the equipment measuring resistance OR temperature			2	2		
			Question 2 total	8	0	5	13	2	3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		The energy converted from some other form (e.g. chemical / solar / light) to <u>electrical</u> [potential] energy (1) per {unit charge / coulomb} [flowing through the cell] (1)	2			2		
	(b)	(i)	$V = E - Ir$ used (1) Point chosen from line and r calculated e.g. $r = \frac{E-IR}{I} = \frac{6-(1 \times 4)}{1}$ (1) Alternative 1 $r = \frac{E}{I}$ at $R = 0$ (1) $\frac{6}{3}$ (1) Alternative 2 When $R = r$ there is twice the total resistance compared to when $R = 0$ (1) From graph the value of resistance that gives half the maximum current is 2Ω (1)	1	1		2	2	
		(ii)	$P = I^2 R$ used at 2Ω i.e. $1.5^2 \times 2 = 4.5$ [W] (1) Power calculated for a resistance that is $< 2\Omega$ (1) Power calculated for a resistance that is $> 2\Omega$ (1) and suitable comment made e.g. Bryn is correct or 4.5W is the highest power			3	3	3	
			Question 3 total	3	1	3	7	5	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Sound waves from loudspeaker reflect off surface of water OR two waves travelling in opposite directions (1) With same {frequency / wavelength} (accept coherent) AND [similar] amplitude (1) Don't accept identical superpose OR interfere (1)	3			3		3
	(b)	(i)	$\frac{0.348-0.332}{0.340} = 0.008$ [m] or equivalent (1) $\frac{0.008^2}{0.340} \times 100 = 2.35$ [%] or 2[%] or 2.4[%] (1) no sig fig penalty			2	2	2	2
		(ii)	$c = f\lambda$ seen AND node to node distance is $\frac{\lambda}{2}$ (1) $2x = \lambda$ (1)			2	2		2
		(iii)	$2 \times 495 \times 0.340 = 337$ OR 336.6 [m s ⁻¹] (1) % unc in c = % unc in f + % unc in x ecf from (b)(i) = 4% OR 4.4% (1) Abs unc in c = 13 OR 15 OR even 10 [m s ⁻¹] (1) ecf no sig fig penalty here Absolute uncertainty to 1 or 2 sig figs and c written to corresponding place value e.g. (337 ± 13) OR (337 ± 15) OR (340 ± 10) OR (340 ± 14) [m s ⁻¹] (1) Allow ecf on c			4	4	4	4
			Question 4 total	3	0	8	11	6	11

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		Spreading [out] of waves due to {gap / obstacle / slit}	1			1		
	(b)	(i)	4 wavefronts drawn with [increasingly longer] straight portions and curved edges (1) Accept at least 3 wavefronts Wavelength consistent with incoming waves (1)	1	1		2		
		(ii)	[Roughly] semicircular or spread around 180° Don't accept more curved or more circular	1			1	1	
	(c)	(i)	Coherent	1			1		
		(ii)	A – {Equidistant from dippers / zero path difference} (1) [arrive in phase hence] constructive interference (1) B – Path difference of <u>1½ wavelengths</u> (1) Arrive in antiphase hence destructive interference (1) Accept $\lambda \approx 0.6\text{-}0.8\text{ cm}$ and path difference $\approx 0.7\text{ cm}$ measured from diagram. So not in phase with partial interference.		4		4		
		(iii)	Red laser suitable as slits act as in phase sources OR light from slits will have a constant phase difference $\therefore$ suitable (1) accept red laser light is coherent Slits would not act as coherent sources OR would not have a constant phase difference OR non-point source so overlapping interference patterns $\therefore$ not suitable with only a double slit (1) Different {wavelengths / frequencies} OR not monochromatic $\therefore$ not suitable (1)		3		3		
			Question 5 total	4	8	0	12	1	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Use of $n = \frac{c}{v}$ or $n_1 v_1 = n_2 v_2$ (1) can be implied Air → plastic: [Slows down from] $3 \times 10^8 \text{ [m s}^{-1}\text{]}$ to $1.9 \times 10^8 \text{ [m s}^{-1}\text{]}$ (1) ACCEPT decreases speed by a factor of 1.57 OR decreases by $1.1 \times 10^8 \text{ [m s}^{-1}\text{]}$ Plastic → water: [Increases speed] to $2.3 \times 10^8 \text{ [m s}^{-1}\text{]}$ (1) ACCEPT increases speed by a factor of {1.18 / 1.2 / 1.21} OR increases by $0.4 \times 10^8 \text{ [m s}^{-1}\text{]}$ $\text{[m s}^{-1}\text{]}$ If no calculations given award 1 mark for air to plastic decreases speed and plastic to water increases speed	1	1		3	1	
		(ii)	Substitution into $\sin C = \frac{n_1}{n_2} = \frac{1}{1.33}$ (1) or equivalent $C = 49^\circ$ (1) First angle $i > 49^\circ$ stated OR $74^\circ > 49^\circ$ (1) so TIR occurs (1)	1	1 1 1		4	4	
	(b)	(i)	{Passing / incoming} photon causes (1) emission of a [second] photon [from an excited atom] (1) of energy equal to energy difference (accept jump / gap) between excited state and state into which the electron drops (1) ACCEPT reference to incoming and stimulated photons having equal {energy / frequency / wavelength} accept in phase or coherent	3			3		
		(ii)	$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{550 \times 10^{-9}}$ or use of $c = f\lambda$ and $E = hf$ (1) $3.62 \times 10^{-19} \text{ [J]}$ (1) $\frac{1 \times 10^{-3}}{3.62 \times 10^{-19}} = 2.8 \times 10^{15} \text{ [s}^{-1}\text{]}$ (1) ecf on photon energy		3		3	3	
Question 6 total				5	8	0	13	8	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		$\Delta E = [-]3.04 - [-]5.14 = 2.10 \text{ [eV]} (1)$ $\times e [= 3.36 \times 10^{-19}] \text{ [J]} (1)$ $\lambda = 592 \text{ nm} (1)$ UNIT MARK AND ecf on ΔE		3		3	3	
	(b)		{Bright / colourful / yellow} lines (1) on a black background (1)		2		2		
	(c)		Photons (accept light) of particular {frequency / wavelength / energy} OR photons of energy 2.10 eV ecf (1) {absorbed by sodium atoms / cause electrons to move up energy levels} (1) Atoms [spontaneously] re-emit photons in random directions OR only a very small fraction of photons will arrive in the position of the dark line (1)		3		3		
			Question 7 total	0	8	0	8	3	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		[Concentric] circles (1) accept ring-like pattern Electrons behave like waves (1) accept reference to wave particle duality of matter	2			2		
	(b)		$9.11 \times 10^{-31} \times 1.8 \times 10^7 = 1.6 \times 10^{-23} \text{ [kg m s}^{-1}\text{]}$ (1) can be implied $p = \frac{h}{\lambda}$ rearranged to give $\lambda = \frac{h}{p}$ (1) $= 40.4 \text{ p[m]}$ (1)		3		3	3	
			Question 8 total	2	3	0	5	3	0

AS UNIT 2 – ELECTRICITY AND LIGHT

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	8	0	11	4	0
2	8	0	5	13	2	3
3	3	1	3	7	5	0
4	3	0	8	11	6	11
5	4	8	0	12	1	0
6	5	8	0	13	8	0
7	0	8	0	8	3	0
8	2	3	0	5	3	0
TOTAL	28	36	16	80	32	14