GCE AS MARKING SCHEME

SUMMER 2025

AS
PHYSICS – COMPONENT 2
B420U20-1

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 COMPONENT 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)	A pattern of disturbances travelling through a medium carrying energy with it (1) Involving particles of the medium vibrating about their equilibrium positions (1) Accept "without particles of the medium moving"	2			2		
		(ii)	Transverse waves – vibrations are at right angles to direction to direction of wave travel (1) Longitudinal – vibrations are along the direction of travel of the waves (1)	2			2		
	(b)	(i)	Period of wave = 0.16 m[s] (1) Frequency = $\frac{1}{T}$ = 6.25 k[Hz] **or** 6250 [Hz] **or** 6.25×10^3 [Hz] (or s^{-1}) (1) **ecf** on power of 10 error		2		2	1	
		(ii)	Correct shape – sinusoid curve starting at t = 0 with correct period (1) Amplitude correct = 0.7 cm (1) Phase difference correct (ignore if drawn leading or behind) (1)		3		3	3	
			Question 1 total	**4**	**5**	**0**	**9**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	Wavefronts (or waves) from S_1 and S_2 spread out [accept waves diffract at each slit] (1) And then overlap [accept superpose or interfere] (1)	2			2		
		(ii)	Bright / maximum intensity at central axis (1) Path difference = 0 so arrive in phase (1)	1	1		2		
	(b)	(i)	Constructive interference observed at P due to maxima (1) Waves arrive in phase at P (1) accept 360° or 2π		2		2		
		(ii)	Method – Using $y = \frac{\lambda D}{a}$ or approach based on path difference $= n\lambda$ and using Pythagoras (1) Determining wavelength i.e. substituting/determining values (1) Wavelength = 1.2 cm and within range of microwaves as expected (1)			3	3	2	
	(c)	(i)	Different wavelengths of the em spectrum is used to observe the universe	1			1		
		(ii)	Many astronomical objects emit radiation outside the visible part of the em spectrum / different physical processes across em range	1			1		
			Question 2 total	**5**	**3**	**3**	**11**	**2**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		**Indicative content** Diagram of set-up given and labelled. Circuit given to measure resistance i.e. ohmmeter or ammeter and voltmeter with variable supply. Vary temperature and measure with thermometer. Description of how to ensure consistent temperature e.g., stirring. Check for zero errors – circuit resistance. Use ice to obtain temperature of 0 °C. Sketch graph with axis labelled. Correct units given on axis. Straight line drawn with intercept on the resistance axis. Resistance increases with temperature. **5-6 marks** Comprehensive explanation given. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Limited description given. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Some attempt at indicative content. *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 not worthy of credit.	6			6		6

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)		Recall and substitute values in $I = nAve$ (1) Number of free electrons per m^3 = 18×10^{28} (1) Drift velocity v = 2.4×10^{-4} [$m\,s^{-1}$] (1) Award 2 marks maximum if omission of factor of 3 for the number of free electrons from each atom	1	1 1		3	2	
	(c)	(i)	Resistance is zero [at very low temperatures]	1			1		
		(ii)	Application e.g. MRI scanners; Maglev trains (1) Advantage – no energy is wasted as heat / B-field large (1) Disadvantage – need to maintain low temperatures (1) N.B. High cost not accepted unless accompanied by valid reason	1	1 1		3		
			Question 3 total	**9**	**4**	**0**	**13**	**2**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Smallest angle = critical angle or using n_1 sin 79º = n_2 sin 90º (1) Refractive index = 1.50 (1)	1	1		2	1	
	(b)	(i)	Using equation: speed of light in fibre = $\frac{c}{n_{core}}$ (1) Speed of light in core = 1.96×10^8 [m s^{-1}] **ecf** (1) Time taken to travel 2.0 km = 10.2 μ[s] (1)	1	1 1		3	3	
		(ii)	Zig zag path is 1.02 (1.019) times longer than central axis (using sin 79º) (1) Time taken is 1.02 longe**r or** calculating 2.037 k[m] (1) Data will be lost / arrive at different times / smear of data – Thomas is correct (1) Final mark accepted as a stand-alone if data will be lost/arrive at different times/smear of data included in the answer.			3	3	2	
			Question 4 total	**2**	**3**	**3**	**8**	**6**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		There is 1.6 J of energy converted from electrical energy to other forms (1) Per {unit / coulomb} of charge [flowing from one point to the other] (1)	2			2		
	(b)	(i)	Using $V = E - Ir$ (1) Total internal resistance = $\frac{0.6}{0.4}$ = 1.5 [Ω] (1) Cells connected in series so r = 0.5 [Ω] (1)	1	1 1		3	2	
		(ii)	Resistance of external circuit = 10.5 [Ω] (1) Emf across circuit = 1.6 [V] (1) Current = $\frac{E}{(R + r_{\text{total}})}$ = 0.13 [A] (1)		3		3	2	
	(c)		Substituting values 6.9 = (n1.6) – 0.44(n0.5) (1) Algebra to solve equation (1) Number of cells required = 5 (1)		3		3	3	
			Question 5 total	**3**	**8**	**0**	**11**	**7**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Using cross-sectional area $A = \frac{\pi d^2}{4}$ **or** $A = \pi r^2$ (1) Cross sectional area = 1.19×10^{-6} m^2 no sfs penalty (1) **UNIT MARK** Percentage uncertainty in area = $2 \times \frac{0.01}{1.23} \times 100\% = 2 \times 0.81\% = 2\%$ (max 2 sfs) (1)	1	1 1		3	3	3
		(ii)	Using $\rho = \frac{RA}{l}$ (1) Resistivity = 1.80×10^{-8} [Ωm] **or** length = 2.66 [m] **or** area = 1.12×10^{-6} [m^2] **ecf** (1) Percentage uncertainty in length is negligible / calculated = 0.04% (1) Percentage uncertainty in resistivity/area/length = 7% (1) Absolute uncertainty in resistivity = 0.13×10^{-8} [Ωm] **or** length = 0.18 [m] or area = 0.08×10^{-6} [m^2] (1) **ecf** Conclusion – value of {resistivity of copper/area/length} within range so correct (1)			6	6	5	6
	(b)		Sectors of society are not disadvantaged by having to buy new leads/phones on a regular basis / makes mobile phone use more accessible to everyone (1) Reduces waste copper / conserves the Earth's resources (1) **Accept** • Market for cable becomes more competitive (1) • Argument based on long and short term – award 2 marks i.e. short term – a lot of waste as cables cannot be used but long-term gain as cables will be standardised.			2	2		
			Question 6 total	**1**	**2**	**8**	**11**	**8**	**9**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	Using $E = \frac{hc}{\lambda}$ (1) Energy of one photon = 3.62×10^{-19} [J] (1) Total number of photons = $\frac{2.5 \times 10^{-3}}{3.62 \times 10^{-19}}$ = 6.9[1] $\times 10^{15}$ photons (1)	1	1 1		3	2	
		(ii)	Wavelength of blue light is shorter than green **OR** frequency of blue light greater than green (1) Energy of one photon of blue is greater than green so less photons emitted per second (1)	1	1		2		
	(b)	(i)	Total charge emitted per second = 4.8×10^{-8} [C] (1) Number of electrons = $\frac{4.8 \times 10^{-8}}{1.6 \times 10^{-19}}$ = 3×10^{11} (1) Assumption - all electrons emitted from the surface are measured by ammeter (1)		3		3	2	
		(ii)	Fraction = $\frac{3 \times 10^{11}\mathbf{ecf}}{6.9 \times 10^{15}\mathbf{ecf}} = \frac{1}{23000}$ which is very low Accept $\frac{23000}{1}$ is the number of photons required to release 1 electron			1	1	1	
		(iii)	Polarity needs to be reversed (1) Power supply needs to be variable (1) Voltmeter connected [across the supply] (1) i.e. if reference to circuit requiring a voltmeter to be connected then award 1 mark		3		3		3
			Question 7 total	**2**	**9**	**1**	**12**	**5**	**3**

AS COMPONENT 2 – LIGHT AND ELECTRICITY

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	5	0	9	4	0
2	5	3	3	11	2	0
3	9	4	0	13	2	6
4	2	3	3	8	6	0
5	3	8	0	11	7	0
6	1	2	8	11	8	9
7	2	9	1	12	5	3
TOTAL	**26**	**34**	**15**	**75**	**34**	**18**