GCE AS MARKING SCHEME

SUMMER 2019

AS LEVEL
PHYSICS - COMPONENT 2
B420U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2019 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

AS COMPONENT 2 – ELECTRICITY AND LIGHT

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)*		Each end has zero displacement (1) Only integers of half wavelengths can fit on string (1) As $c = f\lambda$ and speed is constant - this only occurs at particular frequencies (1) **OR** Waves are reflected from the fixed end (1) At particular frequencies only - arrive in phase with the next wave leaving / complete half wavelengths / nodes created (1) By principle of superposition *or* interference occurs to create nodes / antinodes (1)	3			3		
	(b)	(i)	Node to node distance = $\frac{\lambda}{2}$ (1) Wavelength = 0.24 [m] (1) Speed ($v = f\lambda$) = 108 [m s^{-1}](1)	1	1 1		3	2	
		(ii)	At 450 Hz: Length of string = $n \times 0.12$ (n = no. of loops) (1) At higher f: (n + 2) $\times$ 0.1 = length of sting (1) Therefore $0.12n = 0.1\ (n + 2)$ (1) n = 10 (1)		4		4	4	
			Question 1 total	**4**	**6**	**0**	**10**	**6**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*		**Polarisation** Polarised – vibrations in one plane only Use polarising filters Rotate filter If polarised; intensity will change Intensity will change at intervals of 90° Wave is transverse only. **Interference** Laser light is a coherent source Use of double slits to observe pattern Description of interference pattern Constructive interference occurs when path difference = $n\lambda$ Destructive interference when path difference = (n + ½) λ Young's double slit formula quoted $y = \frac{\lambda D}{a}$ Symbols explained Wavelength can be determined AO1 – show understanding of what polarisation and interference are AO3 – evaluate what properties can be determined using polarisation and interference	2		4	6		6

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5-6 marks Comprehensive description including both polarisation and interference. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Comprehensive description of either polarisation or interference OR limited description including both polarisation and interference. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Limited description of either polarisation or interference. *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)		Advantage – Efficiency; improvements to society (1) Issue – Disposal of materials (1) Benefit of research and development given - impact on environment should always be considered before developing new materials (1)			3	3		
			Question 2 total	**2**	**0**	**7**	**9**	**0**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*		Refraction is a change in direction of the travel of waves (1) Waves travel more slowly in glass than in air (1) Therefore AB is greater than CD (1)	1 1	 1		 3		
	(b)		Measuring lengths AB = 2.9 cm and CD = 1.8 cm within 0.1 cm (1) Speed = $\frac{BD}{t}$ and $\frac{AC}{t}$ (can be implied) (**ecf**) (1) Speed = 1.9 [or 1.86] $\times 10^8$ [m s^{-1}] (1)	1	 1 1		 3	 2	
			Question 3 total	**3**	**3**	**0**	**6**	**2**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*	(i)	Using $R = \frac{\rho l}{A}$ (1) Area = $\frac{\pi d^2}{4}$ = 6.16 × 10^{-8} m^2 (1) Resistivity = 1.62 × 10^{-8} Ω m **unit mark** (1)	1	1 1		3	2	
		(ii)	$p_l = \frac{0.1}{32.4}$ × 100% = 0.3% or statement – negligible (1) p_A = 2 × p_d = 7.1% (1) Total percentage uncertainty = 12% (**ecf**) (1) Abs unc (resistivity) = ± 0.2 × 10^{-8} [Ω m] to 1 sf maximum (**ecf**) (1)		4		4	4	4
		(iii)	Silver and copper lie within range of values (**ecf**) (1) Material cannot be determined exactly from table (1)			2	2		
	(b)	(i)	Current is flow of (free) electrons (1) Flow is obstructed by <u>collisions with ions</u> (1) Collisions increase as temperature increases (1) Because of increased vibrations of ions/lattice *or* random speed of electrons increases (1)	4			4		
		(ii)	Using $R = \frac{V}{I}$ or proportional to $\frac{1}{I}$ OR temperature is inversely proportional to current (V constant) (1) Determining constant for at least 3 values dependent on method $k = \frac{R}{\text{Temperature}}$ or Temperature x I (1) Conclusion – not constant (accept directly proportional if temperature in kelvin) (1)			3	3	2	3
			Question 4 total	**5**	**6**	**5**	**16**	**8**	**7**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)	All resistors connected in parallel (1) Using $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ [or equiv] (1) R_{total} = 1.44 [Ω] (1)	1	 1 1		3	2	3
	(b)	(i)	(A4/emf) is the energy generated in the cell (1) per coloumb (1) Loss of energy in circuit in the load resistor (E4) (1) $E-V$ is the energy is lost in internal resistance (1) Energy is conserved (1) Re-arrange gives $r=\frac{E-V}{I}$ (1)	 1 1 	1 1 1 1		6	1	
		(ii)	Substituting values in $\frac{\text{A7 - E7}}{\text{D7}}$ (1) r = 0.15 [Ω] (1)	1 	 1		2	2	
		(iii)	Using $P=I^2R$ (1) P = 0.45 [W] (1) 0.50 W – has to be greater than the power dissipated (need reason) (1)	1 	 1 1		3	1	
			Question 5 total	**5**	**9**	**0**	**14**	**6**	**3**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*		5.1 [eV]	1			1		
	(b)		Particular wavelengths of the light are absorbed (1) Atoms or electrons are raised to higher energy levels (1) Light re-radiated in all directions (1)	3			3		
	(c)	(i)	Energy (= $\frac{hc}{\lambda}$) = 3.4 × 10^{-19} [J] (1) Conversion to eV = 2.1 [eV] (1) Correct conclusion with justification – does correspond to energy difference in levels (1)			3	3	2	
		(ii)	Wien's Law $\lambda_{max} = \frac{W}{T}$ (1) $T = \frac{2.9 \times 10^{-3}}{\lambda_{max}}$ (1) Temperature = 29 000 [K] (1)	1	1 1		3	3	
			Question 6 total	**5**	**2**	**3**	**10**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			energy needed (1) ….. …. to remove an electron from a surface(1)	2			2		
	(b)	(i)		Energy of one photon = 4.8×10^{-19} [J] (1) Number of photons = 5.2×10^{8} (1)		2		2	2	
		(ii)	I	Threshold frequency = 4.4×10^{14} [Hz] (1) Work function = $hf_o = 2.9 \times 10^{-19}$ [J] (1)		2		2	2	
			II	Line drawn with intercept greater than 4.4×10^{14} Hz (1) Line has same gradient (1)		2		2	1	
			III	Photon energy would stay the same (1) Same surface or work function would stay the same (1)		2		2		
				Question 7 total	**2**	**8**	**0**	**10**	**5**	**0**

AS COMPONENT 2 – ELECTRICITY AND LIGHT

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	6	0	10	6	0
2	2	0	7	9	0	6
3	3	3	0	6	2	0
4	5	6	5	16	8	7
5	5	9	0	14	6	3
6	5	2	3	10	5	0
7	2	8	0	10	5	0
TOTAL	**26**	**34**	**15**	**75**	**32**	**16**