GCE AS MARKING SCHEME

SUMMER 2022

AS
PHYSICS – COMPONENT 2
B420U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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.

GCE AS PHYSICS COMPONENT 2

ELECTRICITY AND LIGHT

SUMMER 2022 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)		Displacement / vibrations / oscillations (1) Parallel to direction of travel of wave – longitudinal (1) Perpendicular to direction of propagation of wave (1)	3			3		
	(b)	(i)	Phase correct – starting from peak (1) Sinusoid curve drawn with amplitude = 12 mm (1) Period of wave = 50 ms (1)		3		3	2	
		(ii)	Points P and R have same amplitude/frequency (1) Phase difference approximately 270° **or** ¾ cycle/wavelength / R is ahead of P by a quarter cycle (1)		2		2		
	(c)	(i)	The displacement at any point is the [vector] sum (1) of the displacements of the individual waves (1)	2			2		
		(ii)	For t = 1.0 s the pulses travel 0.5 m (1) For t = 2.0 s the pulses fully overlap – amplitude double or larger (1) For t = 3.0 s the pulses re-appear – correct on diagrams (1)		3		3	2	
			Question 1 total	**5**	**8**	**0**	**13**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(a)		The spreading of waves through a gap or opening / obstacles or wtte	1			1		
	(b)		Diagram 1: diverging plane waves on RHS with slight curved edges (1) Diagram 2: curved / semi-circular wavefronts (1) Same wavelength as incident waves in both (1)		3		3		
	(c)	(i)	Substituting: $\tan\theta = \frac{66}{50}$ (1) θ = 52.8° [= 53° (2 sf)](1)	1	1		2	2	2
		(ii)	Calculating $d = \frac{1\text{x}10^{-3}}{500}$ = 2×10^{-6} [m] (1) Use of $n\lambda = d\sin\theta$ (1) Substituting values $3\lambda = 2 \times 10^{-6}\sin 53°$ (1) Wavelength = 532 nm **unit mark** (accept 531 nm) (1)	1 1	1 1		4	3	4
	(d)		Use of $\lambda = \frac{ay}{D}$ (1) Determining $y = \frac{7}{4}$ m[m] (1) Substituting values $\lambda = \frac{1.75\ \text{x}10^{-3}\text{x}\ 0.2\text{x}10^{-3}}{0.7}$ (1) Wavelength = 500 n[m] (1)	1	1 1 1		4	3	4
	(e)		Significant distances longer for part (c) (1) So uncertainty will be smaller (1) Spots for diffraction are clearer and sharper or more difficult to measure separation of fringes (1)			3	3		3
			Question 2 total	**5**	**9**	**3**	**17**	**8**	**13**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3.	(a)		Use of $Q = It$ (1) Charge = 144 [C] (1)	1	1		2	1	
	(b)	(i)	Joule (of energy) per coulomb	1			1		
		(ii)	Use of energy = VQ **ecf** (1) Energy = 864 [J] (1)	1	1		2	1	
	(c)	(i)	Attempt to draw a closed circuit (1) Ammeter and voltmeter correctly positioned (1)	2			2		2
		(ii)	**X: Component A and C** X1 The current is proportional to pd for both components X2 They both obey Ohm's law X3 Gradient for component C is twice that of Component A X4 Gradient is $\frac{1}{R}$ X5 So resistance of A is twice that of C (or vice versa) X6 Components A and C could be resistors or lengths of wire **Y: Component B** Y1 Current is not proportional to pd Y2 Temperature may not be constant Y3 Component B could be a filament lamp Y4 Current is proportional to pd at low values of pd Y5 Same resistance as C when curves crosses the line for C Y6 Resistance increases with pd/current			6	6		6

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5-6 marks Comprehensive and correct analysis of all 3 components. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Comprehensive and correct analysis of 2 components **or** incorrect analysis of all 3 components. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Correct analysis of 1 component **or** incorrect analysis of 2 components. *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.						
			Question 3 total	**5**	**2**	**6**	**13**	**2**	**8**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4.	(a)		A dark background (1) Series of different coloured lines - sequence of lines (1)	2			2		2
	(b)		Substituting values into $E = \frac{hc}{\lambda}$ for 565 n[m] **or** by implication (1) Correct conversion from J to eV **or** by implication (1) Energy = 2.2 eV (1) Attempt at calculating difference in energy levels and correct conclusion – Sodium (1)			4	4	3	
	(c)		Electrons are excited to a metastable state – stay for long time (1) Population inversion – more electrons in excited state than ground / greater chance of stimulated rather than spontaneous (1) Simulated emission when the electrons fall (1) When stimulated by a photon of <u>same</u> energy/frequency (1)	4			4		
	(d)	(i)	Determining wavelength using $\lambda = \frac{c}{f}$ or equiv, e.g. $p = \frac{hf}{c}$ (1) Momentum determined correctly (1)		2		2	2	
		(ii)	Conservation of momentum used/Initial momentum = 0 (1) 0 = (2.29 × 10^{-25} v) – (3.56 × 10^{-22}) (1) Final speed v = 1.55 × 10^{3} [m s^{-1}] (accept 1 544 m s^{-1}) (1)	1	1 1		3	3	
		(iii)	Use of $E_k = \frac{1}{2}mv^2$ and $E = hf$ **ecf** (1) E_k = 2.77 × 10^{-19}J or statement that energy of nucleus is negligible (1) Total energy = 1.07 × 10^{-13}[J] (1)	1	1 1		3	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(e)		Other derived quantities can be determined with smaller uncertainty (1) Reduces risks of increasing costs on engineering projects (1)			2	2		
			Question 4 total	**8**	**6**	**6**	**20**	**11**	**2**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5.	(a)		Use of $I = \frac{V}{R}$ (1) Circuit current = 0.75 [A] (1) Total circuit resistance $R = \frac{V}{I}$ = 12 [Ω] (1) R = 12 – 5.6 = 6.4 [Ω] (1) [Or for marks 3 and 4: pd across X = 4.8 V (1); $R_X = \frac{4.8\ \text{V}}{0.75\ \text{A}}$ = 6.4 [Ω](1)] **Alternative:** Use of potential divider equation (1) Substituting values into divider equation 4.2 = $\frac{5.6}{R+5.6}$ 9 (1) Re-arranging (1) R = 6.4 [Ω] clearly calculated (1)	1	1 1 1		4	3	
	(b)		Use of parallel resistor equation $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ (1) (or $R = \frac{\text{product}}{\text{sum}}$) R = 3.8 [Ω] (1) Total circuit resistance = 10.2 [Ω] (1) Circuit current = $\frac{9.0}{10.2}$ (1) Therefore new potential difference = 0.88 × 3.8 = 3.3 [or 3.4] [V] (1) **Alternative for marks 3 and 4**: Use of potential divider equation: $V_{OUT} = V_{IN} \frac{R_{//}}{R_{//} + R_X}$ Correct substitution	1	1 1 1 1		5	4	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		Resistance of the thermistor is much larger than the 5.6 Ω and indicator circuit – can be shown by adding resistors in series (1) Circuit current approximately 1 mA so too small (1)		2		2		
	(d)		Superconductors have resistance = 0	1			1		
			Question 5 total	**3**	**9**	**0**	**12**	**7**	**0**

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	8	0	13	4	0
2	5	9	3	17	8	13
3	5	2	6	13	2	8
4	8	6	6	20	11	2
5	3	9	0	12	7	0
TOTAL	**26**	**34**	**15**	**75**	**32**	**23**