GCE AS MARKING SCHEME

SUMMER 2018

AS
PHYSICS - COMPONENT 2
B420U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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)*		A pattern of disturbances travelling through a medium and carrying energy with it (1) involving the particles of the medium oscillating about their equilibrium positions (1) [Accept answers appropriate to e-m waves: A travelling pattern of oscillating electric and magnetic fields (1) carrying energy with it (1)]	2			2		
	(b)	(i)	Phase difference between A and B = 90^o or $\frac{\pi}{2}$ accept fractions of cycle i.e. ¼ (1) Phase difference between B and C = 0 or $n\ 2\pi$ or $n\ 360^o$(1)		2		2	1	
		(ii)	Determining $f = \frac{1}{T} = \frac{1}{0.4}$ = 2.5 Hz (1) Wavelength = 1.5 km (1) Using $v = f\lambda$ (1) 3.75×10^3 m s^{-1}accept 3.75 km s^{-1} (1)	1	1 1 1		4	4	
	(c)		Substituting values in Young modulus = $= \frac{\text{stress}}{\text{strain}}$ (1) Rearranging $\text{strain} = \frac{900\,\text{MPa}}{70\,\text{GPa}}$ (1) Strain = 0.013 (1) (**ecf** power of 10)	1	1 1		3	3	
	(d)		Data can be used to determine locations/frequency of Earthquakes (hotspots) (1) Informs planning and sites for new builds or increases knowledge of structure of the Earth (1)			2	2		
			Question 1 total	**4**	**7**	**2**	**13**	**8**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*		There are 6 J of energy/work done (converted from electrical to other forms) (1) Per coulomb of charge between X and Y (1)	2			2		
	(b)	(i)	Attempt to use equation to determine resistors in parallel (1) Resistance of parallel combination = 3.7[2] Ω (1) Total circuit resistance = 9.3 Ω **ecf** on parallel (1) Current = $\frac{V}{R}$ = 0.64 A [accept 0.65 A] answer to 2 d.p. (1)	1	1 1 1		4	3	
		(ii)	Apply **ecf** from part (b) (i) PD across parallel = 0.65 × 3.7 **ecf** **OR** pd across 5.6 Ω = 0.65 × 5.6 = 3.6 V (1) Answer = 2.4 V (1)		2		2	1	
		(iii)	Substitute values into $P = I^2R$ [P = 0.65^2× 3.7] (1) P = 1.54 W – **ecf** (1)	1	1		2	2	
			Question 2 total	**4**	**6**	**0**	**10**	**6**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)	The emission of electrons from a surface due to light or em rad^{n}	1			1		
		(ii)	Energy of light is in the form of photons/packets of energy = hf (1) The work function ϕ is needed for the electron to escape (1) $E_{k\,max}$ is the energy remaining for the electron (1)	3			3		
	(b)		Polarity is incorrect/All the electrons will reach collecting electrode (1) No ammeter in circuit (1) Voltmeter not connected correctly (1) No variable supply (1)			4	4		4
	(c)	(i)	Axis labelled correctly with units and suitable scale so that data points occupy half of the axis (1) All points plotted correctly to within ±½ small square division (1) Good line of fit consistent with data (1)		3		3	3	3
		(ii)	Straight line graph of positive gradient (1) Passes close to all data points (1) Cannot determine if passes through origin (allow **ecf)** does not pass through origin/clear negative y intercept (must be consistent with graph)' (1)			3	3	1	3
		(iii)	Planck constant = gradient (implied) (1) Large triangle used [or 2 equivalent suitable points clearly indicated on the graph] and correct values for gradient calculation (1) Gradient calculated correctly and Planck constant = 6.6 (± 0.2) × 10^{-34} (J s) (1)		3		3	2	2
		(iv)	5% of Planck constant (6.63 × 10^{-34} J s) determined (± 0.33 × 10^{-34}) (1) Valid conclusion e.g. value obtained is within 5% (1)		1	1	2		
			Question 3 total	**4**	**7**	**8**	**19**	**7**	**14**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*		Rate of flow of electric charge/electrons (1)	1			1		
	(b)	(i)	During t = 0 to t = 0.8 s current (or I) = 0 (1) Then there is a sudden increase at 0.8 s (1) Value of current = $\frac{1.5}{0.2}$ = 7.5 A (1) Current = 0 from t = 1.0 to 2.5 s (1)		4		4		
		(ii)	Tangent drawn to the graph at t = 3.0 s (1) Gradient calculated correctly (ignore negative sign) (1) Current in the range 1.0 ± 0.1 A (1)			3	3	3	
			Question 4 total	**1**	**4**	**3**	**8**	**3**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*		**3-level energy system** E1 – Clearly labelled diagram of 3-level energy system E2 – Population inversion mentioned E3 – More electrons in higher energy levels than lower E4 – Pumping used to achieve more electrons in higher energy level / state E5 – One state is metastable or long lived **2-level energy system** E6 – Population inversion not possible in 2-level system E7 - Reference to absorption (either 2 or 3 level) **Stimulated Emission** S0 – Incident photon causes an electron to drop S2 – Photon emitted when electron drops S3 – Stimulated emission mentioned S4 – There are 2 photons instead of 1 photon (coherent) S5 – Incident photon of correct energy or frequency or wavelength **5-6 marks** 9 to 12 points from either E1 to E7 and S0 to S5 *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** 5 to 8 points from either E1 to E7 and S0 to S5 *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.*	6			6		

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			1-2 marks 1 to 4 points from either E1 to E7 and S0 to S5 *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)	(i)	Substituting for wavelength into $E = \frac{hc}{\lambda}$ (1) Energy of photon = 3.14×10^{-19}J unit mark(1)	1	1		2	2	
		(ii)	Number of photons per second = $\frac{1\times10^{-3}}{3.14\times10^{-19}}$ = 3.18×10^{15} s^{-1} (**ecf** on value of energy of photon) (1) Number of incident photons per second = $3.18 \times 10^{15} \times 500$ (1) Answer = 1.6×10^{18} (1) **ecf** power 10		3		3	3	
			Question 5 total	**7**	**4**	**0**	**11**	**5**	**0**

Question			Marking details		Marks available				
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)	Rearranging $\sin c = \frac{1.47 \sin 90}{1.52}$ (1) Critical angle = 75.3^{o} (1)		2		2	2	
		(ii)	Substitution into Snell's law i.e. $\sin 15° = 1.52 \sin \theta_r$ (1) Refracted angle = 9.8^{o} (1) A = 80.2^{o} (90 - θ_r) (**ecf** on θ_r) (1)	1	1 1		3	2	
		(iii)	Angle A is greater than critical angle (**ecf** on A and critical angle) (1) So total internal reflection **and** light will travel down the fibre OR technician not correct (1)			2	2		
	(b)		Substituting values in $\text{speed} = \frac{\text{distance}}{\text{time}}$ (1) Speed of light in fibre $= \frac{c}{1.52}$ (1) Time = 7.6×10^{-5} s (1)	1	1 1		3	3	
	(c)	(i)	Monomode – parallel to axis/straight – Multimode zig zag paths	1			1		
		(ii)	No spreading of pulses OR only one path for data (1) Each pulse arrives at same time OR No overlapping of pulses (1) Allows faster rate of data transfer (1)	3			3		
			Question 6 total	**6**	**6**	**2**	**14**	**7**	**0**

AS COMPONENT 2 – ELECTRICITY AND LIGHT

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	7	2	13	8	0
2	4	6	0	10	6	0
3	4	7	8	19	7	14
4	1	4	3	8	4	0
5	7	4	0	11	5	0
6	6	6	2	14	7	0
TOTAL	**26**	**34**	**15**	**75**	**37**	**14**