GCE AS MARKING SCHEME

SUMMER 2017

AS (NEW)
PHYSICS - COMPONENT 2
B420U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2017 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.

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)*		[Particle] oscillations accept displacement (1) Along/parallel to direction of wave travel (1)	2			2		
	(b)		0.6 [mV]	1			1		
	(c)	(i)	Rearrangement of $c = f\lambda$ to give = 3.95×10^6 [Hz]		1		1	1	
		(ii)	Using $T = \frac{1}{f}$ (1) Frequency = 4×10^6 [Hz] (1) Yes must be clarified – close to 3.95×10^6 Hz or values similar (1) **ecf** **Alternative:** Calculation of period 0.25×10^{-6} [s] (1) Period = $\frac{1}{3.95 \times 10^6}$ (1) Yes must be clarified – values similar (1) **ecf**			3	3	2	
			Question 1 total	**3**	**1**	**3**	**7**	**3**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*		Use and rearrangement of: $n_1 \sin\vartheta_1 = n_2 \sin\vartheta_2$ (1) Angle θ = 36[°] (1)		2		2	2	
	(b)	(i)	Use and rearrangement of: 1.47 sin θ = 1.33 sin 90 (1) Critical angle = 65[°] (1)		2		2	2	
		(ii)	Angle of incidence [at boundary] less than critical angle (1) Refraction [occurs] (1)		2		2		
	(c)		Use and rearrangement of: $n = \frac{c}{v}$ (1) Speed of light in oil = 2.0×10^8 [m s^{-1}] (1)		2		2	2	
			Question 2 total	**0**	**8**	**0**	**8**	**6**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*		Label axis with units and suitable scale (1) Plot all points correctly ± ½ small square division (1) Draw a smooth curve with maximum between 2.3 and 2.6 Ω **no** straight lines present (no requirement to extend back to the origin) (1)	1	1 1		3	3	3
	(b)	(i)	6.0 [J] of [chemical] energy transferred/converted/work done to electrical [potential] energy (1) Per unit charge [or coulomb] [flowing through the cell/battery] (1)	2			2		2
		(ii)	Using $P = I^2R$ (1) Data point from graph when R = 4.5 Ω, P = 3.64 W (1) Need 2 dp and within ± ½ small square Calculation of current correctly i.e. = 0.90 [A] (1)	1	1 1		3	3	3
		(iii)	Using $E = V + Ir$ (1) Substituting correct values 6 = 0.90 × 4.5 + 0.90r **ecf** (1) Internal resistance = 2.2 [Ω] (1)	1	1 1		3	3	3
	(c)		Power is <u>higher/greater/larger</u> (1) Total resistance of circuit is less for <u>all values of R</u> (1) Accept peak of graph shifts to left			2	2		2
			Question 3 total	**5**	**6**	**2**	**13**	**9**	**13**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*		Using $I = nAve$ (1) Area calculated correctly = 1.96×10^{-7} m^2 (1) $n = 18 \times 10^{28}$ [m^{-3}] (1) Drift velocity v = 0.000496 or 0.0005[0] m s^{-1} **unit mark** (1)	1	1 1 1		4	4	
	(b)		Current remains the same as do n and e (1) [Cross-sectional] area less in thinner portion (1) Correct conclusion needs to be qualified - drift velocity is <u>greater</u> in thinner portion (1)			3	3		
	(c)	(i)	Superconductor is when $R = 0$ accept negligible	1			1		
		(ii)	**Advantage** No power / energy loss [in the power lines] (1) power lines needs to be referenced if referring to 100% efficient As $R = 0$ [and $P = I^2R$] / no heat (1) **Or** Use in MRI scanners / particle accelerators (1) High currents / large magnetic fields (1) **Disadvantage** Operates at very low temperature (1) Extra energy/apparatus required to cool the wires (1) **Or** Due to cooling [the materials] (1) Cost is high (needs to be qualified) (1)		4		4		
			Question 4 total	**2**	**7**	**3**	**12**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)	Constant phase difference/relationship	1			1		
		(ii)	Waves arrive out $\pi/180^{o}$ out of phase / in antiphase (1) Path difference will be different [for various points on the screen] (1) Path difference = $(n + \frac{1}{2})\lambda$ or $\frac{1}{2}\lambda$ and $\frac{3}{2}\lambda$ or $\frac{5}{2}\lambda$ (1)		3		3		
	(b)	(i)	Using $y = \frac{\lambda D}{a}$ (1) Fringe spacing = 17.6 [mm] (1) Attempt at $\frac{52.8}{17.6} = 3$ (1) Since whole number – a bright fringe is formed at X (1)			4	4	4	
		(ii)	Dark fringe at $\frac{y}{2}$ (1) Therefore distance = 8.8 mm **ecf unit mark** (1)		2		2		
	(c)		This experiment showed that light is a wave (1) up until this point it was thought light was made up of particles (1)	2			2		
	(d)	(i)	Electrons behave as waves **or** [beam of] electron diffracts (1) Atoms cause diffraction/interference **or** behaves like diffraction grating **or** reference to wavelength [of the beam] similar to atom spacing (1)	1	1		2		
		(ii)	Radius is greater for copper or implied by description of pattern change (1) Intensity decreases (1) Accepts stays similar	1		1	2		
			Question 5 total	**5**	**6**	**5**	**16**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*		**Diagram and Method** Attempt at circuit diagram or explained in words Correct circuit diagram drawn Vary wavelength/frequency with different LEDs Vary pd until LED light is on or significant current on Measure pd when light just turns on Repeat readings **Results** Equation $V = \frac{hc}{e\lambda}$ *or* $\frac{hf}{e}$ included Mean V determined Plot graph of V against $\frac{1}{\lambda}$ or f or suitable alternative Determine gradient h can be determined as gradient = $\frac{hc}{\lambda}$ or $\frac{h}{e}$ **5-6 marks** Comprehensive description of the method including correct circuit diagram provided along with comprehensive description of how to analyse results. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Either comprehensive description of the method including circuit diagram provided or comprehensive description of how to analyse results provided or reasonable attempt at both areas. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.*	6			6		6

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			1-2 marks Either an attempt at a description of the method / circuit diagram provided or an attempt how to analyse results. *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)		Repeat same experiment (1) Obtain similar results **or** enables comparison (1)			2	2		
			Question 6 total	**6**	**0**	**2**	**8**	**0**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*	(i)	More electrons in higher energy level [E_2] compared to lower energy level [E_1]	1			1		
		(ii)	Population inversion ensures stimulated emission [rather than spontaneous emission] (1) Produces 2 photons for 1 incoming photon (1)	2			2		
	(b)		Conversion of eV to J correct (1) Wavelength = 1.00×10^{-5} m (1) Wavelength lies in the infra-red (1)	1 1	1		3	2	
	(c)		Converting 2 290 km^2 to 2.29×10^9 m^2 (1) Force on the crater (= pressure × area **ecf**) = 1.38×10^{12} [N] (1) Momentum of each molecule calculated = 4×10^{-23} [N s] (1) Momentum change per collision = 8.03×10^{-23} [N s] **or** realisation that momentum change = initial – (-final) (1) Number of molecules = 1.71×10^{34} (1)		5		5	5	
			Question 7 total	**5**	**6**	**0**	**11**	**7**	**0**

AS COMPONENT 2: ELECTRICITY AND LIGHT

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	1	3	7	3	0
2	0	8	0	8	6	0
3	5	6	2	13	9	13
4	2	7	3	12	4	0
5	5	6	5	16	4	0
6	6	0	2	8	0	6
7	5	6	0	11	7	0
TOTAL	**26**	**34**	**15**	**75**	**33**	**19**