GCE AS MARKING SCHEME

SUMMER 2022

AS
PHYSICS – COMPONENT 1
B420U10-1

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 1

MOTION, ENERGY AND MATTER

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)	(i)	A vector has direction [a scalar doesn't]	1			1		
		(ii)	Vector - displacement and acceleration (1) Scalar - speed, work, distance, energy (1)	2			2		
	(b)		Resolving forces 12 N vertically upwards and 5 N to the left (1) [or equiv or by impl] Resultant force = 13 [N] (1) Angle = 67[.4]° or 22[.6]° or 23° (1)		3		3	3	
	(c)		$[x]$ = m **and** $[ut]$ = m s^{-1} s = m (1) $\frac{1}{2}at^2$ = m s^{-2} s^2 = m (1)		2		2	2	
	(d)		Use of $v^2 = u^2 + 2ax$ (1) $x = \frac{115^2}{(2 \times 3.5)}$ rearranged (1) x = 1 900 or 1 890 or 1 889 [m] (1) Accept equiv alternative for first two marks, e.g. $t = \frac{v-u}{a}$ [=32.86 s] (1st mark✓) Subst t into $x = \frac{1}{2}(u+v)t$ (2nd mark ✓);	1	1 1		3	2	
			Question 1 total	**4**	**7**	**0**	**11**	**7**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(a)		The rate of change of momentum of an object is [directly] proportional / equal to (1) the resultant force acting on it [and takes place in the direction of that force] (1)	2			2		
	(b)	(i)	$\Delta E = 0.5m\,(v_2^2 - v_1^2) = 0.0.08(9^2 - 7^2)$ (1) $\Delta E = 2.56$ J **unit mark**		2		2	2	
		(ii)	$\frac{0.16(9+7)}{1.7}$ must realise direction (1) $F = 1.51$ [N] (1)		2		2	2	
	(c)	(i)	Average velocity is less on the downward leg [because energy lost] (distance the same) (1) [So] Longer downward time / shorter upward time (1) therefore incorrect]			2	2		
		(ii)	At the top of the flight (1) Zero velocity (1)		2		2		
			Question 2 total	**2**	**6**	**2**	**10**	**4**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3.	(a)		Titles [acceleration (or *a*); force (or *F*)] units [N and m s^{-2}] and linear scales so that the points occupy at least half of each axis (1) All points correct to half a small square (1) Reasonable line of best fit (by eye) (1) [Accept line with a small positive intercept on the x-axis, e.g. 0.02 m s^{-2}]		3		3	2	3
	(b)		Yes [Accept, 'almost' if alternative answer is given for 2nd point] (no mark) straight line graph / positive gradient (1) Through origin / 0,0 (1) All points close to line of best fit (1) Accept for 2nd point: best fit line passes close to the origin			3	3	3	3
	(c)		Point taken from the graph / gradient calculated (1) Gradient / $\frac{F}{a} = M + m$ / accept 420 to 500 g (1) Rearrangement $M = \frac{F}{a} - m$ (1) [or by impl.] M = 370 to 450 [g] (1)		4		4	4	4
	(d)		Constant velocity / acceleration zero (so incorrect) (1) No overall forces acting (1) **Alternative:** Decelerating (so incorrect) (1) Only force acting is air resistance against the mass (1)			2	2		2
			Question 3 total	**0**	**7**	**5**	**12**	**9**	**12**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4.	(a)		**Apparatus used** Micrometer / digital callipers to measure diameter Metre ruler to measure length Vernier scale / ruler to measure extension **Method** Measure original length Measure initial diameter to determine (cross-sectional) area Diameter measured in several places Add loads to the wire (under test) Determine the extension Accept reference to Searle's apparatus **Results** Plot a graph of load against extension / stress against strain Determine the gradient E = gradient $\times \frac{l}{A}$	6			6		6

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			5–6 marks Comprehensive account with apparatus, method and results all described. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3–4 marks** Comprehensive account of 2 of apparatus, method and results **or** attempt made at all 3 sections. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1–2 marks** Comprehensive account of 1 of apparatus, method and results **or** attempt made at 2 of the sections. *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.						

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	Stiffest steel **and** least stiff lead		1		1		
		(ii)	Rearrangement $\Delta l = \frac{Fl}{EA}$ (1) Area = 1.13×10^{-6} (m^2) (1) Δl = 1.09×10^{-3} m **unit mark** (1) **Alternative:** Stress = 7.1×10^{7} (N m^{-2}) (1) Strain = 5.44×10^{-4} (1) Extension = 1.1×10^{-3} m **unit mark** (1)		3		3	3	
			Question 4 total	**6**	**4**	**0**	**10**	**3**	**6**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5.	(a)		For a system to be in equilibrium and about the same point (1) **Total / sum** clockwise moments = **Total / sum** anticlockwise moments (1) **Alternative:** For a body in equilibrium the algebraic sum of the moments [of the applied forces] is zero (1) about any point (1)	2			2		
	(b)	(i)	Perpendicular distance from pivot to cable = 2.4 sin 30° [m] (1) [or by impl.] Distance = 1.2 [m] (1) $1.2T = 1.2 \times 1.4 \times 9.81 + 2.4 \times 8 \times 9.81$ (1) [or by impl.] T = 171 [N] (1)		4		4	4	
		(ii)	Breaking stress = $\frac{F}{A}$ (1) $F = 3 \times 10^8 \times \pi \times (0.5 \times 10^{-3})^2$ (1) F = 235[.6] [N] well above 171 N so yes sign will be secure (1) **Alternative:** Applied stress = $\frac{171[\text{N}]}{\pi \times \left(0.5 \times 10^{-3}[\text{m}]\right)^2}$ =2.17 $\times 10^8$ [Pa] This is significantly less than the breaking stress so secure. [Accept: This is not very different from the breaking stress so if sudden loads were applied (e.g. because of wind) it might break]	1		1 1	3	3	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		No (no mark) could fall and injure someone (1) concern for public safety (1) **Alternative:** Yes (no mark) breaking stress is well above that required to support the sign (1) Even if wire breaks sign supported by the hinge (1)			2	2		
			Question 5 total	**3**	**4**	**4**	**11**	**7**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)	See table in appendix 1 One mark for each correct row (4)	4			4		
		(ii)	Positron / e^+	1			1		
		(iii)	Same mass **and** opposite charge / opposite lepton baryon number (1)	1			1		
	(b)	(i)	Charge -1 +1 (l.h.s) +2 -1 (r.h.s) so charge -1 (1) Lepton number 1(l.h.s) 0 (r.h.s) so lepton number 1 (1) so must be an electron (1)	1		1 1	3		
		(ii)	Electromagnetic (force) (1) **All** charged particles involved (in the interaction) / accept valid reasons why it cannot be weak or strong (1)			2	2		
			Question 6 total	**7**	**0**	**4**	**11**	**0**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7.	(a)		Line spectrum arises when radiation with a continuous spectrum passes through the stellar atmosphere (1) Elements (in the stellar atmosphere) can be identified from the wavelengths of the lines / wavelengths correspond to energy differences between energy levels in atoms (1) By comparison with known emission spectra [of elements on earth] (1) **Alternative for 2nd and 3rd marks:** Because electrons in the atoms [of the atmosphere] absorb photons (1) of {wavelength / frequency / energy} which is characteristic of the elements (1)	3			3		
	(b)		$I = \frac{P}{4\pi r^2}$ (1) $P = 4.1 \times 10^{-9} \times 4\pi \times (431 \times 9.5 \times 10^{-15})^2$ (1) $P = 8.64 \times 10^{29}$ [W] (1)		3		3	3	
	(c)		Substitution into: $P = A\sigma T^4$ i.e. $\frac{8.64 \times 10^{29}}{(5.67 \times 10^{-8} \times 7250^4)}$ **ecf** from (b) (1) $A = 5.51 \times 10^{21}$ [m^2] (1) Radius = 2.1×10^{10} [m] (1) Diameter = 4.2×10^{10} [m] (1)	1	1 1 1		4	4	
			Question 7 total	**4**	**6**	**0**	**10**	**7**	**0**

Appendix 1

Particle	Symbol	Quark combination (if any)	Charge	Baryon number	Lepton number
neutron	n	ddu	0	1	0
electron neutrino	υ_e	none	0	0	1
pion	π^+	$u\bar{d}$	+1	0	0
positron	e^+	none	+1	0	-1

GCE AS COMPONENT 1: MOTION, ENERGY AND MATTER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

09	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	7	0	11	6	0
2	2	6	2	10	4	0
3	0	7	5	12	9	12
4	6	4	0	10	3	6
5	3	4	4	11	7	0
6	7	0	4	11	0	0
7	4	6	0	10	7	0
TOTAL	**26**	**34**	**15**	**75**	**36**	**18**