GCE AS MARKING SCHEME

SUMMER 2023

AS
PHYSICS – COMPONENT 1
B420U10-1

© WJEC CBAC Ltd.

INTRODUCTION

This marking scheme was used by WJEC for the 2023 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.

© WJEC CBAC Ltd.

GCE AS PHYSICS COMPONENT 1 – MOTION, ENERGY AND MATTER

SUMMER 2023 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.

© WJEC CBAC Ltd.

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

© WJEC CBAC Ltd.

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 - momentum and weight Scalar – kinetic energy, wavelength, density and temperature One mistake (1) two or more mistakes (0)	2			2		
	(b)	(i)	Use of Pythagoras i.e. $F = \sqrt{60^2 + 80^2}$ (1) F = 100 N (1) **unit mark** $\tan\theta = \frac{60}{80}$ (1) θ = 36.9° or 37° must give a direction (1) **Accept for the 3rd and 4th marks:** $\tan\theta = \frac{80}{60}$ (1) θ = 53.1° or 53° must give a direction (1)	1	1 1 1		4	3	
		(ii)	100 [N] **ecf** (1) in the opposite direction to that of the resultant force, either stated or correct direction given (1)		2		2		
			Question 1 total	**4**	**5**	**0**	**9**	**3**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		**Description of a crystalline material** Long range and long-range order Some dislocations / foreign atoms Cause of weakness faults **When under stress** Layers of atoms slip over each other To fill in the gaps / dislocations Making the wire thinner Causing necking to occur **Method of fracture** Where the wire is thinner the force per unit area is greatest / stress is greatest This causes intermolecular bonds to break This continues until the material breaks / breaking stress **5–6 marks** Comprehensive account from each of the 3 categories provided. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3–4 marks** Comprehensive account from 2 of the categories provided or limited description of all 3. *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 the categories provided or limited description of 1 or 2. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.*	6			6		

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			0 marks No attempt made or no response worthy of credit.						
	(b)	(i)	Substitution: $\frac{56}{(\pi(0.64 \times 10^{-3})^2)}$ (1) Stress = 43.5 M[Pa] (1)	1	1		2	1	
		(ii)	Strain = $\frac{43.5 \times 10^{6}\,\mathbf{ecf}}{1.3 \times 10^{11}} = 3.35 \times 10^{-4}$ (1) Extension = $3.35 \times 10^{-4} \times 2 = 0.67$ [mm] (1)		2		2	2	
	(c)		[Unit of Young modulus = unit of stress (because strain has no unit)] $\text{stress} = \frac{\text{force}}{\text{area}}$ (1) F has units kg m s^{-2} and A has units m^2 (1) Combining base units are kg m^{-1} s^{-2} (1)	1	1 1		3	1	
			Question 2 total	**8**	**5**	**0**	**13**	**4**	**0**

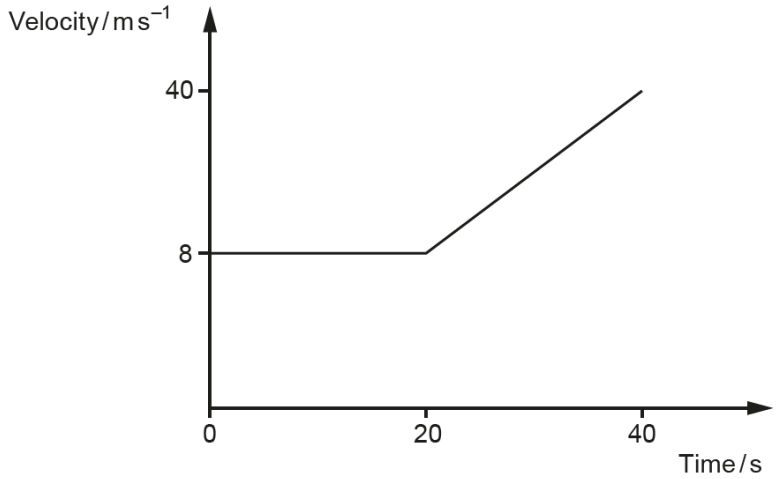
© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		For a system to be in equilibrium (1) Total clockwise moments equal total anticlockwise moments [about any point] (1)	2			2		
	(b)	(i)	Principle of moments applied i.e. $(38 \times 2) + (34 \times 1.4) = (62 \times 2)$ accept g cancelling on both sides (1) Anticlockwise moment = 123.6 [N m] **and** clockwise moment = 124 [N m] (1) These are approximately equal so first statement correct (1) If x increases Olivia's moment will decrease (1) Zac would move downwards so second statement incorrect (1)			5	5	2	
		(ii)	Overall mass = 62 + 38 + 34 + 40 = 174 [kg] (1) Weight = $174 \times 9.81 = 1710$ accept 1705 or 1707 [N] (1) Upwards (1)		3		3	2	
			Question 3 total	**2**	**3**	**5**	**10**	**4**	**0**

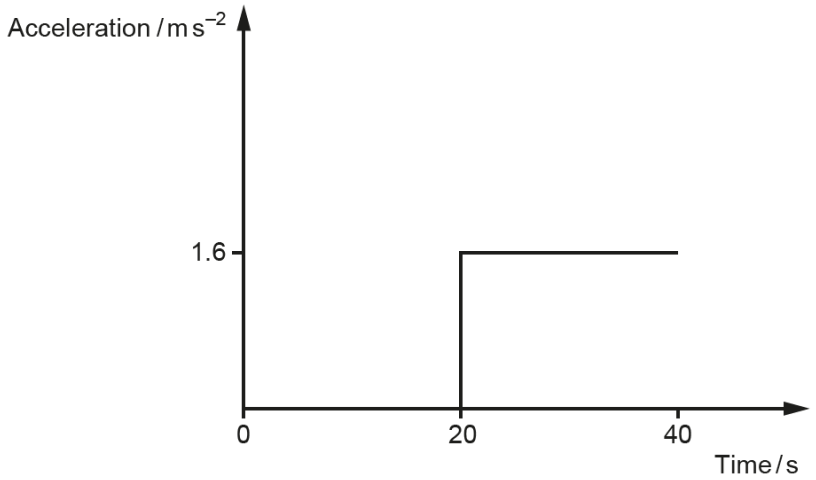
© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		V = 4 189 mm^3 or 4.189 $\times$ 10^{-6} m^3 (1) **unit mark** Accept 4200 mm^3 % uncertainty in radius = 5 [%] (1) % uncertainty in volume = 3 $\times$ 5 = 15 [%] (1)		3		3	2	3
	(b)	(i)	Density = $\frac{32.6}{4\,189}$ **ecf** accept mass and volume in any units (1) Density = 7.78 $\times$ 10^{-3} g mm^{-3} or 7.78 $\times$ 10^3 kg m^{-3} (1) % uncertainty in mass = 0.3 [%] accept irrelevant (1) Overall % uncertainty in density = 15[.3 %] **ecf** (1) Absolute uncertainty = 1.2 or 1.19 $\times$ 10^{-3} g mm^{-3} **or** 1.19 or 1.2 $\times$ 10^4 kg m^{-3} (1) (7.8 ± 1.2) $\times$ 10^{-3} g mm^{-3} **or** (7.8 ± 1.2) $\times$ 10^3 kg m^{-3} Accept 8000 ± 1000 (1)		6		6	6	6
		(ii)	Main uncertainty is the determination of the diameter / radius (1) Use an instrument of greater resolution / micrometer / Vernier callipers. Do not accept [more] repeat readings (1)			2	2		2
			Question 4 total	**0**	**9**	**2**	**11**	**8**	**11**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	 Shape correct and 8 m s^{-1} and 40 m s^{-1} labelled on the y-axis		1		1	1	
		(ii)	40 – 8 = 32 [m s^{-1}]		1		1		
		(iii)	Area below the graph up to 20 s = 160 [m] (1) Area when accelerating = 0.5 × 20 × 32 = 320 and 20 × 8 = 160 so total = 480 [m] (1) Total distance travelled = 640 [m] (1) **Alternative** Area (under the graph) = distance travelled (1) 8 × 20 or 160 [m] (1) Total distance = 640 [m] allow trapezium rule (1)		3		3	3	
		(iv)	Mean velocity = $\frac{640}{40}$ = 16 [m s^{-1}] **ecf** from (a)(iii)		1		1	1	

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	 Acceleration = $\frac{40-8}{20}$ = 1.6 [m s^{-2}] (1) Shape of graph correct (1) Values labelled on the y axis (1)	1	1 1		3	2	
		(ii)	Attempt at calculation of area under the graph / state area under the graph is change in velocity **or** by implication (1) Area = 20 × 1.6 = 32 [m s^{-1}] so Yes / No (1)			2	2	2	
			Question 5 total	**1**	**8**	**2**	**11**	**9**	**0**

© WJEC CBAC Ltd.

<table>
<tr><th colspan="3" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>
<table>
<tr><th>Particle</th><th>Symbol</th><th>Quark combination</th><th>Charge/e</th><th>Baryon number</th><th>Lepton number</th></tr>
<tr><td>proton</td><td>p</td><td>uud</td><td>+1</td><td>1</td><td>None</td></tr>
<tr><td>delta</td><td>Δ^{++}</td><td>uuu</td><td>[+]2</td><td>1</td><td>0</td></tr>
<tr><td>electron</td><td>e^-</td><td>none</td><td>-1</td><td>0</td><td>[+]1</td></tr>
<tr><td>pion</td><td>π^+</td><td>$u\bar{d}$</td><td>+1</td><td>0</td><td>0</td></tr>
<tr><td>neutrino</td><td>υ_e</td><td>none</td><td>0</td><td>0</td><td>[+]1</td></tr>
</table>
One mark for each correct column (4)</td><td>4</td><td></td><td></td><td>4</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Conservation of charge +4 → +5 -1 so X has a charge of 0 (1)
Conservation of lepton no. 0→ 0 +1 so X has lepton no -1 (1)
X must be an anti-neutrino (1)</td><td></td><td></td><td>3</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Weak force (1)
Presence of an anti-neutrino / Change in quark flavour (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>A particle that is made up of quarks / feels the strong force / made up of baryons and mesons</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Yes no credit
Any 2 × (1) from:
• Discoveries benefit the whole scientific community worldwide - Many discoveries lead to scientific advances (that benefit the whole world
• Scientists across the world have the opportunity to study at CERN</td><td></td><td></td><td>2</td><td>2</td><td></td><td></td></tr>
</table>

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
			Alternative **No – no credit** **Any 2 × (1) from:** • Many countries are very poor • Countries should focus on the people living in them • Money better spent on health care etc						
			Question 6 total	**5**	**2**	**5**	**12**	**0**	**0**

© WJEC CBAC Ltd.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		An object that absorbs all em radiation that falls on it	1			1		
	(b)	(i)	$\lambda_{max} = 300 \times 10^{-9}$ (1) $T = \frac{2.9 \times 10^{-3}}{300 \times 10^{-9}} = 9\,667$ [K] (1) **Accept:** $\lambda_{max} = 290 \times 10^{-9}$ (1) $T = 10\,000$ [K] (1)	1	1		2	2	
		(ii)	Blue / white Accept violet			1	1		
	(c)	(i)	Light from the star passes through the outer region (1) Certain wavelengths of light are absorbed by the outer region (1) These wavelengths correspond to the energy levels of the elements in the outer layer / difference in energy levels / energy level gaps (1)	3			3		
		(ii)	Substitution: $E = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{300 \times 10^{-9}}$ **ecf** (1) $E = 6.63 \times 10^{-19}$ [J] (1)	1	1		2	1	
			Question 7 total	**6**	**2**	**1**	**9**	**3**	**0**

© WJEC CBAC Ltd.

AS COMPONENT 1: MOTION, ENERGY AND MATTER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	5	0	9	3	0
2	8	5	0	13	4	0
3	2	3	5	10	4	0
4	0	9	2	11	9	11
5	1	8	2	11	8	0
6	5	2	5	12	0	0
7	6	2	1	9	3	0
TOTAL	**26**	**34**	**15**	**75**	**31**	**11**

© WJEC CBAC Ltd.