GCE AS MARKING SCHEME

SUMMER 2023

AS
CHEMISTRY – UNIT 1
2410U10-1

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 GCE AS CHEMISTRY UNIT 1

THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

Extended response questions

A level of response mark scheme is applied. The complete response should be read in order to establish the most appropriate band. Award the higher mark if there is a good match with content and communication criteria. Award the lower mark if either content or communication barely meets the criteria.

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.

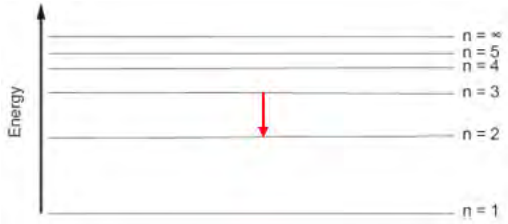
Marking abbreviations

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

Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1.				linear (1) 3 bonding pairs **and** 1 lone pair award (1) for **both**	2			2		
2.				metallic (1) covalent **and** van der Waals award (1) for **both**	2			2		
3.				+6 / +VI do not accept 6+		1		1		
4.	(a)				1			1		
	(b)				1			1		

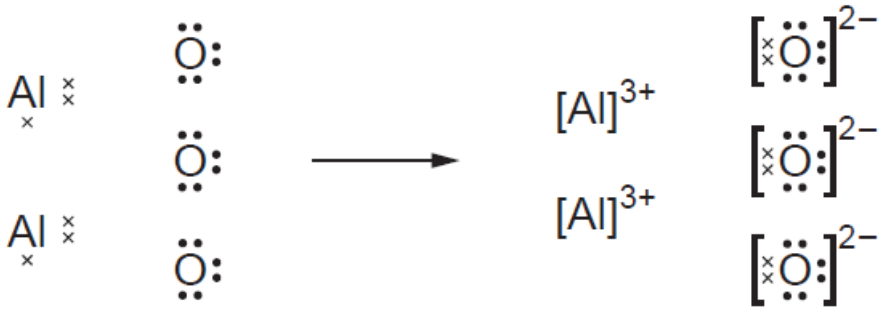
Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
5.	agree both have 18 electrons / same number of electrons / same number of electrons as an argon atom / electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^6$			1	1		
6.	$0.78 = \frac{4.2}{\text{mass of reactants}}$ (1) mass of reactants = $\frac{4.2}{0.78}$ = 5.4 g (1) alternative method n(Cu) formed = $\frac{4.2}{63.5}$ = 0.066 mol (1) 0.066 mol of CuO + 0.066 mol of H_2 = 5.25 + 0.13 = 5.38 g		2		2	1	
	Section A total	**6**	**3**	**1**	**10**	**1**	**0**

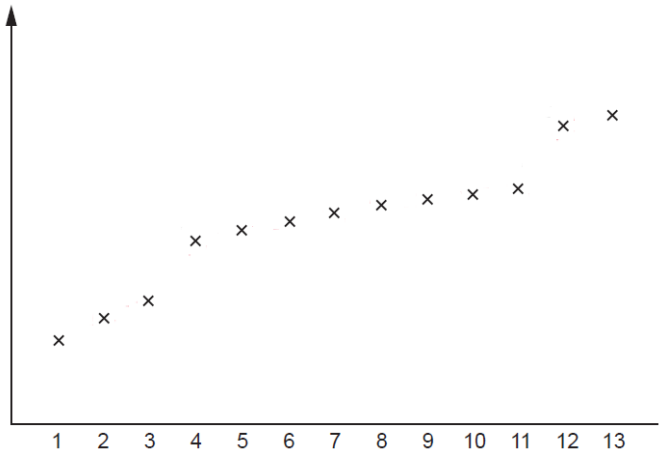
SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			**Indicative content** Trends • boiling temperatures increase down the groups • boiling temperature of HF is anomalous • Group 7 hydrides higher boiling temperatures than those of Group 4 Explanation • the stronger the intermolecular force the higher the boiling temperature • going down a group the number of electrons increases so van der Waals forces / induced dipole-induced dipole forces get stronger • HF has hydrogen bonds between molecules • hydrogen bonds are stronger than van der Waals forces so boiling temperature is much higher than expected • Group 7 hydrides are more polar so dipole-dipole forces present and these are stronger than induced dipole-induced dipole forces in Group 4 hydrides **5-6 marks** Trend down the groups and HF anomaly identified; trend from Group 4 to Group 7 identified; fully explained *The candidate constructs a relevant, coherent and logically structured method including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.* **3-4 marks** Trend down the groups and HF anomaly identified; attempt at explanation with reference to more than one type of intermolecular force *The candidate constructs a coherent account including most of the key elements of the indicative content. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary are generally sound.*	3	2	1	6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Trend/anomaly identified; reference to intermolecular forces *The candidate attempts to link at least two relevant points from the indicative content. Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give an answer worthy of credit.*						
	(b)	(i)		$CH_4 + 4Cu_2O \rightarrow 8Cu + CO_2 + 2H_2O$ accept multiples		1		1		
		(ii)		award (1) for any of following • oxidation number of carbon changes from –4 to +4 and copper changes from +1 to 0 • oxidation number of carbon increases and oxidation number of copper decreases • carbon loses electrons and copper gains electrons • carbon is oxidised and copper is reduced do not accept hydrogen is oxidised	1			1		

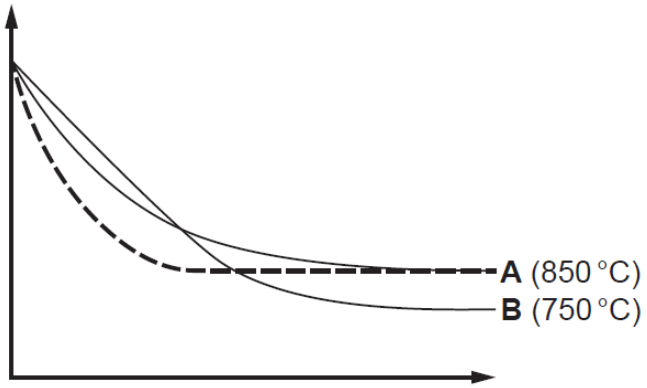
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Li : Al : H $\frac{38.7}{6.94} : \frac{50.1}{27.0} : \frac{11.2}{1.01}$ 5.58 : 1.86 : 11.1 (1) ⇨ 3 : 1 : 6 ⇨ empirical formula Li_3AlH_6 (1) award (1) for final answer Li_3Al where amount of hydrogen present has been overlooked		2		2	1	
				Question 7 total	**4**	**5**	**1**	**10**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)			transfer of electrons / correct electronic structure of ions (1) charges on ions (1) 		2		2		
	(b)			$n = \frac{pV}{RT}$ (1) award (1) for correct units for all of volume, temperature and pressure $V = 6.08 \times 10^{-5}$ m^3 $T = 493$ K $p = 1.01 \times 10^5$ Pa $n = \frac{1.01 \times 10^5 \times 6.08 \times 10^{-5}}{8.31 \times 493}$ $n = 1.499 \times 10^{-3}$ mol (1) $M_r = \frac{0.400}{0.001499} = 266.8$ ⇨ M_r of Al_2Cl_6 is 267 (1)	1	2	1	4	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)				1		1		
		(ii)	I	award (1) for any of following • general increase because there is a greater effective nuclear charge as more electrons are removed • general increase because the same number of protons are holding fewer and fewer electrons • general increase because electrons are being removed from an increasingly positive ion neutral answers – less shielding / electrons are closer to the nucleus	1			1		
			II	award (1) for either of following • sharp rises due to electron being removed from an inner shell / a shell which is closer to nucleus • sharp rises due to electron being removed from a shell which is closer to nucleus so has less shielding do not accept reference to sub-shells	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		^{26}Mg		1		1		
		(ii)		0.0005 g (2) if answer not correct award (1) for either of following 8.0 mg = 0.008 g 2.88×10^6 is equivalent to 4 half-lives		2		2	2	
				Question 8 total	**3**	**8**	**1**	**12**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)			award (1) for any of following • H_2SO_4 loses protons / H^+ ions and NH_3 gains protons / H^+ ions • H_2SO_4 is a proton donor and NH_3 is a proton acceptor • NH_3 accepts a proton from H_2SO_4 neutral answer – reference to salt formation			1	1		
	(b)			moles $(NH_4)_2SO_4 = \frac{1.86}{132.18} = 0.0141$ (1) moles NaOH = 0.0282 (1) concentration = $\frac{0.0282}{0.0267} = 1.06$ mol dm^{-3} (1)		3		3	1 1	
	(c)	(i)		if a system at equilibrium is subjected to a change then the position of equilibrium will shift to minimise/oppose that change	1			1		
		(ii)		student **correct** since more moles of ammonia present at equilibrium at higher temperature (1) system opposes increase in temperature by shifting equilibrium position to the left / in the endothermic direction (1) neutral answer – reference to the 'endothermic <u>side</u>' if **incorrect** award no marks accept converse answer student **correct** since fewer moles of ammonia present at equilibrium at lower temperature (1) system opposes decrease in temperature by shifting equilibrium position to the right / in the exothermic direction (1)	1		1	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		 (1) catalyst does not affect the position of equilibrium / number of moles present at equilibrium but equilibrium reached more quickly / reaction is faster (1)	1 1	1		2		
	(d)			1.26 / 1.3		1		1	1	
	(e)			nitrogen more electronegative than hydrogen / nitrogen and hydrogen have different electronegativities (1) this results in polarity / unequal electron distribution in the bond (1)	1		1	2		
				Question 9 total	**4**	**5**	**3**	**12**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	(a)	(i)		award (1) for any of following • ensure same distance between flame and test-tube each time • use same volume of limewater each time • use same number of moles of carbonate • ensure carbonates all have same particle size			1	1		1
		(ii)		to prevent 'suck back' / cold solution entering hot boiling tube and cracking it			1	1		1
		(iii)		thermal stability increases as you go down the group		1		1		
		(iv)		limewater would **not** turn cloudy because using two Bunsen burners does not increase the temperature (to over 1360 °C)			1	1		1
	(b)	(i)		moles $Ba(NO_3)_2 = 3.68 \times 10^{-3}$ (1) moles of gas $= 9.20 \times 10^{-3}$ (1) volume of gas $= 0.225\ dm^3 = 225\ cm^3$ (1)		3		3	2	
		(ii)		student **incorrect** award (1) for either of following this relationship is true when temperature is in K volume would be 244 cm^3 at this temperature			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			award (1) for conditions under which both conduct electricity barium oxide only conducts electricity when molten (or in solution) whilst barium conducts electricity when (molten or) solid the ions in solid barium oxide cannot move freely but in the molten state they are free to move (and carry electricity) (1) barium has delocalised electrons in the solid state (which can carry electricity) (1)	3			3		
	(d)			0.135 nm (1) award (1) for either of following • radius considerably reduced since 2 electrons lost (to form ion) • Ba^{2+} has one less shell of electrons award (1) for correct explanation if 0.210 nm chosen		1	1	2		
	(e)			137.3 = $\frac{134.9x + 137.9(100-x)}{100}$ (1) $-60 = -3x$ $x = 20$ (1) accept alternative methods and reasoning e.g. difference in mass of isotopes is 3.0 and A_r value is 2.4 more than lighter isotope and 0.6 less than heavier isotope ⇨ must be 80% of the heavier isotope		2		2	2	
				Question 10 total	**3**	**7**	**5**	**15**	**4**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	(a)	(i)		to ensure that the concentration of $AgNO_3$ in the burette is accurate / does not change			1	1		1
		(ii)		award (1) for any of following • undiluted seawater would give too high a titre / a titre of 132 cm^3 • concentration of Cl^- ions is too high (in undiluted seawater) • reduces Cl^- ion concentration (so less $AgNO_3$ needed)			1	1		1
		(iii)		use a pipette/burette to measure seawater (1) into a volumetric flask (1) add 50 cm^3 of seawater to a 250 cm^3 volumetric flask (and make up to the mark with deionised water) / 20 cm^3 of seawater to a 100 cm^3 volumetric flask (and make up to the mark with deionised water) (1)	1 1		1	3	1	3
		(iv)		award (1) for any action and (1) for corresponding explanation e.g. add drop by drop … to avoid 'overshooting' the endpoint shake the flask/rinse the side of the flask … to ensure that all the reactants react place flask on a white tile … to clearly see the colour change			2	2		2
		(v)		$2Ag^+(aq) + CrO_4^{2-}(aq) \rightarrow Ag_2CrO_4(s)$ ignore state symbols		1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(vi)		moles Ag^+ = $\frac{0.100 \times 26.40}{1000}$ = 2.64×10^{-3} (1) moles Cl^- in 25.0 cm^3 diluted sample = 2.64×10^{-3} moles Cl^- in 25.0 cm^3 undiluted sample = $2.64 \times 10^{-3} \times 5 = 0.0132$ (1) moles Cl^- in 1000 cm^3 undiluted sample = $0.0132 \times 40 = 0.528$ (1) mass Cl^- in 1000 cm^3 seawater = $0.528 \times 35.5 = 18.7$ g (1) answer **must** be to 3 sig figs		4		4	3	
	(b)	(i)		pour <u>seawater</u> into a beaker and <u>add barium nitrate solution</u> (and allow precipitate to settle) (1) add more drops of barium nitrate (to the clear solution) until no further precipitate forms (1) filter precipitate (making sure that all of it is transferred to the filter) (1) wash precipitate and dry (1) award (1) for either of following • heat to constant mass • subtract mass of filter paper from mass of precipitate and filter paper	5			5		5
		(ii)		moles $BaSO_4$ = $\frac{0.65}{233.1}$ = 2.789×10^{-3} (1) moles $Ba(NO_3)_2$ = 2.789×10^{-3} volume $Ba(NO_3)_2$ = $\frac{2.789 \times 10^{-3}}{0.100}$ = 0.02789 dm^3 (1) volume = 27.89 / 27.9 / 28 cm^3 (1)		3		3	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		award (1) for any of following • concentrations of barium nitrate solution and sulfate ions in seawater are different • concentration of barium nitrate solution is higher than that of sulfate ions in seawater • concentration of sulfate ions in seawater is lower than that of barium nitrate solution			1	1		
				Question 11 total	**7**	**8**	**6**	**21**	**6**	**12**

UNIT 1

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	6	3	1	10	1	0
7	4	5	1	10	1	0
8	3	8	1	12	5	0
9	4	5	3	12	3	0
10	3	7	5	15	4	3
11	7	8	6	21	6	12
Total	27	36	17	80	20	15