GCE AS MARKING SCHEME

SUMMER 2023

AS
CHEMISTRY – COMPONENT 1
B410U10-1

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.

GCE AS CHEMISTRY

COMPONENT 1: THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark, apart from extended response questions where a level of response mark scheme is applied.

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.

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.

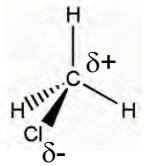
Marking abbreviations

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.

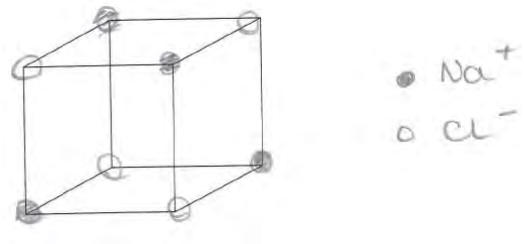
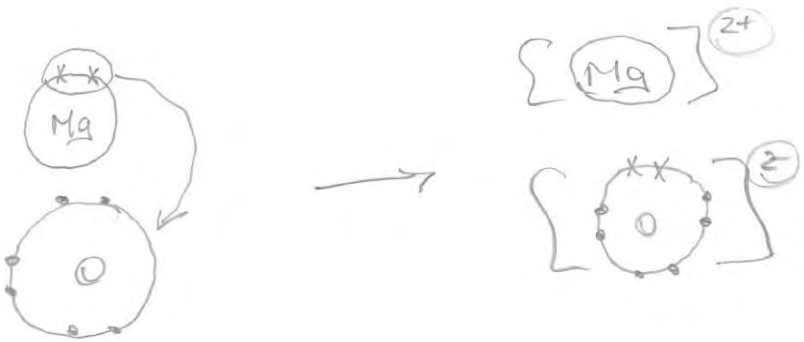
SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				covalent **and** van der Waals – both needed	1			1		
2	(a)			award (1) for either of following $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$ $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$		1		1		
	(b)			award (1) for any of following • chlorine removes electrons (from the bromide ions) • chlorine is reduced • oxidation state of chlorine decreases	1			1		
3				0.5 g		1		1		
4	(a)			atoms bonded have different electronegativities neutral answer – unequal distribution of electrons	1			1		
	(b)					1		1		
5				7			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			formula showing the simplest whole number ratio of the atoms present in the compound	1			1		
	(b)			award (1) for all number of moles Cu ⇨ $\frac{6.10}{63.5}$ = 0.096 Fe ⇨ $\frac{5.35}{55.8}$ = 0.096 S ⇨ $\frac{6.16}{32.1}$ = 0.192 $CuFeS_2$ (1)		2		2	1	
				Section A total	**4**	**5**	**1**	**10**	**1**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			BF_3 has only 3 bond pairs (1) NF_3 however has 3 bond pairs and 1 lone pair (1) award (1) for any of following 3 electron pair shapes are different to 4 electron pair shapes trigonal planar for BF_3 and pyramidal for NF_3 maximum separation and minimum repulsion		3		3		
	(b)			hydrogen bonding occurs between the molecules in ethanol whereas van der Waals / dipole-dipole forces occur between the ethanethiol molecules (1) hydrogen bonding is stronger than van der Waals / dipole-dipole (1) more energy is needed to separate the ethanol molecules / ethanol has the higher boiling temperature (1)	3			3		
	(c)	(i)		award (1) for either of following • all three titre values used to calculate the mean • only the (two) concordant results should have been used 24.30 cm^3 (1)		1	1	2		2
		(ii)		0.240 mol dm^{-3} (1) used a ratio of 1:1 / did not recognise that the alkali to acid ratio is 2:1 (1)		1	1	2	1	2
				Question 7 total	**3**	**5**	**2**	**10**	**1**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			alternating ions on each corner – ions must be identified  	1			1		
	(b)			8 do **not** accept 8:8	1			1		
	(c)			atoms and transfer of electrons (transfer may be implied by correct electronic structure of ions) (1) charges on ions (1)  		2		2		
	(d)			similar to sodium chloride because magnesium and oxide ions have similar relative ratio of sizes to sodium and chloride ions credit alternative answer if a good reason is suggested			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)	(i)		water molecules are polar (1) attractions occur <u>between</u> the water molecules and the ions which can break apart / disrupt the ionic structure (1) credit possible from appropriate diagram	2			2		
		(ii)		barium sulfate is insoluble in water accept very toxic	1			1		
		(iii)		volume of water = 136 dm^3 (1) mass needed = 0.22 × 136 = 29.9 g (1) answer given to 3 sig figs (1)		2	1	3	2	
				Question 8 total	**5**	**4**	**2**	**11**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		$2Li + 2H_2O \rightarrow 2LiOH + H_2$		1		1		
		(ii)		reactivity increases down the group (1) award (1) for any sensible **comparison** of observations e.g. rubidium would catch fire/fizz violently whereas lithium would react much more steadily	2			2		2
		(iii)		moles of Li = $\frac{2 \times 50 \times 10^{-3}}{24.5}$ = 0.004 (1) mass of Li = 0.004 × 6.94 = 0.028 g (1) ecf possible from part (i)		2		2	1	
	(b)	(i)		red do not accept 'brick-red' or 'crimson'			1	1		1
		(ii)		$\Delta E = \frac{hc}{\lambda}$ (1) $\Delta E = \frac{6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{780 \times 10^{-9}}$ = 2.55×10^{-19} J (1) $\Delta E = \frac{2.55 \times 10^{-19} \times 6.02 \times 10^{23}}{1000}$ = 154 kJ mol^{-1} (1)	1	2		3	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		$1s^2$		1		1		
		(ii)		energy required to remove one mole of electrons from one mole of gaseous atoms	1			1		
		(iii)		rubidium has more shells of electrons / more shielding (1) the outer electron is lost much more easily / the first ionisation energy is much lower (1)	2			2		
	(d)			Balmer (1) the Balmer series comes from electron transitions involving n = 2 (1) award (1) for either of following • ionisation of a hydrogen atom corresponds to complete loss of an electron from n = 1 • to calculate ionisation energy transitions involving n = 1 must be used	2		1	3		
				Question 9 total	**8**	**6**	**2**	**16**	**4**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			reversible reaction in which the forward and backward reactions occur at the same rate	1			1		
	(b)			**Indicative content** *Application of Le Chatelier's principle in the Haber process* • effect of changing pressure – for reactions involving gases, equilibrium position shifts to the side with fewer moles of gas as pressure is increased • Haber process should be operated at high pressure because there are 2 mol of gaseous products as opposed to 4 mol of gaseous reactants • effect of changing temperature – if temperature is increased, equilibrium position shifts to the side that reduces temperature i.e. in the endothermic direction • Haber process should be operated at low temperature because the forward reaction is exothermic *Optimum yield requires a compromise in conditions* • pressure cannot be too high because it would be more dangerous/too expensive to operate at very high pressures • temperature cannot be too low because reaction rate would be too low • low yield in a short time is acceptable because reactant gases can be returned to reaction chamber • catalyst is used to increase rate allowing lower operating temperature	4	2		6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Full explanation of ideal temperature and pressure conditions for this reaction; clear understanding of the compromise for optimum yield *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 is used accurately throughout.* **3-4 marks** Reference to Le Chatelier's principle and ideal temperature or pressure conditions for this reaction *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.* **1-2 marks** General reference to Le Chatelier's principle; some reference to yield *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.*						
	(c)	(i)		**4**NH_3 + **5**O_2 → **4**NO + **6**H_2O		1		1		
		(ii)		moles NO = $\frac{12000 \times 10^6}{30}$ = 400 × 10^6 mol (1) mass NH_3 = $\frac{100}{80}$ × 400 × 10^6 17.03 = 8515 tonnes (1) ecf allowed possible		2		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		moles H^+ = $\frac{2.05 \times 10^{23}}{6.02 \times 10^{23}}$ = 0.34 (1) $[H^+] = \frac{0.34}{0.5}$ = 0.68 (1) pH = –log$[H^+]$ = 0.167 (1)		3		3	3	
		(iv)	I	proton donor	1			1		
			II	award (1) for either of following $NH_4^+ \rightleftharpoons NH_3 + H^+$ $NH_4^+ + OH^- \rightleftharpoons NH_3 + H_2O$			1	1		
				Question 10 total	**6**	**8**	**1**	**15**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			$MCO_3 \rightarrow MO + CO_2$		1		1		
	(b)			become more difficult to decompose (down the group)	1			1		1
	(c)			$M_r = \frac{mRT}{pV}$ (1) $M_r = \frac{0.490 \times 8.31 \times 1063}{1.01 \times 10^5 \times 425 \times 10^{-6}}$ = 100.8 (1) A_r of metal = 100.8 – 12 – 48 = 40.8 (1) metal is calcium (1)	1	1	2	4	3	
	(d)	(i)		heated the solid until constant mass			1	1		1
		(ii)		each reading has an error of ±0.005 so ±0.01 for two readings $\frac{0.01}{0.47} \times 100 = 2.13\%$		1		1		1
				Question 11 total	**2**	**3**	**3**	**8**	**3**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			average mass of one atom of the element (1) relative to $\frac{1}{12}$ the mass of one atom of carbon-12 (1)	2			2		
	(b)	(i)		magnet deflects the positive ions	1			1		
		(ii)		award (1) for either of following • it is too heavy • its m/z value is too high neutral answer – the magnet is not strong enough			1	1		
		(iii)		award(1) for either of following • it is a 2+ ion • z value for particle A is higher than 1			1	1		
	(c)			(0.16 × 30) + (0.60 × 31) + (0.24 × 32) = 31.08 (2) if answer incorrect award (1) for either of following • all abundances read correctly from grid • all m/z values read correctly from grid		2		2	1	
	(d)	(i)		gamma rays can pass through the skin/tissue whereas alpha particles cannot comparison needed neutral answer – reference to ionising ability			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		$^{99}_{43}\mathrm{Tc} \rightarrow {}^{99}_{44}\mathrm{Ru} + {}^{0}_{-1}\beta$ (2) ignore atomic numbers if answer incorrect award (1) for either of following • 99 (mass number of product isotope) • Ru			2	2		
				Question 12 total	**3**	**2**	**5**	**10**	**1**	**0**

COMPONENT 1: THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
Section A	4	5	1	10	1	0
7	3	5	2	10	1	4
8	5	4	2	11	2	0
9	8	6	2	16	4	3
10	6	8	1	15	5	0
11	2	3	3	8	3	3
12	3	2	5	10	1	0
Totals	31	33	16	80	17	10