GCE AS MARKING SCHEME

SUMMER 2022

AS
CHEMISTRY – UNIT 1
2410U10-1

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 CHEMISTRY UNIT 1

THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

SUMMER 2022 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.

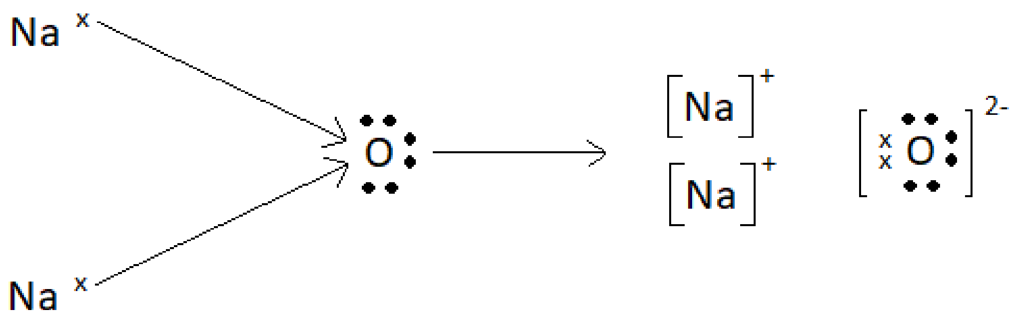
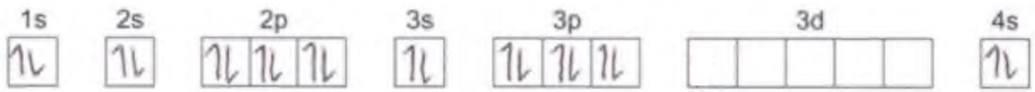
Marking abbreviations

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	AO1	AO2	AO3	Total	Maths	Prac
1.	transfer of electrons / correct electronic structure of ions (1) charges on ions (1) 		2		2		
2.	(very) electronegative nitrogen / oxygen / fluorine (accept correct compound e.g. H_2O) both needed	1			1		
3.		1			1		
4.	47.1%		1		1	1	
5.	a covalent bond where the shared pair of electrons comes from the same atom	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)			^{231}Th		1		1		
	(b)			1/16th		1		1	1	
7.				$n(SO_2) = \frac{9.1}{64.1} = 0.142$ (1) 0.142 × 40.1 = 5.69 / 5.7 g (1)		2		2	1	
				Section A total	**3**	**7**	**0**	**10**	**3**	**0**

Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)	(i)		**B** iodine **C** ice **E** sodium chloride **F** caesium chloride award (2) for all four correct award (1) for any two correct	2			2		
		(ii)		ice iodine cadmium graphite award (2) for all four correct award (1) for any two correct		2		2		
		(iii)		Van der Waals / induced dipole-induced dipole accept London forces / dispersion forces do not accept dipole-dipole	1			1		
		(iv)		graphite **and** cadmium both needed		1		1		
		(v)		weak forces between the layers are easily broken (1) layers can slide over each other / be removed (and mark the paper) (1)	2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(vi)		metals consist of a regular arrangement / lattice of metal cations (1) surrounded by a 'sea' of delocalised electrons (1) there are electrostatic forces of attraction between them (1) first two marks can be obtained from suitable diagram	3			3		
	(b)	(i)	I	white precipitate	1			1		1
			II	colourless solution / no observable change	1			1		1
		(ii)		$Cd^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cd(OH)_2(s)$ accept Mg^{2+} instead of Cd^{2+} accept $Cd^{2+}(aq) + SO_4^{2-}(aq) \rightarrow CdSO_4(aq)$ accept incorrect state symbols for products if consistent with observations in (b)(i)		1		1		
				Question 8 total	**10**	**4**	**0**	**14**	**0**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)	(i)		electrons in an atom are excited and the additional energy promotes them to higher energy levels (1) (when the source of energy is removed) the electrons fall back down to a lower energy level emitting energy/light (in the form of a photon) (1)	2			2		
		(ii)		award (1) for either of following absorption spectrum comprises dark lines while emission spectrum comprises coloured lines absorption spectrum has coloured background while emission spectrum has dark background	1			1		
	(b)			f = $\frac{3.00 \times 10^8}{95 \times 10^{-9}}$ (1) f = 3.16×10^{15} Hz = 3.16×10^9 MHz (1)		2		2	2	
	(c)	(i)		exothermic since percentage product decreases as temperature increases (1) system opposes increase in temperature and takes in heat by shifting equilibrium to the left /endothermic direction (1)			2	2		
		(ii)		decrease in moles since percentage product increases as pressure increases(1) system opposes increase in pressure by shifting equilibrium to the right / to the side of fewer moles of gas (1)			2	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			moles NaCl = $\frac{15 \times 10^6}{58.5}$ = 2.56×10^5 (1) moles Na_2CO_3 = 1.28×10^5 mass Na_2CO_3 = $1.28 \times 10^5 \times 106$ = 13 568 000 g (1) mass Na_2CO_3 = 1.36×10^4 kg (1) final answer **must** be given to 3 sig figs		1 1	1	3	3	
				Question 9 total	**3**	**4**	**5**	**12**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	(a)			**Indicative content** Elements and water • reactivity increases down **both** groups • both potassium and calcium metals react with water to give the hydroxide and hydrogen • Group 1 metals react more vigorously • Group 1 metals lose only one electron while Group 2 metals lose two electrons / Group 1 metals form cations easier than Group 2 metals • potassium melts into a ball and catches fire/lilac flame • calcium produces a steady stream of bubbles/cloudy white solution forms • $2K + 2H_2O \rightarrow 2KOH + H_2$ • $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ Carbonates • Group 1 and Group 2 carbonates show different properties • Group 1 carbonates are soluble, Group 2 carbonates are insoluble **5-6 marks** Comparison of similarities/differences, description of reactions and appropriate equations *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** Comparison of similarities/differences and description of reactions OR description of reactions and appropriate equations *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.*	4	2		6		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Description of reactions only or fair attempt at equations *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)			$n(CO_2) = \frac{186}{24500} = 7.59 \times 10^{-3}$ (1) $n(K_2CO_3) = 7.59 \times 10^{-3}$ mass $K_2CO_3 = 7.59 \times 10^{-3} \times 138.2 = 1.05$ g (1) mass impurity = 1.40 – 1.05 = 0.35 g (1)		2	1	3	2	
	(c)			flame test - lilac flame (1) (HNO_3 followed by) $AgNO_3$(aq) - white precipitate (1)	2			2		2
	(d)			large increase from 1st to 2nd ionisation energy / high 2nd ionisation energy / too much energy needed to remove 2nd electron (1) second electron removed from a shell nearer to the nucleus / with increased effective nuclear attraction / less shielding (1)	2			2		
				Question 10 total	**8**	**4**	**1**	**13**	**2**	**3**

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
11.	(a)	(i)		+3		1		1		
		(ii)		$2FeAsS + 5O_2 \rightarrow As_2O_3 + Fe_2O_3 + 2SO_2$ formulae (1) balancing (1) – only awarded if **all** formulae are correct award (1) for correctly balanced equation including FeO instead of Fe_2O_3 $2FeAsS + 4\frac{1}{2}O_2 \rightarrow As_2O_3 + 2FeO + 2SO_2$		2		2	1	
	(b)	(i)		moles As_2O_3 in 100 cm^3 = $\frac{2.06}{197.8}$ = 0.0104 (1) moles As_2O_3 in 1 dm^3 = 0.0104 × 10 = 0.104 (1) concentration H_3AsO_3 = 0.104 × 2 = 0.208 mol dm^{-3} (1) accept alternative method		2	1	3	2	
		(ii)		$[H^+] = 10^{-5.11} = 7.76 \times 10^{-6}$ mol dm^{-3}		1		1	1	
	(c)			pyramidal (1) contains three bonding pairs and one lone pair of electrons (1) <u>electron pairs</u> arrange themselves around the central atom as far as possible from each other so that the <u>repulsion between them is at a minimum</u> / lp – bp repulsion > bp – bp repulsion (1) first two marks can be obtained from suitable diagram		1	2	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			n = $\frac{pV}{RT}$ (1) n = $\frac{1.01 \times 10^5 \times 39 \times 10^{-6}}{8.31 \times 360}$ (1) n = 1.317×10^{-3} mol (1) $M_r = \frac{0.181}{1.317 \times 10^{-3}}$ = 137.4 M_r PCl_3 = 137.5 therefore chloride is PCl_3 (1) accept alternative method e.g. assume PCl_3 and work back to show volume of 39 cm^3	1	1 1	1	4	3	
	(e)	(i)		$(P^{35}Cl_2)^+$ accept if charge missing			1	1		
		(ii)		chlorine has isotopes ^{35}Cl and ^{37}Cl in ratio of 3:1 / 75% to 25% (1) since peak **C** due to $(P^{35}Cl_2)^+$ and peak **E** due to $(P^{37}Cl_2)^+$ height of **C** : **E** is (3 : 1) × (3 : 1) i.e 9 : 1 (1)		1	1	2		
				Question 11 total	**1**	**10**	**6**	**17**	**7**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.	(a)			Error 1 student is incorrect since solid weighed by difference (1) Error 2 Student is correct - improve by rinsing out the beaker (with distilled water) and transferring washings to the volumetric flask (before making up to 250 cm^3) (1)			2	2		2
	(b)			to show the end point / when to stop adding acid / when solution is neutralised neutral answer – to see a colour change	1			1		1
	(c)			award (1) for any of following so that a certain volume of acid can be added quickly before adding drop by drop to save time before doing accurate titrations to give a rough idea of the end point	1			1		1
	(d)			titres that are within 0.20 cm^3 of each other / within a small range / very close to each other	1			1		1
	(e)			Titration 2 final reading 23.65, initial reading 0.40 (1) Titration 3 final reading 23.90, initial reading 0.30 (1) mean titre = 23.60 cm^3 (1)		2	1	3		3
	(f)	(i)		$n(HCl) = 0.1 \times \frac{23.60}{1000} = 2.36 \times 10^{-3}$ (1) $n(M_2CO_3) = \frac{2.36 \times 10^{-3}}{2} = 1.18 \times 10^{-3}$ (1)		2		2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		mass of carbonate = 1.25 (1) $n(M_2CO_3)$ in solution = $1.18 \times 10^{-3} \times 10 = 1.18 \times 10^{-2}$ (1) $M_r = \frac{1.25}{1.18 \times 10^{-2}} = 106$ (1) $A_r(M) = \frac{106-60}{2} = 23$ ⇨ M is sodium (1) do not accept sodium if there is insufficient working to arrive at that conclusion ecf possible from part (i)		2	2	4	2	
				Question 12 total	**3**	**6**	**5**	**14**	**3**	**8**
				Paper total	**28**	**35**	**17**	**80**	**20**	**13**