GCE AS MARKING SCHEME

SUMMER 2022

AS
CHEMISTRY – COMPONENT 1
B410U10-1

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

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

SUMMER 2022 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	(a)			a bond in which the electrons are not shared equally	1			1		
	(b)			$\overset{\delta+}{H}—\overset{\delta-}{F}$	1			1		
2				xenon / Xe	1			1		
3				uncertainty in one weighing = 0.0005 (1) percentage error = $\frac{2 \times 0.0005}{2.750} \times 100 = 0.036\%$ (1)		1	1	2	1	2
4				$(1s^2\ 2s^2\ 2p^6)\ 3s^2\ 3p^6\ 3d^6\ 4s^2$	1			1		
5				$Ca(OH)_2 \rightarrow CaO + H_2O$		1		1		
6	(a)			both have their outer electrons in s-orbitals	1			1		
	(b)			magnesium sulfate would give no colour whereas barium sulfate would give a green/apple green colour	1			1		1
	(c)			any soluble sulfate e.g. sodium sulfate	1			1		1
				Section A total	**7**	**2**	**1**	**10**	**1**	**4**

Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			$K_c = \frac{[NO]^2\,[Cl_2]}{[NOCl]^2}$ (1) unit ⇨ mol dm^{-3} (1)	1	1		2		
	(b)			$[Cl_2] = K_c \times \frac{[NOCl]^2}{[NO]^2}$ (1) $7.4 \times 10^{-3} \times \frac{(0.126)^2}{(0.0573)^2}$ (1) 0.0358 (1) ecf possible from incorrect K_c expression		3		3	2	
	(c)			less chlorine would be produced (1) the equilibrium would shift to oppose the increase in pressure (1) so would move to the side with fewer gas moles / the LHS (1)		1 1	1	3		
				Question 7 total	**1**	**6**	**1**	**8**	**2**	**0**

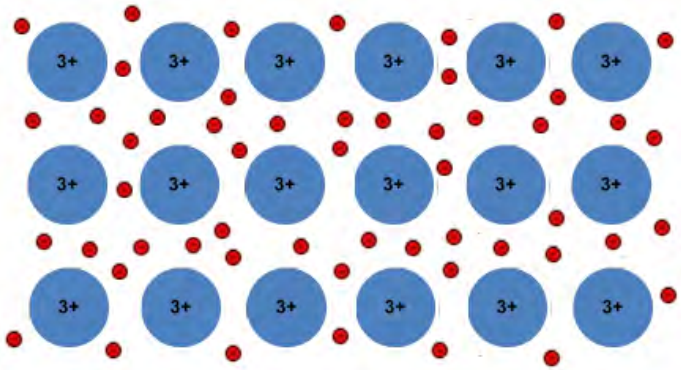
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		(lower than krypton) because xenon is in the next period (1) bigger atomic radius / more shells of electron / more shielding (and so easier to remove outer electron) (1)	2			2		
		(ii)		(higher than iodine) because xenon has a greater nuclear charge / more protons (1) award (1) for either of following with similar shielding (and so harder to remove outer electron) smaller atomic radius (and so harder to remove outer electron)	2			2		
	(b)	(i)		ability of an atom to attract the electrons in a covalent bond	1			1		
		(ii)		(simple) molecular structure			1	1		
		(iii)		$Xe + F_2 \rightarrow XeF_2$		1		1		
		(iv)		$n(XeF_2) = \frac{5.00}{169} = 0.0296$ (1) $pV = nRT$ $V = \frac{0.0296 \times 8.31 \times 673}{1.00 \times 10^5}$ (1) 1.66 dm^3 (1)		3		3	2	
		(v)		electron pairs as far apart as possible in order to minimise repulsion (1) lone pairs repel more than bond pairs (and so the angle between them is greater) (1)			2	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(vi)		oxidation state of xenon changes from +2 to 0 and oxidation state of oxygen changes from –2 to 0 (1) must have reference to oxidation states award (1) for any of following oxidation state of xenon becomes less positive showing that it has been reduced oxidation state of xenon becomes less positive showing that it has oxidised oxygen accept xenon gains electrons whilst oxygen loses electrons	2			2		
		(vii)		$2XeF_2 + 2H_2O \rightarrow 2Xe + O_2 + 4HF$ products (1) balancing (1) only if products are correct			2	2		
				Question 8 total	**7**	**4**	**5**	**16**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			**Indicative content** Mass spectrometer • Element is vaporised • Ionised by having electron knocked off / electron gun • Positive ions formed • Accelerated by charge plates • Made into beam by slits • Deflected by electromagnet • Deflected according to m/z • Detected • Whole system under vacuum Mass spectrum of chlorine • Peaks at 35 and 37 – two isotopes ^{35}Cl and ^{37}Cl • These peaks in 3:1 ratio • Peaks due to chlorine molecules – at 70, 72 and 74 • These peaks in a ratio of 9:6:1	4	2		6		
				5-6 marks Good description of how the mass spectrometer works; good description of all peaks in the mass spectrum of chlorine *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** Basic description of how the mass spectrometer works; some knowledge of molecular peaks in the mass spectrum of chlorine *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** Description of some processes happening in the mass spectrometer; knowledge of peaks due to ^{35}Cl and ^{37}Cl isotopes *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.*						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		330		1		1		
		(ii)		$n(H_2O) = \frac{330}{18.02} = 18.3$ (1) number of H atoms = $2 \times 18.3 \times 6.02 \times 10^{23} = 2.20 \times 10^{25}$ (1) ecf possible		2		2	1	
		(iii)		mass of arsenic = $10 \times 10^{-6} \times \frac{330}{1000} = 3.30 \times 10^{-6}$ g moles of arsenic = $\frac{3.30 \times 10^{-6}}{74.9} = 4.41 \times 10^{-8}$ (1) mass of copper = $2 \times 10^{-3} \times \frac{110}{1000} = 2.20 \times 10^{-4}$ g moles of copper = $\frac{2.20 \times 10^{-4}}{63.5} = 3.46 \times 10^{-6}$ (1) there are more moles of copper (1) working **must** be shown to award final mark ecf possible throughout		1 1 1		3	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			award (1) for relevant point for fluoridation reduces tooth decay / prevents cavities reduces teeth extractions / reduces number of general anaesthetics award (1) for relevant point against fluoridation mass medication / freedom of choice excess fluoride discolours teeth / causes fluorosis many people get enough fluoride from other sources such as toothpaste or their natural water supply may also cause brittle bones / IBS / thyroid problems / bone cancer award (1) for any sensible conclusion / judgement based on their previous statements	1 1		1	3		
	(d)			$\frac{1.7\times10^{-3}}{78.1}$ = 2.2 × 10^{-5}		1		1	1	
				Question 9 total	**6**	**8**	**2**	**16**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			 award (1) for each of following • regular array of metal ions • ions identified as having 3+ charge • 'sea' of delocalised electrons credit may be awarded for labelled diagram and/or description	1 1		1	3		
	(b)			gallium made of <u>molecules</u> and there are only <u>weak forces</u> (van der waals) between these molecules (1) aluminium is made of metal ions and delocalised electrons <u>held together by strong</u> electrostatic attraction (1) a lot less energy is needed to allow the particles in gallium to overcome the forces holding them in the solid structure than is the case in aluminium (1)			3	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			abundance Ga-69 = 100 – Ga-71 (1) 69.798 = $\frac{[69 \times (100 - \text{Ga71})] + [71 \times \text{Ga71}]}{100}$ (1) Ga-71 = $\frac{6979.8 - 6900}{2}$ = 39.9% Ga-69 = 60.1% (1) both values needed		3		3	2	
	(d)	(i)		Ga(g) → $Ga^+(g)$ + e^-	1			1		
		(ii)		1st ionisation energy for one atom = $1.602 \times 10^{-19} \times 5.9993 = 9.61 \times 10^{-19}$ (1) $E = h \times \frac{c}{\lambda}$ (1) $\lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3.00 \times 10^8}{9.61 \times 10^{-19}}$ = 2.07×10^{-7} m (1)		1 1 1	1	3	2	
				Question 10 total	**3**	**5**	**5**	**13**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		droplet from the funnel could enter the burette / affect volume / readings / titre	1			1		1
		(ii)		air bubble in jet neutral answer - reference to poor technique e.g. misreading the burette, overshooting the end-point	1			1		1
	(b)	(i)		award (1) for either of following $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ $NaOH + CO_2 \rightarrow NaHCO_3$	1			1		
		(ii)	I	2.25×10^{-2}		1		1	1	1
			II	$V = 2.50\ cm^3$ (1) $n = 1.00 \times \frac{2.5}{1000} = 2.50 \times 10^{-3}$ (1)		2		2	1	2
			III	moles $CO_3^{2-} = 2.50 \times 10^{-3}$ (1) moles $OH^- = 2.25 \times 10^{-2} - 2.50 \times 10^{-3} = 0.0200$ (1) ecf possible		2		2	1	2
			IV	moles CO_2 absorbed = moles CO_3^{2-} made $= 2.50 \times 10^{-3}$ in $25\ cm^3$ (1) moles in $1.00\ dm^3$ flask $= 2.50 \times 10^{-3} \times 40 = 0.100$ (1) volume $= 0.100 \times 24.5 = 2.45\ dm^3$ (1)		3		3	2	3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		fully dissociates in aqueous solution (1) $HCl \rightarrow H^+ + Cl^-$ (1)	1	1		2		
		(ii)	I	pH = –log [0.50] = 0.30		1		1	1	
			II	new $[H^+] = 10^{-1.0} = 0.10$ mol dm^{-3} (1) new $V = \frac{n}{c} = \frac{0.25}{0.10} = 2.50$ dm^3 (1) volume water added = 2.50 – 0.50 = 2.00 dm^3 (1)		1 1	1	3	2	2
				Question 11 total	**4**	**12**	**1**	**17**	**8**	**12**

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	7	2	1	10	1	4
7	1	6	1	8	2	0
8	7	4	5	16	2	0
9	6	8	2	16	4	0
10	3	5	5	13	4	0
11	4	12	1	17	8	12
Totals	28	37	15	80	21	16