GCE AS MARKING SCHEME

SUMMER 2024

AS
CHEMISTRY – UNIT 1
2410U10-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE AS CHEMISTRY UNIT 1

THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

SUMMER 2024 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.

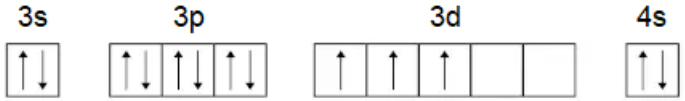
Marking abbreviations

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

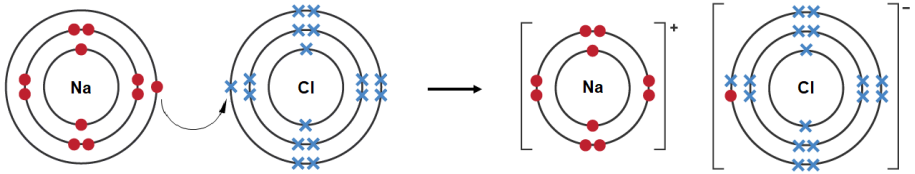
Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				kills bacteria / microbes	1			1		
2				electronegativity increases across Period 3	1			1		
3				phosphorus	1			1		
4					1			1		
5				**2** $Mg(NO_3)_2 \longrightarrow 2\,MgO + \mathbf{4}\,NO_2 + O_2$		1		1		
6	(a)			disagree – since 16 neutrons in $^{32}_{16}S^{2-}$ and 10 neutrons in $^{18}_{8}O$			1	1		
	(b)			agree – since 18 electrons in both species			1	1		
7				4.5		1		1		
8				22.4 dm^3 = 1 mol n = $\frac{1}{22.4}$ (1) 1 dm^3 = 0.0446 mol $M_r = \frac{0.717}{0.0446}$ = 16.1 (1)		2		2	1	
				Section A total	**4**	**4**	**2**	**10**	**1**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)	I	each carbon atom in diamond has four (strong) covalent bonds at tetrahedral angles / in tetrahedral structure (1) each carbon atom in graphite has three (strong) covalent bonds within the same plane / forming hexagons in planes (1) if no other credit award (1) if both statements partially correct	2			2		
			II	credit property common to both and corresponding explanation both have high melting points (1) due to giant molecular structure of strong covalent bonds / because a large amount of energy is needed to break strong covalent bonds (1) or both are insoluble in water (1) because they are non-polar (1) credit different property and corresponding explanation graphite is soft but diamond is hard (1) because graphite has weak forces between planes (1) or graphite conducts electricity but diamond does not (1) because graphite has delocalised electrons along the planes (1)	4			4		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)	I	 electron transfer and correct electronic structure of ions (1) charge on both ions (1)		2		2		
			II	Na^+ **ion** smaller than Cs^+ **ion** (so fewer Cl^- ions can pack around it)	1			1		
	(b)	(i)		yellow (1) $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$ (1) ignore state symbols	1	1		2		1
		(ii)		iodine (causes the brown colouration) (1) (bromine is an) oxidising agent (1)	1	1		2		1
	(c)			add any suitable sulfate solution e.g. sodium sulfate (1) no change with Mg^{2+} and white precipitate with Ba^{2+} (1) or add sodium hydroxide solution (1) white precipitate with Mg^{2+} and no change with Ba^{2+} (1)	1		1	2		2
				Question 9 total	**10**	**4**	**1**	**15**	**0**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		award (2) for correct equation $^{124}_{53}I \rightarrow {}^{124}_{52}Te + \beta^{+}$ if not correct award (1) for correct symbol for tellurium	2			2		
		(ii)		award (1) for points plotted correctly 50 units at 4 days, 25 units at 8 days, 12.5 units at 12 days and 6.25 units at 16 days award (1) for smooth curve through points	2			2	1	
	(b)			bromine has two isotopes ^{79}Br and ^{81}Br (1) m/z 158 due to molecules containing two of smaller isotope / ^{79}Br only, m/z 162 due to molecules containing two of larger isotope / ^{81}Br only and m/z 160 due to molecules containing one of each isotope / one ^{79}Br and one ^{81}Br (1) 50% of each isotope / ratio of isotopes is 1:1 therefore height of $^{158}Br_2^+$ and $^{162}Br_2^+$ same and $^{160}Br_2^+$ twice as big (1) accept answer in terms of probability	1		2	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		$[H^+] = 1.20 \times 10^{-2}$		1		1	1	
		(ii)		moles of $Ba(OH)_2 = 1.18 \times 10^{-4}$ (1) moles of $H^+ = 2.36 \times 10^{-4}$ (1) $[H^+] = 9.46 \times 10^{-3}$ (1) ecf possible throughout		3		3	2	3
		(iii)		agree – since $[H^+]$ is different, the pH must be different			1	1		
				Question 10 total	**5**	**4**	**3**	**12**	**4**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		**large** increase after removing the 2nd electron			1	1		
		(ii)		student is partially correct / incorrect (can be inferred from answer) – must have some sensible attempt at explanation (1) **X** is higher than **Y** since **X** has a larger nuclear charge but little/no extra shielding (1) **X** is not lower than **Z** since the outer electron in **Z** is partly shielded by the s electrons (and therefore more easily lost) (1) reference to stronger attraction is neutral			3	3		
	(b)	(i)		$Na^+(g) \rightarrow Na^{2+}(g) + e^-$	1			1		
		(ii)		$\Delta E = \frac{4560000}{6.02 \times 10^{23}} = 7.57 \times 10^{-18}$ J (1) $f = \frac{\Delta E}{h} = \frac{7.57 \times 10^{-18}}{6.63 \times 10^{-34}} = 1.14 \times 10^{16}\ s^{-1}$ (1) $\lambda = \frac{3.00 \times 10^8}{1.14 \times 10^{16}} = 2.63 \times 10^{-8}$ m (1) λ = 26.3 nm (1) ecf possible throughout	1	3		4	4	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		award (1) for each of following H—C—H 109.5° accept 109° Cl—Al—Cl 120° Cl—Be—Cl 180°	3			3		
		(ii)		(second sentence is incorrect because) total number of electron pairs important not just bonding pairs (1) e.g. bond angle in H_2O (105°) is less than that in $AlCl_3$ (120°) even though there are fewer bonds in H_2O (1) accept any sensible example but must refer to two molecules / structures / shapes / angles for second mark			2	2		
				Question 11 total	**5**	**3**	**6**	**14**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			**Indicative content** *Information about reaction* • as temperature increases yield decreases • as temperature is increased equilibrium moves to the left / in the endothermic direction • therefore forward reaction is exothermic • as pressure increases yield increases • as pressure is increased equilibrium moves to the right / to the side with fewer gas moles • therefore more gas moles in reactants *Optimum conditions and explanation* • optimum temperature likely to be 100-200°C – higher rate than at lower temperature; sharp fall in conversion above 200°C • optimum pressure likely to be 30-40 atm – no increase in yield above 40 atm • optimum pressure could be 20-30 atm – if costs of plant are significantly greater for higher pressure • compromise required between % conversion and rate i.e. best conversion at around room temperature but rate could be very low • must have information about the reaction rate to determine the optimum conditions • other factors for consideration – catalysts, ease of separation of reactants/products for reactants to be returned to reaction vessel, increased costs of plant to operate at higher pressure	2	2	2	6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Correct information about reaction and sensible optimum conditions suggested; sound reasoning throughout (including reference to rate) *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** Largely correct information about reaction and some reference to optimum conditions; some sensible reasoning *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** Some information about reaction and/or optimum conditions; some attempt at reasoning *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)		$K_c = \frac{[CH_3OH]}{[CO][H_2]^2}$ (1) unit ⇨ $dm^6\ mol^{-2}$ (1)		2		2	1	
		(ii)		$[CH_3OH] = K_c \times [CO] \times [H_2]^2$ (1) $[CH_3OH] = 0.183\ mol\ dm^{-3}$ (1)		2		2	2	
	(c)	(i)		$\frac{111.6}{243.6} \times 100$ (1) 45.8% (1) answer given to 3 sig figs (1)		3		3	1	
		(ii)		moles of $Fe_2O_3 = \frac{20\ 000\ 000}{159.6} = 125313.2$ (1) moles of $CO_2 = 3 \times 125313.2 = 375939.6$ (1) volume of $CO_2 = \frac{375939.6 \times 8.31 \times 1373}{1.01 \times 10^5}$ (1) volume of $CO_2 = 42460\ m^3$ (1) ecf possible throughout		4		4	3	
				Question 12 total	**2**	**13**	**2**	**17**	**7**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)			award (1) for **all** readings in the table correct Titre **A** 7.40 7.45 7.50 Titre **B** 14.90 15.00 14.85 award (1) each for means calculated mean titre **A** = 7.45 cm^3 mean titre **B** = 14.92 cm^3 accept 14.90	1	2		3	2	3
	(b)			(volumetric) pipette	1			1		1
	(c)			award (1) for any of following double the mass of solid dissolved double the amount of solution used halve the concentration of acid			1	1		1
	(d)			award (1) for any sensible suggestion colour change for titre **A** easier to see colour change for titre **B** more difficult to see only one indicator needed for titre **A** second titre depends on the first one			1	1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)	(i)		7.45×10^{-4} mol in $25cm^3$ 7.45×10^{-3} mol in original solution		1		1		1
		(ii)		moles of HCl in titre **B** = 1.492×10^{-3} (1) moles of $NaHCO_3$ in $25cm^3$ = $(1.492 \times 10^{-3}) - (7.45 \times 10^{-4})$ $= 7.47 \times 10^{-4}$ moles of $NaHCO_3$ in original solution = 7.47×10^{-3} (1)		2		2	1	2
		(iii)		moles of $NaHCO_3$ ≈ moles of Na_2CO_3 therefore $x = 1$			1	1		
	(f)			M_r of anhydrous $Na_2CO_3.NaHCO_3$ = 190 (1) M_r of water present in formula = 226 – 190 = 36 $\frac{36}{18} = 2$ therefore $y = 2$ (1)		2		2	1	2
				Question 13 total	**2**	**7**	**3**	**12**	**4**	**11**

UNIT 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	4	2	10	1	0
9	10	4	1	15	0	4
10	5	4	3	12	4	3
11	5	3	6	14	4	0
12	2	13	2	17	7	0
13	2	7	3	12	4	11
Totals	28	35	17	80	20	18