GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
CHEMISTRY – COMPONENT 1
A410U10-1

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 A LEVEL CHEMISTRY

COMPONENT 1 – PHYSICAL AND INORGANIC CHEMISTRY

SUMMER 2025 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				award (1) for each correct colour potassium ions ⇨ lilac lithium ions ⇨ red	2			2		2
2				$2C(s) + 3H_2(g) + ½O_2(g) \rightarrow C_2H_5OH(l)$ award (1) for correct balanced equation award (1) for state symbols must have correct formulae for state symbols mark to be awarded	1	1		2		
3	(a)			provides an alternative pathway with lower activation energy	1			1		
	(b)			different physical state from reactants	1			1		1
4				award (1) for tangent drawn at t = 0 initial rate = $\frac{22}{10}$ = 2.20 (1) accept any value in the range 2.0-2.8 when it fits the tangent drawn		2		2	2	2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			award (1) for any of following $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ $NaOH + CO_2 \rightarrow NaHCO_3$ $2OH^- + CO_2 \rightarrow CO_3^{2-} + H_2O$ $OH^- + CO_2 \rightarrow HCO_3^-$ $H_2O + CO_2 \rightarrow H^+ + HCO_3^-$	1			1		1
	(b)			(lead(II) oxide) reacts with both acids and bases	1			1		1
6				–1076 (2) if incorrect award (1) for any of following 3748 (energy required to break bonds in reactants) 4824 (energy released by making bonds in products) 1076		2		2		
7				a (reversible) reaction where the forward and reverse reactions occur at the same rate	1			1		
8	(a)			alpha / α particle		1		1		
	(b)			deflected towards negative plate / away from positive plate ecf possible from incorrect part (a)	1			1		1
				Section A total	**9**	**6**	**0**	**15**	**2**	**8**

SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		frequencies absorbed correspond to the differences between energy levels in atom / dark lines formed by electron moving from a lower energy level to a higher energy level (1) (dark lines get closer together until they overlap because) energy levels get closer (until they overlap and the atom is ionised) (1)	2			2		
		(ii)		energy per atom = $\frac{1312 \times 1000}{N_A}$ = 2.179 × 10^{-18} J (1) frequency = $\frac{E}{h}$ = 3.287 × 10^{15} Hz (1) wavelength = $\frac{c}{f}$ = 91.3 nm (1)		3		3	3	
	(b)	(i)		accept any value in the range 500-850 kJ mol^{-1} (1) must make sensible attempt at reason must be greater than Na as ionisation energies decrease as you go down a group and lower than Be as they increase across a period (1)		1	1	2		
		(ii)		accept any value in the range 590-890 kJ mol^{-1} (1) must make sensible attempt at reason must be lower than Be as electron experiences lower effective nuclear charge / more shielding (1) must be greater than Al as ionisation energies decrease from Group 2 to Group 3 as the electrons are in a different subshell with increased shielding of nuclear charge (1)		2	1	3		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		award (1) for either of following • strong acids dissociate completely and weak acids dissociate partially • strong acids dissociate completely and weak acids dissociate in a reversible reaction	1			1		1
		(ii)		pH = pK_a + log$\left(\frac{[salt]}{[acid]}\right)$ ⇨ log$\left(\frac{[salt]}{[acid]}\right)$ = 0.250 (1) $\frac{[salt]}{[acid]}$ = 1.78 (1) accept use of K_a expression for first two marks concentration of acid in buffer = $\frac{0.200}{2.78}$ = 0.072 mol dm^{-3} (1) concentration of NaOH used = 0.128 mol dm^{-3} (1)		1	1 2	4	4	
	(d)			**Indicative content** *What is meant by hydrogen bonding* 1. It is stronger than van der Waals/dipole-dipole OR strongest intermolecular force (but NOT strong) 2. Needs H bonded to N/O/F 3. These are the most electronegative elements 4. This creates a large dipole 5. Hydrogen nucleus is exposed/has very low electron density 6. Hydrogen bond exists between the hydrogen δ+ and lone pair on an atom in another molecule	5	1		6		

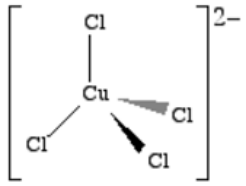
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				Properties of water 7. High boiling temperature 8. Need more energy to overcome hydrogen bonding and boil the water 9. Ice is less dense than water OR water expands when it freezes 10. Hydrogen bonds (are directional so) cause an open (tetrahedral) structure in ice 11. Water is a good solvent 12. It can form hydrogen bonds with molecules that contain e.g. oxygen or nitrogen atoms						
				5-6 marks Full description of origin of hydrogen bonding; at least two properties given and at least one explained *The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated reasoning is evident and scientific conventions and vocabulary are used accurately throughout.* **3-4 marks** Basic description of origin of hydrogen bonding; at least one property given and explained *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** Candidate includes at least four points of indicative content, showing an understanding of the intermolecular nature of hydrogen bonding *The candidate attempts to link at least three 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 9 total	**8**	**8**	**5**	**21**	**7**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			outermost electron is in a *p*-orbital	1			1		
	(b)	(i)		Cl / Cl_2 / chlorine		1		1		
		(ii)		award (1) for any of following S / sulfur Se / selenium Te / tellurium		1		1		1
		(iii)		I / I_2 / iodine	1			1		1
	(c)	(i)		silicon is the only one that has a giant covalent / macromolecular structure (1) Need to break strong covalent bonds to melt (1)		2		2		
		(ii)		inert pair effect becomes greater down the group (so +2 becomes most stable oxidation state for lead)	1			1		
		(iii)		chlorine is a stronger oxidising agent than bromine so chlorine is able to oxidise bromide ions (1) iodine is a weaker oxidising agent than bromine so iodine is not able to oxidise bromide ions (1) $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$ (1)		3		3		3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		percentage oxygen is 21.2% ratio ⇨ $\frac{78.8}{119}$: $\frac{21.2}{16}$ ⇨ 0.662 : 1.324 (1) simplifies to 1 : 2 ratio ⇨ formula is SnO_2 (1)		2		2	1	
		(ii)	I	Sn^{2+} + $2Fe^{3+}$ → Sn^{4+} + $2Fe^{2+}$		1		1		
			II	moles Fe^{3+} = $17.40 \times \frac{0.0210}{1000}$ = 3.654×10^{-4} mol (1) moles Sn^{2+} = 1.827×10^{-4} mol (1) concentration Sn^{2+} = $\frac{1.827 \times 10^{-4}}{25.0 \times 10^{-3}}$ = 7.308×10^{-3} mol dm^{-3} (1)		3		3	3	3
		(iii)		arsenic has three bond pairs and one lone pair in AsH_3 (1) electron pairs repel to be as far away from each other as possible / lone pairs repel more than bonded pairs (1) shape is pyramidal (accept 3D diagram) (1)		3	0	3		
				Question 10 total	**3**	**16**	**0**	**19**	**4**	**8**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			calcium conducts when solid but calcium chloride only conducts when molten/dissolved (1) in calcium, electrons are delocalised and can flow and carry a charge (1) in calcium chloride, ions can move and carry a charge (1)	3			3		1
	(b)	(i)		$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	1			1		1
		(ii)	I	entropy is positive as a gas is formed from a solid (1) gases have much higher entropies as they are disordered (1)		2		2		
			II	T = 719K (1) $\Delta H = T\Delta S$ = 719 × 153 = 11 0007 J mol^{-1} (1) ΔH = 110 kJ mol^{-1} (1)		3		3	2	
	(c)	(i)		moles of water = $\frac{2.25}{18.02}$ = 0.125 mol (1) d = $\frac{\text{moles of water}}{\text{moles of gaylussite}}$ = $\frac{0.125}{2.50 \times 10^{-2}}$ = 5 (1)			2	2	1	2
		(ii)		mass of 2.50 × 10^{-2} mol = $\frac{2.25}{0.304}$ = 7.40 g (1) M_r = $\frac{7.40}{2.50 \times 10^{-2}}$ = 296 (1)			2	2	1	2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		mass of CO_2 = 29.7 × 10^{-2} × 7.40 = 2.20 g (1) can also gain this by proportion from mass of water moles of CO_2 = $\frac{2.20}{44}$ = 0.050 mol (1) c = $\frac{0.050}{2.50 \times 10^{-2}}$ = 2 (1)			3	3	2	
		(iv)		proportion of M_r resulting from Ca and M = 296.1 – 5(18.02) – 2(60) = 86 (1) total charge of metal ions must be +4 so can only be one Ca^{2+} ion remaining mass of 46 so M must be Na (1) $CaNa_2(CO_3)_2.5H_2O$ (1)			3	3		
				Question 11 total	**4**	**5**	**10**	**19**	**6**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$	1			1		
	(b)	(i)		colour changes from orange to green (1) Fe^{2+} reduces dichromate to Cr^{3+} (1)	1	1		2		1
		(ii)		colour changes from orange to yellow (1) in alkaline solutions dichromate splits to form CrO_4^{2-} ions (1) accept equation $Cr_2O_7^{2-} + 2OH^- \rightleftharpoons 2CrO_4^{2-} + H_2O$	2			2		2
	(c)	(i)		(water) ligands split the *d*-orbitals into 3 lower and 2 higher energy orbitals (1) electrons move from lower to higher orbitals by absorbing (specific) frequencies/energies/colours of light (1) colour seen is the colours/frequencies not absorbed (1)	3			3		
		(ii)			1			1		1
	(d)	(i)		award (1) for any reference to Cu+ reacting with air e.g. oxygen would oxidise Cu^+ to Cu^{2+}			1	1		1
		(ii)		where atoms of the same element are oxidised and reduced in a reaction	1			1		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)	I	s^{-1}	1			1	1	
			II	50°C is 323K ⇨ $\frac{1}{T}$ = 0.003096 (1) ln *k* = –7.4 ⇨ *k* = 6.11 × 10^{-4} (1) rate = *k* [copper complex] (1) rate = 6.11 × 10^{-4} × 2.5 × 10^{-5} = 1.53 × 10^{-8} mol dm^{-3} s^{-1} (1) accept any value in the range 1.50-1.55 × 10^{-8}		2	2	4	4	
			III	ln *k* = ln *A* – $\left(\frac{E_a}{R}\right)\left(\frac{1}{T}\right)$ ⇨ gradient = – $\left(\frac{E_a}{R}\right)$(1) gradient = – $\frac{3.1}{0.0004}$ = –7750 (1) accept –7700 to –7950 E_a = – (–7750) × $\frac{8.31}{1000}$ = 64.4 kJ mol^{-1} (1) accept any value in the range 64.0-66.1 kJ mol^{-1}			3	3	3	
		(iv)		K_a of —COOH is greater than that of —OH (and other protons)			1	1		1

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(v)		only Pr will end as +3 oxidation state (1) for an ion to be reduced the standard electrode potential of $[Cu(CN)_2]^-$ must be more negative than the standard electrode potential of the metal ion / EMF of reaction must be positive (1) award (1) for any two of following and award (2) for all three • Mn would be reduced to Mn^{3+} and then to Mn^{2+} • Pr would be reduced to Pr^{3+} but not reduced further to Pr^{2+} • V cannot be reduced by $[Cu(CN)_2]^-$ alternative for last two marks +4 oxidation state in Mn and Pr can be reduced to +3 but +4 in V cannot (1) +3 oxidation state in Mn can be reduced further but +3 in Pr cannot (1)			4	4		4
				Question 12 total	**10**	**3**	**11**	**24**	**8**	**10**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)			$K_c = \frac{[I_3^-]}{[I_2][I^-]}$ (1) initial concentration of KI = $\frac{0.100}{166.1}$ = 6.02×10^{-4} mol dm^{-3} (1) award (1) for both equilibrium concentrations ⇨ $[I_2] = 1.33 \times 10^{-3} - 2.62 \times 10^{-4} = 1.068 \times 10^{-3}$ mol dm^{-3} ⇨ $[I^-] = 6.02 \times 10^{-4} - 2.62 \times 10^{-4} = 3.40 \times 10^{-4}$ mol dm^{-3} K_c = 721.5 mol^{-1} dm^3 (1)		4		4	3	1
	(b)	(i)		relative mass of KBrI = 39.1 + 79.9 + 127 = 246 remaining mass = 373 – 246 = 127 (1) 127 corresponds to one more iodine atom ⇨ formula is $KBrI_2$ (1)		1	1	2		
		(ii)		(mass spectrometer is normally adapted for positive ions so) need to reverse magnetic field or current in electromagnet accept reference to changing location of detector as ions deflected in other direction			1	1		1
		(iii)	I	127 / mass of iodine subtracted from 285, 287 and 289 gives the masses at which peaks are found / gives peaks at 158, 160 and 162 (1) isotopes are $\frac{158}{2}$ = 79 and $\frac{162}{2}$ = 81 (1)		2		2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
			II	79.98 = $\frac{[(\text{percentage } ^{79}\text{Br} \times 79) + (\text{percentage } ^{81}\text{Br} \times 81)]}{100}$ (1) 7998 = 79(100 – x) + 81x 7998 = 7900 –79x + 81x 2x = 98 (1) ^{81}Br ⇨ 49% and ^{79}Br ⇨ 51% (1)		3		3	2	
		(iv)		$M_r(ClF_3)$ = 92.5 (1) molar volume = $\frac{92.5}{3.60}$ = 25.7 dm^3 = 0.0257 m^3 (1) $T = \frac{pV}{nR}$ (1) $T = \frac{1.01 \times 10^5 \times 0.0257}{1 \times 831}$ = 312 K (1)		4		4	3	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			**Indicative content** 1. $K_w = [H^+][OH^-]$ 2. It is the equilibrium constant for $H_2O \rightleftharpoons H^+ + OH^-$ 3. It is a very small value as very little of the water has dissociated 4. The value of K_w increases with temperature 5. Much more dissociation at a higher temperature / the equilibrium shifts to the right at higher temperature 6. The reaction is endothermic 7. A strong alkali dissociates completely releasing $[OH^-]$ so $[OH^-]$ = [ALKALI] 8. To find $[H^+]$ in a strong alkali then $[H^+] = \frac{K_w}{[OH^-]}$ 9. pH = – log$[H^+]$ 10. As temperature increases K_w increases so $[H^+]$ increases and pH decreases	2	2	2	6	2	
				5-6 marks Complete discussion including enthalpy change and change in pH with temperature *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** Discussion includes at least five points from indicative content *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** Discussion includes at least three points from indicative content *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 13 total	**2**	**16**	**4**	**22**	**10**	**2**

COMPONENT 1: PHYSICAL AND INORGANIC CHEMISTRY

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL	MATHS	PRACTICAL
Section A	9	6	0	**15**	**2**	**8**
9	8	8	5	**21**	**7**	**1**
10	3	16	0	**19**	**4**	**8**
11	4	5	10	**19**	**6**	**6**
12	10	3	11	**24**	**8**	**10**
13	2	16	4	**22**	**10**	**2**
TOTALS	**36**	**54**	**30**	**120**	**37**	**35**