GCE AS MARKING SCHEME

SUMMER 2024

AS
CHEMISTRY – COMPONENT 1
B410U10-1

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

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

SUMMER 2024 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.

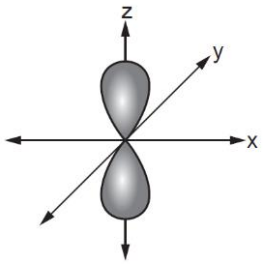
Marking abbreviations

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.

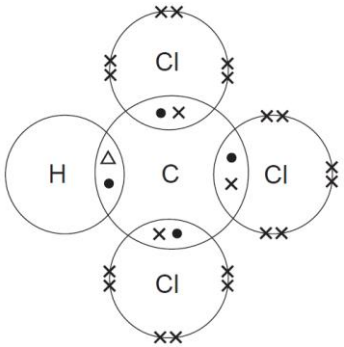
SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				$\frac{143.5}{228.5}$ × 100 = 62.8% accept 63%		1		1		
2				**3**NaOH + H_3PO_4 → **Na_3PO_4** + **3**H_2O award (1) for formula of sodium phosphate award (1) for balancing only if formula is correct		2		2		
3	(a)			region where there is a high probability of finding an electron of a given energy accept – region of an atom that can hold up to two electrons	1			1		
	(b)				1			1		
4				moles of $Ca(OH)_2$ = $\frac{75.0}{74.12}$ = 1.012 mol (1) mass of CaO = 1.012 × 56.1 = 56.8g (1) ecf possible from incorrect M_r value		2		2	1	

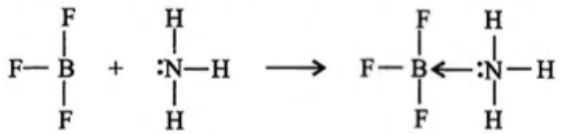
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			when the forward and backward reactions occur at the same rate	1			1		
	(b)			$K_c = \frac{[HCOOCH_3][H_2O]}{[CH_3OH][HCOOH]}$ (1) no unit (1)		2		2	1	
				Section A total	**3**	**7**	**0**	**10**	**2**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			they have a full/stable outer shell (1) so have no/little tendency to form bonds with other atoms (1)	2			2		
	(b)			there are only very weak van der Waals forces between the atoms/particles	1			1		
	(c)			energy per atom = $\frac{1521 \times 1000}{6.02 \times 10^{23}}$ = 2.53×10^{-18} (1) frequency = $\frac{2.53 \times 10^{-18}}{6.63 \times 10^{-34}}$ = 3.82×10^{15} Hz (1) 3.82×10^{9} MHz (1)		3		3	3	
	(d)	(i)		the mass of an atom of an isotope relative to one-twelfth the mass of an atom of carbon-12	1			1		
		(ii)		$^{222}_{86}\text{Rn} \rightarrow {}^{218}_{84}\text{Po} + {}^{4}_{2}\alpha$ award (1) for α-particle accept He^{2+} award (1) for correct mass numbers / A values ignore missing atomic number / Z values		2		2		
				Question 6 total	**4**	**5**	**0**	**9**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		pair of electrons shared between two atoms (with each atom giving one electron)	1			1		
		(ii)		 award (1) for four electron pairs in overlap region award (1) for octet on all chlorine atoms		2		2		
		(iii)		award (1) for either of following • there is a greater electron density around the chlorine atoms so there is greater repulsion between them (which pushes them closer to the hydrogen atom) • the chlorine atoms are larger so there is greater repulsion between them (which pushes them closer to the hydrogen atom) accept – chlorine is more electronegative than hydrogen			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		**Indicative content** **trichloromethane** • simple molecular structure • atoms in a tetrahedral arrangement • strong covalent bonds between the atoms • but weak van der Waals forces between the molecules **diamond** • giant covalent structure • atoms in a tetrahedral arrangement • strong covalent bonds between each carbon atom and four others • covalent bonds are much stronger than intermolecular forces and so much more energy is needed to break them • to melt diamond (millions of) strong covalent bonds must be broken • to melt trichloromethane only weak intermolecular forces/van der Waals forces must be overcome. **5-6 marks** Good descriptions of both structures; clear understanding of the reasons for difference in melting temperatures *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 both structures; some understanding of weak bonds between molecules *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.*	6			6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Some knowledge of one or both structures *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)	(i)		award (1) for any of following • three bond pairs and no lone pairs • three identical bond pairs • three bond pairs only bond pairs repel equally so minimum repulsion exists when they are at 120° to each other (1)	1	1		2		
		(ii)		the lone pair on the nitrogen atom (1) is donated into an empty valence orbital (in the boron atom) / forms a coordinate bond (with the boron atom) (1) full credit possible for diagram e.g. 			2	2		
				Question 7 total	**8**	**3**	**3**	**14**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			when a force is applied the layers of cations/atoms can slide over each other	1			1		
	(b)	(i)		volume = $3.0 \times 3.0 \times 0.1 \times 10^{-4} = 9.0 \times 10^{-5}$ cm^3 (1) mass = $19.32 \times 9.0 \times 10^{-5} = 1.74 \times 10^{-3}$ g (1) number of atoms = $\frac{1.74 \times 10^{-3}}{197} \times 6.02 \times 10^{23} = 5.32 \times 10^{18}$ (1) ecf possible e.g. from multiplier error		3		3	3	
		(ii)		moles of Au in 1 cm^3 of 24-karat gold = $\frac{19.32}{197} = 0.0981$ mol (1) $\frac{22}{24} \times 0.0981 = 0.0899$ mol (1)			2	2		
				Question 8 total	**1**	**3**	**2**	**6**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			thermal decomposition	1			1		
	(b)	(i)	I	$\frac{(9.908 - 9.732)}{100.1} = 1.76 \times 10^{-3}$			1	1	1	1
			II	moles of carbon dioxide = $\frac{(9.908 - 9.842)}{44.0} = 1.50 \times 10^{-3}$ (1) yield = $\frac{1.50 \times 10^{-3}}{1.76 \times 10^{-3}} \times 100 = 85.2\%$ (1) ecf possible from part I		2		2	1	2
		(ii)		heat until constant mass (owtte) (1) to ensure that reaction has finished (owtte) (1)			2	2		2
	(c)			$pV = nRT$ (1) $T = 1073$ (1) $V = \frac{3.75 \times 10^{-3} \times 8.31 \times 1073}{2 \times 1.01 \times 10^{5}} = 1.66 \times 10^{-4}$ m^3 (1) 166 cm^3 (1) ecf possible	2	2		4	3	
				Question 9 total	**3**	**4**	**3**	**10**	**5**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			mass of magnesium sulfate = $\frac{120.4}{4}$ = 30.1g (1) dissolve the solid in a small amount of deionised water (1) transfer it quantitatively to a 250 cm^3 volumetric flask (1) make up to 250 cm^3 and mix (1)	3	1		4		3
	(b)	(i)		magnesium hydroxide is insoluble	1			1		1
		(ii)	I	9.17cm^3 accept 9.20cm^3		1		1		1
			II	original moles of HCl = 0.4 × $\frac{100}{1000}$ = 0.04 (1) moles of unreacted HCl = 4 × $\frac{9.17}{1000}$ = 0.03668 (1) moles of HCl reacted = 0.04 – 0.03668 = 3.32 × 10^{-3} (1)		3		3	2	3
			III	moles of $Mg(OH)_2$ = 1.66 × 10^{-3} (1) mass of $Mg(OH)_2$ = 1.66 × 10^{-3} × 58.32 = 0.09681 g (1) % purity = $\frac{0.50 - 0.09681}{0.50}$ × 100 = 80.6% (1)		3		3	2	
			IV	$\frac{2 \times 0.05}{9.20}$ × 100 = 1.09%		1		1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
			V	moles of unreacted HCl = 0.10 – 3.32 × 10^{-3} = 0.09668 (1) moles of NaOH in needed to react = $\frac{0.09668}{4}$ = 0.02417 (1) titre volume = $\frac{0.02417}{1.00}$ × 1000 = 24.17 cm^3 (1) yes – this change would reduce the percentage error because a larger titre means a lower percentage error (1)			4	4	2	2
		(iii)		no brick red colour would be seen	1			1		1
		(iv)	I	pH = –log 0.4 = 0.398		1		1	1	
			II	pH value of sulfuric acid would be lower (1) award (1) for explanation in terms of greater concentration of H^+ ions e.g. more H^+ ions twice as many H^+ ions higher $[H^+]$ [H+] is 0.8 (compared with 0.4) pH = –log 0.8 = 0.097 accept pH = –log(2 × $[H^+]$)			2	2		
				Question 10 total	**5**	**10**	**6**	**21**	**7**	**12**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			$2Br^- \rightarrow Br_2 + 2e^-$		1		1		
	(b)			award (1) for either of following bromide ion loses electrons oxidation state of bromine increases (from –1 to 0)	1			1		
	(c)			chlorine atoms are smaller and so have a greater ability to attract electrons than bromine	1			1		
	(d)			moles of bromide ions per $dm^3 = \frac{12}{79.9} = 0.150$ moles of bromine per $dm^3 = 0.075$ (1) total moles of bromine = $0.075 \times 4500 \times 1000 = 3.38 \times 10^5$ (1)		2		2	1	
	(e)	(i)		award (1) for either of following because iodine cannot oxidise / displace bromine iodine is less reactive than bromine brown colour is iodine solution (1)			2	2		1
		(ii)		halogens are non-polar molecules (1) water is a polar molecule (1) halogens form more van der Waals attractions with non-polar solvents like cyclohexane than they do with water (1) accept – covalent substances are more soluble in non-polar solvents	3			3		
				Question 11 total	**5**	**3**	**2**	**10**	**1**	**1**

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	3	7	0	10	2	0
6	4	5	0	9	3	0
7	8	3	3	14	0	0
8	1	3	2	6	3	0
9	3	4	3	10	5	5
10	5	10	6	21	7	12
11	5	3	2	10	1	1
Totals	29	35	16	80	21	18