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

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 question

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.

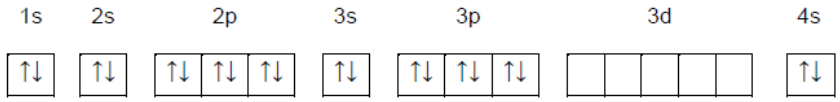
Marking abbreviations

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

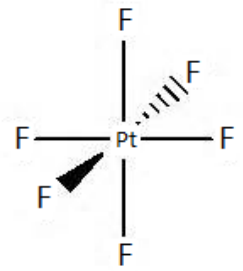
Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1.						1		1		
2.	*(a)*			NO_2 must show some working		1		1	1	
	(b)			N_2O_4		1		1		
3.				2 (1) pyramidal (1)	2			2		
4.				$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$	1			1	1	
5.				$Ga^+(g) \rightarrow Ga^{2+}(g) + e^-$		1		1		
6.				48		1		1	1	
7.				$f = \frac{E}{h}$ or $f = \frac{3.4 \times 10^{-19}}{6.6 \times 10^{-34}}$ (1) 5.2×10^{14} (1) award (2) for correct answer only (cao)	1 1			2	2	
				Section A total	**4**	**6**	**0**	**10**	**5**	**0**

Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	*(a)*			$A_r = \frac{(39 \times 93.26) + (40 \times 0.0117) + (41 \times 6.730)}{100}$ (1) = 39.1 (1) (answer must be given to 3 sig figs)		2		2	2	
	(b)	(i)		atomised / turned into a gas (1) (atoms) bombarded by electrons / electron gun (1)	2			2		
		(ii)		passed through magnetic field / electromagnet (1) (potassium) particles of different masses are deflected by different amounts (1)	2			2		
	(c)	(i)		proton captures an electron (from inner orbital) forming a neutron (1) atomic number decreases to 18 which is that of argon (mass number remains unchanged) (1)	1	1		2		
		(ii)		3.75×10^9 years		1		1	1	
	(d)			^{63}Ni no mark for selection without reasoning must be a β-emitter as γ-rays pass easily through thin foil (1) must have a long half-life (1)			2	2		
				Question 9 total	**5**	**4**	**2**	**11**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	*(a)*	(i)		all ionisation energies showing gradual increase **and** one large jump (1) large jump occurs after 8 electrons (1)		1	1	2		
		(ii)		eighth and ninth electrons come from different shells (1) ninth electron is much closer to nucleus / has less or no shielding / has greater effective nuclear charge (1)	2			2		
	(b)	(i)		ionisation energy of argon is much higher than that of xenon (1) because the outer electron is closer to nucleus / has less shielding / has greater effective nuclear charge (1)	2			2		
		(ii)		 must be attempt to show 3D structure ignore charge		1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	*(c)*			electrons move from lower to higher energy levels (1) by absorbing specific frequencies of light (1) dark lines correspond to light absorbed (1)	3			3		
	(d)			1 mol of XeO_3 released 2.5 mol gas products (1) 2.5 mol of gas occupies $24.0 \times 2.5 = 60$ dm^3 (1) $\frac{60}{298} \times 323 = 65$ dm^3 (1) error carried forward (ecf) possible award (3) for cao credit alternative method of calculation	1	2		3	3	3
				Question 10 total	**8**	**4**	**1**	**13**	**3**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	*(a)*	(i)		any one for (1) • whether pure sodium hydroxide is needed • whether less pure sodium hydroxide is acceptable to the customer • whether high concentration sodium hydroxide is needed • whether lower concentration sodium hydroxide is acceptable to the customer • whether the cost of replacement diaphragms is an important economic consideration			1	1		1
		(ii)		any two for (1) each up to max 2 • can it operate at a lower current / using less energy (1) • does it give a pure product (thereby avoiding need for purification) (1) • does it use or produce (other) toxic materials (1) • do parts need replacing regularly (1)			2	2		2
	(b)	(i)		measure out exactly 25.0 cm^3 using a pipette / burette (1) reference to volumetric flask **and** dropping pipette (1) dilute with (distilled) water up to the mark **and** shake (1)	 1	1 1		 3		 3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	*(b)*	(ii)	I	0.00512 mol NaOH (1) $\frac{0.00512}{0.020}$ = 0.256 (1) 2.56 (1) ecf possible award (3) for cao		1 1 1		3	1	3
			II	more accurate result using 0.2M HCl **credit for reasons only** requires significant volume (1) percentage error is greater in measuring smaller volume (1)			2	2		2
			III	$[H^+]$ = 0.2 (1) pH = 0.7 (1)		1 1		2	1	2
				Question 11 total	**1**	**7**	**5**	**13**	**2**	**13**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	*(a)*	(i)		42.0 g of ethene needs 54.75 g of HCl therefore ethene in excess (1) n(HCl) = 1.2 (1) mass chloroethane = 1.2 × 64.5 = 77.4 g (1) award (3) for cao		3		3	3	
		(ii)		$\frac{65.0}{77.4} \times 100$ allow ecf from part (i) 84.0		1		1		1
	(b)	(i)		$\frac{64.5}{202.5} \times 100$ (1) 31.9 (1) award (2) for cao		1 1		2		
		(ii)		any one for (1) • comparison of availability of reactants e.g. ethene comes mainly from a non-renewable source / crude oil but ethanol can be produced renewably / plentiful supply of NaCl / H_2SO_4 • less energy used / higher yield / higher rate linked to lower costs or improved sustainability			1	1		
				Question 12 total	**0**	**6**	**1**	**7**	**3**	**1**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.	*(a)*			concentration of hydrogen ions / $[H^+]$ would increase (1) as an increase in the concentration of reactants moves the position of equilibrium to the right (1)	1		1	2		
	(b)			limestone required, problems associated with quarrying (1) carbon dioxide produced, contributes to global warming (1)			2	2		
	(c)	(i)		$2640\,dm^3$		1		1	1	1
		(ii)		M_r $BaSO_4$ = 233.1 (1) $\frac{0.0047}{233.1} = 2.02 \times 10^{-5}$ (1) ecf possible		2		2		2
				Question 13 total	**1**	**3**	**3**	**7**	**1**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13.	*(a)*			Indicative content • choice of two appropriate **soluble** reagents e.g. calcium nitrate and sodium carbonate • dissolve solids in water / use aqueous solutions • mix solutions • filter, wash (with water) and dry precipitate • $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$ **5-6 marks:** Each point included in the correct order; correct ionic equation. *The candidate constructs a relevant, coherent and logically structured account 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:** A calcium salt and a carbonate named; reference to solutions and mixing; some attempt at ionic equation with correct formula for $CaCO_3$. *The candidate constructs a coherent account including most of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.* **1-2 marks:** Minimum of two from the following included in some form of description – calcium salt, carbonate, dissolve/solution, mix, filter, precipitate. *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.*	3	2	1	6		6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13.	*(b)*	(i)		NaOH reacted $0.188 \times 0.0248 = 4.66 \times 10^{-3}$ mol (1) 1 mol HCl : 1 mol NaOH therefore 4.66×10^{-3} mol HCl left over after reaction with limestone (1) HCl used up = $1.29 \times 10^{-2} - 4.66 \times 10^{-3} = 8.24 \times 10^{-3}$ mol (1) ecf possible		1 2		3	1 1	3
		(ii)		2 mol HCl : 1 mol $CaCO_3$ therefore 4.12×10^{-3} mol $CaCO_3$ in 0.497 g limestone (1) mass $CaCO_3 = 4.12 \times 10^{-3} \times 100.1 = 0.412$ g (1) $\frac{0.412}{0.497} \times 100 = 82.9$ % (1) ecf possible		1 1 1		3	1 1 1	3
				Question 14 total	**3**	**6**	**3**	**12**	**4**	**12**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
14.	*(a)*	(i)		each oxygen atom is **covalently** bonded to two hydrogen atoms (1) hydrogen bonds between oxygen in one molecule and hydrogen in another (1) hexagonal arrangement of water molecules (1) full credit could be gained from a correctly drawn and well labelled diagram	3			3		
		(ii)		delocalised electrons in graphite can move to carry a current (1) ice has no delocalised electrons (1)	2			2		
	(b)			van der Waals forces between molecules of iodine and covalent bonds between atoms in graphite (1) van der Waals forces are much weaker than covalent bonds (1)	2			2		
				Question 15 total	**7**	**0**	**0**	**7**	**0**	**0**

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SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
Section A	4	6	0	10	5	0
8.	5	4	2	11	3	0
9.	8	4	1	13	3	3
10.	1	7	5	13	2	13
11.	0	6	1	7	3	1
12.	1	3	3	7	1	3
13.	3	5	4	12	4	12
14.	7	0	0	7	0	0
Totals	**29**	**35**	**16**	**80**	**21**	**32**