GCE AS MARKING SCHEME

AUTUMN 2020

AS
CHEMISTRY – COMPONENT 1
B410U10-1

INTRODUCTION

This marking scheme was used by WJEC for the 2020 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

AUTUMN 2020 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

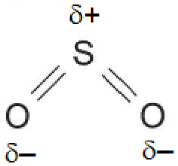
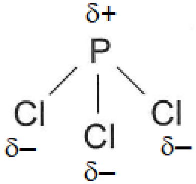
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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				($1s^2 2s^2$) $2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$		1		1		
2				Award (1) for any of following +6 6 +VI VI		1		1		
3	*(a)*			$K_c = \dfrac{[NO_2]^4\,[O_2]}{[N_2O_5]^2}$		1		1		
	(b)			$mol^3\ dm^{-9}$		1		1	1	
4				12		1		1		
5				6.73 (2) if answer incorrect award (1) for total relative mass of reactants as 30.02 / 30		2		2		
6				**3** K_2CO_3 + **2** $AlCl_3$ + **3** H_2O → **6** KCl + **2** $Al(OH)_3$ + **3** CO_2		1		1		

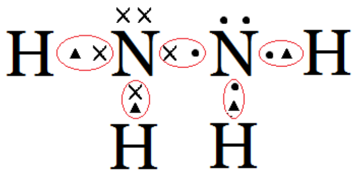
Question				**Marking details**	**Marks available**					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
7	*(a)*			tendency of atom to pull shared pair of electrons in a covalent bond towards itself	1			1		
	(b)			  accept δ– on only one oxygen and one chlorine		1		1		
				Section A total	**1**	**9**	**0**	**10**	**1**	**0**

Section B

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
8	*(a)*			energy required to remove one electron from each atom in <u>1 mol</u> of <u>gaseous atoms</u> of the element (2) award (1) if answer missing reference to 1 mol <u>or</u> to gaseous atoms do not accept 'energy required to remove one electron from each atom of the element' if no other credit award (1) for equation only e.g. $X(g) \rightarrow X^+(g) + e^-$	2			2		
	(b)			**Indicative content** • visible spectrum is Balmer series • transitions to n = 2 • ionisation involves transition from n = 1 to n = ∞ • Lyman series corresponds to transitions to n = 1 • this is in ultraviolet region of the spectrum • measure frequency of the convergence limit • corresponds to movement of electron from n = 1 to n = ∞ • $\Delta E = hf$ • molar first ionisation energy given by multiplying ΔE by Avogadro's number	4		2	6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Clear understanding of difference between Balmer and Lyman series; significance of convergence limit; reference to Avogadro's number *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** Understanding that visible spectrum is not linked to first ionisation; transition from $n = 1$ to $n = \infty$; reference to $E = hf$ *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** Ionisation involves transition of electron to $n = \infty$; reference to convergence limit or calculation of energy from frequency *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**
	(c)			$\Delta E = hf = \frac{hc}{\lambda}$ (1) $\frac{6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{550 \times 10^{-9}}$ (1) = 3.62×10^{-19} J per atom (1) = 218 kJ mol^{-1} (1) ecf possible		4		4	4	
	(d)	(i)		(sodium is lower than magnesium) because they are both in the same period / both have same amount of shielding (1) sodium has fewer protons (1)	2			2		
		(ii)		(potassium is lower than sodium) because potassium is in the next period (1) potassium has a bigger atomic radius / potassium has more shielding (1)	2			2		
				Question 8 total	**10**	**4**	**2**	**16**	**4**	**0**

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
9	*(a)*	(i)		 all single bonds shown (1) lone pair shown on both N atoms (1)		2		2		
		(ii)		accept any value in the range 107-109 ° (1) (each N atom has) 3 bond pairs and 1 lone pair (1) (distorted) tetrahedral shape / pyramidal / bond pair-lone pair repulsion > bond pair-bond pair repulsion (1)		3		3		
	(b)			20 cm^3 of N_2H_4 has a mass of 20.4 g (1) $n(N_2H_4) = \frac{20.4}{32.04} = 0.637$ (1) 0.637 mol of N_2 has a volume of 14.26 dm^3 (1) $14.26 \times \frac{35}{100} = 4.99$ dm^3 (1)		2	2	4	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			award (1) for any sensible suggestion related to the environment e.g. products are non-toxic no CO_2 / greenhouse gas produced			1	1		
				Question 9 total	**0**	**7**	**3**	**10**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*			**A** calcium oxide (1) **B** calcium hydroxide (1) **C** calcium carbonate (1) **D** calcium chloride (1) accept any Group 2 element other than beryllium or magnesium			4	4		4
	(b)			hydrochloric acid / $HCl(aq)$			1	1		1
	(c)			heating		1		1		1
	(d)			accept either of following $O^{2-}(s) + H_2O(l) \rightarrow 2OH^-(aq)$ $CaO(s) + H_2O(l) \rightarrow Ca^{2+}(aq) + 2OH^-(aq)$ formulae (1) state symbols (1)		2		2		
	(e)			dropwise white precipitate forms (1) excess precipitate insoluble in excess (1) allow 'no visible change' if metal given as barium or strontium in part (a)		2		2		2

Question				**Marking details**	**Marks available**					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
	(f)			flame test (1) (brick) red flame (1) allow apple-green for barium or crimson red for strontium	2			2		2
				Question 10 total	**2**	**5**	**5**	**12**	**0**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	*(a)*			need to break intermolecular forces (to change state) (1) iodine has more electrons (1) more/stronger Van der Waals forces / induced dipole attractions (1)	3			3		
	(b)			in diamond all (valence) electrons are involved in (covalent) bonds (1) in graphite there are delocalised electrons / electrons between the layers (1) delocalised electrons are free to move (1)	3			3		
	(c)			bromine has two isotopes m/z 79 and 81 (1) these are in the ratio 1:1 (1) molecular ion peaks at 158, 160 and 162 are produced by $^{79}Br_2$, $^{79}Br^{81}Br$ and $^{81}Br_2$ respectively (1)			3	3	1	
				Question 11 total	**6**	**0**	**3**	**9**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	*(a)*			mass residue = 1.73 g (1) $M_r(BaCl_2)$ = 208 $M_r(H_2O)$ = 18.02 **both** needed for (1) $n(BaCl_2) = \frac{1.73}{208} = 8.32 \times 10^{-3}$ mol (1) $n(H_2O) = \frac{0.28}{18.02} = 1.55 \times 10^{-2}$ mol (1) $x = \frac{1.55 \times 10^{-2}}{8.32 \times 10^{-3}} = 1.86 \sim 2$ (1)		5		5	4	
	(b)	(i)		to avoid spitting / frothing / loss of solid			1	1		1
		(ii)		to avoid water being absorbed (from the atmosphere)			1	1		1
	(c)	(i)		not all water lost			1	1		1
		(ii)		heat to constant mass			1	1		1
	(d)			$\frac{0.10}{2.01} \times 100 = 4.98\%$ accept 5%		1		1	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			award (1) for either of following use a larger mass of solid use a balance that reads to more decimal places			1	1		1
				Question 12 total	**0**	**6**	**5**	**11**	**5**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13	*(a)*			ratio C : H : O						
				$\frac{40.0}{12} : \frac{6.7}{1.01} : \frac{53.3}{16}$ (1)		1				
				1 : 2 : 1 ⇨ empirical formula CH_2O (1)		1				
				pV = nRT (1)	1					
				$n = \frac{1.01 \times 10^5 \times 1.76 \times 10^{-3}}{8.31 \times 423} = 0.0506$ (1)		1				
				$M_r = \frac{m}{n} = \frac{1.52}{0.0506} = 30.1$						
				therefore molecular formula must also be CH_2O (1)		1				
				alternative method				5	4	
				$\frac{V1}{T1} = \frac{V2}{T2}$						
				$\frac{1.76}{423} = \frac{V2}{273}$						
				$V_2 = 1.14\ dm^3$ at standard temperature and pressure (1)						
				$n = \frac{1.14}{22.4} = 0.0509$ (1)						
				$M_r = \frac{m}{n} = \frac{1.52}{0.0509} = 29.9$						
				therefore molecular formula must also be CH_2O (1)						

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td></td><td><em>(b)</em></td><td>(i)</td><td></td><td>proton donor</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>it has a lone pair of electrons on the nitrogen atom / it can form a coordinate bond (1)
accepts proton / H^+ (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>pH = –log [H^+] (1)
pH = 0.37 (1)</td><td>1</td><td>1</td><td></td><td>2</td><td>1</td><td></td></tr>
<tr><td></td><td><em>(c)</em></td><td></td><td></td><td><table>
<tr><th>Compound</th><th>Structure</th><th>Bonding</th></tr>
<tr><td>MgO</td><td>giant</td><td>ionic</td></tr>
<tr><td>ClO_2</td><td>simple molecular / simple covalent</td><td>covalent</td></tr>
</table>
award (2) for all four correct
award (1) for any two correct</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td><strong>Question 13 total</strong></td><td><strong>7</strong></td><td><strong>5</strong></td><td><strong>0</strong></td><td><strong>12</strong></td><td><strong>5</strong></td><td><strong>0</strong></td></tr>
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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	**1**	**9**	**0**	**10**	**1**	**0**
8	**10**	**4**	**2**	**16**	**4**	**0**
9	**0**	**7**	**3**	**10**	**3**	**0**
10	**2**	**5**	**5**	**12**	**0**	**10**
11	**6**	**0**	**3**	**9**	**1**	**0**
12	**0**	**6**	**5**	**11**	**5**	**5**
13	**7**	**5**	**0**	**12**	**5**	**0**
Totals	**26**	**36**	**18**	**80**	**19**	**15**