GCE AS MARKING SCHEME

SUMMER 2016

CHEMISTRY - NEW AS UNIT 1
2410U10-1

INTRODUCTION

This marking scheme was used by WJEC for the 2016 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 CHEMISTRY

SUMMER 2016 MARK SCHEME

AS UNIT 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 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.

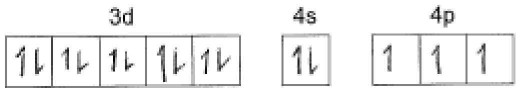
Marking abbreviations

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.					1			1		
2.				(+)6	1			1		
3.	*(a)*			$^{15}_{7}N$	1			1		
	(b)			$\frac{1}{32}$	1			1		
4.				Any of following • The second electron is being removed from a full shell that is nearer to the nucleus • The second electron is being removed from a positive ion • Greater effective nuclear charge on second electron • Less shielding since second electron in a new shell	1			1		
5.				HNO	1			1		
6.				63.1	1			1	1	
7.	*(a)*			$K_c = \frac{[HI]^2}{[H_2][I_2]}$	1			1		
	(b)			$[H_2(g)] = \frac{[HI(g)]^2}{[I_2(g)]\ K_c}$ (1) $= 15.00^2 / 1.20 \times 46.0 = 4.08$ (mol dm^{-3}) (1) ecf possible from part *(a)*	1	1		2	1	
				Section A total	**9**	**1**	**0**	**10**	**2**	**0**

Section B

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks available					
8.	*(a)*			Fe_2O_3 + 3CO → 2Fe + $3CO_2$ (1) Any of the following for (1) • During this process the iron(III) ions (in Fe_2O_3) gain electrons (to produce iron); reduction is a process of electron gain • The oxidation number of iron is reduced from +3 to 0; a reduction in (positive) oxidation number is reduction • Carbon monoxide loses electrons; oxidation is a process of electron loss • The oxidation number of carbon is increased from +2 to +4; an increase in (positive) oxidation number is oxidation • Fe_2O_3 loses oxygen and CO gains oxygen	2			2		
	(b)			350 tonnes of which 0.02 % is sulfur ∴ Mass of sulfur = $\frac{350 \times 0.02}{100}$ = 0.07 tonnes (1) Mg + S → MgS 0.07 tonnes sulfur needs $\frac{24.3 \times 0.07}{32.1}$ = 0.0530 tonnes = 53.0 (kg) (1) ecf possible	2			2	1	
	(c)			Cubic structure shows alternating different ions (1) Ions labelled as Mg^{2+} and S^{2-} (1)		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	*(d)*	(i)		White solid / precipitate (of magnesium hydroxide)		1		1		1
		(ii)		Number of mol of MgS = $\frac{0.224}{56.4}$ = 0.00397 ∴ 0.00397 mol of H_2S also produced (1) Volume of H_2S = 0.00397 × 24.0 = 0.095(3) dm^3 (1) = 95.(3) cm^3 (1) ecf possible Accept alternative method using pV = nRT	1	2		3	1	
	(e)			A colourless solution (1) The solubility of the group 2 hydroxides increases down the group (1)	1	1		2		1
	(f)			$BaO + H_2O \rightarrow Ba(OH)_2$ (1) pH $>$ 7 (1)	2			2		
	(g)			Any two of following for (1) each • Barium is in group 2 and has two outer electrons • Too much energy is needed to remove a third electron • This necessitates removing an electron from a shell nearer to the nucleus (to produce a Ba^{3+} ion)	1	1		2		
				Question 8 total	**9**	**7**	**0**	**16**	**2**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	*(a)*	(i)		$C_{12}H_{22}O_{11}$ + **18** [O] → **6** $(COOH)_2$ + **5** H_2O	1			1		
		(ii)		Mass of the anhydrous acid = 4.05g ∴ Moles of the anhydrous acid = 4.05 / 90 = 0.045 (1) Mass of the water lost = 1.62g ∴ Moles of water = 1.62/18.02 = 0.090 (1) Mole ratio acid : water is 1 :2 Value of x is 2 (1) If no working is shown award (1) for the correct answer		3		3	2	
	(b)			Sample of potassium methanoate not pure / not all HCOOK reacted (1) Inadequate heating / not heated for long enough / not heated at a high enough temperature (1)			2	2		2
	(c)	(i)		Allow to settle / test the filtrate (1) Add a few drops of calcium chloride solution and see if a precipitate forms / cloudiness (1)			2	2		2
		(ii)		Moles of calcium oxalate = 2.49/128 = 0.0195 (1) ∴ Number of moles of potassium oxalate is also 0.0195 Mass of potassium oxalate is 0.0195 × 166 = 3.24 g (1) ∴ % of potassium oxalate in mixture = 3.24 × 100 /4.69 = 69.1 (to 3 sig. figs.) (1) (accept values from 68.9 to 69.1 depending on use of significant figures during the calculation) ecf possible		3		3	1	
				Question 9 total	**1**	**6**	**4**	**11**	**3**	**4**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10.	*(a)*		Total percentage of ^{29}Si and ^{30}Si is 100 – 92.2 = 7.8 % of $^{29}Si = \frac{2 \times 7.8}{3} = 5.2$ and % of $^{30}Si = \frac{1 \times 7.8}{3} = 2.6$ (1) $\therefore A_r = \frac{(28 \times 92.2) + (29 \times 5.2) + (30 \times 2.6)}{100}$ (1) $\therefore A_r = \frac{2582 + 151 + 78}{100} = \frac{2811}{100} = 28.1$ (1) Answer only – no mark ecf possible		2	1	3	1 1	
	(b)	(i)	Tetrahedral	1			1		
		(ii)	There are no free electrons or ions to carry the charge	1			1		
		(iii)	Any of the following • There are no electronegativity differences in the Si—Si bond • All the bonding electrons are shared equally between the four Si atoms • Si cannot lose or gain 4 electrons			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	*(c)*			M_r HF is 20.01 Solution contains 500g HF in 1000g solution (using V = m/D) 1000 g of the solution has a volume of 855 cm^3 or Number of moles of HF in 1000g / 855 cm^3 solution is $\frac{500}{20.01}$ = 24.98 (1) 855 cm^3 contain 24.98 mol ∴ Concentration of HF = 29.2 mol dm^{-3} (1) ecf possible		2		2	2	
	(d)	(i)		(There are 6 bonding pairs of electrons and no lone pairs –) position of minimum repulsion taken up (1) Drawing shows clear octahedral shape (1) Bond angle is 90° equatorial / equatorial or 90° equatorial / vertical (accept 180° if vertical bonds only considered) (1)	1	2		3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.		(ii)		1 mol of H_2SiF_6 (144g) gives 6 mol of F^- ions (6 × 19g) = 114g (1) ∴ 114 mg of fluoride ions from 144 mg H_2SiF_6 The increase in fluoride ion concentration needed is 0.76 – 0.15 = 0.61 mg dm^{-3} (1) Amount of H_2SiF_6 needed is $\frac{144 \times 0.61}{114}$ = 0.77 mg (1) Accept alternative method Award (3) for cao			3	3	2	
	(e)			$MgSiF_6$ M_r 166 ∴ Moles of $MgSiF_6$ = 2.6/166 = 1.566×10^{-2} (1) $[H^+]$ is ∴ 4 × 1.566×10^{-2} = 0.06265 mol dm^{-3} (1) pH = $-\log_{10}[H^+]$ = 1.20 (1) ecf possible		3		3	2	
				Question 10 total	**3**	**9**	**5**	**17**	**8**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	*(a)*			Diagram should show: Polarisation of N—H or O—H bonds in 2-aminoethanol (1) Lone pairs of electrons used in hydrogen bonding to nitrogen or oxygen atoms (1) Polarisation of water molecules (1) Hydrogen bonds indicated between 2-aminoethanol and water molecules using relevant nitrogen / oxygen and hydrogen atoms (1) If no water then 3 marks maximum	2	2		4		
	(b)			The forces of attraction between molecules of 2-aminoethanol are stronger than the attractive forces between molecules of 1,2-diaminoethane (as the former has a higher boiling temperature) (1) This suggests that intermolecular hydrogen bonding between / involving O and H is stronger than the hydrogen bonding between N and H (1) This is (probably) due to a greater electronegativity difference between O and H than between N and H / O more electronegative than N / size considerations (1)		1	2	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	*(c)*			**Indicative content** 1 aqueous sulfuric acid in burette (accept aqueous ammonia in burette) 2 measure volume of ammonia into flask 3 use of an indicator (not universal indicator) 4 titrate with aqueous sulfuric acid until colour of indicator just changes 5 read burette and repeat without indicator / use of decolorising charcoal and filter 6 concentrate neutralised solution 7 cool (concentrated) solution / leave to evaporate over time 8 filter and dry crystals	3	3		6		6
				5-6 marks The method provided leads to pure dry crystals of ammonium sulfate. *The candidate constructs a relevant and logically structured account including all key elements of the indicative content. Scientific conventions and vocabulary are used accurately throughout.* **3-4 marks** The method outlined leads to the production of a solution of ammonium sulfate. *The candidate constructs a logically structured account including the main elements of the indicative content. The use of scientific conventions and vocabulary are generally sound.* **1-2 marks** The method provided leads to the production of a solution that contains ammonium sulfate. *The candidate has given an outline method of the production of ammonium sulfate but a number of key points are missing. There is some evidence of the correct use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give an answer worthy of credit.*						
				Question 11 total	**5**	**6**	**2**	**13**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.	*(a)*	(i)		The iodide ions (moved to the anode and) were oxidised / lost electrons forming iodine (1) $2I^-(aq) \rightarrow I_2(aq) + 2e^-$ (1) (Aqueous) iodine was produced giving a yellow/brown coloration (around the anode) (1)	1	1	1	3		1
		(ii)		Both iodide and chloride ions formed precipitate – yellow and white observed (1) On adding ammonia and shaking the white precipitate / silver chloride dissolves (1) Leaving silver iodide as a pale yellow solid / silver iodide does not dissolve (1)		3		3		3
		(iii)		Number of moles of potassium iodate(V) $= \frac{0.100 \times 18.00}{1000}$ $= 1.8 \times 10^{-3}$ (1) Number of moles of NaI present in 25.0 cm^3 of the solution of the mixture $= 1.8 \times 10^{-3} \times 2 = 3.6 \times 10^{-3}$ $\therefore$ Number of moles of sodium iodide in 250 cm^3 = 0.036 (1) Mass of sodium iodide present in 250 cm^3 of the solution of the mixture = 0.036 × 150 = 5.40 g $\therefore$ % sodium iodide in the mixture $= \frac{5.40 \times 100}{11.24} = 48$ (1) ecf possible		3		3	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.	*(b)*			$f = c/\lambda = 3 \times 10^8/278 \times 10^{-9} = 1.079 \times 10^{15}$ (Hz) (1) $E = hf \quad \therefore E = 6.63 \times 10^{-34} \times 1.079 \times 10^{15}$ J $= 7.154 \times 10^{-19}$ J (per molecule) $\therefore$ per mole $7.154 \times 10^{-19} \times 6.02 \times 10^{23}$ J mol^{-1} $= 4.307 \times 10^5$ J mol^{-1} (1) $= 431$ kJ mol^{-1}			2	2	2	
	(c)			As the group is descended the bond energies decrease and the wavelengths increase / astatine is below iodine in the Periodic Table / λ_{max} > 400nm (1) coloured gas linked with the visible region (1)			2	2		
				Question 12 total	**1**	**7**	**5**	**13**	**3**	**4**

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1. to 7.	9	1	0	10	2	0
8.	9	7	0	16	2	2
9.	1	6	4	11	3	4
10.	3	9	5	17	8	0
11.	5	6	2	13	0	6
12.	1	7	5	13	3	4
Totals	28	36	16	80	18	16