GCE A LEVEL MARKING SCHEME

SUMMER 2018

A LEVEL
CHEMISTRY - COMPONENT 3
A410U30-1

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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.

COMPONENT 3: CHEMISTRY IN PRACTICE

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

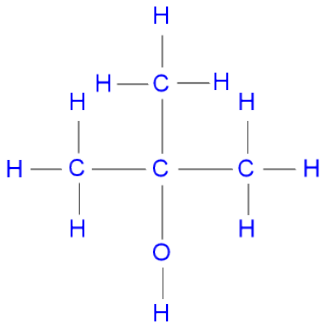
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				**Indicative content** Reaction 1 • add ammonia solution to the pale blue copper(II) sulfate solution • $[Cu(H_2O)_6]^{2+}$ • royal blue coloured solution formed • $[Cu(H_2O)_2(NH_3)_4]^{2+}$ ions • $[Cu(H_2O)_6]^{2+}(aq) + 4NH_3(aq) \rightarrow [Cu(H_2O)_2(NH_3)_4]^{2+}(aq) + 4H_2O(l)$ Reaction 2 • add concentrated hydrochloric acid to the pale blue copper(II) sulfate solution • yellow-green solution formed • $[CuCl_4]^{2-}$ ions • $[Cu(H_2O)_6]^{2+}(aq) + 4Cl^{-}(aq) \rightarrow [CuCl_4]^{2-}(aq) + 6H_2O(l)$ credit any correct variations on these reactions e.g. dropwise addition of ammonia solution to copper(II) sulfate solution giving pale blue precipitate of copper(II) hydroxide	2	4		6		4

				5-6 marks Product colours and formulae given for two reactions; good attempt at equations for both *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 is used accurately throughout.* **3-4 marks** Outline of both reactions including colours and formulae of products *The candidate constructs a coherent account including many 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 is generally sound.* **1-2 marks** Outline of one of the reactions including colour or formula of product *The candidate attempts to link at least two relevant points from the indicative material. Coherence is limited by omission and/or inclusion of irrelevant materials. 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 2 total	**2**	**4**	**0**	**6**	**0**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			 (1) methylpropan-2-ol (1)		2		2		
	(b)			award (1) for reagents • aqueous iodine **and** aqueous sodium hydroxide • aqueous potassium iodide **and** aqueous sodium chlorate(I) award (1) for observation • yellow crystalline solid formed	2			2		2
	(c)			$CH_3CH_2CH_2CH_2Cl$ / $CH_3CH_2CH_2CH_2Br$ / $CH_3CH_2CH_2CH_2I$ (1) $(CH_3)_2CHCOOH$ (1)		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			moles of nitrogen gas = 0.269 mol (1) mass of 1-aminobutane used = 19.7 g (1) volume of 1-aminobutane = 26.6 cm^3 (1)		3		3	2	
	(e)	(i)		conical flask connected to a gas syringe (1) constant temperature water bath (20°C) (1)	2			2		2
		(ii)		points plotted correctly (±½ square) (1) curve of best fit drawn (1)	2			2	2	
		(iii)		n(benzenediazonium chloride) = 0.0055 mol (1) *using pV = nRT* $V = \frac{0.0055 \times 8.31 \times 293}{1.01 \times 10^5}$ (1) V = 133 cm^3 (1) *using Charles' Law* V at 293K = $\frac{0.135 \times 293}{298}$ (1) V at 293K = 133 cm^3 (1)		3		3	3	

Question	Marking details	Marks available

					AO1	AO2	AO3	Total	Maths	Prac
		(iv)	I	tangent drawn at t = 0 (1) gradient = 8.75 $cm^3\ min^{-1}$ (1) (accept value in range 8.5 to 11) initial rate = $8.75 \times 10^{-3}\ dm^3\ min^{-1}$ (1) (accept value in range 8.5×10^{-3} to 11×10^{-3})		1 1	1	3	1 1	
			II	$k = \frac{8.75 \times 10^{-3}}{0.110} = 7.95 \times 10^{-2}$ (1) ecf possible from part I unit of rate constant = $\frac{dm^3\ min^{-1}}{mol\ dm^{-3}} = mol^{-1}\ dm^6\ min^{-1}$ (1)		2		2	2	
				Question 2 total	**6**	**14**	**1**	**21**	**11**	**4**

<table>
<tr><th colspan="4">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>3</td><td></td><td></td><td></td><td>award (1) for each ion correctly identified

<table><tr><th>Inorganic salt</th><th>Cation</th><th>Anion</th></tr><tr><td>P</td><td>Mg^{2+}</td><td>I^-</td></tr><tr><td>Q</td><td>Pb^{2+}</td><td>NO_3^-</td></tr><tr><td>R</td><td>Fe^{2+}</td><td>SO_4^{2-}</td></tr><tr><td>S</td><td>Ba^{2+}</td><td>Cl^-</td></tr></table>
award (1) for equation for the formation of any precipitate
award (1) for correct state symbols

$Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$

$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$

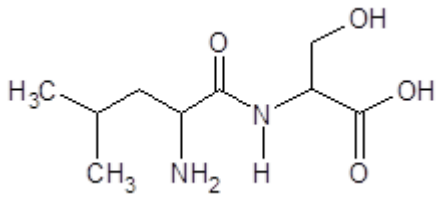
$Pb^{2+}(aq) + 2OH^-(aq) \rightarrow Pb(OH)_2(s)$

$Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$

$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$

$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$</td><td>1</td><td>1</td><td>8</td><td>10</td><td></td><td>8</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 3 total</td><td>1</td><td>1</td><td>8</td><td>10</td><td>0</td><td>8</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		distance travelled by alanine = 2.2 (1) R_f = 0.275 / 0.28 (1) ecf possible for incorrect distance travelled by alanine		2		2	1	2
		(ii)		**spot 1** corresponds to **both** glycine and serine (as they have the same R_f value)			1	1		1
		(iii)		award (1) for each of following spot drawn above spot 1 at 3.3 cm spot drawn above spot 1 at 3.7 cm spot drawn above spot 2 at 4.6 cm spot drawn above spot 3 at 5.9 cm			4	4		4
	(b)			correct structure drawn e.g.  accept any unambiguous formula for correct structure		1		1		
				Question 4 total	**0**	**3**	**5**	**8**	**1**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)					1	1		1

Statement	Correct order
Calculate the number of moles of **X** in the aqueous layer	3
Calculate the mass of **X** in the organic layer and hence its concentration in mol dm^{-3}	5
Calculate the number of moles of NaOH used in the titration	1
Calculate the value for the equilibrium constant *K* at 298K	6
Calculate the mass of **X** in the aqueous layer and hence its concentration in mol dm^{-3}	4
Calculate the number of moles of **X** in 25.0 cm^3 of the aqueous layer	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		n(NaOH) = 0.00047 mol (1) n(**X**) in 25 cm^3 of aqueous layer = 0.00047 mol n(**X**) in 200 cm^3 of aqueous layer = 0.00376 mol (1) mass of **X** in 200 cm^3 of aqueous layer = 0.436 g (1) mass of **X** in 200 cm^3 of organic layer = 14.564 g (1) $K = \frac{0.1256}{0.00376} = 33.4$ (1) ecf possible throughout		5		5	4	
	(b)			for a 23.50 cm^3 titre percentage error = $\frac{2 \times 0.05 \times 100}{23.50} = 0.43$ %		1		1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		n(**X**) in 200 cm^3 aqueous solution = 0.00376 mol c = $\frac{0.00376}{0.200}$ = 0.0188 mol dm^{-3} (1) ecf possible from part (a)(ii) $[H^+] = \sqrt{(1.32 \times 10^{-5})} \times 0.0188 = 4.98 \times 10^{-4}$ mol dm^{-3} (1) pH = $-\log 4.98 \times 10^{-4}$ = 3.30 (1)		3		3	3	
		(ii)		*x*-axis scale of 0 to 50 and labelled as volume of NaOH solution (cm^3) *y*-axis scale of 0 to 14 and labelled as pH (1) starting pH of 3.30 [allow ecf from part (i)] **and** volume of NaOH used at endpoint 23.50 cm^3 **and** vertical portion of curve at 23.50 cm^3 (1) correct sketch of the curve – vertical portion **and** correct shape in the buffer region **and** pH rising to ~ 12 **and** extending beyond 45 cm^3 of NaOH (1) pH at equivalence point > 7 (1) any two of following labelled (1) buffer region, half-equivalence point, equivalence point, end point	1		4	5		
				Question 5 total	**1**	**9**	**5**	**15**	**7**	**2**

COMPONENT 3: CHEMISTRY IN PRACTICE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	2	4	0	6	0	4
2	6	14	1	21	11	4
3	1	1	8	10	0	8
4	0	3	5	8	1	7
5	1	9	5	15	7	2
Totals	10	31	19	60	19	25