GCE A LEVEL MARKING SCHEME

SUMMER 2017

A LEVEL (NEW)
CHEMISTRY - COMPONENT 3
A410U30-1

INTRODUCTION

This marking scheme was used by WJEC for the 2017 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.

<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>1</td><td>(a)</td><td></td><td></td><td>transfer to 250 cm^3 volumetric / standard flask (1)

award (1) for any two of the following in the correct order
• use of funnel
• wash funnel / glass rod / beaker with deionised water into volumetric flask
• add distilled water up to mark
• shake solution / mix thoroughly</td><td>3</td><td></td><td></td><td>3</td><td></td><td>3</td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>
<table>
<tr><th>Rough titration</th><th>Titration 1</th><th>Titration 2</th><th>Titration 3</th><th>Titration 4</th></tr>
<tr><td>0.80</td><td>23.00</td><td>0.40</td><td>21.45</td><td>2.05</td></tr>
<tr><td>23.00</td><td>44.00</td><td>21.45</td><td>43.25</td><td>23.00</td></tr>
<tr><td>22.20</td><td>21.00</td><td>21.05</td><td>21.80</td><td>20.95</td></tr>
</table>
correct calculation and titre volumes all given to 2dp (1)
mean titre = 21.00 cm^3 given to 2dp (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td>2</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			$n(NaOH) = 21.00/1000 \times 0.1 = 2.1 \times 10^{-3}$ (1) $n(H_3X) = 2.1 \times 10^{-3} \div 3 = 7 \times 10^{-4}$ in 25 cm^3 (1) $n(H_3X)$ in 250 $cm^3 = 7 \times 10^{-3}$ (1) $M_r(C_4H_3KO_8.\ nH_2O) = \frac{1.78}{7 \times 10^{-3}} = 254.29$ (1) $n = \frac{254.29 - 218.13}{18.02} = 2$ (1) ecf from part (b) and throughout method **must** be shown for first two marks in order to award any credit for final answer					1 1 1	
						5		5		
	(d)			for the 21.10 cm^3 titre percentage error $= \frac{2 \times 0.05}{21.10} \times 100 = 0.47\ \%$ (1) **must** be 2 sig figs		1		1	1	1
				Question 1 total	**3**	**8**	**0**	**11**	**4**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			**X** is magnesium $Mg + H_2O \rightarrow MgO + H_2$ (1)	1			1		1
	(b)	(i)		$n[\mathbf{Y}(OH)_2]$ in $600cm^3 = \frac{0.0431 \times 600}{1000} = 0.02586$ (1) 1:1 ratio of $\mathbf{Y}:\mathbf{Y}(OH)_2$ therefore $n(\mathbf{Y}) = 0.02586$ (1) $A_r = \frac{2.27}{0.02586} = 87.8$ therefore **Y** is strontium / Sr (1)		1 1	1	3	2	
		(ii)	I	$\mathbf{Y}(OH)_2(aq) + Na_2CO_3(aq) \rightarrow \mathbf{Y}CO_3(s) + 2NaOH(aq)$ $\mathbf{Y}^{2+}(aq) + CO_3^{2-}(aq) \rightarrow \mathbf{Y}CO_3(s)$ accept either equation but must be balanced and include state symbols; accept Sr in place of **Y** ecf possible from part (i) if incorrect Group 2 metal identified	1			1		
			II	$200cm^3$ of solution $= \frac{0.0431}{1000} \times 200 = 0.00862$ mol of $\mathbf{Y}CO_3$ (1) mass of $\mathbf{Y}CO_3 = 0.00862 \times M_r(\mathbf{Y}CO_3) = 0.00862 \times 147.6$ (1) = 1.27 g **must** be given to 3 sig figs (1)		3		3	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			**Indicative content** **carbonates more thermally stable down the group** description of sensible method such as following examples • carbonate taken in clamped test tube connected to delivery tube dipping into second tube containing limewater • carbonate heated using Bunsen flame **until limewater turns milky** • control variables ✓ **same number of moles of carbonate** ✓ same volume + concentration of limewater ✓ same distance of test tube to flame + same flame temperature • **time** taken for limewater to turn milky (cloudy) **increases** for carbonates on **going down** the group • carbonate taken in a crucible and heated to determine the **loss in mass of the carbonate** • control variables ✓ **same number of moles of carbonate** ✓ same distance of crucible to flame + same temperature of flame ✓ carbonates heated for the same amount of time • **mass loss** on heating for the **same set time** is **less** on **going down** the group no trend or incorrect trend in thermal stability and no description of how to control variables used should be considered as 'significant omissions' and credit must be limited to the 1-2 marks band	1		5	6		6

				5-6 marks All aspects of question covered and key details given, including those in **bold** print *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** Correct description of trend in thermal stability; basic description of apparatus / method used; reference to one control variable; observation and expected results *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** Description of apparatus or method used / simple observation *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				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			addition of solution containing SO_4^{2-} ions (1) $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ (1) accept appropriate full equation including soluble barium compound and all state symbols white precipitate with Ba^{2+} and no precipitate with Mg^{2+} because solubilities of sulfates (of Group 2) decrease down the group / $BaSO_4$ insoluble whereas $MgSO_4$ soluble (1)	1 1 1			3		3
				Question 2 total	**6**	**5**	**6**	**17**	**4**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			filter paper soaked in aqueous KNO_3 / U-tube of agar / gel soaked in saturated KNO_3 (or other suitable named electrolyte)	1			1		1
	(b)			$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$ (1) E_{cell} = 1.52 – 0.77 = 0.75 V (1)	1 1			 2		
	(c)			half-cell **A** solution becomes less green in colour (as the concentration of the Fe^{2+} decreases) / becomes more yellow or brown in colour (as the concentration of the Fe^{3+} increases) (1) half-cell **B** solution becomes less purple (violet) in colour (as the concentration of the MnO_4^- decreases) / becomes a paler pink in colour (as the concentration of the Mn^{2+} increases) (1)		1 1		2		2
	(d)			any of following for (1) • cell not 100 % efficient • cell not at standard temperature / conditions not standard • electrodes become contaminated on the surface (over time) • concentration of solutions changes (over time) • not a high resistance voltmeter			1	1		1
				Question 3 total	**3**	**2**	**1**	**6**	**0**	**4**

<table>
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<tr><td>4</td><td>(a)</td><td></td><td></td><td>hazard and associated risk required

<table><tr><th>Hazard</th><th>Risk</th></tr><tr><td>bromine is very toxic

or

bromine is corrosive</td><td>bromine produces a vapour which is very toxic if inhaled
or
bromine causes severe burns to the eyes and skin if spilt onto skin or eyes</td></tr></table></td><td>1</td><td></td><td></td><td>1</td><td></td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>$m = d \times v = 3.10 \times 10 = 31$ (1)

$n(Br_2) = \frac{m}{M_r} = \frac{31}{159.8} = 0.194$ mol (1)</td><td></td><td></td><td>2</td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>$n(Na_2S_2O_3) = 1.05 \times 17.35/1000 = 0.01822$ mol (1)

$n(I_2) = \frac{0.01822}{2} = 0.00911$ mol in 25 cm^3 (1)

$n(I_2)$ in 250 cm^3 = 0.0911 mol (1)

$n(Br_2)$ in excess following reaction with alkene = 0.0911 mol

$n(Br_2)$ that reacted = 0.194 – 0.0911= 0.103 mol (1)</td><td></td><td>1

1

1</td><td>1</td><td>4</td><td>1</td><td></td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		n(alkene) = $\frac{0.103}{2}$ = 0.0515 mol (1) M_r(alkene) = $\frac{3.50}{0.0515}$ = 68.0 (1) therefore molecular formula is C_5H_8 (1) ecf possible from part (ii) if incorrect M_r and hence incorrect molecular formula award (1) for stating that alkene is a diene / contains two C=C bonds (ratio of 1**U** : 2Br_2) award (1) for structural formula and (1) for name any of the following penta-1,3-diene CH_3—CH=CH—CH=CH_2 penta-1,4-diene CH_2=CH—CH_2—CH=CH_2 penta-2,3-diene CH_3—CH=C=CH—CH_3 penta-1,2-diene CH_2=C=CH— CH_3—CH_3			1 1 1 2	 5		
				Question 4 total	**1**	**3**	**8**	**12**	**3**	**1**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5				Test 1: Observation orange colour becomes green (1)	1					
				Test 2: Observation purple coloured solution formed (1)	1					
				Test 3: Reagent(s) $NaNO_2$ / HCl or HNO_2 (or names) (1)	1					
				Test 4: Structure R—$NH_3^+Cl^-$ (1)	1			4		4
				Question 5 total	**4**	**0**	**0**	**4**	**0**	**4**

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<tr><td>6</td><td>(a)</td><td></td><td></td><td>all three correct for (2)
award (1) for two correct
3 sig figs required

<table>
<tr><th>Temperature (T) / K</th><th>1/T / K^{-1}</th><th>$\log_{10}(1/t)$</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>298</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>–1.74</td></tr>
<tr><td></td><td>0.00300</td><td></td></tr>
</table>
</td><td></td><td>2</td><td></td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>award (1) for any of following
• concentration of peroxodisulfate ions
• concentration of iodide ions
• volume of each component / reactant</td><td>1</td><td></td><td></td><td>1</td><td></td><td>1</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			correct plotting of points (± ½ square) (1) line of best fit (1) gradient of line = $\frac{\Delta y}{\Delta x}$ = $\frac{-0.61}{0.22 \times 10^{-3}}$ = -2.77×10^3 K correct numerical value (1) –ve sign (1) gradient = $\frac{-E_a}{2.30R}$ or E_a = –gradient × 2.30 R (1) $E_a = 2.773 \times 10^3 \times 2.30 \times 8.31$ E_a = 53,000 J mol^{-1} or 53.0 KJ mol^{-1} correct numerical value (1) correct unit (1)	1	1	5	7	7	
				Question 6 total	**2**	**3**	**5**	**10**	**9**	**1**

COMPONENT 3: CHEMISTRY IN PRACTICE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	3	8	0	11	4	6
2	6	5	6	17	4	10
3	3	2	1	6	0	4
4	1	3	8	12	3	1
5	4	0	0	4	0	4
6	2	3	5	10	9	1
Totals	19	21	20	60	20	26