GCE A LEVEL MARKING SCHEME

SUMMER 2022

A LEVEL
CHEMISTRY – UNIT 5
1410U50-1

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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.

WJEC GCE A LEVEL CHEMISTRY

UNIT 5 – PRACTICAL EXAMINATION

SUMMER 2022 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

The mark total should be entered onto the grid on the front cover.

Marking rules

All work should be seen to have been marked.

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

EXPERIMENTAL TASK

MARK SCHEME TEST 1

Skill		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Parts A & B	Teacher-awarded marks	efficient use of time (1) working safely (1)	2			2		2
Part A Results	Precision	temperature recorded to appropriate precision based on the thermometer used (1)	1			4		1
	Tables	appropriate titles and units (1)		1				1
	Recording temperatures	for $KHCO_3$ temperature decreases sharply as reaction happens (and begins to rise in final readings) (1) for K_2CO_3 temperature increases sharply as reaction happens (and begins to fall in final readings) (1) award (1) max if temperature recorded for less than 420s for either solid	2					2

Skill		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Part B Results	Observations	solubility – insoluble / does not dissolve (1) nitric acid – fizzes / bubbles (1) flame test – brick-red flame colour (1) sodium sulfate solution – white precipitate forms no mark awarded for this sodium hydroxide solution – white precipitate/solid forms (1)		4		4		4

Skill	Question	Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Analysis Part A	(i)	3 marks are available for each graph appropriate scale on time axis (1) correct plotting (1) line extrapolated back to 2½ minutes to find maximum temperature change (1) expect change of approximately –6 to –10°C for $KHCO_3$ expect change of approximately 6 to 10°C for K_2CO_3	2 2		2	14	2	6
	(ii)	3 marks are available for each enthalpy change number of moles of solid added (1) ΔH divided by 1000 to give value in kJ mol^{-1} (1) correct sign for ΔT ⇨ correct sign for ΔH (1) expect value of approximately +30 kJ mol^{-1} for $KHCO_3$ (ΔH_1) expect value of approximately –50 kJ mol^{-1} for K_2CO_3 (ΔH_2) ignore sig figs		2 2 2			6	
	(iii)	$\Delta H + \Delta H_2 = (2 \times \Delta H_1)$ $\Delta H = (2 \times \Delta H_1) - \Delta H_2$ (1) $\Delta H = (2 \times 30) - (-50) = +110$ kJ mol^{-1} (1) ecf possible throughout		2			2	

Skill	Question	Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Analysis Part B	(iv)	$n(CO_2) = \frac{1.100}{44} = 0.025$ (1) 1:1 mole ratio of unknown carbonate to CO_2 M_r of unknown carbonate = $\frac{2.500}{0.025}$ = 100 (1) ⇨ s-block metal is Ca (1) award (1) each for up to **four** conclusions e.g. unknown carbonate is insoluble ⇨ Group 2 metal brick-red flame colour ⇨ confirms metal is Ca white precipitate with sulfate ions ⇨ confirms metal is not Mg white precipitate with hydroxide ions ⇨ suggests metal is Mg/Ca credit any sensible conclusion following from observations neutral answer fizzes with nitric acid ⇨ confirms carbonate			6	6	2	3
		Total	**9**	**13**	**8**	**30**	**12**	**19**

MARK SCHEME ALTERNATIVES FOR TEST 2

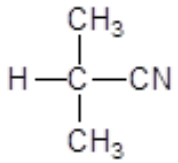
Skill		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Part B Results	Observations	solubility – insoluble / does not dissolve (1) nitric acid – fizzes / bubbles (1) flame test – no flame colour (1) accept orange/yellow sodium sulfate solution – no observable change no mark awarded for this sodium hydroxide solution – white precipitate/solid forms (1)		4		4		4

Skill	Question	Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
Analysis Part B	(iv)	$n(CO_2) = \frac{1.309}{44} = 0.02975$ (1) 1:1 mole ratio of unknown carbonate to CO_2 M_r of unknown carbonate = $\frac{2.500}{0.02975} = 84$ (1) ⇨ s-block metal is Mg (1) award (1) each for up to **four** conclusions e.g. unknown carbonate is insoluble ⇨ Group 2 metal no flame colour ⇨ confirms metal is Mg no precipitate with sulfate ions ⇨ confirms metal is Mg white precipitate with hydroxide ions ⇨ suggests metal is Mg/Ca credit any sensible conclusion following from observations neutral answer fizzes with nitric acid ⇨ confirms carbonate			6	6	2	3

PRACTICAL METHODS AND ANALYSIS TASK

MARK SCHEME

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			(pale) green solution forms (1) do not accept yellow grey-green precipitate forms; precipitate dissolves forming green solution (1) Br^- ions present (1)		1	2	3		3
	(b)			$Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$ state symbols must be correct ecf possible if incorrect anion identified in part (a)		1		1		
				Question 1 total	**0**	**2**	**2**	**4**	**0**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		reagent **and** observation needed I_2(aq) / NaOH(aq) or KI(aq) / NaClO(aq) (pale) yellow precipitate accept antiseptic smell neutral answer – iodoform test			1	1		1
		(ii)		reagent **and** observation needed ammoniacal silver nitrate solution / Tollens' reagent silver mirror or Fehling's solution / Benedict's solution brick-red / brown precipitate forms accept 'blue solution turns brown'			1	1		1
	(b)			n(compound **E**) = $\frac{2.92}{88.08}$ = 0.0332 (1) theoretical mass of product = 0.0332 × 247.88 = 8.23 percentage yield = $\frac{6.87}{8.23}$ × 100 = 83.5 (1)		2		2	2	
	(c)			 do not accept if – sign on CN group			1	1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			n(compound **A**) = $\frac{0.825 \times 10}{1000}$ = 0.00825 n(Mg) = 0.004125 (1) m(Mg) = 0.004125 × 24.3 = 0.100 minimum length = $\frac{0.100}{1.3 \times 10^{-2}}$ = 7.69 (1)		1	1	2	2	
				Question 2 total	**0**	**3**	**4**	**7**	**4**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			award (1) for any of following its purity is not high enough (to be a primary standard) it absorbs moisture from the air concentration of solution changes over time neutral answer - it is not a primary standard	1			1		1
	(b)			potassium manganate(VII) has a deep (purple) colour which disappears on reaction and when the end-point is reached a single drop more turns the solution pink neutral answers - it changes colour by itself / it is self-indicating	1			1		1
	(c)			when using only one tablet the mean titre would be less than 5cm^3 and such a small volume has a high percentage error must have reference to small volume **and** high error			1	1		1
	(d)	(i)		award (1) for overall equation $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$		1		1	1	
		(ii)		$n(MnO_4^-) = 0.00105 \times \frac{22.75}{1000} = 2.389 \times 10^{-5}$ mol (1) $n(Fe^{2+})$ in 25.0 cm^3 of solution $= 5 \times 2.389 \times 10^{-5} = 1.195 \times 10^{-4}$ $n(Fe^{2+})$ in 250 cm^3 of solution $= 1.195 \times 10^{-3}$ $n(Fe^{2+})$ in one tablet $= \frac{1.195 \times 10^{-3}}{5} = 2.39 \times 10^{-4}$ mol (1) ecf possible within the calculation and from an incorrectly balanced equation		2		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		mass = $2.39 \times 10^{-4} \times 55.8 = 13.3$ mg (1) ecf possible from part (i) this method finds the amount of Fe^{2+} in the tablets and it is possible that some of the Fe^{2+} would have been oxidised to Fe^{3+} before the titration / as the solution was prepared (1)		1 1	 1	 2		 1
				Question 3 total	**2**	**4**	**2**	**8**	**3**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		n(NaOH) = $\frac{15.10 \times 1.96}{1000}$ = 0.0296 (1) total number of moles of acid at eq^{m} = 0.0296 × 6 = 0.178 (1)		1 1		2	1	
		(ii)		n(HCl) = $\frac{4.00 \times 11.00}{1000}$ = 0.044 n(CH_3COOH) = 0.178 – 0.044 = 0.134 (1) ecf possible		1		1	1	
	(b)			n(HCl) = 0.044 mol 0.044 × 36.5 = 1.606 g HCl in 4.00 cm^3 of solution (1) mass of 4.00 cm^3 HCl solution = 4.00 × 1.18 = 4.72 g (1) mass of H_2O in 4.00 cm^3 HCl solution = 4.72 – 1.606 = 3.114 g total mass of water = 2.00 + 3.114 = 5.114 g (1) ecf possible			1 1 1	3	2	1
	(c)	(i)		initial mass of ethyl ethanoate = 54.00 × 0.901 = 48.654 (1) n($CH_3COOCH_2CH_3$) = $\frac{48.654}{88.08}$ = 0.552 (1)		2		2	2	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		$n(CH_3CH_2OH) = 0.134$ (1) ecf possible for value carried over from part (a)(ii) award (1) for **both** of following $n(CH_3COOCH_2CH_3) = 0.418$ $n(H_2O) = 0.150$ do not accept any negative values for moles of ester/water			2	2		
		(iii)		$K_c = \frac{0.134 \times 0.134}{0.418 \times 0.150} = 0.286$ ecf possible for incorrect values previously calculated		1		1		
				Question 4 total	**0**	**6**	**5**	**11**	**6**	**3**

GCE a LEVEL UNIT 5: PRACTICAL EXAMINATION

SUMMARY OF ASSESSMENT OBJECTIVES

	Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Experimental Task	**Total**	**9**	**13**	**8**	**30**	**12**	**19**
Practical Methods and Analysis Task	**1**	**0**	**2**	**2**	**4**	**0**	**3**
	2	**0**	**3**	**4**	**7**	**4**	**3**
	3	**2**	**4**	**2**	**8**	**3**	**4**
	4	**0**	**6**	**5**	**11**	**6**	**3**
		11	**28**	**21**	**60**	**25**	**32**