GCE A LEVEL MARKING SCHEME

SUMMER 2019

A LEVEL
CHEMISTRY - COMPONENT 3
A410U30-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2019 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.

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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.

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*			award (2) for any three sources of error award (1) for any two sources of error glass beaker / no insulation / heat gained from surroundings temperature of water not constant before mixing of solids incomplete reaction / no stirring of reactants	2			2		2
	(b)			$\Delta H = \frac{50 \times 4.18 \times 10}{n}$ = 10.5 kJ mol^{-1} = 10500 J mol^{-1} n = 0.199 mol (1) m = 0.199 × M_r = 0.199 × 171 = 34.03g (1)		2		2	1	
	(c)			5.0°C because the same amount of heat is produced but dissipated through twice the volume			1	1		1
				Question 1 total	**2**	**2**	**1**	**5**	**1**	**3**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*	(i)		both axes labelled and appropriate scale (1) all points plotted correctly (2) any 11 points plotted correctly (1) tolerance ±½ small square appropriate curve drawn (1)	1	2	1	4	3	
		(ii)	I	volume NaOH read from graph = 26.5 cm^3 (1) n(NaOH) = $\frac{26.5}{1000} \times 0.0962$ = 0.00255 mol n(CH_3COOH) = 0.00255 mol (1) [CH_3COOH] = $\frac{0.00255}{0.025}$ = 0.102 mol dm^{-3} (1) ecf possible		1 1	1	3	1	1
			II	8.8 accept any value in the range 8.4-9.2		1		1		1
			III	pH = pK_a at half-equivalence point = 4.8 accept 4.5-5.1 (1) K_a = 1.58 × 10^{-5} accept 3.2 × 10^{-6} - 7.9 × 10^{-6} (1) alternative method [H^+] = $\sqrt{K_a} \times c$ ⇨ 1.259 × 10^{-3} = $\sqrt{K_a}$ × 0.102 (1) K_a = 1.55 × 10^{-5} (1)		1	1	2	2	

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			red because the pH at the equivalence point is ≥ 6			1	1		1
	(c)			$K_a = \frac{[H^+][X^-]}{HX}$ or $[X^-] = \frac{Ka \times [HX]}{[H^+]}$ (1) $[H^+] = 3.47 \times 10^{-5}$ (1) $X^- = \frac{1.35 \times 10^{-5} \times 0.210}{3.47 \times 10^{-5}}$ = 0.0817 mol dm^{-3} (1) 0.0409 mol in 500 cm^3 0.0409 × 96.1 = 3.93 g (1) ecf possible			4	4	4	
				Question 2 total	**1**	**6**	**8**	**15**	**10**	**3**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)		$Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$	1			1		
		(ii)		addition of $NaOH(aq)$ / $OH^-(aq)$ (1) green precipitate formed (1) $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ (1)	3			3		1 1
	(b)			prevents the oxidation of Fe^{2+} to Fe^{3+}			1	1		
	(c)	(i)		$\frac{0.02 \times 250}{1000}$ = 0.005 mol (1) $0.005 \times 294.2 = 1.47$ g (1)		2		2	1	
		(ii)		1. Record the initial volume (of dichromate(VI)) in the burette 2. Add 3-5 drops of diphenylamine sulfonate indicator (into conical flask) 3. Add dichromate(VI) solution from the burette until indicator starts to change colour 4. Swirl the solution in the flask / washing down the sides with distilled water 5. Then add dichromate(VI) solution drop by drop until first / permanent violet colour 6. Record the final volume (of dichromate(VI)) in the burette award (4) for points 1 or 6 and any other three points award (3) for any three points award (2) for any two points award (1) for any one point		4		4		4

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		award (1) for any of following • identify any anomalous titres • obtain concordant results • mean titre is more accurate	1			1		1
		(ii)		$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6Fe^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) + 6Fe^{3+}(aq)$			1	1		
		(iii)		$n(Cr_2O_7^{2-}) = \frac{0.02 \times 19.85}{1000} = 3.97 \times 10^{-4}$ mol (1) $n(Fe^{2+}) = 6 \times 3.97 \times 10^{-4} = 2.38 \times 10^{-3}$ mol in 25 cm^3 ecf possible from part (ii) $n(Fe^{2+}) = 2.38 \times 10^{-3} \times 20 = 0.0476$ mol in 500 cm^3 (1) mass Fe = 0.0476 × 55.8 = 2.66 g percentage Fe = $\frac{2.66}{2.78} \times 100 = 95.7\,\%$ (1)		3		3	2	3
		(iv)		percentage error = $\frac{2 \times 0.005}{2.78} \times 100 = 0.36\,\%$		1		1		1
				Question 3 total	**5**	**10**	**2**	**17**	**3**	**11**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4				**Indicative content** Na^+ ions identified by flame test - yellow colour add dilute hydrochloric acid / nitric acid until no more fizzing seen CO_3^{2-} ions react / removed from solution $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$ SO_4^{2-} ions identified by adding barium chloride solution addition of **excess** Ba^{2+} ions precipitates all SO_4^{2-} $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ solid $BaSO_4$ filtered, washed with distilled water to remove soluble impurities dried to constant mass 25.7 % of 4.55 g = 1.17 g of Na_2SO_4 in original solid sample $\frac{1.17}{142.1} = 0.00823$ mol 0.00823 × 233.1 = 1.92 g		2	4	6	2	6

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Clear understanding of quantitative aspects; equations; appropriate calculation *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** Basic understanding of quantitative aspect; attempt at equations and calculation *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** Knowledge of qualitative aspect; observations *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 4 total	**0**	**2**	**4**	**6**	**2**	**6**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)		**D** butanamide (butylamide) (1) **F** butan-2-ol (1)		2		2		
		(ii)		any indication of what is observed in a positive test for **both** reagents i.e. yellow solid / precipitate for reagent **2 and** yellow-orange solid / precipitate for reagent **3** (1) for reagent **2** **E** and **F** both give positive result and all others NR (1) for reagent **3** **C** and **E** both give positive result and all others NR (1)	1	1 1		3		3
	(b)			no reaction with reagent **3** because no carbonyl group but methyl carbonyl group formed by oxidation in the presence of reagent **2**			1	1		1

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)								

	Reagent: **1** Description: dip red litmus paper into solution	Reagent: **5** Description: add drops of sodium hydrogencarbonate solution	Reagent: **4 + 1** Description: heat with sodium hydroxide solution, hold red litmus paper above beaker
A	red litmus paper turns blue		
B	NR	effervescence / fizzing	
D	NR	NR	red litmus paper turns blue (NH_3 gas evolved)

for **A**	reagent **1** identified **and** correct observation (1)			1		
for **B**	reagent **5** identified **and** correct observation (1)			1		
for **D**	reagents 4 + 1 identified **and** description of test (1) correct observation (1)			2	4	4
	(ii)					
for **A**	amine group is basic (1)		1			
for **B**	(carboxylic) acid group present (1)		1			
for **D**	hydrolysis of amide group releases ammonia / alkaline gas (1)		1		3	3

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		4-hydroxybutanal		1		1		
		(ii)		award (1) for any suitable oxidising agent with linked observation e.g. • acidified potassium dichromate(VI) – orange to green • acidified potassium manganate(VII) – purple to colourless		1		1		1
		(iii)		award (1) for either of following • Tollen's Reagent (ammoniacal silver nitrate solution) – silver mirror • Fehling's solution – red-brown precipitate		1		1		1
		(iv)		bromine solution – brown to colourless		1		1		1
				Question 5 total	**1**	**11**	**5**	**17**	**0**	**14**

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COMPONENT 3: CHEMISTRY IN PRACTICE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	2	2	1	5	1	3
2	1	6	8	15	10	3
3	5	10	2	17	3	11
4	0	2	4	6	2	6
5	1	11	5	17	0	14
Totals	9	31	20	60	16	37

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