GCE AS MARKING SCHEME

SUMMER 2023

AS
CHEMISTRY – UNIT 2
2410U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2023 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 AS CHEMISTRY UNIT 2

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

<u>Extended response questions</u>

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.

<u>Marking rules</u>

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.

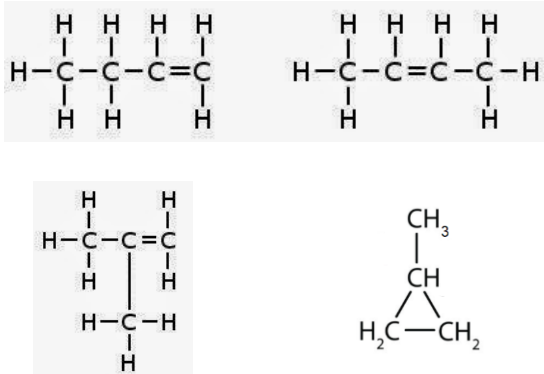Crossed out responses not replaced should be marked.

<u>Marking abbreviations</u>

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 will be given 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.	$C_7H_{14}O_2$		1		1		
2.	award (1) for either of following $C_3H_8 + 3\frac{1}{2}O_2 \rightarrow 3CO + 4H_2O$ $2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$		1		1		
3.	hydrogen	1			1		
4.	award (1) each for any two of following accept both *E* and *Z* isomers of but-2-ene accept skeletal formulae		2		2		
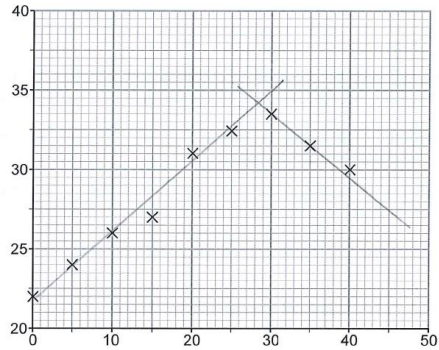
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5.				award (1) for **two** correct structures 2-bromopropane (1)		2		2		
6.				40 / +40 do not accept –40	1			1		
7.				award (2) for *Z*-3-bromohex-3-ene award (1) for either of following 3-bromohex-3-ene *E*-3-bromohex-3-ene no credit for any other answer		2		2		
				Section A Total	**2**	**8**	**0**	**10**	**0**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
8.				**Indicative content** **Advantages** • renewable • lower carbon footprint than fossil fuels – but not entirely carbon neutral • can be made from waste • reduces dependence on fossil fuels • preserves other non-renewable resources for use where needed **Disadvantages** • land not available for other uses • less food crops • crops can fail due to drought / disease • deforestation and associated problems • use of water can strain local resources • use of large quantities of fertiliser can cause water pollution • combustion not as efficient **Examples** • wood is a biofuel - trees can be grown and harvested for burning • biofuels can be made indirectly from plant material e.g. ethanol by fermentation of sugar cane, biodiesel from sunflower oil	6			6		

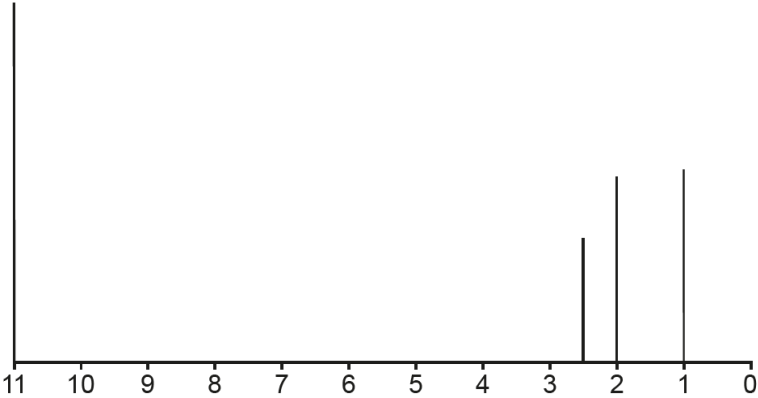| Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Good discussion of several advantages and disadvantages with reference to one biofuel example; conclusion drawn *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The information included in the response is relevant to the argument.* **3-4 marks** Basic discussion including at least two advantages and one disadvantage of biofuels *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.* **1-2 marks** Simple reference to any advantage or disadvantage of biofuels in general *There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.* **0 marks** No attempt made or no response worthy of credit.						
				Question 8 total	6	0	0	6	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)	(i)		award (2) for 0.6 accept any value in the range 0.57-0.63 if answer incorrect award (1) for correct Δy or Δx value taken from tangent		2		2	2	
		(ii)		award (1) for either of following rate is (directly) proportional to concentration rate halves as concentration halves accept converse neutral answer – rate falls as concentration falls			1	1	1	
	(b)			measure change in colour **with time** / use a colorimeter (1) colour becomes darker as bromine is formed (1) OR measure change in pH **with time** / use a pH probe (1) pH rises as H^+ used up (1) reference to time may be linked to the change or the explanation but must be included for both marks to be awarded	1		1	2		2
	I			0.4 mol dm^{-3}			1	1	1	
				Question 9 total	**1**	**2**	**3**	**6**	**4**	**2**
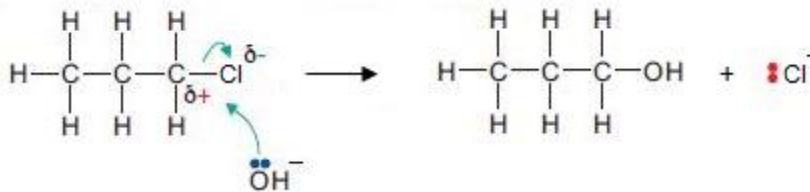
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	(a)	(i)		pipette / burette	1			1		1
		(ii)		more H^+ / methanoic acid is neutralised			1	1		1
		(iii)		all the H^+ / methanoic acid has been neutralised (1) award (1) for either of following excess OH^- added cools the solution same amount of energy has to heat a greater volume neutral answer – cools to room temperature			2	2		2
		(iv)		two straight lines drawn through points **and** intersecting			1	1	1	1
		(v)		award (1) for volume and (1) for temperature increase within the following ranges volume ⇨ 27.0-30.0 cm^3 temperature increase ⇨ 11.0-13.0 °C 		2		2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(vi)		based on graph in part (iv) total volume of solution heated = 25.0 + 28.0 = 53.0 (1) heat released = 53.0 × 4.18 × 12.0 = 2660 J (1) ecf possible when 25.0 or 28.0 used as the mass or when the maximum temperature is used instead of the temperature <u>increase</u>		2		2	1	
		(vii)		moles methanoic acid = $\frac{24.7}{46.02}$ = 0.537 (1) moles in 25.0 cm^3 = 0.0537 (1) enthalpy change = $-\frac{2660}{0.0537 \times 1000}$ = −49.5 kJ mol^{-1} (1) ecf possible when an attempt has been made to calculate a number of moles			3	3	2	
	(b)			more H$^+$ is available / there is a higher concentration of H$^+$ (1) award (1) for either of following hydrochloric acid is strong and methanoic acid is weak hydrochloric acid is stronger than methanoic acid neutral answers – more acidic / donates H$^+$ more easily	1		1	2		
	(c)	(i)		$CuCO_3(s) + 2HCOOH(aq) \rightarrow (HCOO)_2Cu(aq) + CO_2(g) + H_2O(l)$ formulae of reactants and products (1) state symbols and balancing (1)		2		2		
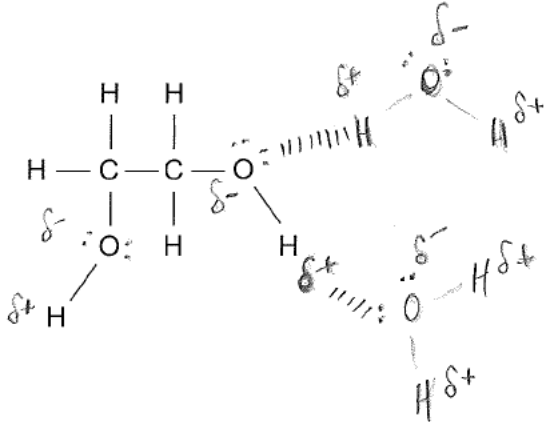
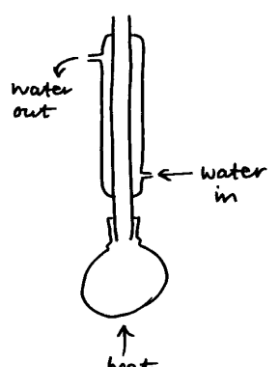| Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		award (1) each for any two of following effervescence / bubbles / fizzing blue solution forms solid disappears neutral answer – colour changes	2			2		2
				Question 10 total	**4**	**9**	**5**	**18**	**5**	**7**

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
11.	(a)			no reaction with dichromate → not 1° or 2° alcohol or aldehyde / could be 3° alcohol or ketone or carboxylic acid(1)		1 1				2

				MS molecular ion peak → M_r 72 (1)
				MS fragments 15 → CH_3^+
				          29 → $C_2H_5^+$
				          43 → $CH_3C=O^+$
				          57 → $C_2H_5C=O^+$ (any two) (1)
					1	1				

				IR has no OH peak → not acid (1)			1			
				IR peak at 1750 → C=O present(1)			1			
				^{13}C NMR 4 peaks → four carbon environments (1) peak at 30/40 → must be ketone OR peak at 210 → must be aldehyde or ketone (1)			1 1			
				molecular formula C_4H_8O (1)				8		
				award any seven of eight possible marks						
				final mark reserved for correct compound						
				X is $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_3$ (1) accept butanone						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
(b)				total three peaks (1) (from left to right ⇨ 2.0 to 3.0, 2.0 to 2.5 and 0.1 to 2.0) height ratio 2 : 3 : 3 (1) ecf possible if incorrect compound given in part (a) e.g. butanal → four peaks, ratio 3:2:2:1			2	2		
				Question 11 total	**1**	**3**	**6**	**10**	**0**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.	(a)	(i)		add aqueous NaOH and then (neutralise with) HNO_3 (1) add aqueous $AgNO_3$ (1) yellow precipitate for iodine, cream for bromine and white for chlorine (1)	3			3		3
		(ii)		**Y** is C_4H_9Cl / chlorobutane (1) award (1) for any explanation supported by a simple calculation e.g. showing that chlorine accounts for 38% of mass of chlorobutane showing that bromine (and iodine) account for greater than 40% of mass of their respective halogenoalkanes showing that the hydrocarbon chain has a mass of 57 and only chlorine has an A_r value less than 40% of the total mass			2	2		
	(b)	(i)		 diagram showing $\delta+$ and $\delta-$ (1) lone pair on OH^- (1) curly arrows from lone pair **and** to break C—Cl bond (1) propan-1-ol and Cl^- formed (1)	4			4		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		nucleophilic substitution / hydrolysis	1			1		
	(c)	(i)		reflux/heat with ethanolic / alcoholic sodium hydroxide	1			1		
		(ii)		$CH_2=CHCH_2CH_2CH_3$ (1) $CH_3CH=CHCH_2CH_3$ (1) only credit one *E/Z* isomer award (1) for **both** correct names if no structures given pent-1- and pent-2-ene		2		2		
				Question 12 total	**9**	**2**	**2**	**13**	**0**	**3**

	Question			Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13.	(a)	(i)	

dipole shown on O—H bond using $\delta+$ and $\delta-$ (either water **or** diol)   (1)

lone pair of electrons shown on oxygen atom (either water **or** diol)   (1)

hydrogen bond shown between diol oxygen (lone pair) and hydrogen atom in water **or** between water oxygen (lone pair) and appropriate hydrogen atom in diol (1) | | 3 | | 3 | | |
| | | (ii) | | award (1) for any of following
• hydrogen bonding interferes with the formation of the ice lattice
• hydrogen bonding stops the ice lattice from forming
• disrupts the hydrogen bonding between water molecules
• water molecules hydrogen bond more strongly with diol molecules than each other
• water prefers to form hydrogen bonds with the diol than with itself

neutral answer – hydrogen bonds form between molecules of the diol and water molecules | | | 1 | 1 | | |

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(b)	(i)		award (1) for either of following acidified (potassium) dichromate or $Cr_2O_7^{2-}$ / H^+ acidified (potassium) manganate(VII) or MnO_4^- / H^+	1			1		1
	(ii)		accept formulae in any format e.g. $CH_2OHCH_2OH + 4[O] \rightarrow (COOH)_2 + 2H_2O$ $(CH_2OH)_2 + 4[O] \rightarrow (COOH)_2 + 2H_2O$ $C_2H_6O_2 + 4[O] \rightarrow C_2O_4H_2 + 2H_2O$ correct formulae of reagents and products (1) balancing (1)		2		2		
	(iii)		 vertical condenser with flask being heated (1) water going through condenser in correct direction (1) award (1) only if condenser shown in distillation apparatus with water going from low to high	2			2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		$(HC=O)_2^+$ / $(HCO)_2^+$ / $H_2C_2O_2^+$ must have + charge do not accept 2+ charge			1	1		
		(v)		moles of ethane-1,2-diol = $\frac{2.00}{62.06}$ = 0.0322 (1) this gives 0.0323 mol of ethanedioic acid M_r of ethanedioic acid = $\frac{3.94}{0.0322}$ = 122 (1) relative mass of water = 122 − 90 = 32 (1) $\Rightarrow x$ = 1.78 / 1.8 / 2 (1) **Alternative method** moles of ethane-1,2-diol = $\frac{2.00}{62.06}$ = 0.0322 (1) this gives 0.0323 mol of ethanedioic acid 0.0322 × 90 = 2.90 g (1) 3.94 − 2.90 = 1.04 g of water moles of water = $\frac{1.04}{18}$ = 0.0577 (1) mole ratio 0.0322 : 0.0577 1:1.79 $\Rightarrow x$ = 1.79 / 1.8 / 2 (1)		4		4	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(vi)	I	 full structure of the diester (1) two molecules of water (1)	1	1		2		
			II	ester	1			1		
				Question 13 total	**5**	**10**	**2**	**17**	**3**	**3**

UNIT 2

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	2	8	0	10	0	0
8	6	0	0	6	0	0
9	1	2	3	6	4	2
10	4	9	5	18	5	7
11	1	3	6	10	0	2
12	9	2	2	13	0	3
13	5	10	2	17	3	3
Total	28	34	18	80	12	17

2410U20-1 WJEC GCE AS Chemistry – Unit 2 MS S23/CB