GCE AS MARKING SCHEME

SUMMER 2019

AS (NEW)
CHEMISTRY - UNIT 2
2410U20-1

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.

UNIT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

MARK SCHEME

GENERAL INSTRUCTIONS

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.

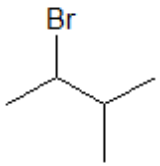
Marking abbreviations

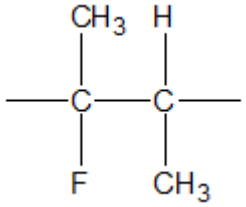
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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.

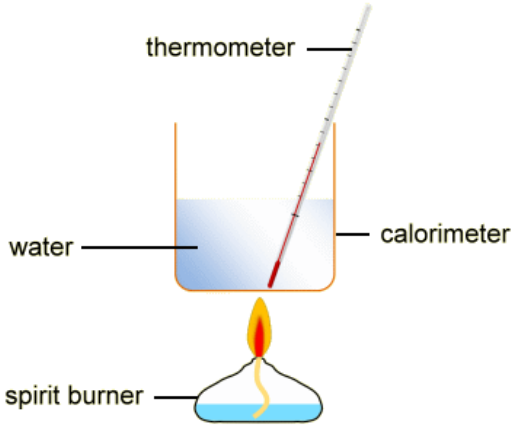
Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1						1		1		
2				$Mg(s) + C(s) + 1½O_2(g) \rightarrow MgCO_3(s)$ award (1) for reactants and product award (1) for balancing and state symbols - **only** if reactants and products correct	2			2		
3				award (1) for either of following • **B** can exist in *E-Z* forms because each of the double bonded carbon atoms has two different groups attached to it • **A** cannot exist in *E-Z* forms because (one of) the double bonded carbon atoms has two groups attached to it which are the same **B** is *Z*-but-2-ene (1) award (1) for 2-methylpropene if isomer **A** chosen		2		2		
4				C_3H_7Br is hydrolysed most rapidly (1) because the C—Br bond is the weakest (of the C-halogen) bonds (1)	2			2		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			addition	1			1		
	(b)					1		1		
6				$C_6H_{12}O_6 \rightarrow$ **$2CO_2$ + $2C_2H_5OH$** ignore state symbols	1			1		
				Section A total	**6**	**4**	**0**	**10**	**0**	**1**

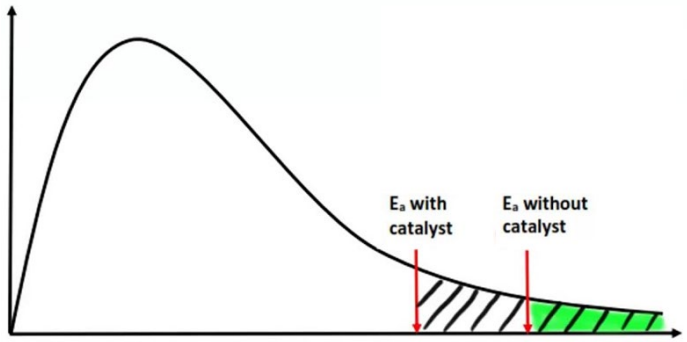
Section B

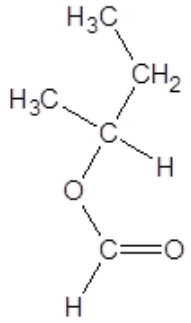
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*	(i)		moles CaO = $\frac{1.90}{56}$ = 0.0339 (1) moles HCl = $\frac{50 \times 1.40}{1000}$ = 0.070 (1) 0.07 mol HCl would neutralise 0.035 mol CaO so acid in excess (1)		3		3	1 1	3
		(ii)		4284.5		1		1		
		(iii)		$\frac{mc\Delta T}{n}$ / $\frac{4284.5}{0.0339}$ (1) –126.4 kJ mol^{-1} **both** sign and value needed (1)		2		2	1	
		(iv)		Hess diagram shown with arrows in correct direction (1) ignore products of reactions $\Delta_r H$ = 126.4 – 196 = –69.6 kJ mol^{-1} (1) *(using value given in question 110 – 196 = –86 kJ mol^{-1})*		2		2	1	
		(v)		award (1) each for any two of following • suitable apparatus to minimise **heat losses** e.g. lid/ polystyrene container • thermometer reading to 0.1°C / graduations to allow reading to less than 0.5°C • use a burette since it can be read to 0.05 cm^3			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		$CH_3OH(l) + 1½O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ ignore state symbols, do **not** allow multiples		1		1		
		(ii)		liquid in burner with flame (1) thermometer in water and suitable container (1)  	2			2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		bonds broken (C=C) + 4(C—H) + 3(O=O) = 614 + 4(C—H) + 1485 (1) bonds made 4(C=O) + 4(O—H) = 3196 + 1860 = 5056 (1) 2099 + 4(C—H) – 5056 = –1387 (1) average C—H bond enthalpy = $\frac{1570}{4}$ = 392.5 / 393 kJ mol^{-1} (1)		4		4	3	
		(ii)		ethene is a gas / not a liquid			1	1		1
				Question 7 total	**2**	**13**	**3**	**18**	**7**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*			at higher concentration, more particles in a given volume / particles closer together (1) more **frequent** collisions / more **chance** of collisions (1)	2			2		
	(b)	(i)		using expts 1 and 2 - when [NO] doubled (1) rate increases by factor of 4 / rate α $[NO]^2$ (1) or using expts 1 and 3 - when [NO] trebled (1) rate increases by factor of 9 / rate α $[NO]^2$ (1)			2	2	2	
		(ii)		using expts 2 and 4 when $[O_2]$ doubled (1) rate stays the same / rate unaffected by $[O_2]$ (1)			2	2	2	
		(iii)		monitor changes in volume of gas / use a gas syringe / monitor changes in pressure / use a manometer (1) reagents have more moles of gas (1) **or** use a colorimeter (1) since NO_2 is brown/coloured (1)			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		award (1) each for any two of following • $NO/NO_2/CO$ are toxic • CO_2 contributes to greenhouse effect / global warming • NO_2/NO_x contribute to acid rain		2		2		
		(v)		exhaust (1) award (1) for any of following • heterogenous • a transition metal / a transition metal compound • palladium / platinum / rhodium	2			2		
	(c)			 shape of curve (1) lower activation energy with catalyst / shown on graph (1) more collisions / molecules have energy greater than activation energy (1)	3			3		
				Question 8 total	**7**	**2**	**6**	**15**	**4**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*	(i)		reflux (1) to avoid loss of reagents / products / solvent (1)	2			2		2
		(ii)		distillation (1) boiling temperature of ester is lower than alcohol/acid (1)	2			2		2
		(iii)		(conc) sulfuric acid	1			1		1
		(iv)		reagents $CH_3CH_2CH(OH)CH_3$ + HCOOH (1) products  + H_2O (1)		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			award (1) each for any **two** of following • Na_2CO_3 / Mg - effervescence / fizzing / bubbles • acidified potassium dichromate - orange to green accept acidified potassium manganate(VII) - purple to colourless • iodine and sodium hydroxide / potassium iodide and sodium chlorate(I) - yellow precipitate award (1) for correct ✓/× for all three compounds for first test award (1) for correct ✓/× for all three compounds for second test award (1) for tests that enable all three compounds to be identified		5		5		5

Reagent(s)	Observation expected for positive result	butan-2-ol	2-methylpropanoic acid	3-hydroxybutanoic acid
Na_2CO_3	effervescence / fizzing / bubbles	×	✓	✓
Mg	effervescence / fizzing / bubbles	×	✓	✓
acidified potassium dichromate	orange to green	✓	×	✓
acidified potassium manganate(VII)	purple to colourless	✓	×	✓
iodine and sodium hydroxide	yellow precipitate	✓	×	✓

				Question 9 total	**5**	**7**	**0**	**12**	**0**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*			**Indicative content** • alkanes and alkenes both contain C and H • C and H have similar electronegativities • there are no dipoles in either alkanes or alkenes • alkenes have double bonds and are much more reactive • due to high electron density of π bond • caused by p-p sideways overlap • alkanes are saturated whilst alkenes are unsaturated • this makes alkenes susceptible to electrophilic addition • alkanes need light to react • by radical substitution	6			6		

5-6 marks
Explanation of difference in reactivity of alkanes and alkenes in terms of π bond; reference to different reaction mechanisms
The candidate constructs a relevant, coherent and logically structured account including key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary is used accurately throughout.

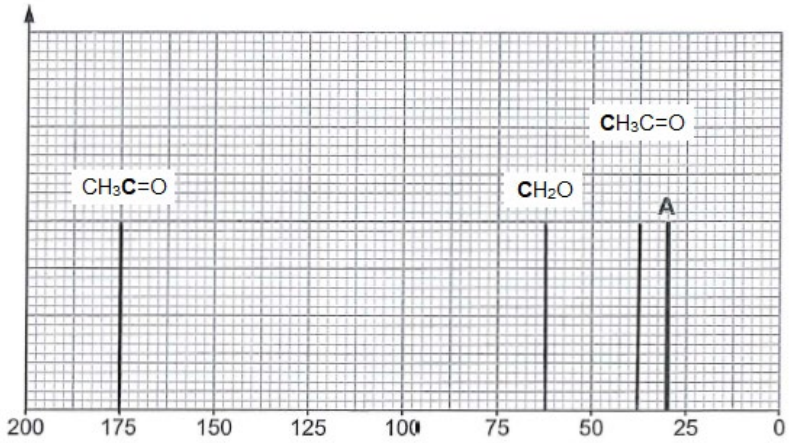
3-4 marks
Explanation of lack of dipoles; reference to alkenes as being reactive and alkanes as being unreactive
The candidate constructs a coherent account including many of the key elements of the indicative content. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.

1-2 marks
Some knowledge of the different reactivities of alkanes and alkenes
The candidate attempts to link relevant points from the indicative content. Coherence is limited by omission and/or inclusion of irrelevant material. 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
	(b)	(i)		award (1) for either of following • the aldehyde is being oxidised to a carboxylic acid and reduced to an alcohol • the aldehyde gains oxygen forming a carboxylic acid and gains hydrogen forming an alcohol			1	1		
		(ii)		moles of C_6H_5CHO = $\frac{9.5}{106.06}$ = 0.0896 (1) this should make 0.0448 mol of $C_6H_5CH_2OH$ (1) percentage yield = $\frac{3.39}{4.84} \times 100$ = 70 % (1) accept alternative method moles of $C_6H_5CH_2OH$ = $\frac{3.39}{108.08}$ = 0.0314 (1) formed from 2 × 0.0314 = 0.0628 mol of C_6H_5CHO (1) mass of C_6H_5CHO = 6.66 g percentage yield = $\frac{6.66}{9.50} \times 100$ = 70 % (1)		3		3	2	
		(iii)		$2C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$			1	1		
				Question 10 total	**6**	**3**	**2**	**11**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	*(a)*			**Empirical formula** percentage oxygen = 53.33 (1) C : H : O $\frac{40.0}{12} : \frac{6.67}{1.01} : \frac{53.33}{16}$ ⇨ 1 : 2 : 1 ⇨ CH_2O (1) **Mass spectrum** M_r = 90 (1) molecular formula $C_3H_6O_3$ (1) m/z of a fragment linked to identity of fragment (1) e.g. CH_3^+ at 15, $COOH^+$/ $CH_3CH(OH)^+$ at 45, OH^+ at 17 **IR spectrum** peak in range 1650 to 1750 due to C=O (1) peak in range 2500 to 3200 / 3200 to 3550 due to O—H (1) **^{1}HNMR** 4 hydrogen environments / ratio of 1 : 1 : 1 : 3 (1) any δ value linked to group (1) e.g. 1 to 1.5 due to C**H**$_3$, 2.5 to 3.0 due to CH_3C**H**, 4.0 due to RCO**H**, 12.5 due to C=OO**H** **Identification** **X** is $CH_3CH(OH)COOH$ / 2-hydroxypropanoic acid do **not** accept 3-hydroxypropanoic acid		1 1 1 1 1 1 1 1 1	1 1 1 1	10		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		ignore peak heights accept any sensible approach to labelling peaks award (1) for peak labelled CH_3**C**=O at 160 to 185 award (1) for peak labelled **C**H_2O at 50 to 90 award (1) for peak labelled **C**H_3C=O at 20 to 50 e.g.  			1 1 1	3		
		(ii)		nothing can be deduced from peak size of ^{13}C	1			1		
				Question 11 total	**1**	**6**	**7**	**14**	**0**	**0**

UNIT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
Section A	6	4	0	10	0	1
7	2	13	3	18	7	8
8	7	2	6	15	4	2
9	5	7	0	12	0	10
10	6	3	2	11	2	0
11	1	6	7	14	0	0
Totals	27	35	18	80	13	21