GCE AS MARKING SCHEME

SUMMER 2018

AS
CHEMISTRY - COMPONENT 2
B410U20-1

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

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.

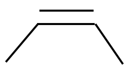
Marking abbreviations

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.

Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1.				phosphoric acid	1			1		
2.	(a)					1		1		
	(b)			*E*-*Z* isomerism occurs due to restricted rotation about the double bond (1) but-2-ene has two different groups attached to the carbons in the double bond while but-1-ene has two hydrogens attached to one carbon in the double bond (1)	1	1		2		
3.				when a bond is broken and one atom receives both electrons	1			1		
4.				2-methylbut-1-ene	1			1		
5.				it provides an <u>alternative route</u> with a lower activation energy (1) therefore more particles have the minimum energy needed to react (1)	2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)			curve **A** reaches 1.10 g before 7 mins then stays flat		1		1		
	(b)			curve **B** reaches 2.20 g before 8 mins then stays flat		1		1		
				Section A total	**6**	**4**	**0**	**10**	**0**	**0**

Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			sulfur combines with oxygen to form sulfur dioxide (1) reacts with rainwater to form acid rain (1)	2			2		
	(b)			bonds broken (8 × C—H) + (2 × 348) + (5 × 496) (1) bonds formed (6 × 743) + (8 × 463) = 8162 (1) −1690 = (8 × C—H) + 3176 – 8162 C—H = 412 (1)		3		3	2	
	(c)	(i)		radical substitution	1			1		
		(ii)		$Cl_2 \rightarrow 2Cl\bullet$ (1) $Cl\bullet + CH_4 \rightarrow CH_3\bullet + HCl$ (1) $CH_3\bullet + Cl_2 \rightarrow CH_3Cl + Cl\bullet$ (1) e.g. $CH_3\bullet + Cl\bullet \rightarrow CH_3Cl$ (1)	4			4		
	(d)			butane −1°C, propan-1-ol 97°C, ethanoic acid 118°C (1) butane shows no hydrogen bonding between molecules (1) ethanoic acid has more/stronger hydrogen bonds between molecules than propan-1-ol (1) (accept answers in terms of more dipoles)		3		3		

<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></td><td>(e)</td><td></td><td></td><td>Indicative content
• A is ethanoic acid, B is propan-1-ol
• ^{13}C NMR for butane has 2 peaks between 5 and 40 ppm
• ^{13}C NMR ethanoic acid has 2 peaks but propan-1-ol has 3 peaks
• both have peaks at m/z 60 due to molecular ion (butane does not)
• both have peaks at m/z 45 due to $COOH^+$ and $CH_2CH_2OH^+$ respectively (butane does not)
• mass spectrum for butane has peaks at m/z 15, 29, 43 and 58
• propan-1-ol has a peak at m/z 29 due to $CH_3CH_2^+$ and m/z 31 due to CH_2OH^+ (ethanoic acid does not)
• ethanoic acid has a peak at m/z 43 due to CH_3CO^+ (propan-1-ol does not)</td><td></td><td>4</td><td>2</td><td>6</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="7">5-6 marks
Correctly identifies compounds giving a comprehensive explanation and gives details of spectra for butane.
The candidate constructs a relevant, coherent and logically structured method 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.

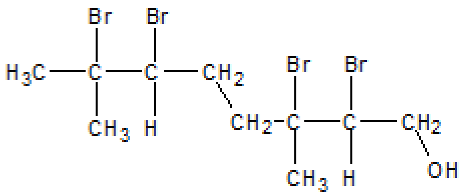
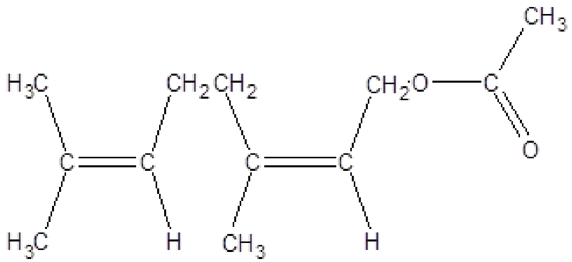
3-4 marks
Correctly identifies compounds giving good basic explanation and gives details relating to one spectrum for butane.
The candidate constructs a coherent account including most of the key elements of the indicative content. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary are generally sound.

1-2 marks
Correctly identifies compound(s) giving some explanation.
The candidate attempts to link at least two 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.</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
	(f)			only ethanoic acid would have an absorption at 1650-1750 cm^{-1} due to presence of the C=O bond (1) ethanoic acid would have an absorption at 2500-3200 cm^{-1} due to the presence of the O—H bond, while the absorption due to O—H in propan-1-ol would be at 3200-3550 cm^{-1} (1)	2			2		
				Question 7 total	**9**	**10**	**2**	**21**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)	(i)		moles NaOH = 0.2 × 23.4/1000 = 4.68 × 10^{-3} therefore 4.68 × 10^{-3} moles of **E** (1) M_r(**E**) = 0.412/4.68 × 10^{-3} = 88.03 (1)		2		2	1	
		(ii)		**A** is but-1-ene (1) **B** is 2-bromobutane (1) **C** is 1-bromobutane (1) **D** is butan-1-ol (1) **E** is butanoic acid (1) award (1) each for any two of following • **E** must be acid since neutralised by NaOH • **D** must be primary alcohol since oxidised to acid • **A** must be alkene since reacts with HBr • **B**/**C** must be bromoalkane since formed from alkene (and **C** forms alcohol)		5	2	7		
		(iii)		elimination	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		alkene / C=C **and** alcohol / hydroxyl	1			1		
		(ii)		$C_{10}H_{18}O$	1			1		
		(iii)	I	 accept addition across 1 double bond only		1		1		
			II	 ignore error in chain		1		1		
				Question 8 total	**3**	**9**	**2**	**14**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)			$\Delta H = \dfrac{-mc\Delta T}{n}$ (1) ΔT = 6.8°C, m = 200 g, n = 2.043×10^{-3} (1) ΔH = −2796000 (1) ΔH = −2796 (1)	1	3		4	4	
	(b)	(i)		$\dfrac{0.2}{6.8} \times 100 = 2.9$		1		1	1	1
		(ii)		use less water (e.g. 50 cm^3) / burn for longer (1) temperature rise higher so percentage error less (1)			2	2		2
	(c)	(i)		reduce distance between flame and beaker / protect flame from draughts			1	1		1
		(ii)		incomplete combustion / thermal capacity of beaker			1	1		1
	(d)	(i)		$C_5H_{11}OH + 7\frac{1}{2}O_2 \rightarrow 5CO_2 + 6H_2O$		1		1		
		(ii)		$\Delta_f H^\theta$ reactants = −380 **and** $\Delta_f H^\theta$ products = −3686 (1) $\Delta_c H^\theta$ = −3686 **–** (−380) = −3306 (1) ecf possible from part (i)		2		2	2	
		(iii)		oxygen gas is an element in its standard state	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			reflux both with acidified potassium dichromate (1) colour changes from orange to green with pentan-2-ol (1) no change with 2-methylbutan-2-ol (1)		3		3		
	(f)	(i)		thermometer bulb adjacent to outlet leading to condenser (1) water in through lower tube and out through upper tube (1)	2			2		2
		(ii)		mass of alcohol = 5 × 0.805 = 4.025 moles of alcohol = 4.025 ÷ 88 = 0.0457 (1) theoretical mass of chloroalkane = 0.0457 × 106.5 = 4.87 actual mass chloroalkane = 4.05 × 0.866 = 3.51 g (1) percentage yield = 3.51/4.87 × 100 = 72% therefore student is incorrect (1)			3	3	2	
				Question 9 total	**4**	**10**	**7**	**21**	**9**	**7**

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
10.	(a)			she is correct since all solutions are identical / it is more efficient / it is quicker			1	1		1
	(b)			ensure that the temperature is constant / use water bath (1) because all rates of reaction are temperature dependent (1) repeat each experiment and calculate mean of the concordant results (1) ensures that the mean value is more accurate (1) accept using colorimeter (1) and valid reason (1)	4			4		4
	(c)			so that all the peroxide can be added quickly to the mixture rather than over a few seconds since the reaction starts when peroxide is added / to ensure that the correct volumes of peroxide and water are added			1	1		1
	(d)			reaction time would be too short so percentage error would be too high			1	1		1
	(e)	(i)		rate is proportional to the concentration of peroxide		1		1		
		(ii)		$\frac{1}{time}$ is 0.044 s^{-1} at concentration 0.012 mol dm^{-3} (1) time = 23 (1)		2		2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(f)			the intensity of the colour of the iodine can be monitored over time (1) using a colorimeter (1)			2	2		2
	(g)			as concentration increases there are more molecules in the same volume so there is an increase in the number of collisions (1) there is a greater chance of collisions with energy greater than the activation energy (1)	2			2		
				Question 10 total	**6**	**3**	**5**	**14**	**1**	**9**

COMPONENT 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	0
7.	9	10	2	21	2	0
8.	3	9	2	14	1	0
9.	4	10	7	21	9	7
10.	6	3	5	14	1	9
Totals	28	36	16	80	13	16