GCE AS MARKING SCHEME

SUMMER 2017

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

INTRODUCTION

This marking scheme was used by WJEC for the 2017 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

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.

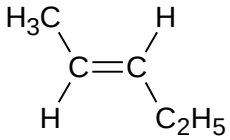
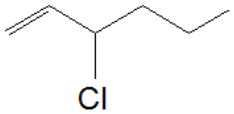
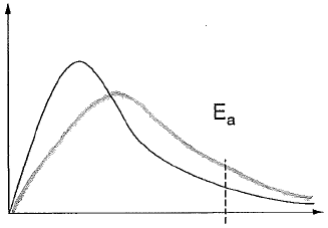
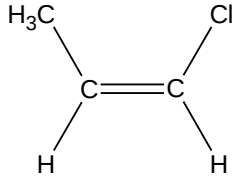
Marking abbreviations

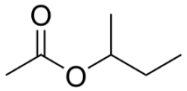
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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.	(a)					1		1		
	(b)					1		1		
2.				$C_{50}H_{100}Cl_2$		1		1		
3.				 (1) more particles have energy ≥ Ea at higher T / greater area under curve at higher temperatures (1)	2			2		
4.				 accept *E*-isomer		1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5.				aqueous sodium hydroxide (excess dilute) nitric acid (aqueous) silver nitrate yellow all four correct (2) if not all correct award (1) for silver nitrate **and** yellow	2			2		2
6.	(a)			any unambiguous formula representing 1-methylpropyl ethanoate e.g.  or $CH_3COOCH(CH_3)CH_2CH_3$		1		1		
	(b)			(concentrated) sulfuric acid do not accept 'dilute sulfuric acid'	1			1		1
				Section A total	**5**	**5**	**0**	**10**	**0**	**3**

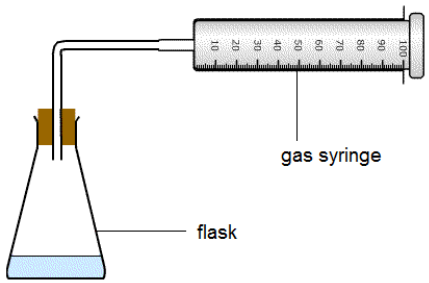
Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			$2C(s) + 3H_2(g) + ½O_2(g) \rightarrow C_2H_5OH(l)$ correct formulae (1) balancing and state symbols (1)		2		2		
	(b)			any of following for (1) • if carbon, hydrogen and oxygen are reacted other products (as well as ethanol) would form • the activation energy for the reaction is too high • carbon, hydrogen and oxygen do not easily react with each other under these conditions	1			1		
	(c)	(i)		use of energy / $Q = mc\Delta T$ (1) use of moles (ethanol) = $\frac{\text{mass of ethanol}}{46/\ M_r}$ (1) $\Delta_c H$ = energy/ moles ethanol (1)		3		3		3
		(ii)		ethane is a gas / practical problem based on ethane being a gas			1	1		1
	(d)			Euan: temperature rise / loss in mass very small therefore greater percentage error / less accurate (1) Carys: mass of fuel used after boiling did not result in temperature rise therefore calculated value of $\Delta_c H$ too small (1)			2	2		2

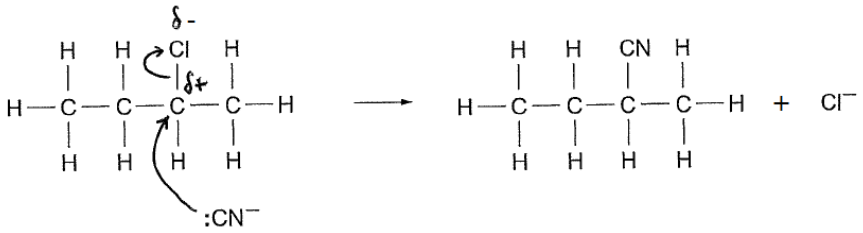
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)	(i)		Hess' cycle drawn (1) $\Delta_f H^{\ominus}$ – 1371 = 2(–394) + 3(–286) (1) $\Delta_f H^{\ominus}$ = –275 (1) award (3) for cao ecf possible		3		3	2	
		(ii)		Amir is correct – no credit award credit only for calculations C 394/12 H_2 286/2.02 C_2H_5OH 1371/46 (1) C 32.8 H_2 142 C_2H_5OH 29.8 (1)			2	2	1	
				Question 7 total	**1**	**8**	**5**	**14**	**3**	**6**

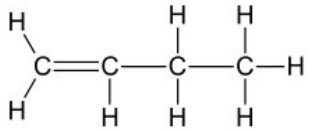
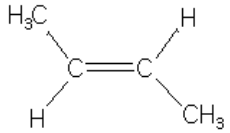
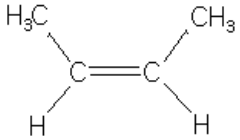
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)	(i)		ratio C : H $\Rightarrow$ $\frac{85.6}{12} : \frac{14.4}{1.01}$ $\Rightarrow$ 7.13 : 14.26 (1) ratio = 1:2 $\Rightarrow$ empirical formula is CH_2 (1) M_r in the range 50-60 empirical formula M_r = 14 therefore molecular formula must be C_4H_8 (1)		3		3	1	
		(ii)		0.2 mol of C_4H_8 and 0.2 mol of bromine (1) so 1 double bond (1) **must** have some justification		1	1	2		
		(iii)		electrophilic addition	1			1		
		(iv)		radical substitution	1			1		
		(v)		compound **X** CH_2=$CHCH_2CH_3$ or CH_3CH=$CHCH_3$ (1) product of reaction of **X** with bromine in the absence of light $CH_2BrCHBrCH_2CH_3$ or $CH_3CHBrCHBrCH_3$ - must follow from part (i) (1) product of reaction of **X** with excess bromine in sunlight displayed formula of any substituted bromo-compound - must follow from part (ii) (1)			3	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			**Indicative content** IR spectrum link C—H to 3000 and C—Cl to 650 Mass spectrum M_r is 126 / 128 / 130 two chlorine atoms present from peaks at 35 and 37 / peak height ratios / from M_r differences comment on any fragment ^{13}C NMR two different carbon environments comment on δ values ^{1}H NMR two different hydrogen environments same number of hydrogens in each environment $\Rightarrow$ 1,4-dichlorobutane rather than 2,3-dichlorobutane		2	4	6		
				5-6 marks At least one valid comment on all four spectra and a correct conclusion for the identity of **Y** (1,4-dichlorobutane) *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 are used accurately throughout.* **3-4 marks** At least one valid comment on three spectra and good attempt at the identity of **Y**. *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** At least one valid comment on two spectra . *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 8 total	**2**	**6**	**8**	**16**	**1**	**0**

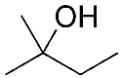
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)			 flask with stopper and delivery tube (1) method of collecting and measuring volume of oxygen (1) accept collection over water using measuring cylinder	2			2		2
	(b)	(i)		tangent drawn at t = 0 or t = 200 s (1) initial rate = 10-15 (cm^3s^{-1}) (1)		2		2	2	2
		(ii)		rate at t = 200s = 3-5 (cm^3s^{-1})		1		1	1	1
		(iii)		at t = 200 concentration lower / particles further apart (1) less frequent collisions / less chance of collisions, so rate less (1)	2			2		
		(iv)		2000 cm^3 oxygen = 2000/24500 mol = 0.0816 (1) number of moles H_2O_2 = 0.163 (1) concentration = 1.63 – must be correct to 3 sig figs (1)		2	 1	 3	 1 1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			any three of following for (1) each • measure volume of gas at a particular time / time how long it takes to produce a fixed volume • use the same amount of catalyst • use the same volume of the same concentration of H_2O_2 • better catalyst increases rate by more		1 1	1	3		3
				Question 9 total	**4**	**7**	**2**	**13**	**5**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	(a)	(i)								
				δ+ and δ– shown on C and Cl (1)	1					
				arrow from **lone pair** on CN^- to δ+ C (1)		1				
				arrow from C—Cl bond to Cl (1)	1					
				2-cyanobutane and Cl^- as products (1)		1		4		
		(ii)		nucleophilic substitution	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		 but-1-ene (1)  *E*-but-2-ene (1)  *Z*-but-2-ene (1) award (1) for all formulae with no names		3		3		
		(ii)		elimination	1			1		
	(c)			award (1) for each of the following • CFCs destroy ozone • we are then more exposed to UV radiation / greater risk of skin cancer • (CFCs) produce •Cl / chlorine radical / HFCs do not produce •Cl • •Cl / chlorine radical starts chain reaction • HFCs contain C—H / C—F bonds and these are too strong to be broken by UV light	5			5		
				Question 10 total	**9**	**5**	**0**	**14**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	(a)	(i)		any three of following for (1) each • needs yeast / enzyme added to the mixture • should be kept at body temperature / 25-40°C • must have some means of allowing CO_2 produced to escape / keeping oxygen out • distillation needed to separate the ethanol	1 1	1		3		3
		(ii)		180 g of glucose produces 92 g of ethanol (1) atom economy = 92/180 × 100 = 51.1% (1)		2		2	1	
		(iii)		hydration of ethene needs high temperature / lots of energy (1) this uses fossil fuels (1) OR hydration of ethene uses non-renewable petroleum (1) fermentation uses renewable sugars / plant materials / is carbon neutral (1)	1		1	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		—OH attached to a carbon that is attached to not more than one other carbon atom / attached to two hydrogen atoms	1			1		
		(ii)		 (1) 2-methylbutan-2-ol (1)		2		2		
		(iii)		add **acidified** (potassium) dichromate (1) positive result for 2° but negative result for 3° (1) (positive result is) colour change orange to green (1)	3			3		3
				Question 11 total	**7**	**5**	**1**	**13**	**1**	**6**

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	5	5	0	10	0	3
7.	1	8	5	14	3	6
8.	2	6	8	16	1	0
9.	4	7	2	13	5	8
10.	9	5	0	14	0	0
11.	7	5	1	13	1	6
Totals	28	36	16	80	10	23