GCE AS MARKING SCHEME

SUMMER 2016

CHEMISTRY - NEW AS UNIT 2
2410U20-1

© WJEC CBAC Ltd.

INTRODUCTION

This marking scheme was used by WJEC for the 2016 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 CBAC Ltd.

GCE CHEMISTRY

SUMMER 2016 MARK SCHEME

AS 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

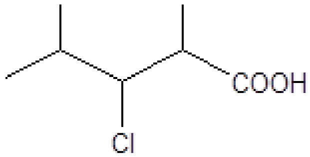
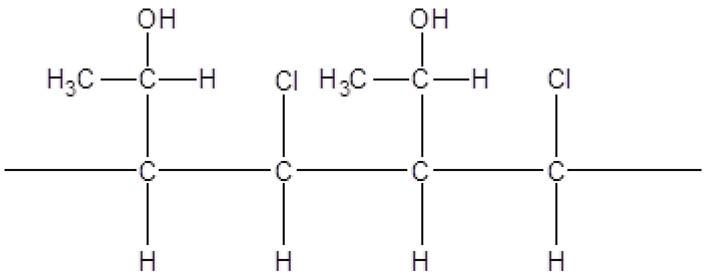
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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.

© WJEC CBAC Ltd.

Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1.	*(a)*			3-chloro-2,4-dimethylpentanoic acid		1		1		
	(b)					1		1		
2.				Sketch graph to show products at higher energy than reactants (1) E_a and ΔH correct (1)		2		2		
3.						1		1		

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4.				Any two of following for (1) each • Use a colorimeter to measure colour changes <u>with time</u> • Use a pH meter to measure pH changes <u>with time</u> • Use a gas syringe / collect gas over water to measure changes in volume <u>with time</u> • Use a balance to measure mass changes <u>with time</u> Award (1) for one correct method but no mention of time		2		2		2
5.	*(a)*			Presence of a (carbon to carbon) double bond	1			1		
	(b)			No – because two of the groups on one of the double bonded carbon atoms are the same		1		1		
6.				$CuO + 2HCOOH \rightarrow (HCOO)_2Cu + H_2O$ (ignore state symbols)		1		1		
				Section A total	**1**	**9**	**0**	**10**	**0**	**2**

© WJEC CBAC Ltd.

Section B

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks available					
7.	*(a)*			Diagram to show insulated / polystyrene container with reagents (1) Lid (1) Thermometer (1)		3		3		3
	(b)			Energy = 25 × 4.18 × 14.5 = 1515 J (1) Moles Mg = 0.1/24.3 = 4.12×10^{-3} (1) ΔH = 1515/ 4.12×10^{-3} = –368 $kJmol^{-1}$ (1) ecf posible		3		3	3	
	(c)			Moles Mg = 8.23×10^{-3} (1) Requires 1.64×10^{-2} moles HCl for all to react Moles HCl = 5×10^{-3} i.e. not enough for a complete reaction (1)			2	2		
	(d)			Maximum error in the one reading taken = 0.05 g (1) (Allow 0.1 g if clearly states that mass was measured using weighing by difference) Maximum % error = $\frac{0.05}{0.1} \times 100$ = 50% (1)		1	1	2	1	1
	(e)			Cannot measure ΔH – can only measure ΔT/ no water / solution present to measure temperature change			1	1		1
				Question 7 total	**0**	**7**	**4**	**11**	**4**	**5**

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	*(a)*	(i)		Enthalpy / energy change when 1 mol of substance is burned (1) Completely / in excess oxygen under standard conditions (1)	2			2		
		(ii)		C_2H_6 + **3**½O_2 → $2CO_2$ + $3H_2O$ (1) Bonds broken 1(C—C) + 3½(O=O) + 6(C—H) = 2080.5 + 6(C—H) (1) Bonds formed 4(C=O) + 6(O—H) = 5974 (1) 2080.5 + 6(C—H) – 5974 = –1561 (C—H) = 389 $kJmol^{-1}$ (1) award (3) for cao ecf possible		4		4	1 1 1	
		(iii)		Average used since each individual bond will be in a different environment and therefore have a different strength (1)			1	1		

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	*(b)*			**Indicative content** Correct in that energy produced per gram is 32.8 kJ from charcoal and 55.6 kJ from methane Both give CO_2 on burning 1 mol of each fuel produces 1 mol of CO_2 Wood for charcoal comes from (living) trees Methane comes from sources living millions of years ago / is a fossil fuel Charcoal is renewable / methane is non-renewable Trees take in CO_2 in photosynthesis Trees release the **same** amount of CO_2 on combustion that they took in during growth Charcoal burning is overall carbon neutral		1	5	6	1	
				***5*-6 marks** Must calculate energy per gram for both fuels. *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** Clear comparison of methane and charcoal. *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** Main focus on only one of methane or charcoal. *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.*						
				Question 8 total	**2**	**5**	**6**	**13**	**4**	**0**

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	*(a)*			Any five of following for (1) each • Alkenes contain σ and π bonds • σ bonds are formed from s-s orbital overlap / end-on orbital overlap • π bonds are formed from sideways overlap of p orbitals / overlap above and below plane • The π bond gives a region of high electron density • This is susceptible to electrophilic attack/ attack by an electron deficient species • (This attack) leads to addition reactions	5			5		
	(b)			Diagram to show Correct dipole on Br_2 (1) Two correct arrows (1) Formula of intermediate **and** arrow from lone pair or negative charge (1) Correct product (1)	4			4		
				Question 9 total	**9**	**0**	**0**	**9**	**0**	**0**

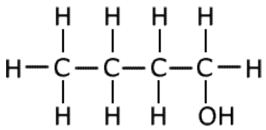
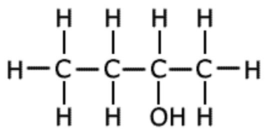
© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10.	*(a)*	(i)		Equation with displayed or structural formulae e.g. $CH_3CH(CH_3)CHClCH_2CH_3$ + NaOH → $CH_3CH(CH_3)CHOHCH_2CH_3$ + NaCl $CH_3CH(CH_3)CHClCH_2CH_3$ + OH^- → $CH_3CH(CH_3)CHOHCH_2CH_3$ + Cl^-		1		1		
		(ii)		Nucleophilic substitution	1			1		
		(iii)		Neutralise hydroxide with nitric acid **and** add aqueous silver nitrate (1) White precipitate forms (1) Accept heat with acidified dichromate (1) orange to green (1)	2			2		2
	(b)	(i)		Rate α concentration of halogenoalkane with explanation e.g. concentration doubles, rate doubles (1) Rate not affected by concentration of OH^- (1)			2	2	1	
		(ii)		Rate would be faster **because** C—X bond needs to be broken (1) C—Br is weaker than C—Cl / takes less energy to break (1) This outweighs effect of greater dipole in C—Cl / chlorine being more electronegative (1)	3			3		
				Question 10 total	**6**	**1**	**2**	**9**	**1**	**2**

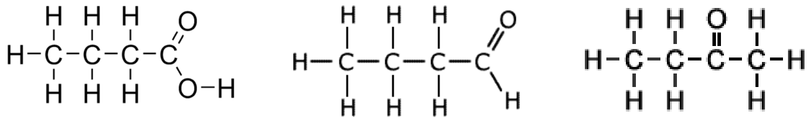
© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11.	*(a)*	(i)		Labels on diagram to show vertical condenser (unsealed at top) (1) Water in and out of condenser in correct direction (1) Heat source below flask with reagents (1)	3			3		3
		(ii)		Liquid evaporates, vapour goes into condenser, cools and goes back to liquid / condenses	1			1		1
		(iii)		Any of following for (1) • The reaction is slow • Allows time for equilibrium to be established • Stops reactants / products boiling away			1	1		1
		(iv)		Catalyst/ dehydrating agent	1			1		
	(b)	(i)		Fractional distillation (1)	1			1		1
		(ii)		Moles of ethanoic acid = 0.05 and moles of methanol = 0.04 (1) Theoretical yield of methyl ethanoate = $0.04 \times 74 = 2.96$ g (1) % of theoretical yield = $\frac{1.18}{2.96} \times 100 = 40$ % (1) ecf possible		3		3	3	

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		Reflux for longer (1) Reaction is slow/ needs time to establish equilibrium (1) or Add extra methanol / ethanoic acid (1) To allow more of the acid to react/ push the equilibrium to RHS (1)			2	2		2
	(c)	(i)		Dehydration/ elimination	1			1		
		(ii)		Displayed formulae of butan-1-ol and butan-2-ol for (1) each  butan-1-ol  butan-2-ol		2		2		
		(iii)		Orange to green	1			1		
		(iv)		Oxidation of alcohol / redox	1			1		

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(v)		Displayed formula of butanoic acid / butanal / butanone 		1		1		
				Question 11 total	**9**	**6**	**3**	**18**	**3**	**8**

© WJEC CBAC Ltd.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12.				**From % composition** ratio C: H : O $\frac{61.2}{12} : \frac{6.1}{1.01} : \frac{32.7}{16}$ = 5.1 : 6.04 : 2.04 (1) 2.5 : 3 : 1 → 5 : 6 : 2 Empirical formula is $C_5H_6O_2$ (1)		2			2	
				From mass spectrum M_r is 98 (1) Molecular formula is $C_5H_6O_2$ (1) Identification of one fragment from m/z value (1)		3				
				From reaction with sodium carbonate **X** is a carboxylic acid/ contains CO_2H (1)	1					
				From ^{13}C spectrum There are 5 different carbon environments (1)		1				
				From reaction with bromine 320 g of bromine is 2 mol (1) **X** contains 2 (C to C) double bonds (1)		2				
				X is CH_2=CHCH=CHCO_2H (accept any isomer with 2 double bonds, 5 carbon environments and CO_2H) (1)			1	10		
				Question 12 total	**1**	**8**	**1**	**10**	**2**	**0**

© WJEC CBAC Ltd.

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1. to 6.	1	9	0	10	0	2
7.	0	7	4	11	4	5
8.	2	5	6	13	4	0
9.	9	0	0	9	0	0
10.	6	1	2	9	1	2
11.	9	6	3	18	3	8
12.	1	8	1	10	2	0
Totals	28	36	16	80	14	17

© WJEC CBAC Ltd.