GCSE MARKING SCHEME

SUMMER 2022

GCSE
CHEMISTRY – UNIT 2
3410U20-1 AND 3410UB0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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 GCSE CHEMISTRY

UNIT 2 – CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY

SUMMER 2022 MARK SCHEME

GENERAL INSTRUCTIONS

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.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

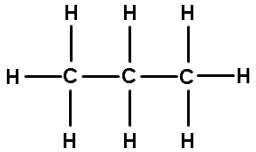
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Foundation Tier only questions

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			award (1) for each correct label beaker (filter) funnel (evaporating) basin accept (evaporating) dish (electronic) balance accept (weighing) scales	4			4		4
	(b)			bubbling increases ☐ bubbling stops ☑ bubbling decreases ☐	1			1		1
	(c)			carbon dioxide	1			1		1
	(d)			filtration (1) evaporation (1)	2			2		2
	(e)			13.9		1		1	1	1
				Question 1 total	**8**	**1**	**0**	**9**	**1**	**9**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			hundreds of years ☐ thousands of years ☐ millions of years ✓	1			1		
	(b)			fractional distillation ✓ filtration ☐ cracking ☐ polymerisation ☐	1			1		
	(c)	(i)		petrol			1	1		
		(ii)		diesel (oil)			1	1		
		(iii)		naphtha			1	1		
		(iv)		petrol (1) forms no smoke (1)	1		1	2		
				Question 2 total	**3**	**0**	**4**	**7**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			 (1) C_4H_{10} (1)	2			2		
	(b)			**C** accept correct structure drawn	1			1		
	(c)			bromine (water)	1			1		1
	(d)	(i)		ethanol	1			1		
		(ii)		46 (2) if incorrect award (1) for any clear indication of correct number of atoms of each element e.g. (2 × C) + (6 × H) + (1 × O) or 2(12) + 5(1) + 16 + 1		2		2	2	
				Question 3 total	**5**	**2**	**0**	**7**	**2**	**1**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		$PbBr_2$		1		1		1
		(ii)		liquid neutral answer - molten	1			1		
		(iii)		bromine / Br_2 accept Br ignore any reference to molten do not accept bromide / Br^-		1		1		1
		(iv)		$Pb + 2e^- \longrightarrow Pb^{2+}$ ☐ $Pb^{2+} - 2e^- \longrightarrow Pb$ ☐ $Pb^{2+} + 2e^- \longrightarrow Pb$ ✓ $Pb - 2e^- \longrightarrow Pb^{2+}$ ☐		1		1		
	(b)	(i)		coke (1) oxygen (1) limestone (1)	3			3		
		(ii)		**B** accept $2Fe + 3CO_2$		1		1	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		mild steel		1		1		
		(ii)		brittleness increases			1	1		
		(iii)		award (1) for any of following malleable easily shaped easy to bend do not accept ductile / soft / strong / hard			1	1		
		(iv)		**A** (1) award (1) for either of following • contains two different types of atoms / contains two elements / contains iron and carbon (atoms) • B only has one type of atoms and C has three types of atoms neutral answers contains two atoms / contains different atoms		1 1		2		
				Question 4 total	**4**	**7**	**2**	**13**	**1**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		award (2) for all three correct award (1) for any two correct		2		2	2	2
		(ii)		award (1) for correct order calcium / Ca magnesium / Mg zinc / Zn iron / Fe				1		1
		(iii)		Alex (1) award (1) for any of following copper is a (good) (heat) conductor copper is not an insulator heat can travel through copper (more) easily neutral answer - copper is a metal / copper absorbs heat			2	2		2
		(iv)		award (1) for each correct product $MgSO_4$ Cu ignore any attempt at balancing		2		2		
	(b)			between zinc and iron / below zinc and above iron more reactive than iron but less reactive than the other three metals neutral answer – less reactive than zinc, calcium and magnesium		1		1		1

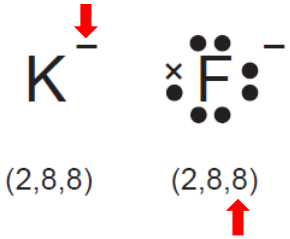
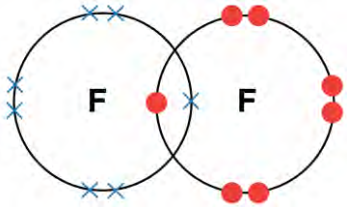
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			5 250 (2) if answer is incorrect award (1) for 50 × 4.2 × 25 ecf possible if incorrect temperature selected from table [or 30 used from part (b)]		2		2	2	
				Question 5 total	**0**	**7**	**3**	**10**	**4**	**6**

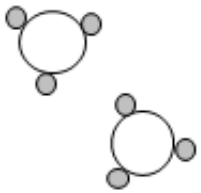
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6				**Indicative content** • scale that measures strength of an acid/alkali • pH 7 is neutral • lower than pH 7 acidic • higher than pH 7 alkaline • acid strength decreases from 1 to 6 • alkali strength increases from 8 to 16 • pH values given by colour seen using universal indicator • battery acid ⇨ red ⇨ pH 1 ⇨ strong acid • milk ⇨ yellow ⇨ pH 6 ⇨ weak acid • water ⇨ (pale) green ⇨ pH 7 ⇨ neutral • drain cleaner ⇨ purple ⇨ pH 14 ⇨ strong alkali	2	4		6		6
				5-6 marks Good description of all aspects of scale; correct description of pH of substances *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3-4 marks** Description including reference to acids, alkalis and neutral substances; correct description of pH of two substances *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Reference to acids, alkalis or neutral substances; colours linked to pH *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 6 total	**2**	**4**	**0**	**6**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Gloves need to be worn when using hand warmers ☐ Boiling water is used to recharge battery powered hand warmers ☐ Some chemical reactions give out heat energy ✓ All hand warmers are reusable ☐			1	1		1
		(ii)		award (1) for each of following cheapest accept cheap / only costs £1 least temperature drop (over time) / keeps warmer longer neutral answer – it lasts longer			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		award (2) for all points plotted correctly – tolerance ±½ square award (1) for any 6 points plotted correctly award (1) for smooth curve through all points (from origin)		3		3	3	
		(ii)		2 hours ☐ 3 hours ☑ 4 hours ☐ 5 hours ☐		1		1	1	1
		(iii)		Iron reacts with oxygen forming iron oxide until all the oxygen is used up ☐ Heat formed expands the iron ☐ Iron oxide loses oxygen, forming iron ☐ Iron reacts with oxygen forming iron oxide until all the iron is used up ☑			1	1		1
				Question 7 total	**0**	**4**	**4**	**8**	**4**	**5**

Common questions

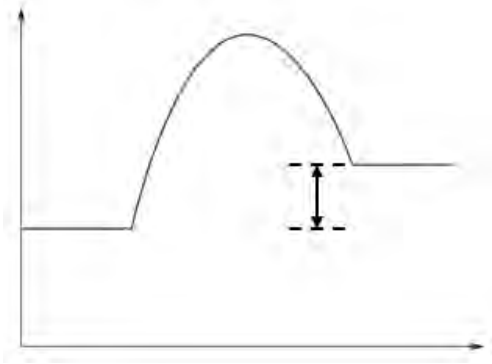
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8/1	(a)	(i)		 award (1) for each mistake identified [no explanation required but should be K^+ and (2,8)]		2		2		
		(ii)		ionic		1		1		
		(iii)		**C**	1			1		
	(b)			 award (2) for correct answer if not correct award (1) for shared pair of electrons accept dots used to represent all electrons		2		2		
				Question 8/1 total	**1**	**5**	**0**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9/2	(a)	(i)		air do not accept oxygen	1			1		
		(ii)		award (1) for any sensible answer e.g. strong(er) equipment required requires thick(er) pipes requires strong(er) pipes more maintenance may explode more energy needed more expensive neutral answer - dangerous	1			1		
		(iii)		catalyst	1			1		
		(iv)		 award (2) for correct answer award (1) for one ammonia molecule drawn correctly award (1) max if any additional product(s) included		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			**A**			1	1		
	(c)			$2NH_3 + 3Cl_2 \longrightarrow N_2 + \boxed{6} HCl$		1		1		
				Question 9/2 total	**3**	**3**	**1**	**7**	**0**	**0**

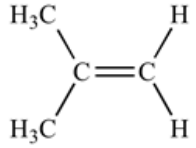
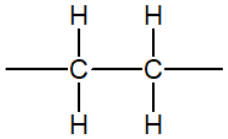
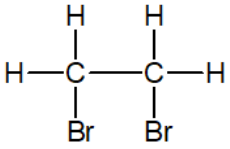
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10/3	(a)	(i)		electrolysis	1			1		
		(ii)		Carbon is reduced ☐ Tin is oxidised ☐ Tin oxide is reduced ✓ Carbon dioxide is oxidised ☐	1			1		
		(iii)		$2Al + 3$ CuO $\longrightarrow$ Al_2O_3 $+$ 3 Cu award (1) for reactant award (1) for product award (1) for balancing - can only be awarded if reactant is correct		3		3		
	(b)			**D** **B** **A** **C** award (2) for correct order award (1) for any two in correct position			2	2		
				Question 10/3 total	**2**	**3**	**2**	**7**	**0**	**0**

Higher Tier only questions

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			464 (2) ignore minus sign if incorrect award (1) for either of following 4(O—H) $\frac{1856}{4}$		2		2	2	
	(b)			498 (2) ignore minus sign if incorrect award (1) for either of following 2(H—H) (2 × 436) 872		2		2	2	
	(c)				1			1		
				Question 4 total	**1**	**4**	**0**	**5**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		award (1) for each correct answer **A** fermentation **B** filtration **C** (fractional) distillation	3			3		3
		(ii)	I	add bromine water ☐ add acidified potassium dichromate solution ✓ add silver nitrate solution ☐ add barium chloride solution ☐	1			1		1
			II	orange to colourless ☐ orange to green ✓ green to orange ☐ colourless to green ☐	1			1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		**A**			1	1		
		(ii)		**F**			1	1		
	(c)	(i)		award (1) for any sensible answer e.g. liver disease cancer of mouth / throat / oesophagus high blood pressure brain damage ulcers breast cancer obesity heart disease depression accept damage ≡ disease neutral answer - cancer do not accept skin cancer / lung cancer / prostate cancer	1			1		
		(ii)		award (1) for any sensible answer e.g. impaired judgement unconsciousness / blackouts fights / domestic violence car accidents / alcohol poisoning vomiting	1			1		
				Question 5 total	**7**	**0**	**2**	**9**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		cracking	1			1		
		(ii)		C_6H_{14}		1		1		
	(b)			award (1) for any correct structure e.g. 		1		1		
	(c)	(i)		 ignore brackets / number of units	1			1		
		(ii)	I			1		1		
			II	1,2-dibromoethene ☐ 1,1-dibromoethane ☐ 1,2-dibromoethane ✓ 1,1-dibromoethene ☐		1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		award (1) for method incineration / burning award (1) for any associated problem toxic fumes acid rain climate change / global warming / formation of carbon dioxide neutral answers - air pollution	2			2		
		(ii)		crude oil / petroleum (1) award (1) for any of following non-renewable resource finite resource used to make other important products neutral answer - conserves crude oil	2			2		
				Question 6 total	**6**	**4**	**0**	**10**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			It is cheaper than the traditional method ☐ It uses less energy ✓ It reduces carbon dioxide emissions ✓ It uses gold nano-particles ☐ It uses more fuel ☐			2	2		
	(b)			$2CH_4$ + O_2 → 2 CH_3OH award (1) for reactant and product award (1) for balancing - can only be awarded if reactant and product are correct			2	2		
	(c)			The melting points of gold nano-particles and bulk gold are the same ☐ Gold nano-particles have a fixed melting point value ☐ Smaller gold nano-particles have higher melting points than larger gold nano-particles ☐ The melting point of gold nano-particles depends on their size ✓			1	1		
				Question 7 total	**0**	**0**	**5**	**5**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			80 (2) if answer incorrect award (1) for any of following 84 000 J in method final answer of 0.008 or 8 no ecf possible if formula is rearranged incorrectly or if incorrect energy value taken from table		2		2	2	
	(b)			award (2) for all points plotted correctly - tolerance ±1 square award (1) for any 3 points plotted correctly award (1) for straight line through all point - ruler must be used		3		3	3	
	(c)			award (2) for high-level quantitative description • as the mass doubles, the energy doubles • mass and energy are directly proportional award (1) for lower-level description • as the mass increases, the energy increases • mass and energy are proportional • mass and energy are directly correlated • mass and energy have a linear relationship		2		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			award (1) for resolution and (1) for sensible explanation e.g. change glass beaker to copper can (1) copper is a better conductor (of heat) / increase heat transfer (1) shield the apparatus (1) prevent draughts / reduce heat loss to surroundings (1) lower the beaker (nearer the flame) (1) increase heat transfer / reduce heat loss to surroundings (1) use a lid / insulate the beaker (1) reduce heat loss to surroundings (1)			2	2		2
				Question 8 total	**0**	**7**	**2**	**9**	**7**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		award (1) for any reference to solutions/compounds <u>changing colour</u> e.g. • green (solution) turns orange/brown (in reaction 1) • orange/brown (solution) turns green (in reaction 2)			1	1		1
		(ii)	I	$Fe + 2\ FeCl_3 \longrightarrow \boxed{3}\ FeCl_2$ award (1) for reactant award (1) for balancing - can only be awarded if reactant is correct		2		2		
			II	(oxidation is) the <u>loss of electrons</u> (1) award (1) for any of following Fe forms / is oxidised to Fe^{2+} $Fe \rightarrow Fe^{2+} + 2e^-$ $Fe - 2e^- \rightarrow Fe^{2+}$ one statement could achieve both marks e.g. Fe loses electrons to form Fe^{2+}	1		1	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			award (1) for reagent sodium hydroxide (solution) / NaOH award (1) for observation blue precipitate formed accept blue solid formed accept any shade of blue e.g. light blue neutral answers - blue / blue solution	2			2		2
				Question 9 total	**3**	**2**	**2**	**7**	**0**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		moles = $\frac{conc \times volume}{1000} = \frac{1.5 \times 12}{1000}$ = 0.018 (2) accept 0.02 if working correct if answer incorrect award (1) for either of following 0.012 18 no ecf possible if formula is rearranged incorrectly		2		2	2	2
		(ii)		0.036 ecf possible from part (i)		1		1	1	1
		(iii)		3.6 (2) ecf possible from parts (i) and (ii) if answer incorrect award (1) for $\frac{0.036}{10}$		2		2	2	2
	(b)	(i)		award (1) for either of following any positive temperature change of less than 19°C temperature change will be less than 19°C / lower award (1) for reason e.g. (ethanoic acid) is a weaker acid / has a higher pH (ethanoic acid) is less dissociated / has fewer H^+ ions accept ethanoic acid / it is a weak acid			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)	I	copper(II) ethanoate accept copper ethanoate	1			1		
			II	$Cu(CH_3COO)_2$			1	1		
				Question 10 total	**1**	**5**	**3**	**9**	**5**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11				**Indicative content** • H^+ and Na^+ ions attracted to negative electrode because opposites attract • H^+ ions gain electrons forming hydrogen (gas) • $2H^+ + 2e^- \rightarrow H_2$ • hydrogen formed rather than sodium because hydrogen is below sodium in reactivity series so Na^+ ions remain in solution • OH^- and Cl^- ions are attracted to the positive electrode because opposite attract • Cl^- ions lose electrons forming chlorine (gas) • $2Cl^- \rightarrow Cl_2 + 2e^-$ • OH^- ions less easily oxidised than Cl^- ions so remain in solution • Na^+ and OH^- ions remain in solution ⇨ sodium hydroxide	6			6		
				5-6 marks Full explanation of formation of hydrogen and chlorine with attempt at sodium hydroxide; good attempt at ionic equations *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3-4 marks** Good attempt at explanation of formation of hydrogen and chlorine; attempt at ionic equation *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Attempt at explanation of formation of hydrogen or chlorine *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 11 total	**6**	**0**	**0**	**6**	**0**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	8	1	0	9	1	9
2	3	0	4	7	0	0
3	5	2	0	7	2	1
4	4	7	2	13	1	2
5	0	7	3	10	4	6
6	2	4	0	6	0	6
7	0	4	4	8	4	5
8	1	5	0	6	0	0
9	3	3	1	7	0	0
10	2	3	2	7	0	0
TOTAL	28	36	16	80	12	29

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	1	5	0	6	0	0
2	3	3	1	7	0	0
3	2	3	2	7	0	0
4	1	4	0	5	4	0
5	7	0	2	9	0	0
6	6	4	0	10	0	0
7	0	0	5	5	0	0
8	0	7	2	9	7	2
9	3	2	2	7	0	3
10	1	5	3	9	5	7
11	6	0	0	6	0	0
TOTAL	30	33	17	80	16	12