GCSE MARKING SCHEME

SUMMER 2023

GCSE
SCIENCE (DOUBLE AWARD) – UNIT 2

3430U20-1 AND 3430UB0-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2023 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.

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GCSE SCIENCE (DOUBLE AWARD) UNIT 2 – CHEMISTRY 1

SUMMER 2023 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

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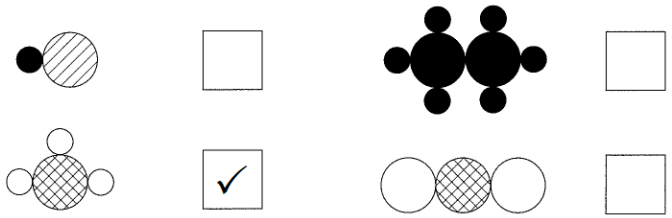
FOUNDATION TIER ONLY QUESTIONS

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		hydrogen bromide accept HBr		1		1		
		(ii)		carbon **and** hydrogen **both** needed, either order		1		1		
		(iii)		3		1		1		
		(iv)				1		1		
	(b)			H_2CO_2 accept correct number of atoms in **any** order		1		1		
	(c)	(i)		Li^+ and Cl^- **both** needed		1		1		
		(ii)		$MgBr_2$		1		1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		$2Ca + O_2 \longrightarrow 2CaO$ ✓ $Ca + O_2 \longrightarrow 2CaO$ ☐ $Ca + O \longrightarrow CaO$ ☐		1		1		
				Question 1 total	**0**	**8**	**0**	**8**	**0**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	I	**D**	1			1		
			II	**B** **E** **F** award (1) for **each** correct letter – **any** order	3			3		
		(ii)		convection	1			1		
	(b)	(i)		14.8			1	1	1	
		(ii)		carbon dioxide neutral answers – methane / greenhouse gas	1			1		
		(iii)		award (1) each for up to **two** of following climate change (more) extreme weather (more) drought conditions (more) flooding forest fires snowier winters slowing of gulf stream leading to colder weather in UK/ northern Europe polar ice caps melting (at a faster rate) sea levels rising crop failure different pests affecting farmland loss of wildlife habitat	2			2		
				Question 2 total	**8**	**0**	**1**	**9**	**1**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			2 times ☐ 3 times ☑ 4 times ☐ 5 times ☐			1	1	1	
	(b)	(i)		award (2) all points plotted correctly tolerance ±½ square award (1) for 4/5 points plotted correctly award (1) for suitable curve ecf possible from incorrect plotting		3		3	3	3
		(ii)	I	award (1) for any value in the range 72-76 ecf possible from incorrectly plotted/drawn line		1		1	1	1
			II	award (1) for any value in the range 34-38 ecf possible from incorrectly plotted/drawn line		1		1	1	1
	(c)	(i)		$2KNO_3 \rightarrow \mathbf{2}\ KNO_2 + O_2$		1		1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		72 (2) if answer incorrect award (1) for any of following $\frac{3.13}{4.35}$ $\frac{6260}{87}$ 71.9		2		2	2	
				Question 3 total	**0**	**8**	**1**	**9**	**8**	**5**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		24		1		1	1	1
		(ii)		accept any value in the range 4.7-5.0			1	1	1	1
		(iii)		1 ☑ 2 ☐ 3 ☐			1	1		1
		(iv)		0.25 (2) if answer incorrect award (1) for either of following indication of time of 30s indication of calculation using 0.5 i.e. $\frac{7.5}{0.5}$ / 15			2	2	2	
	(b)	(i)		**B**	1			1		1
		(ii)		more (1) a greater (1)	2			2		
				Question 4 total	**3**	**1**	**4**	**8**	**4**	**4**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5				**Indicative content** use large trough of water small piece of metal tongs safety glasses safety screen lithium - least reactive – floats, moves slowly and only produces a small amount bubbles sodium - floats, melts into a ball, moves quickly and produces more bubbles potassium - most reactive – floats, moves very quickly, burns with a lilac flame and produces a large amount of bubbles **5-6 marks** Good safety precautions; good description of observations with some specific detail; clear indication of order of reactivity *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** One safety precaution; basic description of general observations for Group 1 metals; some reference to order of reactivity *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.*	6			6		6

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Basic reference to safety; some relevant observations *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 5 total	**6**	**0**	**0**	**6**	**0**	**6**

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Question				Marking details		Marks available					
						AO1	AO2	AO3	Total	Maths	Prac
6	(a)			London, Yorkshire and the North West all have a mean DMFT of 1.0				2	2		
				The South East has the lowest mean DMFT	✓						
				East Midlands has the highest mean DMFT							
				East England, the South West and the South East have a mean DMFT of 0.7							
				The East Midlands has a lower mean DMFT than Yorkshire	✓						
				London, the North West and South West all have a mean DMFT of 0.9							
	(b)	(i)		All areas with fluoridated drinking water have lower mean DMFT than areas which do not fluoridate water				1	1		
				All areas with fluoridated drinking water have the same mean DMFT as non-fluoridated areas							
				All areas with fluoridated drinking water have lower mean DMFT than the North West	✓						
		(ii)		It is not possible to decide whether fluoridation of drinking water lowers mean DMFT	✓			1	1		
				All areas with fluoridated drinking water have higher mean DMFT than areas which do not fluoridate drinking water							
				All areas with fluoridated drinking water have a higher mean DMFT than the South West							

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			award (1) for any of following • more people brush their teeth (with toothpaste) • better dental hygiene / use mouthwash / floss • natural fluoride in (drinking) water • less sugar in diets neutral answers toothpaste better education wealthier area			1	1		
				Question 6 total	**0**	**0**	**5**	**5**	**0**	**0**

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COMMON QUESTIONS

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7/1	(a)			**A** and **B** (1) **both** needed both contain two shells (of electrons) (1)	1	1		2		
	(b)			**D** (1) has a full outer shell (of electrons) (1) accept **all** shells full neutral answers has 8 electrons in outer shell has full shell		2		2		
	(c)			award (1) for either of following • number of electrons (in the shells) is equal to the number of protons (in the nucleus) • **E** has 11 electrons so it also has 11 protons award (1) for either of following • number of protons is equal to the atomic number • because it has 11 protons its atomic number is 11 number of electrons, number of protons and atomic number must all be linked to gain both marks	2			2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			**4** $K + O_2 \rightarrow 2\ K_2O$ award (1) for K_2O award (1) for balancing only if formula correct		2		2		
				Question 7/1 total	**3**	**5**	**0**	**8**	**0**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8/2	(a)			0.42 (2) if answer incorrect award (1) for any of following 42 420000 4.2×10^5		2		2	2	
	(b)			award (1) for any of following • distillation • reverse osmosis • graphene membrane neutral answers desalination boiling / evaporation / condensation	1			1		
	(c)			add soap solution to both water samples **and** shake (1) fair testing - **equal volumes** of both water samples **and shake for an equal amount of time** (1) the sample that produces more lather is the softer water / the sample that produces less lather is the harder (1) alternative method add $1cm^3$ / small volume of soap solution and shake; if no lather add further $1cm^3$ / small volume (1) fair testing - **equal volumes** of both water samples **and shake for an equal amount of time** (1) the sample that lathers with less soap is the softer / the sample that requires more soap is the harder (1)	3			3		3

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Na_2CO_3		1		1		
				Question 8/2 total	**4**	**3**	**0**	**7**	**2**	**3**

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HIGHER TIER ONLY QUESTIONS

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			award (1) for any of following • yellow and green have similar R_f values • yellow and green travel similar distances • yellow and green have similar solubilities neutral answers • spots will overlap on chromatogram • colours won't separate			1	1		1
	(b)			award (1) for any of following • one spot stays on the start line (and another one travels around half way up the chromatogram) • yellow doesn't move • only the green would move neutral answer – one travels further than the other			1	1		1
	(c)			(yellow) spot at 3.5 cm (1) tolerance ±1 square (green) spot at 8.1 cm (1) tolerance ±1 square			2	2		2
				Question 3 total	**0**	**0**	**4**	**4**	**0**	**4**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4				**Indicative content** **A** – destructive/convergent plate boundary oceanic and continental plates move towards one another more dense oceanic plate forced under less dense continental plate friction causes earthquakes, subducted plate melts, rising magma forms volcanoes, mountain building **B** – constructive/divergent plate boundary plates move apart magma wells up to fill gap magma cools and forms new igneous, sea-floor spreading **5-6 marks** Both boundaries discussed, good detail for both *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** Some detail relating to both boundaries or one boundary with good detail *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.*	6			6		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Some detail relating to one boundary *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 4 total	**6**	**0**	**0**	**6**	**0**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			more acid added than is needed to react with all the marble chips accept marble chips run out <u>first</u> / acid is in excess		1		1		1
	(b)			line drawn steeper / to the left of line **A** <u>and</u> reaching a maximum level of 60 cm^3		1		1		
	(c)			8.66 (2) if answer incorrect award (1) for either of following $\frac{7.8}{100}$ / 0.078 / 7.8 × 111 0.078 × 111 / $\frac{866}{100}$ ecf possible alternative method $n(CaCO_3) = 0.078$ mol ⇨ $n(CaCl_2) = 0.078$ mol (1) mass $CaCl_2 = 0.078 \times 111 = 8.66$ g (1) ecf possible		2		2	2	

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			26.6 (2) if answer incorrect award (1) for either of following $\frac{14.3}{53.7}$ / 0.266 0.266 × 100 no ecf possible alternative methods $\frac{14.3}{0.537}$ (1) $\frac{100}{53.7}$ × 14.3 (1) 26.6 (1) 26.6 (1) no ecf possible		2		2	2	
	(e)			a catalyst lowers the minimum energy needed for reaction / successful collisions / lowers the activation energy (1) this means more <u>successful</u> collisions (per second) / higher frequency/chance of <u>successful</u> collisions (so higher rate) (1) if no reference to collisions award (1) mark for 'a catalyst provides a suitable surface for a reaction'	2			2		
				Question 5 total	**2**	**6**	**0**	**8**	**4**	**1**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			DMFT award (1) for any of following • the higher the fluoride concentration, the lower the mean DMFT / the lower the fluoride concentration, the higher the mean DMFT / OWTTE • at this concentration DMFT is low • at lower concentration DMFT is high / higher award (1) for increasing fluoride ion concentrations above 1.0 mg/dm^3 does not make a difference to DMFT levels / OWTTE fluorosis award (1) each for any two of following • the higher the fluoride concentration, the higher the percentage affected by fluorosis / the lower the fluoride concentration, the lower the percentage affected by fluorosis / OWTTE • at this concentration fluorosis is low • at higher concentration fluorosis increases <u>significantly</u> / when fluoride ion concentration reaches 1.2 mg/dm^3 there is a <u>significant</u> increase in fluorosis (to 35%) / OWTTE • this concentration is best/optimum balance between DMFT and fluorosis			4	4		
	(b)			chlorine kills bacteria / sterilises drinking water / makes the water safe to drink (1) award (1) for either of following • fluoride can cause side effects e.g. can cause stomach cancer, bone cancer, birth defects, infertility, brittle bones, IBS • adding fluoride is a form of mass medication / people are forced to consume it	2			2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			titanium fluorine $\frac{2.4}{48}$ $\frac{3.8}{19}$ (1) 0.05 0.2 (1) TiF_4 (1) award (2) for Ti_4F with working shown ecf possible		3		3	3	
				Question 6 total	**2**	**3**	**4**	**9**	**3**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Carbon dioxide concentration increased by approximately 10 ppm every 10 years ☐ Carbon dioxide concentration increased more between 1970 and 2010 than it did between 1930 and 1960 ✓ Carbon dioxide concentration increased more between 1930 and 1960 than it did between 1970 and 2010 ☐ There is no trend to the change in carbon dioxide concentration between 1930 and 2010 ☐			1	1	1	
	(b)			as carbon dioxide concentration increases (from 1930 to 2010) then so does the Earth's mean temperature (so good evidence) to support this claim (1) award (1) for any of following / OWTTE • as solar activity increases from 1930 to 1960 then so does Earth's mean temperature but after 1960 solar activity decreases but Earth's average temperature continues to increase (so not good evidence) • solar activity does not change much between 1930 and 2010 but the temperature increases (so not good evidence) • solar activity decreasing at the end but temperature still increasing (so not good evidence) if neither of these marks credited award (1) for 'data suggests that claim is true for carbon dioxide but not true for solar activity' / OWTTE			2	2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			award (1) for any of following • this is only one piece of evidence / not enough evidence to prove global dimming / more evidence needed from other events • this is only local information (for a 20-mile radius) around Mount Pinatubo • more information is needed about the temperature values before 1990			1	1		
	(d)			carbon capture / carbon capture and storage	1			1		
	(e)			green plants evolved which photosynthesised (thus absorbing carbon dioxide) (1) award (1) each for any two of following • (some) carbon dioxide became locked into fossil fuels • (some) carbon dioxide became locked into shells of marine animals / limestone / chalk / rocks • (some) carbon dioxide was absorbed by oceans / seas	3			3		
	(f)			$Ca(OH)_2$		1		1		
				Question 7 total	**4**	**1**	**4**	**9**	**1**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		sodium bromide / NaBr (1) iodine / I_2 (1)		2		2		2
		(ii)		bromine is more reactive than <u>iodine</u> / elements get less reactive down <u>Group 7</u> (1) so bromine **displaces** iodine / **takes electrons** from iodide / **oxidises** iodide (1)	2			2		2
	(b)			$2Fe + 3Br_2 \rightarrow 2FeBr_3$ award (1) for correct product award (1) for balancing only if all formulae are correct		2		2	1	
	(c)	(i)		yellow precipitate	1			1		1
		(ii)		$Ag^+ + I^- \rightarrow AgI$ award (1) for reactants award (1) for product		2		2		
				Question 8 total	**3**	**6**	**0**	**9**	**1**	**5**

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FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	0	8	0	**8**	0	0
2	8	0	1	**9**	1	0
3	0	8	1	**9**	8	5
4	3	1	4	**8**	4	4
5	6	0	0	**6**	0	6
6	0	0	5	**5**	0	0
7	3	5	0	**8**	0	0
8	4	3	0	**7**	2	3
TOTAL	**24**	**25**	**11**	**60**	**15**	**18**

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HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	5	0	**8**	0	0
2	4	3	0	**7**	2	3
3	0	0	4	**4**	0	4
4	6	0	0	**6**	0	0
5	2	6	0	**8**	4	1
6	2	3	4	**9**	3	0
7	4	1	4	**9**	1	0
8	3	6	0	**9**	1	5
TOTAL	**24**	**24**	**12**	**60**	**11**	**13**

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