UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the 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.

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

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		All 5 points plotted correctly (2) [Credit (1) for 3 or 4 correct points] Straight line of best fit attempted (1)		2 1		3	3	3
		(ii)		Both increase as temperature increases (1) Any two of following for (1) each Solubilities the same at 50°C KNO_3 more soluble than $Pb(NO_3)_2$ above 50°C / KNO_3 less soluble than $Pb(NO_3)_2$ below 50°C KNO_3 increases much more than $Pb(NO_3)_2$		2	1	3	1	
	(b)			4.9 g of substance **X** undissolved (1) 15.1 g of substance **X** has dissolved (in 50 g of water) (1) 30.2 (1) Award (3) for correct answer only		3		3	3	3
				Question 1 total	**0**	**7**	**2**	**9**	**7**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Gas syringe	1			1		1
	(b)	(i)		As concentration of acid increases the rate of reaction increases (1) Greater number of acid particles at higher concentration (1) Greater chance of (successful) collisions with magnesium / more (successful) collisions per second (1)	 1 1		1	 3		
		(ii)		No useful data was collected / 30 cm^3 of gas collected in most experiments (1) All the magnesium was used up well before 60 s / the final volume of gas was collected well before 60 s / the reaction was over well before 60 s (1)			 2	 2	1	 2
		(iii)		Temperature of the acid (1) Surface area of the magnesium (1)	 2			 2		
	(c)			Method – add three samples to water and measure loss of mass (1) Controlled variables – award (1) each for up to two of the following: same volume of each water sample same amount of time samples of same or similar size/shape/mass		 2	1	 3		 3
				Question 2 total	**5**	**2**	**4**	**11**	**1**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Respiration takes in oxygen and produces carbon dioxide (1) Photosynthesis takes in carbon dioxide and produces oxygen (1)	2			2		
	(b)	(i)		Greenhouse effect is a natural process but global warming occurs when this effect becomes stronger as a result of increased amounts of carbon dioxide / greenhouse gases being released to the atmosphere	1			1		
		(ii)		Any two of following for (1) each **More** extreme weather/storms/floods/droughts Animals lose habitat Unable to grow crops Sea levels rise Credit other sensible points	2			2		
		(iii)		Stop carbon dioxide gas escaping to the atmosphere / trap carbon dioxide gas (1) Store it in some form e.g. by pumping it into empty oil wells / reacting it with other chemicals to form solid products (1) Accept any sensible suggestion	2			2		
				Question 3 total	**7**	**0**	**0**	**7**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Potassium carbonate – **highest** decomposition temperature/needs **most** heat to decompose		1		1		1
		(ii)		Award up to (2) for method Heat in a tube (1) Gas collected – delivery tube, teat pipette or sensible method (1) Award up to (2) for observations Green powder turns black (1) Test gas with limewater – turns milky showing gas to be carbon dioxide (1)	1 1	1 1		4		4
		(iii)		Appearance – **C** is copper(II) carbonate (1) Flame test – **A** is calcium carbonate, **B** is potassium carbonate and **D** is magnesium carbonate (1)			2	2		2
	(b)	(i)		**2**KNO_3 → **2**KNO_2 + O_2		1		1	1	
		(ii)		47.5 % (2) Accept 48 % If answer is incorrect award (1) for calculation of M_r of 101		2		2	2	
				Question 4 total	**2**	**6**	**2**	**10**	**3**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5				Constructive / divergent plate boundary (1) Plates move apart and magma rises forming new rock as it cools (1) Destructive / convergent plate boundary (1) Plates move together and subduction occurs / less dense plate forced underneath more dense plate (1) Subducted plate melts with magma creating volcanoes (1) Max (3) if reference to conservative plate boundary	5			5		
				Question 5 total	**5**	**0**	**0**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Melting points increase going down the group (1) At 20 °C Chlorine is a gas Bromine is a liquid Iodine is a solid Award (2) for all three states correct Any (1) for any two correct		3		3	2	
	(b)			Credit sensible **explanation** if melting point value given in the range 180-260 °C e.g. difference between chlorine-bromine and bromine-iodine melting points is approximately 100 °C therefore approximately 100 °C higher again			1	1	1	
	(c)			35.5 (3) If answer is incorrect award (1) for each of following Indication that ^{37}Cl is the isotope making up 25 % of all atoms (35 × 75) **and** (37 × 25) or 2625 **and** 925		3		3	3	
				Question 6 total	**0**	**6**	**1**	**7**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			45 % (2) Accept values in the range 42-48 If answer is incorrect award (1) for One value correctly read from graph		2		2	2	
	(b)			Award (1) for sensible reason and further (1) for linked point / explanation e.g. People got fluoride from other sources – toothpaste/mouthwash Better dental care – less tooth decay	2			2		
	(c)			Both graphs suggest that fluoridation leads to decrease in DMFT (1) However Graph 2 shows that DMFT has also decreased in unfluoridated areas (1) Any two of following for (1) each Other factors may be involved e.g. dental care More data should be collected / examined Possible side effects should be considered Accept other sensible points			4	4		
				Question 7 total	**2**	**2**	**4**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8				***Indicative content*** • Ion exchange – resin containing sodium ions exchange with calcium/magnesium ions in hard water; removes permanent and temporary hardness; column re-charged with saturated sodium chloride solution • Boiling – decomposes hydrogencarbonate ions to form scale on heating elements; removes temporary hardness only; expensive method • Distillation – water is boiled and steam collected; all ions left behind therefore removes all hardness; expensive method • Washing soda – reacts with calcium and magnesium ions to form insoluble salts (scum); effectively removes temporary and permanent hardness **5–6 marks** Good description of minimum of three methods including details of how they work and which type of hardness is removed *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** Basic description of minimum of two methods discussed with reference to how one of them works; reference to removal of temporary and permanent hardness *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** Basic reference to one method used with some indication of how it works or the type of hardness removed *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.*	6			6		
				Question 8 total	**6**	**0**	**0**	**6**	**0**	**0**

<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>9</td><td>(a)</td><td>(i)</td><td></td><td>
<table>
<tr><th rowspan="2">Halogen</th><th colspan="3">Solution of halide ion</th></tr>
<tr><th>sodium chloride</th><th>sodium iodide</th><th>sodium bromide</th></tr>
<tr><td>bromine, Br_2</td><td>×</td><td>✓</td><td></td></tr>
<tr><td>chlorine, Cl_2</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>iodine, I_2</td><td>×</td><td></td><td>×</td></tr>
</table>
All five ✓/ × correct (2)
Any four correct (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Reactivity decreases down the group (1)

Going down the group the size of the atom increases / distance between (positive) nucleus and (negative) electrons increases (1)

Therefore more difficult to attract an electron into outer shell (1)</td><td>2</td><td>1</td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>$Br_2 + 2NaI \rightarrow 2NaBr + I_2$ (2)

If equation not correct award (1) if all formulae are correct</td><td></td><td>2</td><td></td><td>2</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>BrF_3 with working showing $80 + (3 \times 19)$ (1)

Br → 355/80 = 4.44 and F → 430/19 = 22.6 (1)

Ratio 1:5 therefore BrF_5 (1)</td><td></td><td></td><td>3</td><td>3</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 9 total</td><td>4</td><td>3</td><td>3</td><td>10</td><td>4</td><td>2</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Catalyst increases the rate of reaction (1) Lowers the energy required for a successful collision between SO_2 and O_2 molecules (1)	1	1		2		
	(b)	(i)		2.75×10^9 mol (3) If answer is incorrect award (1) for each of following $M_r(SO_2) = 64$ Indication of 176/64 **or** 2.75		3		3	3	
		(ii)		165 tonnes (2) If answer is incorrect award (1) for either 1.375×10^9 mol **or** Indication that mass in grams multiplied by 120 Error carried forward from part (i)		2		2	2	
				Question 10 total	**1**	**6**	**0**	**7**	**5**	**0**