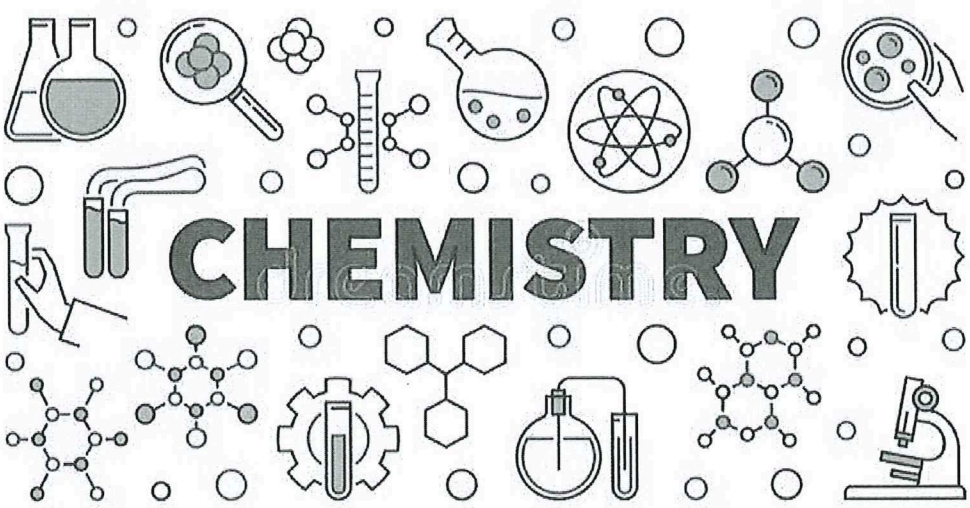

WJEC Chemistry 1

Dual Award – Higher Tier

1.3 Mark Scheme

Higher Tier only questions

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Samples A, B and C contain magnesium or calcium ions ✓ Only samples A and B contain magnesium or calcium ions Only samples B and C contain magnesium or calcium ions None of the samples contain magnesium or calcium ions			1	1		
	(b)			To show the expected result for permanent hard water To show the expected result for temporary hard water To act as a control for the experiment ✓ To make sure the investigation is a fair test	1			1		1
	(c)			volume of soap solution and number of times shaken volume of water sample and volume of soap solution used volume of water sample and number of times shaken ✓ volume of water sample, volume of soap solution and number of times shaken	1			1		1
	(d)			Sample B contains temporary hardness only Sample B contains permanent hardness only Sample B contains a mixture of temporary and permanent hardness ✓ Sample B does not contain hardness the volume of soap needed after boiling is less than before / less soap is needed after boiling (1) the volume of soap after boiling is still more than the distilled water (1)			3	3		3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			if answered yes accept any two of following for (1) each • strengthens bones / teeth • reduced chance of heart disease • better for baking / brewing industry • improves flavour of water if answered no accept any two of following for (1) each • forms a scum with soap / wastes soap • furs up kettles / pipes / forms limescale • appliances become less efficient (or named appliance) • bad taste / tastes different if answered 'unable to decide' must have one reason in favour and one against to gain (2) if no opinion is stated, credit may still be awarded if the reasons clearly imply an opinion neutral: reference to cost / calcium / magnesium accept other creditworthy answers	2			2		
				Question 3 total	**4**	**0**	**4**	**8**	**0**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		add soap solution to each sample and shake (1) the sample that produces a lather is soft water (1) boil the remaining samples (1) the sample that now gives a lather is temporary hard water and the one that still does not give a lather is permanent hard water (1)	2		2	4		4
		(ii)		**Z** is temporary hard water / has significant temporary hardness with a small amount of permanent hardness (1) it has a high concentration of hydrogencarbonate ions / it has a high concentration of hydrogencarbonate ions and a small concentration of sulfate ions (1) ignore reference to high magnesium ion concentration			2	2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		hard water contains magnesium ions / calcium ions / Mg^{2+} / Ca^{2+} (1) swap places with two sodium ions (1) accept replace / exchange for swap must be one reference to **ions** for full credit	2			2		2
		(ii)		either of following • all sodium ions have been used up • no more sodium ions left	1			1		1
	(c)			0.00135 / 1.35×10^{-3} (2) if answer incorrect award (1) for M_r $CaSO_4$ = 136 award (1) only if answer not given to three significant figures ecf possible from incorrect M_r		2		2	2	
				Question 7 total	**5**	**2**	**4**	**11**	**2**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9/2	*(a)*	(i)		temperature decreased (1) water vapour condensed to form oceans (1)	2			2		
		(ii)		award (1) each for any two of following • (green) plants evolved which carried out photosynthesis • carbon dioxide absorbed by the oceans • carbon dioxide absorbed by shells of marine organisms / trapped in limestone rock • carbon dioxide trapped in fossil fuels	2			2		
	(b)			increase in percentage of carbon dioxide due to burning of fossil fuels / deforestation (1) award (1) for any of following • climate change • <u>more</u> extreme weather • <u>more</u> drought conditions • polar ice caps melting at a <u>higher rate</u> • rising sea levels • <u>more</u> flooding • loss of wildlife habitat accept other sensible answers	2			2		
	(c)			$\mathbf{4}NH_3 + 3O_2 \rightarrow \mathbf{2}N_2 + 6H_2O$		1		1	1	
				Question 9/2 total	**6**	**1**	**0**	**7**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			award (1) for any of following • getting crystals to form • temperature below room temperature • cooling to 4°C / 10°C place the boiling tube in ice (1)			2	2		2
	(b)	(i)		all points plotted correctly (2) 4/5 points plotted correctly (1) tolerance ±½ small square suitable straight line / curve drawn (1)		3		3	3	
		(ii)		no - maximum of around 4.9 g will dissolve at this temperature accept any sensible explanation using graph ecf possible from incorrect graph plotting / poor line			1	1		1
	(c)			put 5.0 g sample in 50 g of water and mix/stir well (1) accept any volume which will not dissolve all of the solid filter off undissolved solid, dry and weigh (1) work out how much dissolved and hence value for solubility (1)	1	1	1	3		3
				Question 4 total	**1**	**4**	**4**	**9**	**3**	**6**

Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
6	**Indicative content** • removal of temporary hardness by boiling • hydrogencarbonate ions are not thermally stable and decompose easily on heating • this forms a layer of calcium carbonate (inside kettles) • calcium hydrogencarbonate → calcium carbonate + water + carbon dioxide • $Ca(HCO_3)_2 \rightarrow CaCO_3 + H_2O + CO_2$ • boiling does not remove permanent hardness • removal of permanent hardness by adding washing soda/sodium carbonate • this forms a (white) precipitate • sodium carbonate + calcium sulfate → calcium carbonate + sodium sulfate • $Na_2CO_3 + CaSO_4 \rightarrow CaCO_3 + Na_2SO_4$	6			6		3
	5-6 marks Detailed description of how hard water is softened using both methods; one correct equation *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 description of how water is softened using both methods *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** Brief description of how water is softened using one of the methods *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	**6**	**0**	**0**	**6**	**0**	**3**

Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
5	**Indicative content** temporary hard water contains hydrogencarbonate (HCO_3^-) ions whilst permanent hard water contains sulfate (SO_4^{2-})/other ions add soap solution to each sample shake each sample neither will produce a lather boil both samples the sample that now gives a lather on the addition of soap solution is temporary hard water / the sample that does not give a lather is permanent hard water method works due to hydrogencarbonate ions forming calcium carbonate/limescale on heating whilst sulfate/other ions are unaffected by heating	5	1		6		6
	5-6 marks Good description of different composition and how to differentiate between the samples; clear understanding of the method *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 composition of either temporary or permanent hard water and how to differentiate between the samples; reference to 'furring' or precipitation of calcium carbonate *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** Simple description of how to differentiate between the water samples *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	**5**	**1**	**0**	**6**	**0**	**6**

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

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**

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		

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**