GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

JANUARY 2014

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were 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 conferences was to ensure that the marking schemes were 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' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Chemistry 1 - Foundation Tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	 *atoms must be touching*			
			(ii)		1	NH_3	H_3N		
		(b)	(i)		1	O_2 / He / Ne *any **two***	oxygen / helium / neon		O
			(ii)		1	CO_2 / CH_4 / SO_2 *any **two***	carbon dioxide / methane / sulfur dioxide		
		(c)	(i)		1	1			
			(ii)		1	5			
		(d)	(i)		1	Mg^{2+} Cl^- ***both*** *ions needed (including charges)*	$2Cl^-$		Cl^-_2
			(ii)		1	NaOH	Na^+OH^-		

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	iron ore ——— source of iron limestone ✕ acts as a fuel coke ✕ removes impurities All **three** correct (2) Any **one** correct (1)			
		(b)			1	carbon + oxygen → carbon dioxide			air coke
		(c)			2	**A** (1) oxygen removed / oxygen loss (1)	iron oxide is reduced oxygen lost by iron oxide gains **both** marks	reference to 'oxide'	oxygen lost by **iron**
		(d)			1	mixture			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			3	all points plotted correctly (2) any 8 points plotted correctly (1) curve of best fit ....judgement by eye *i.e. smooth continuous single line* (1)	±½ square		 ruler used in drawing 'curve'
		(b)	(i)		1	5.5 follow through error from graph (ft)			
			(ii)		1	50 ±1 ft			
		(c)			2	using a polystyrene cup (1) use a lid / closed top use two polystyrene cups / use thicker polystyrene cup add the acid quickly (1)	beaker **traps air** form of further insulation around beaker	beaker	
		(d)			1	exothermic			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	magnesium sulfate + copper	magnesium sulfate *solution* / copper *solid* / copper *metal*		
		(b)			1	displacement			
		(c)			2	equal to 80.6 (1) (in a chemical reaction) atoms are not created or destroyed / (in a chemical reaction) atoms are re-arranged / nothing has entered / left the beaker (1) [Marks linked (unless **no** box ticked) i.e. second mark cannot be awarded if first is not]		'it is a sealed container'	
		(d)			1	sodium magnesium copper	Na Mg Cu		

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			1	91	±½ square		
		(b)	(i)		2	(SO_2 emissions) decreasing / go from 1.3 → 0.4 (1) (SO_2 emissions) below international targets (1)	 idea of 'levelling out'		
			(ii)		2	Any **two** from: • more electricity generated / used • increased fuel consumption / more coal burned / more oil burned / more gas burned • harsh winter / colder weather *Any **two** for (1) each*			
		(c)	(i)		2	pH: increases (1) acidity: decreases (1)	 gets weaker		stronger
			(ii)		2	**B** (1) (pH readings recorded) **continuously** / **remotely** / without someone being there / (pH) readings can be **stored** (1)	 over a long period of time	 'graph plotted automatically'	

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6	**1**	(a)			1	**B**	Ne / neon		
		(b)			2	**D** and **F** (1) **both** needed *either order* (**D** and **F**) are in the same group / (**D** and **F**) are both in Group 6 (**D** and **F**) both have 6 electrons in their outer shell (1) [Marks linked (unless **no** letters given)]			
		(c)			2	Set of properties: **2** (1) **both** metallic **and** non-metallic properties / metalloid / semi-metal [If referring to specific properties from table it must clearly convey the idea that one (or more) is a metallic property and another is a non-metallic property, e.g. high m.p. and b.p. (like a metal) and brittle (like a non-metal); no credit for a simple list of all properties] (1) [Marks linked (unless **no** number is given) i.e. second mark cannot be awarded if first is not]	'high m.p., b.p. and shiny **BUT** brittle'	Reference to Group 4	

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	**2**	(a)	(i)		1	1			
			(ii)		1	increases			
			(iii)		1	8	C_8		
		(b)			1	lighter / lower density doesn't break (as easily) / not brittle / flexible	not dangerous when broken	can be recycled strong / durable can be coloured	
		(c)			2	12/60 (1) 12/60 × 100 = 20 % (1) 2 marks for correct answer only (cao)			
		(d)			3	Advantages reducing amount of plastic for disposal (1) conservation of raw materials/crude oil (1) Further (1) mark for development of any link to either advantage, e.g. less plastic going to landfill so fewer sites needed; less plastic litter which is unsightly / harms wildlife; burning plastics produces toxic gases; crude oil is a finite resource; crude oil can be used for other things.			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**3**	(a)			3	copper chloride (1) carbon dioxide (1) sodium hydroxide (1)	$CuCl_2$ CO_2 NaOH		
		(b)			1	2			

Question Number			
FT	HT	Mark	Answer
9	**4**	6 QWC	**Indicative content:** **Fluoridation** **Chlorination** **Reasons why:-** **Reasons why:-** reduce tooth decay / kill bacteria/ sterilisation reduce teeth extractions / reduce number of general anaesthetics **Reasons for opposition** **Reasons for no opposition** mass medication / freedom of choice makes water safe to drink / excess fluoride discolours teeth / causes fluorosis / poisonous couldn't drink the water otherwise not added for medical reasons may also cause brittle bones / IBS / thyroid problems / cancer / bone cancer **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	an ion: Al^{3+} / O^{2-} an atom: Al a molecule: O_2 All **three** correct (2) Any **one** correct (1)	$2O^{2-}$		
			(ii)		2	cathode / negative / – (1) Al^{3+} / aluminium ions / positive ions attracted to cathode / negative electrode (1)	'go to **opposite charge**'	'go to'	attach
			(iii)		2	aluminium oxide (1) Al_2O_3 (1)	$Al^{3+}{}_2O^{2-}{}_3$		
			(iv)		1	*problem to be associated with electrolysis process **not** the extraction of the ore* fluoride emission / acid rain / global warming / climate change		reference to carbon dioxide / greenhouse gas	
		(b)			1	heat conductor e.g. saucepans low density e.g. aeroplanes malleable e.g. cans corrosion resistance e.g. window frames ductile e.g. over-head power cables shiny e.g. mirrors *correct property must be linked with an appropriate use to gain mark*			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	2×10^6	2000000 2 million		2
			(ii)		2	***(1) for a reason and (1) for linked explanation*** sulfur scrubbing / react with lime / with sea water ….removes sulfur dioxide / neutralises sulfur dioxide use cleaner fuels …….remove sulfur from oil / gas / fuel use coal / fuel containing less sulfur use less coal ……greater use of alternative energy sources which do not produce sulfur dioxide			
			(iii)		1	$\mathbf{2}SO_2 + \mathbf{2}H_2O + O_2 \longrightarrow \mathbf{2}H_2SO_4$			
		(b)	(i)		1	neutralisation		exothermic	
			(ii)		2	(adding limestone) increases the pH (1) (higher the pH the) lower the acidity (1) *i.e. relationship between pH and acidity*	goes from 3.4 → 4.3 'weaker' the acidity		
			(iii)		1	increased lake acidity /decreased pH of lakes increased soil acidity / decreased pH of soil destruction of trees / fish killed / destruction of food chains / destruction of food webs increased metal corrosion (e.g. bridges)	lakes = reservoirs / ponds / rivers	'harmful to nature' 'marine life'	drinking water

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			2	**increased** (fossil) fuel consumption / **burning more** (fossil) fuels causes (1) **increased** carbon dioxide emissions / **more** carbon dioxide formed (1) [Credit (1) for 'burning (fossil) fuels forms carbon dioxide' when no reference made to **increase**]	accept named fossil fuel	deforestation	reference to 'ozone layer' or 'acid rain'
		(b)			1	Any **one** from: sea level rises / flooding destruction of habitats / kills wildlife	accept named animal e.g. polar bears decrease in number / nowhere for polar bears to live		
		(c)			2	Any **two** sensible disadvantages, e.g. separation issues: cost (of separation) transport issues: road – burns fuels pipeline – cost, hazards storage issues: leakage back into the atmosphere / dissolves into the sea / increases acidity unproven only power stations – other sources not addressed other options available			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	8	(a)			2	30 cm^3 (1) too much variation between readings (for experiment 1 and 2) (1)	other sensible answer, e.g. 10 cm^3 or 20 cm^3 on the basis that they have the same temperature reading in experiment 2		
		(b)			3	all 9 points plotted correctly (2) any 8 points plotted correctly (1) appropriate curve of best fit – judgement by eye (1)	±½ square		
		(c)			1	when plotted the mean value does not highlight the unreliability in the individual readings unreliability in individual readings cancelled out / mean follows the pattern			
		(d)			3	Three marking points: • (temperature rise due to) neutralisation reaction / exothermic reaction (1) • temperature **peaks** when neutralisation completed / reaction is completed / reaction is over / one reactant used up / both reactants used up (1) • (temperature falls because) dilution causes cooling / cold liquid added causes cooling / cools to room temperature over time (1)	implication of 'peak' by reference to increase followed by decrease		

Question Number			
FT	HT	Mark	Answer
	9	6 QWC	**Indicative content:** Description / explanation of advantages and disadvantages of hydrogen gas as fuel for cars e.g. **Disadvantages** **Production**: requires a lot of electricity (electrolysis), therefore relatively more expensive *NB Electricity generation might form carbon dioxide, therefore contributes to global warming* **Storage**: pressurised gas containers (relatively larger tank for equivalent distance travelled by petrol) **Reactivity**: explosive mixture with air **Distribution and infrastructure**: limited at present **Use in fuel cells requires catalysts**: most often platinum which is extremely rare and expensive **Advantages** **Combustion product**: only water, therefore cleaner (doesn't contribute to global warming) **Availability**: plentiful supply of water so **renewable** resource **Energy release on burning**: large **Efficiency**: good **Ignition:** easy *A 'full answer' should address at least **two** advantages and **two** disadvantages.* **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

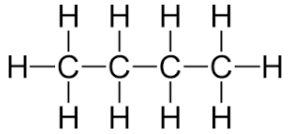
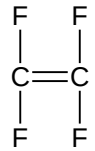
Chemistry 2 – Foundation Tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	2,8,7			
			(ii)		1	**D** and **E** (both needed)			
			(iii)		1	**A** and **D** (both needed)			
			(iv)		1	5			
		(b)			2	1 (1) +1 (1)		1	

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			1	potassium	K		
		(b)			1	potassium + oxygen → potassium oxide follow through (ft) error from (a) only if Group 1 metal given	$K + O_2 \rightarrow K_2O$ (ignore balancing) consequential possible	gas	
		(c)			1	lithium / sodium ft only if Group 1 metal given is less reactive than that named in (a)	Li / Na		
		(d)	(i)		1	silver nitrate	$AgNO_3$		
			(ii)		1	dissolved (in water)	diluted / solution	liquid / molten	
			(iii)		1	white independent of (i)		milky	creamy

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			1	horse **C**			
		(b)			1	no, none have a spot corresponding to caffeine	no samples match caffeine		
		(c)			2	3 (1) R_f value = 0.3 (1) correct answer only (cao) – 2 marks ft incorrect 'distance moved' only if value given divided by 10 i.e. correct distance moved by solvent – 1 mark			

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	sodium chloride	NaCl		
		(b)			1	62			
		(c)			2	140 – 80 (1) 60 (1) cao – 2 marks			
		(d)			2	increases (to maximum) then falls / up and down (1) maximum at 30 °C / maximum of 70 ± 2 g per 100 g water (1) rises more steeply than it falls – 2 marks			

Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
5		(a)			4	*Name* propene (1) *Molecular formula* CH_4 (1) *Structural formula*  (1) *Family of hydrocarbons* – **both** needed (1) alkane alkene			
		(b)			2	double bond breaks / changes to single bond (1) **many** ethene molecules join together / form **long chain** or **polymer** (1)			
		(c)			1	 ignore ‘n’ and any brackets used			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		3	all points plotted correctly (2) 4 correct (1) smooth curve through points (1)			 line drawn using ruler
			(ii)		1	the higher the temperature, the shorter the time / faster the reaction / higher the rate	'faster the rate'		'faster / quicker the **time**'
			(iii)		1	curve must be **below** original curve and **steeper** – ignore end point			
		(b)			2	light intensity decreases (1) continuous readings / graph plotted automatically / more precise end point (1)	light blocked more reliable than eyesight / more repeatable / no judgement required	 reference to 'reliability' or 'accuracy' or to 'human error' needs qualification	 '**no chance** of human error'

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	**1**	(a)			3	*mass number* 7 (1) *atomic number* 6 (1) *number of neutrons* 12 (1)			
		(b)	(i)		1	2,8			
			(ii)		2	two shells (containing electrons) outer shell is full / can't accept any more electrons		 8 in outer shell	
		(c)			2	**B** and **C** (1) same number of protons but different numbers of neutrons / same atomic number but different mass number (1) [marks linked i.e. second mark cannot be awarded if first is not given]		 reference to electrons	

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**2**	(a)			2	graphite and nanotube (1) both have **free moving** / **delocalised** electrons (1)	mark independently		
		(b)			2	graphite (1) weak bonds **between** layers / **layers** able to slide over each other (1) [marks linked i.e. second mark cannot be awarded if first is not given]			

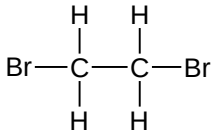
Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	**3**	(a)			1	chlorine gas is toxic / poisonous		harmful / dangerous / kills any reference to $FeCl_3$	
		(b)			2	$Fe + Cl_2$ (1) balancing 2,3,2 (1) [balancing mark only awarded if correct formulae included]			
		(c)			3	$M_r(FeCl_3) = 162.5$ [or $3 \times A_r(Cl) = 106.5$] (1) $106.5 / 162.5 \times 100$ (1) 65.5% (1) cao – 3 marks	 allow 66		

Question Number			
FT	HT	Mark	Answer
10	**4**	6 QWC	**Indicative content** Materials that change their properties reversibly according to conditions; thermochromic pigments change colour according to temperature; photochromic pigments change colour according to light intensity; shape memory alloys can regain shape by heating / spring back in to shape (NITINOL) Uses: thermochromic pigments – forehead thermometers, baby spoons etc. photochromic pigments – lenses for sunglasses; UV marker pens etc. shape memory alloys – spectacle frames; stents in veins etc. **5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	manganese dioxide is most effective / little effect with zinc oxide (1) full description of correct order of effect (2) more oxygen produced as time progresses / reaction slows down as time goes on (1) (2 max)			reference to one oxide being more '**reactive**' than another
			(ii)		2	same concentration of hydrogen peroxide same volume of hydrogen peroxide same mass/amount of metal oxide same temperature / specified temperature same particle size for each oxide any 3 for 2 marks; any 2 for 1 mark	 room temperature	same amount of hydrogen peroxide ignore time	
		(b)			2	two linked points required for 2 marks e.g. allows lower temperature to be used (1) which saves energy / improves efficiency / reduces costs (1) more product in the same time (1) which increases profitability / makes it more economical (1)	other relevant linked points		

Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	6	(a)			1	*lithium* 2,1 *chlorine* 2,8,7 - **both** needed for 1 mark			
		(b)			3	lithium loses 1 electron (1) chlorine gains 1 electron (1) forms Na^+ and Cl^- (1) diagram clearly shows transfer with no ambiguity e.g. electron(s) not in two places at the same time			
		(c)			2	sharing 2 pairs of electrons (1) full octet around both oxygen (1)			
		(d)			3	lithium chloride is ionic **and** oxygen is covalent (1) strong bonds between <u>ions</u> in lithium chloride result in high melting point (1) weak bonds between <u>molecules</u> in oxygen result in low boiling point (1)	(1) only if 'particles' used instead of 'ions' and 'molecules'		

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			3	**A** – potassium chloride (1) **B** – sodium iodide (1) **C** – lithium bromide (1)	KCl NaI LiBr	ions identified	
		(b)	(i)		1	chlorine is more reactive than bromine **and** displaces it from its halide			
			(ii)		3	reactants $KBr + Cl_2$ (1) products $KCl + Br_2$ (1) balancing 2,1,2,1 (1) [balancing mark only awarded if correct formulae included]			

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)	(i)		1				
			(ii)		1	(bromine) turns colourless	decolourises	colour change ‘goes clear’	
		(b)			2	*Reaction* **A** addition (1) *Reaction* **B** polymerisation (1)	hydrogenation / reduction addition polymerisation	 additional	additional / polymerisation

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			3	1:2 ratio from equation (1) 12 tonnes C would produce 128 tonnes of copper (1) 1.5 tonnes C would produce 1.5/12 × 128 = 16 tonnes of copper (1) cao – 3 marks alternative method using moles moles C = 0.125 (1) moles Cu = 0.25 (1) mass Cu = 0.25 × 64 = 16 (1)	15.9 (3 marks)		
		(b)			1	75%	consequential		

Question Number			
FT	HT	Mark	Answer
	10	6 QWC	**Indicative content:** **Ion exchange:** beads containing sodium ions; calcium / magnesium ions in hard water are exchanged for sodium ions; column can be recharged by passing sodium chloride solution through it. Advantages – works on both permanent and temporary hardness; continuous. Disadvantages – cost of column; need to recharge; waste water from recharging can cause limescale in sewage works; increased sodium levels in softened water. **Boiling:** boiling causes hydrogencarbonate ions to decompose forming scale on heating element. Advantages – no need for expensive equipment. Disadvantages – forms limescale; does not work on permanent hardness. Only effective with small volumes of water. **Washing soda:** reacts with calcium and magnesium ions to produce insoluble salts but produces scum. Effective with both permanent and temporary. **5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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