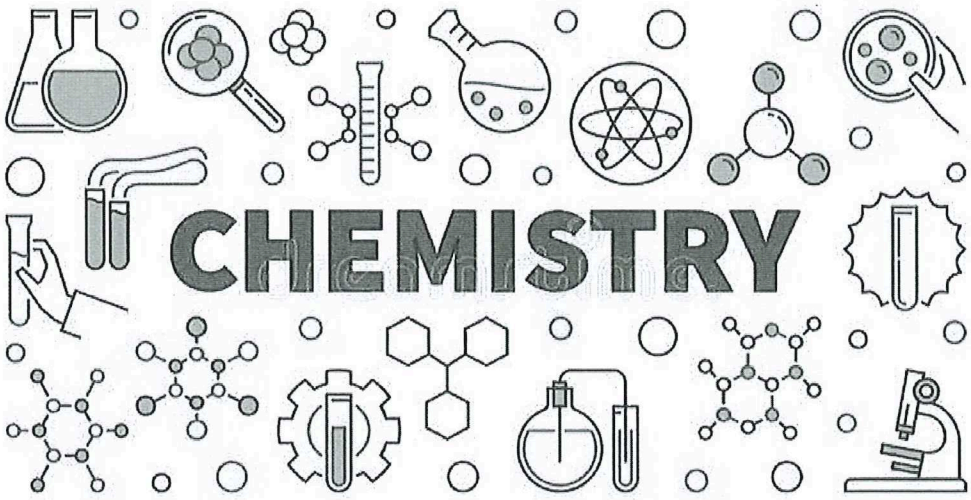


WJEC Chemistry 2

Option – Higher Tier

2.3 Mark Scheme

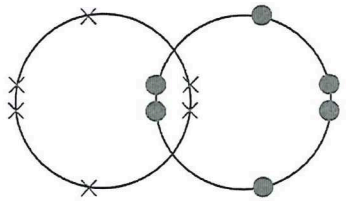
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8/2	(a)	(i)		either of following • (reaction) temperature above melting point of iron • melting point of iron below reaction temperature / 2500°C			1	1		1
		(ii)		Al_2O_3 (1) 2 Fe (1) product **must** be correct for balancing mark to be awarded		2		2	1	
		(iii)		aluminium is oxidised because it gains oxygen do not accept aluminium oxide is oxidised accept 'aluminium is oxidised because it loses electrons'	1			1		
		(iv)		magnesium aluminium iron **must** be in correct order			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		What are the positions of the four metals in the reactivity series? ✓			1	1		1
		(ii)		**D**		1		1		1
		(iii)		any of following for (1) • copper in copper(II) sulfate • tin in tin(II) sulfate • iron in iron(II) sulfate • zinc in zinc sulfate • metal in its own sulfate solution • metals in their own sulfate solutions metals do not displace themselves from solution / metals do not react with their own sulfate (1)	2			2		2
	(c)	(i)		any of following • silvery/grey solid formed • (brown) copper turns silvery/grey • (colourless) solution turns blue neutral answer – 'metal changes colour' or 'solution changes colour'	1			1		1
		(ii)		$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$ products (1) balancing (1) reactants and products **must** be correct for balancing mark to be awarded		2		2		2
				Question 8/2 total	**4**	**5**	**3**	**12**	**1**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			appropriate scales (1) all points plotted correctly (2) any three points plotted correctly (1) tolerance ±½ square straight line of best fit through origin (1) drawn using a ruler; judgement by eye		3	1	4	4	4
	(b)			accept answers in range 1.03 to 1.05			1	1	1	
	(c)			Cu^{2+} concentration stays the same (1) $Cu - 2e^- \rightarrow Cu^{2+}$ (1) $Cu^{2+} + 2e^- \rightarrow Cu$ (1) Cu^{2+} ions leave and enter at same rate / same number of Cu^{2+} ions leave and enter (1)	4			4		
				Question 8 total	**4**	**3**	**2**	**9**	**5**	**4**

Higher Tier only questions

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*	(i)		sodium is above hydrogen in reactivity series / sodium is more reactive than hydrogen / hydrogen is below sodium in reactivity series / hydrogen is less reactive than sodium	1			1		
		(ii)		$2Cl^- \rightarrow Cl_2 + \mathbf{2e^-}$ accept 2e		1		1		
		(iii)		award (1) for any of following • sodium hydroxide is formed / present • hydroxide is formed • OH^- ions are formed sodium hydroxide is a (strong) alkali (1)		2		2		2
	(b)	(i)		Cu^{2+} / copper ions gain (two) electrons accept $Cu^{2+} + 2e^- \rightarrow Cu$	1			1		
		(ii)		use copper electrodes / use copper anode (1) award (1) for explanation • Cu^{2+} ions coming out of solution are replaced • number of Cu^{2+} ions present (in solution) stays the same • concentration of Cu^{2+} ions (in solution) stays the same			2	2		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		 award (1) for two shared pairs award (2) for two full octets		2		2		
				Question 4 total	**2**	**5**	**2**	**9**	**0**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		$CO_2 + C \rightarrow 2CO$ award (1) for reactants and products award (1) for balancing only if reactants and products correct	2			2		
		(ii)		award (1) for any of following • limestone forms lime / quicklime • calcium carbonate forms calcium oxide / • $CaCO_3$ forms CaO • $CaCO_3 \rightarrow CaO + CO_2$ award (1) for any of following • lime / quicklime reacts with sand (to form slag) • calcium oxide reacts with silicon dioxide to form slag • $CaO + SiO_2 \rightarrow CaSiO_3$ award (1) for identification of one of the reaction types e.g. • thermal decomposition / breaks down with heat • neutralisation	3			3		
	(b)	(i)		$Fe_2O_3(s) + \mathbf{6}HCl(aq) \rightarrow \mathbf{2}FeCl_3(aq) + \mathbf{3}H_2O(l)$		1		1	1	
		(ii)		$3OH^-(aq) + Fe^{3+}(aq) \rightarrow Fe(OH)_3(s)$ award (1) for product award (1) for balancing **only** if all formulae are correct		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		high purity oxygen is used ☐ impurities are oxidised forming heat ☐ oxygen is blasted in at supersonic speed ☐ scrap steel is used in the process ✓			1	1		
		(ii)		ductility increases, hardness increases ☐ tensile strength increases, ductility increases ☐ ductility decreases, tensile strength increases ✓ hardness increases, tensile strength decreases ☐			1	1		
		(iii)		0.2 ☐ 0.6 ☐ 1.0 ✓ 1.5 ☐			1	1		
		(iv)		low carbon steel			1	1		
				Question 6 total	**5**	**3**	**4**	**12**	**1**	**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**

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
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 **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.*	6			6		
	Question 11 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			sodium zinc iron lead			1	1		1
	(b)	(i)		award (2) for **all** points plotted correctly tolerance ± ½ square award (1) for **any** 4 correct (1) suitable straight line drawn (with ruler) (1)		3		3	3	
		(ii)		award (1) for either of following • order of reactivity is Mg > Al > Zn > Cu • magnesium and aluminium are more reactive than zinc and copper is less reactive than zinc – must refer to all four metals award (1) for any of following • copper does not react with zinc chloride / does not displace zinc • temperature doesn't change/increase with copper • aluminium and magnesium react with zinc chloride / displace zinc award (1) for any of following • reaction between magnesium and zinc chloride is more exothermic than that between aluminium and zinc chloride • magnesium reaction more exothermic than aluminium • temperature increases more with magnesium than aluminium • magnesium most exothermic			3	3		3
				Question 4 total	**0**	**3**	**4**	**7**	**3**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Indicative content** **X** identified as hydrochloric acid **Y** identified as sodium chloride **Z** identified as ethanoic acid **X** is the stronger acid – more vigorous reaction / produces hydrogen more quickly; greater temperature increase / more exothermic **Y** does not react so cannot be an acid / must be sodium chloride **Y** must be sodium chloride – magnesium less reactive than sodium so can't displace it **Z** is the weaker acid – less vigorous reaction / produces hydrogen less quickly; smaller temperature rise / less exothermic magnesium + hydrochloric acid → magnesium chloride + hydrogen $Mg + 2HCl \rightarrow MgCl_2 + H_2$ magnesium + ethanoic acid → magnesium ethanoate + hydrogen $Mg + CH_3COOH \rightarrow (CH_3COO)_2Mg + H_2$ **5-6 marks** All three identified; clear reasoning; good attempt at 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.*	2		4	6		4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks At least two identified; some reasoning; reference to named salt and/or hydrogen as products *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** At least one identified; reference to gas/hydrogen as product *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.*						
	(b)			iron(II) ions will produce a green precipitate (1) iron(III) ions will produce a brown precipitate (1) if no reference to precipitate award (1) for iron(II) green **and** iron(III) brown award (1) if correct precipitate colours given but assigned to incorrect ions	2			2		2
				Question 6 total	**4**	**0**	**4**	**8**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			aluminium ions gain electrons therefore are reduced (1) accept $Al^{3+} + 3e^- \rightarrow Al$ ⇨ reduction oxide ions lose electrons therefore are oxidised (1) accept $2O^{2-} \rightarrow O_2 + 4e^-$ ⇨ oxidation neutral answer – oxidation is loss, reduction is gain	2			2		
	(b)	(i)		$\frac{36}{100} \times 500 = 180$ tonnes of Al_2O_3		1		1	1	
		(ii)		95.3 / 95 (3) if answer incorrect credit each correct step in method 102 tonnes Al_2O_3 produces 54 tonnes of Al (1) 1 tonne Al_2O_3 produces $\frac{54}{102}$ tonnes of Al (1) 180 tonnes Al_2O_3 produces 95.3 tonnes of Al (1) ecf possible from part (i)		3		3	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				alternative method $\frac{180}{102}$ = 1.765 (1) 1.765 × 2 = 3.530 (1) 3.530 × 27 = 95.3 (1) ecf possible from part (i)						
				Question 9 total	**2**	**4**	**0**	**6**	**4**	**0**