

Question	Answer	Marks	AO Element	Notes	Guidance
1	electron(s) (1) ion(s) (1)	2			
2	breakdown	1			
	compound	1			
	molten	1			
	electricity	1			
3	negative electrode: hydrogen / H ₂ (1) positive electrode: chlorine / Cl ₂ (1)	2			NOT H NOT Cl
4	negative electrode: zinc / Zn positive electrode: iodine / I ₂	2		NOT iodide / I	
5	test tubes of solution covering <u>each</u> electrode	1			
6	graphite / it conducts electricity	1			
7	negative electrode: lead (1) positive electrode: bromine (1)	2			

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8	+ electrode labelled anode AND – electrode labelled cathode (1) liquid labelled electrolyte (1)	2			
9	(in solid) ions don't move (1) (when molten) ions move / ions mobile (1)	2			
10(a)	magnesium floats (on the molten magnesium chloride)	1			
10(b)	chlorine	1			
10(c)	to stop the magnesium oxidising / to stop the magnesium reacting with the air / to stop it oxidising / to stop it reacting with the air	1			
10(d)	argon / krypton / xenon	1			
11	<i>positive electrode (anode):</i> iodine (1) <i>negative electrode (cathode):</i> calcium (1)	2			
12	B	1			

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13	<i>positive electrode (anode):</i> bromine / Br ₂ (1) <i>negative electrode (cathode):</i> potassium / K (1)	2			
14(a)	oxidation	1			
14(b)	acid(ic)	1			
15	electrolysis	1			
16	<i>negative:</i> calcium / Ca (1) <i>positive</i> chlorine / Cl ₂ (1)	2			
17(a)	<i>negative electrode:</i> calcium / Ca (1) <i>positive electrode:</i> bromine / Br ₂ (1)	2			
17(b)	platinum / Pt	1			
18	<i>negative electrode:</i> potassium / K (1) <i>positive electrode:</i> bromine / Br ₂ (1)	2			
19	B	1			

Question	Answer	Marks	AO Element	Notes	Guidance
20	B	1			
21	positive: anode and negative cathode	1			
	at + electrode → chlorine	1			
	at – electrode → potassium	1			
22(a)	$AlCl_3 + 3Na \rightarrow 3NaCl + Al$ species (1) balancing (1)	2			
22(b)	M1 electrolysis M2 molten sodium chloride or M1 add named more reactive metal (e.g. K) M2 molten sodium chloride	2			
23(a)	cathode	1			
23(b)	Zinc is formed at the negative electrode and oxygen at the positive electrode;	1			
24(a)	A;	1			

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24(b)	(anode): decreases in size / becomes eroded;	1			
	cathode: increases in size;	1			
24(c)	134;	2			
25(a)	to melt the lead bromide / to allow ions to move;	1			
25(b)	graphite;	1			
25(c)	anode: bromine and cathode: lead; (both required)	1			
26(a)	platinum	1			
26(b)	chlorine	1			
26(c)	$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$ H ⁺ + e ⁻ on left hand side (1) rest of equation (1) state symbols of (aq) → (g) (1)	3			

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26(d)	increases (sodium) hydroxide is formed (sodium) hydroxide is an alkali	3			
27(a)	arrow (anywhere) going from Zn → Cu	1			
27(b)	reading would decrease (1) Fe less reactive than Zn (1) OR difference in reactivity (between Fe and Cu) is smaller	2			
27(c)	Ag less reactive than Cu	1			
28(a)	720(.09)	1			
28(b)	(it contains) ions (1) (ions) are able to move (1)	2			
28(c)	magnesium is not inert	1			
28(d)	bromine / Br ₂	1			
28(e)	H ⁺ and e ⁽⁻⁾ on LHS (1) fully correct, i.e.: 2H ⁺ + 2e ⁻ → H ₂ (1)	2			

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29(a)	inert / unreactive / does not react with chlorine	1			
29(b)	bubbles / fizzing / effervescence	1			
29(c)	M1 increases M2 (solid) copper deposited	2			
29(d)	M1 colour fades / becomes pale(r) / becomes colourless / becomes lighter M2 copper (ions) removed (from solution)	2			
29(e)	M1 species oxidised: chloride (ions) / Cl^- M2 explanation: loss of electrons / increase in oxidation state	2			
30(a)	M1 spoon as cathode M2 (pure) silver as anode M3 aqueous silver nitrate as electrolyte M4 $Ag^+ + e^- \rightarrow Ag$	4			

Question	Answer	Marks	AO Element	Notes	Guidance
30(b)	any one from: <ul style="list-style-type: none"> • Improves appearance • prevent / resist corrosion / oxidation • antibacterial 	1			
31(a)	M1 electrolyte aqueous or solution of named nickel salt M2 anode impure nickel M3 cathode pure nickel	3			
31(b)	nickel produced at cathode under the liquid surface	1			
32(a)	hydrogen	1			
32(b)	Heat until magnesium chloride is molten and electrolyse	1			
33(a)	M1 inert / unreactive M2 conducts electricity	2			

Question	Answer	Marks	AO Element	Notes	Guidance												
33(b)	<table border="1"> <tr> <td data-bbox="398 217 501 451">observation at the anode (+)</td> <td data-bbox="501 217 602 451">name of product at the anode (+)</td> <td data-bbox="602 217 703 451">observation at the cathode (-)</td> <td data-bbox="703 217 806 451">name of product at the cathode (-)</td> </tr> <tr> <td data-bbox="398 451 501 616">M1 green/ yellow bubbles</td> <td data-bbox="501 451 602 616">M2 chlorine</td> <td data-bbox="602 451 703 616"></td> <td data-bbox="703 451 806 616">M3 hydrogen</td> </tr> <tr> <td data-bbox="398 616 501 780"></td> <td data-bbox="501 616 602 780">M4 oxygen</td> <td data-bbox="602 616 703 780">M5 pink/ brown solid</td> <td data-bbox="703 616 806 780">M6 copper</td> </tr> </table>	observation at the anode (+)	name of product at the anode (+)	observation at the cathode (-)	name of product at the cathode (-)	M1 green/ yellow bubbles	M2 chlorine		M3 hydrogen		M4 oxygen	M5 pink/ brown solid	M6 copper	6			
observation at the anode (+)	name of product at the anode (+)	observation at the cathode (-)	name of product at the cathode (-)														
M1 green/ yellow bubbles	M2 chlorine		M3 hydrogen														
	M4 oxygen	M5 pink/ brown solid	M6 copper														
34	<p>any three from: (apparatus A): solution becomes paler / fades in A (1)</p> <p>(apparatus B): solution stays the same colour in B (1)</p> <p>(explanation): copper ions removed (but not added) / copper ions not replaced in A</p> <p>O R copper ions both removed and added (at the same rate) / copper ions are being replaced (continually) in B (1)</p>	3															

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35(a)	H ⁺ + e ⁽⁻⁾ as the only species on the left (1) equation fully correct (1) 2H ⁺ + 2e ⁽⁻⁾ → H ₂ bromine at the anode (1) potassium hydroxide (1)	4			
35(b)	potassium	1			
36(a)	(a pink/brown) solid / deposit forms	1			
36(b)	bubbles / fizzing (at the anode) (1) solution becomes paler / less blue / colourless (1)	2			
37	a green gas would be seen (on the anode)	1			
38(a)	electrons	1			
38(b)	(positive and negative) ions	1			
38(c)	nickel (1) iodine (1) Ni ²⁺ + 2e ⁻ → Ni OR 2I ⁻ → I ₂ + 2e ⁻ (1)	3			

- Mark Scheme

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39	oxidation (because) (the O ²⁻ ion OR 'oxide ions') lose electrons OR (the O ²⁻ ion OR 'oxide ions') oxidation number increases	1			
40	electrodes / anodes are made from carbon / graphite (1) oxygen (made) reacts with carbon / anode (1)	2			
					[Total: 122]