**- Mark Scheme /**

**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 |  | positive electrode: oxygen /O2 (1)negative electrode: aluminium /A*l* (1) |  | **2** |
|  | 2(a) |  | positive electrode: chlorine /C*l* 2 (1) |  | **2** |

negative electrode: hydrogen /H2 (1)

2(b) bubbles (of gas) **1**

3(a) (anhydrous) cobalt chloride **1**

3(b) graphite **1**

3(c) calcium oxide **1**

3(d) aluminium **1**

3(e) ceramic **1**

4 graphite (1) **2**

conducts electricity / inert (1)

5 positive electrode: chlorine (1) **2**

negative electrode: magnesium(1)

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 6(a) |  | arrow (anywhere) going from Zn→ Cu |  | **1** |

6(b) reading would decrease (1) **2**

Fe less reactive than Zn (1)

**OR**

difference in reactivity (betweenFe and Cu) is smaller

6(c) Ag less reactive than Cu **1**

7(a) 720(.09) **1**

7(b) (it contains) ions (1) **2**

(ions) are able to move (1)

7(c) magnesium is not inert **1**

7(d) bromine / Br2

**1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 7(e) |  | + and e(–) on LHS (1)H |  | **2** |

+ + 2e– → fully correct, i.e.: 2H

H2 (1)

8(a) platinum **1**

8(b) chlorine **1**

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 8(c) |  | +(aq) + 2e– → H2H2(g) |  | **3** |

 + + e– on left hand side (1)H

rest of equation (1)

state symbols of (aq) → (g)(1)

8(d) increases **3**

(sodium) hydroxide is formed

(sodium) hydroxide is an alkali

9(a) bauxite **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 9(b) |  | positive electrode: oxygen / O2 /O (1) |  | **2** |

negative electrode: aluminium / A*l* (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 9(c) |  | aluminium is tooreactive / aluminium is veryreactive / aluminium is high in thereactivity series |  | **1** |

10 iodine / I **1**

2

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11(a) **M1** spoon as cathode **4**

**M2** (pure) silver as anode

**M3** aqueous silver nitrate as electrolyte

+ + e– → Ag **M4** Ag

11(b) any one from: **1**

• Improves appearance

• prevent / resist corrosion/oxidation

• antibacterial

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 12(a) |  | inert / unreactive / does not reactwith chlorine |  | **1** |

12(b) bubbles / fizzing / effervescence **1**

12(c) **M1** increases **2**

**M2** (solid) copper deposited

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 12(d) |  | **M1** colour fades / becomespale(r) / becomescolourless / becomes lighter |  | **2** |

**M2** copper (ions) removed (from solution)

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 12(e) |  | **M1** species oxidised: chloride(ions) / C*l* – |  | **2** |

**M2** explanation: loss ofelectrons / increase in oxidationstate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 13(a) |  | **M1** electrolyte aqueous orsolution of named nickel salt |  | **3** |

**M2** anode impure nickel

**M3** cathode pure nickel

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 13(b) |  | nickel produced at cathodeunder the liquid surface |  | **1** |
|  | 14(a) |  | chromium is a reactivemetal / chromium is high in thereactivity series / chromium is tooreactive to be made by reductionwith carbon |  | **1** |

14(b) positive electrode: oxygen (1) **2**

negative electrode: chromium(1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 15(a) |  | cathode (spoon) correctlylabelled (1) |  | **2** |

electrolyte correctly labelled(1)

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**Question Answer Marks AO Element Notes Guidance**

15(b) spoon silvery in colour **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 15(c) |  | more corrosion resistant / moreattractive appearance |  | **1** |

16(a) hydrogen **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 16(b) |  | Heat until magnesium chlorideis molten and electrolyse |  | **1** |
|  | 17 |  | breakdown of an ionic**compound** when molten or inaqueous solution (1) |  | **2** |

(using) electricity / electriccurrent (1)

18(a) anode correctly labelled (1) **2**

electrolyte correctly labelled(1)

|  |  |
| --- | --- |
|  | 18(b) *positive electrode*: bromine / Br2 **1 NOT** Br |

*negative electrode*: potassium / K

18(c) red-brown / brown fumes **1**

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 18(d) |  | graphite is inert / graphite isunreactive/magnesium isreactive / magnesium wouldreact with the bromine |  | **1** |

19 electron(s) (1) **2**

ion(s) (1)

20 150 (g) **1**

21 negative electrode: zinc / Zn **2**

positive electrode: iodine / I **NOT** iodide / I

2

22 anode **1**

23 carbon / platinum **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 24 |  | substance that conductselectricity/(undergoes)electrolysis (1) |  | **2** |

decomposed/chemicallychanged

**OR**

molten / liquid / solution / aqueous **AND** containing ions / ionic (1)

25 electrolysis **1**

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 26(a) |  | magnesium floats (on the moltenmagnesium chloride) |  | **1** |

26(b) chlorine **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 26(c) |  | to stop the magnesiumoxidising / to stop the magnesiumreacting with the air / to stop itoxidising / to stop it reacting withthe air |  | **1** |

26(d) argon / krypton / xenon **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 27 |  | *positive electrode (anode)*:iodine (1) |  | **2** |

*negative electrode (cathode)*: calcium (1)

28 *negative:* calcium / Ca (1) **2**

*positive* chlorine / C*l* 2 (1)

[Total: 89]