**Electrolysis topic test solutions**

**SECTION A: Multiple-choice questions (1 mark each)**

**Question 1**

*Answer:* D

*Explanation:*

The power supply pushes electrons from the positive anode to the negative cathode.

**Question 2**

*Answer:* B

*Explanation:*

If multiple items are to be plated the plating would get difficult as the metal ion concentration drops. Using a metal anode allows the oxidation reaction on the metal to replace the ions in solution.

**Question 3**

*Answer:* D

*Explanation:*

Q = It = 193 x 1000 = 193000 C = 2 mol of electrons

Therefore 2 mole of silver = 216 g

**Question 4**

*Answer:* A

*Explanation:*

Iodide ions will be oxidised at the anode and water reduced to hydrogen gas a t the cathode.

**Question 5**

*Answer:* B

*Explanation:*

To obtain aluminium requires a molten electrolyte such as Al2O3.

**Question 6**

*Answer:* C

*Explanation:*

When concentrated solutions are used, chloride ions will react at the anode instead of water to form chlorine gas.

**Question 7**

*Answer:* B

*Explanation:*

The reaction must be oxidation if it is the anode. Option B is correctly balanced.

**Question 8**

*Answer:* C

*Explanation:*

In KCl, neither the potassium ions or the chloride ions will react, so water reacts at each electrode.

**Question 9**

*Answer:* B

*Explanation:*

The metals that have electrochemical series potentials less than that of water at -0.83 V

**Question 10**

*Answer:* C

*Explanation:*

The aluminium must be a molten electrolyte.

**SECTION B: Short-answer questions**

**Question 1** (9 marks)

**a.** Anode: 2Cl-(l) 🡪 Cl2(g) + 2e-

 Cathode: Ca2+(l) + 2e- 🡪 Ca(l)

 Overall equation: Ca2+(l) + 2Cl-(l) 🡪 Ca(l) + Cl2(g) 3 marks

b. High temperatures required to achieve molten state and electrical energy needed for the cell to operate.

 2 marks

c. Anode: oxygen gas and hydrogen ions 4 marks

 Cathode: hydrogen gas and hydroxide ions

**Question 2** (13 marks)

**a.** Anode: 2Cl-(l) 🡪 Cl2(g) + 2e-  3 marks

 Cathode: Li+(l) + e- 🡪 Li(l)

 Overall equation: 2Li+(l) + 2Cl-(l) 🡪 Cl2(g) + 2Li(l)

**b**. **i**. If the anode was steel (iron), the iron would be oxidized to Fe2+ instead of chloride ions reacting.

 2 marks

 **ii**. A small amount of KCl lowers the melting point of the LiCl, saving money on energy.

 1 mark

 **iii**. The voltage used needs to be greater than the difference in the voltage values given on the

 electrochemical series. 2 V is not high enough. 1 mark

**c. i.** Q = It =3550 × 24 × 3600 = 307000000 C

 n(e) = Q/96500 = 3180 mol

 n(Li) = 3180

 mass = 3160 × 6.9 = 21900 g = 21.9 kg 3 marks

 **ii**. V =  = 17200 L 3 marks

**Question 3** (10 marks)

**a**. Silver: 30 mol 3 marks

 Aluminium: 0 as water reacts instead

 Copper: 15 mol

**b**. 30/4 mol of oxygen in each of the cells at the anode. Also 30/2 mol of hydrogen in the aluminium cell.

 Total 37.5 mol 3 marks

c. Faraday’s first law: The mass of metal obtained at the cathode will be proportional to the time the cell is

 run. The same will be observed in the silver and copper cells.

 Faraday’s second law: The number of mol of copper obtained will be half the number of mol of silver as

 the charge on copper is double. The ratio between mole of metal and electrons is a whole number ratio.

 4 marks

**Question 4** (8 marks)

**a**. galvanic reaction on the left cell: Cu(s) + 2Ag+(aq) 🡪 Cu2+(aq) + 2Ag(s) 2 marks

 electrolysis reaction on the right cell. Cu2+(aq) + 2Ag(s) 🡪 Cu(s) + 2Ag+(aq)

**b**. 2 marks

|  |  |
| --- | --- |
| Similarities | Differences |
| Electrons travel from the anode to the cathodeOxidation is at the anode and reduction cathode | Anode is positive in electrolysis and negative in galvanic. Galvanic cell produces energy, electrolytic cell requires energy |

**c. i**. 0.8 – 0.34 = 0.46 V 1 mark

 **ii**. Cu(s) 1 mark

 **iii**. The cell will stop running if the reactants are consumed – if all copper ions are deposited, the cell will

 no longer function. 1 mark

 **iv**. No – the number of mol of silver reacting will be double that of copper but not the mass.

 1 mark