SL & HL Answers to Electrochemical cells questions

1. A salt bridge enables ions to move from the solution of one half-cell to the solution of the other half-cell and hence completes the electrical circuit between the two solutions.

2. i. When a magnesium half-cell is connected to a copper half-cell the voltage is 2.71 V and when an iron half-cell is connected to a copper half-cell the voltage is 0.78 V so when a magnesium half-cell is connected to an iron half-cell the voltage will be 2.71 – 0.78 = 1.93 V.

ii. A zinc half-cell gives a higher voltage than an iron half-cell when both are connected to a copper half-cell so zinc is more reactive than iron. The positive electrode will be iron and the negative electrode will be zinc.
At the positive electrode: $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
At the negative electrode: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
Overall equation: $Zn(s) + Fe^{2+}(aq) \rightarrow Zn^{2+}(aq) + Fe(s)$

3. Sodium is a metal. It contains delocalised electrons which can move from one atom to another and so conducts electricity by the movement of electrons and no chemical change takes place. This can happen when the atoms are in close contact in the solid or liquid state but not when they are far apart in the gaseous state.

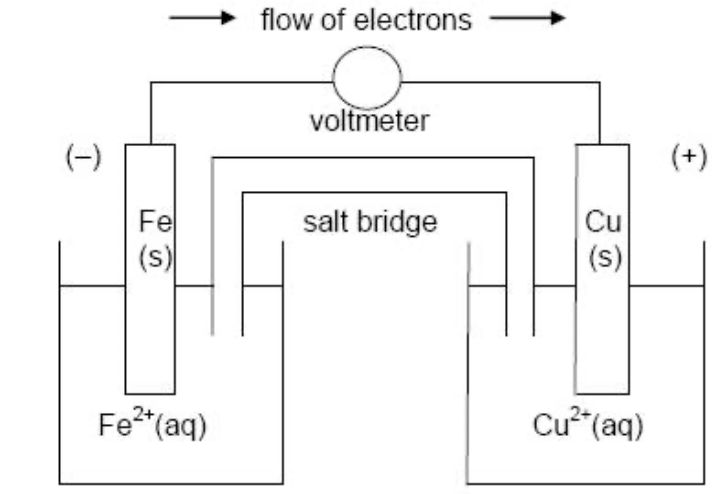
4. i. Sodium chloride is a salt consisting of sodium and chloride ions. In the solid state the ions are held in a fixed lattice and cannot move to the respective electrodes. There are also no free or delocalised electrons in the salt. When molten the ions are free to move to the oppositely charged electrodes where a chemical reaction takes place and electrons are released or accepted.

ii. It is difficult to get the salt to melt (the melting point of NaCl is 801 °C) using the heating available (such as a Bunsen burner) in most school laboratories.

5. i. Positive electrode: Chlorine produced. $2Cl^-(l) \rightarrow Cl_2(g) + 2e^-$
Negative electrode: Magnesium produced: $Mg^{2+}(l) + 2e^- \rightarrow Mg(s)$

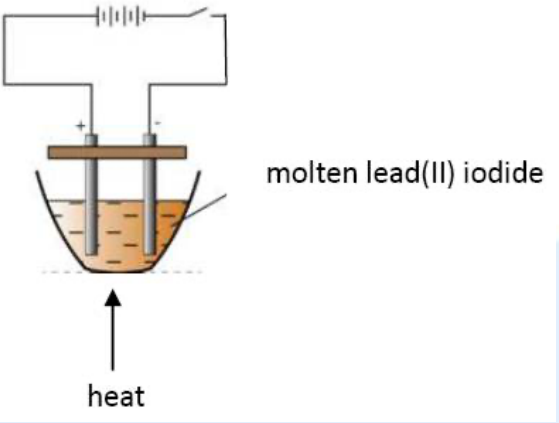
ii. (i) Electricity is conducted by the flow of electrons in the metal wires.
(II) Electricity is conducted by the movement of ions in the electrolyte.

6. i.



ii. $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
Overall equation: $Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$

7. i.



ii. $2I^-(l) \rightarrow I_2(g) + 2e^-$ Product: iodine
iii. Loss of electrons so oxidation.
iv. $Pb^{2+}(l) + 2e^- \rightarrow Pb(l)$ Product: lead
v. Gain of electrons so reduction.