AS Level Chemistry B

H033/02 Chemistry in depth

Question Set 3

3 Brine is a concentrated aqueous sodium chloride solution. Chlorine is made by the electrolysis of brine. Sodium hydroxide and hydrogen are co-products.

The equation representing the overall reaction that occurs during this electrolysis is shown below.

$$2Cl^-(aq) + 2H_2O(l) \longrightarrow Cl_2(g) + 2OH^-(aq) + H_2(g)$$

(a) (i) Calculate the amount (in moles) of NaOH in 0.50 tonne of sodium hydroxide.

amount of NaOH = ...mol **[1]**

(ii) Calculate the mass of chlorine (in tonnes) produced at the same time as 0.50 tonne of sodium hydroxide.

mass = ...tonnes **[1]**

(iii) Calculate the volume (in m^3) that this chlorine would occupy at RTP.

volume = ... m^3 **[1]**

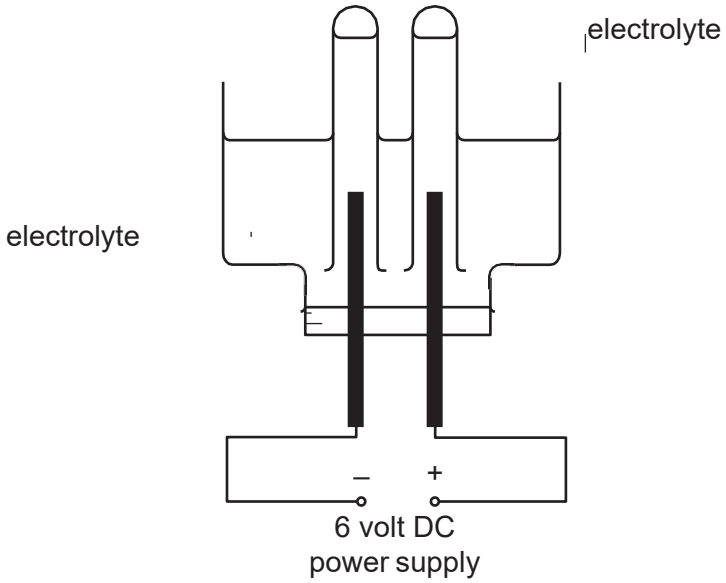
(b) Molten sodium chloride is electrolysed instead of an aqueous solution.

What would be the similarity and the difference in the products at the two electrodes?

Similarity .....

Difference ..... **[1]**

(c) A student investigates the electrolysis of aqueous solutions of sodium halides in the laboratory using the apparatus shown below.



Describe what would be **observed** at each electrode when the electrolyte is aqueous sodium **iodide**.

(i) at the anode (positive electrode)

(ii) at the cathode (negative electrode) **[1]**

(d) Write the half-equations involved in the electrolysis of sodium **bromide** solution.

(i) at the anode (+) **[1]**

(ii) at the cathode (–) **[1]**

(e) A student investigates the reactions of aqueous halogen solutions with aqueous solutions of sodium halides.

The student adds 1 cm depth of bromine solution to an equal volume of a sodium halide solution in a test-tube.

A 1 cm depth of cyclohexane is then added, the mixture is shaken and the immiscible liquids allowed to separate. The upper layer is purple.

(i) What is the colour of the lower layer? **[1]**

(ii) Write the **ionic** equation for the reaction between the aqueous solutions of bromine and the sodium halide.

[1]

(f) In a separate test-tube reaction, aqueous solutions of chlorine and sodium iodide are mixed. The equation for the reaction is shown below.

$$Cl_2(aq) + 2NaI(aq) \longrightarrow I_2(aq) + 2NaCl(aq) \qquad \textbf{equation 3.1}$$

(i) Write the ionic half-equation for the oxidation reaction.

[1]

(ii) Identify the oxidising agent in the reaction in **equation 3.1**. **[1]**

(g) The oxidising strength of the halogens decreases going down the Group.
Explain this trend. **[3]**

Total Marks for Question Set 3: 14