The Electrolysis of Solutions

Answer all the questions below then check your answers

1. What are ionic compounds?

2. What charge do metal and non-metal ions have?

3. What must be done to an ionic compound to make it conduct electricity?

b. What is electrolysis?

4 What is usually produced at the cathode during an electrolysis experiment?

a. What is produced at the anode during an electrolysis experiment?

5. In terms of electron loss and gain what do the words oxidation and reduction mean?

6. Where in an electrolytic cell does oxidation and reduction take place?

7. Water undergoes an equilibrium reaction where a few of the molecules ionise to produce hydrogen ions and hydroxide ions.

a. Write an ion-electron equation to show this ionisation reaction that water molecules undergo.

8 When ionic compounds are dissolved in water the metal ions and the non-metals are free to move and the solution will conduct electricity. However in predicting what will form at the anode and cathode during the electrolysis of these solutions we need to consider the ions present not only from the ionic compound but from the water molecules ionising.

potassium
sodium
lithium
calcium
magnesium
aluminium
carbon
zinc
iron
tin
lead
hydrogen
copper

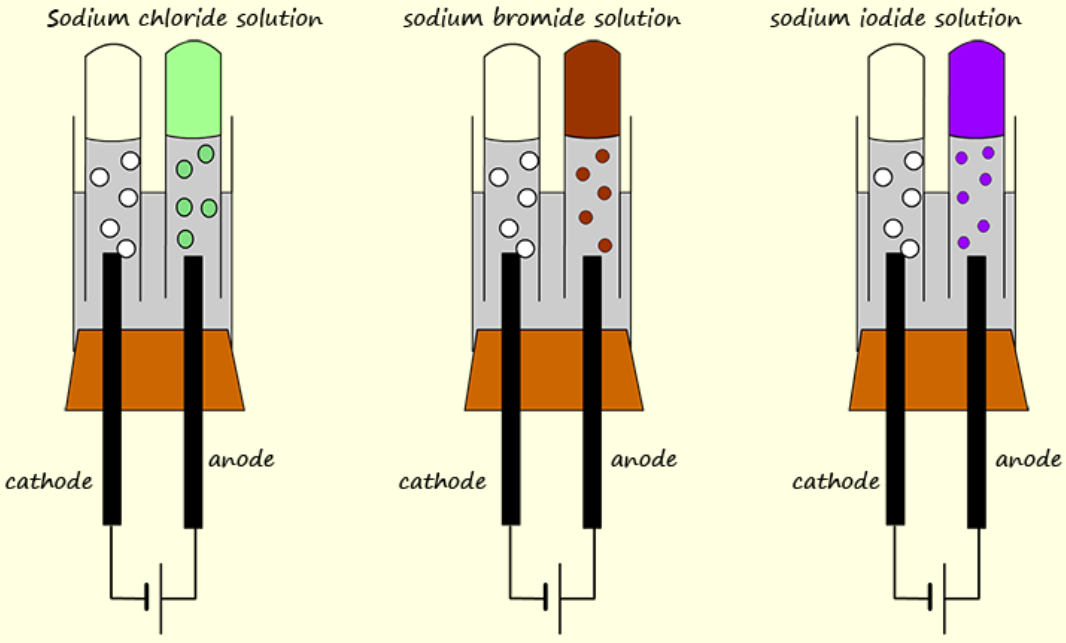
a. What rule can you use to predict whether a metal or hydrogen gas will form at the cathode during the electrolysis of a solution of an ionic compound?

b. If the non-metal ions are halide such as chloride, bromides or iodides are these discharged at the anode during the electrolysis of solutions?

c. What are group ions? Name the most common ones you are likely to meet.

d. Are group ions discharged at the electrodes during electrolysis?

e. Predict the products formed at the anode and cathode in each of the electrolysis experiments shown below:



9.

Cathode product			
Anode product			

Write ion-electron half equations for each of the reactions happening at the anodes and cathodes in each of the experiments above.

10 Complete the following sentence by filling in the gaps using a suitable phrase:

During the electrolysis of a solution the _____ reactivity series is always produced at the cathode.

a Complete the table below giving the anode and cathode products when the following <u>SOLUTIONS ARE ELECTROLYSED.</u>

solution	cathode product	anode product
copper chloride		
potassium chloride		
sodium iodide		
sodium bromide		
magnesium oxide		
calcium bromide		

silver chloride		
potassium sulfate		
sodium nitrate		
magnesium sulfate		

Answers

1. What are ionic compounds? Compounds containing metal and non-metal ions

2. What charge do metal and non-metal ions have? Metal ions are positively charged, non-metal ions have a negative charge

3. What must be done to an ionic compound to make it conduct electricity? Melt it or dissolve it in water to form a solution.

b. What is electrolysis? Splitting up ionic compounds into the elements that make it up using electricity.

4 What is usually produced at the cathode during an electrolysis experiment?

Metals are usually formed at the cathode during electrolysis

a. What is produced at the anode during an electrolysis experiment?

Non-metals are formed at the cathode during electrolysis

5. In terms of electron loss and gain what do the words oxidation and reduction mean?

Oxidation is loss of electrons, reduction is gain of electrons

6. Where in an electrolytic cell does oxidation and reduction take place?

Oxidation takes place at the anode

Reduction takes place at the cathode

7. Water undergoes an equilibrium reaction where a few of the molecules ionise to produce hydrogen ions and hydroxide ions.

a. Write an ion-electron equation to show this ionization reaction that water molecules undergo.

$H_2O \rightleftharpoons H^+ + OH^-$

8 When ionic compounds are dissolved in water the metal ions and the non-metals are free to move and the solution will conduct electricity. However in predicting what will form at the anode and cathode during the electrolysis of these solutions we need to consider the ions present not only from the ionic compound but from the water molecules ionising.

a. What rule can you use to predict whether a metal or hydrogen gas will form at the cathode during the electrolysis of a solution of an ionic compound?

If there is a choice between 2 metals (or hydrogen) then whatever is lowest in the reactivity series is produced at the cathode.

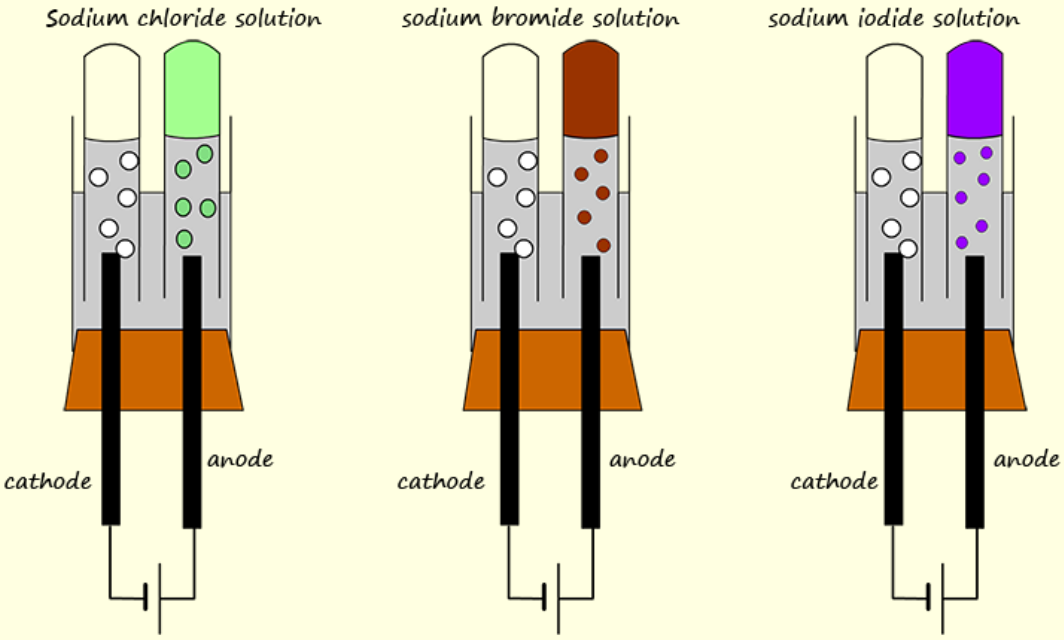
b. If the non-metal ions are halide such as chloride, bromides or iodides are these discharged at the anode during the electrolysis of solutions? Yes halides are discharges, group ions are not

c. What are group ions? Name the most common ones you are likely to meet.

Group ions are ions which are compounds, common examples are nitrate, sulfate, carbonate, phosphate

d. Are group ions discharged at the electrodes during electrolysis? No, though hydroxide ions are.

e. Predict the products formed at the anode and cathode in each of the electrolysis experiments shown below:



Cathode product	hydrogen	hydrogen	hydrogen
Anode product	chlorine	bromine	iodine

9. Write ion-electron half equations for each of the reactions happening at the anodes and cathodes in each of the experiments above.

Cathode reaction for all above is

$2H^+_{(aq)} + 2e \rightleftharpoons H_{2(g)}$ or $2H_2O + 2e \rightleftharpoons H_2 + 2OH^-$

Anode reactions:

$2Cl^- - 2e \longrightarrow Cl_2$ $2Br^- - 2e \longrightarrow Br_2$ $2I^- - 2e \longrightarrow I_2$

or

$2Cl^- \longrightarrow Cl_2 + 2e$ $2Br^- \longrightarrow Br + 2e$ $2I^- \longrightarrow I_2 + 2e$

10 Complete the following :

During the electrolysis of a solution the METAL LOWEST IN the reactivity series is always produced at the cathode.

a Complete the table below giving the anode and cathode products when the following ***SOLUTIONS ARE ELECTROLYSED.***

solution	cathode product	anode product
copper chloride	copper	chlorine
potassium chloride	hydrogen	chlorine
sodium iodide	Hydrogen	iodine
sodium bromide	hydrogen	bromine
magnesium oxide	hydrogen	oxygen
calcium bromide	hydrogen	bromine
silver chloride	silver	chlorine
Potassium sulfate	hydrogen	oxygen
sodium nitrate	hydrogen	oxygen
magnesium sulfate	hydrogen	oxygen