**Electrolysis**

### Conducting liquids
- Electrolysis is the decomposition of a liquid using electricity. During electrolysis:
  - the electrolyte is a liquid that conducts electricity
  - the anode is the positive electrode
  - the cathode is the negative electrode
  - anions are negative ions attracted to the anode
  - cations are positive ions attracted to the cathode.

### Testing for hydrogen and oxygen
- Sulphuric acid solution can be broken down into hydrogen and oxygen.
  - To test for the two gases: a lit splint burns with a 'pop' in hydrogen, a glowing splint in oxygen.

### Electrolytic decomposition
- Aluminium is extracted from its mineral using electricity. The mineral is called bauxite.
  - The key features in the production of aluminium by electrolytic decomposition are:
    - the use of molten aluminium oxide
    - aluminium is formed at the graphite cathode, oxygen formed at the graphite anode
    - the anodes are gradually worn away by oxidation
    - the process requires a high electrical energy input.
  - The word equation for the decomposition of aluminium oxide is:
    \[ \text{aluminium oxide} \rightarrow \text{aluminium} + \text{oxygen} \]

### Questions
1. Which electrode is the positive electrode?
2. The ratio of hydrogen gas to oxygen gas made during the electrolysis of water is 2:1. Explain why.

### Transition elements
- Transition elements are metals and have typical metallic properties. They:
  - conduct heat
  - are shiny
  - conduct electricity
  - are malleable
  - are ductile

### Copper and iron
- Copper and iron are examples of transition elements.
  - A compound that contains a transition element is often coloured:
    - copper compounds are blue
    - iron(II) compounds are pale green
    - iron(III) compounds are orange/brown.

### Thermal decomposition
- Thermal decomposition is a reaction in which a substance is broken down into at least two other substances by heat.
  - If a transition metal carbonate is heated, it decomposes to form a metal oxide and carbon dioxide.
    - \( \text{CaCO}_3 \) decomposes forming calcium oxide and carbon dioxide
    - \( \text{MnCO}_3 \) decomposes forming manganese oxide and carbon dioxide
    - \( \text{ZnCO}_3 \) decomposes forming zinc oxide and carbon dioxide.
  - The metal carbonates change colour during decomposition.

### Sodium hydroxide solution
- Sodium hydroxide solution is used to identify the presence of transition metal ions in solution:
  - \( \text{Fe}^{2+} \) ions form a blue solid
  - \( \text{Fe}^{3+} \) ions form a grey/green solid
  - \( \text{Cu}^{2+} \) ions from an orange gelatinous solid.

### Precipitation reaction
- Precipitation is a reaction between solutions that makes an insoluble solid.
  - When a yellow solution of potassium chromate is added to a colourless solution of silver nitrate, a precipitate (solid) is formed. The precipitate is orange-coloured silver chromate.

### Top Tip!
- A catalyst is an element or compound that changes the rate of a chemical reaction without taking part in the reaction. Catalysts are unchanged during the reaction.
Electrolysis

1a Finish the sentences by choosing the best words from this list. You may use any word more than once.

anode cathode electrolysis electrolyte negative positive

The decomposition of a liquid by using electricity is called __________.

The __________ is a liquid that conducts electricity. There are two electrodes called the __________ and the __________.

The __________ is the positive electrode and the __________ is the negative electrode.

During electrolysis the __________ ions are attracted to the anode and the __________ ions are attracted to the cathode. 

1 mark

2a Explain the key features of the electrolysis of dilute sulphuric acid.

__________________________________________________________________________

__________________________________________________________________________________________________________________________ ...

6 marks

2b Explain why the volume of hydrogen gas and the volume of oxygen gas given off in this process are different.

__________________________________________________________________________

1 mark

Transition elements

1a Transition elements have typical metallic properties. Write down six properties.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

6 marks

1b A compound that contains a transition element is often coloured.

i What is the colour of copper compounds?

__________________________________________________________________________

ii What is the colour of iron(II) compounds?

__________________________________________________________________________

iii What is the colour of iron(III) compounds?

__________________________________________________________________________

3 marks

1c A transition metal and its compounds are often catalysts.

i Which transition metal is used in the Haber process to produce ammonia?

__________________________________________________________________________

1 mark

b If the metal used to harden margarine is number 28, suggest whether this is a transition metal or not. Use the periodic table on page 238 to help you.

__________________________________________________________________________

1 mark

2a When a yellow solution of potassium chromate is added to a colourless solution of silver nitrate a yellow solid is formed. What is this type of reaction called?

__________________________________________________________________________

3a In a reaction a substance is broken down into at least two other substances by heat. What is this type of reaction called?

__________________________________________________________________________

1 mark

b If a transition metal carbonate is heated it decomposes to form a metal oxide and carbon dioxide. Write down the word equation for the decomposition of copper carbonate.

__________________________________________________________________________

1 mark

4a Sodium hydroxide solution is used to identify the presence of transition metal ions in solution. Finish the table.

<table>
<thead>
<tr>
<th>Ion</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu^{2+}</td>
<td></td>
</tr>
<tr>
<td>Fe^{2+}</td>
<td></td>
</tr>
<tr>
<td>Fe^{3+}</td>
<td></td>
</tr>
</tbody>
</table>

3 marks

26 OCR Sci Found p193-201.qxd 21/11/08 16:42 Page 198