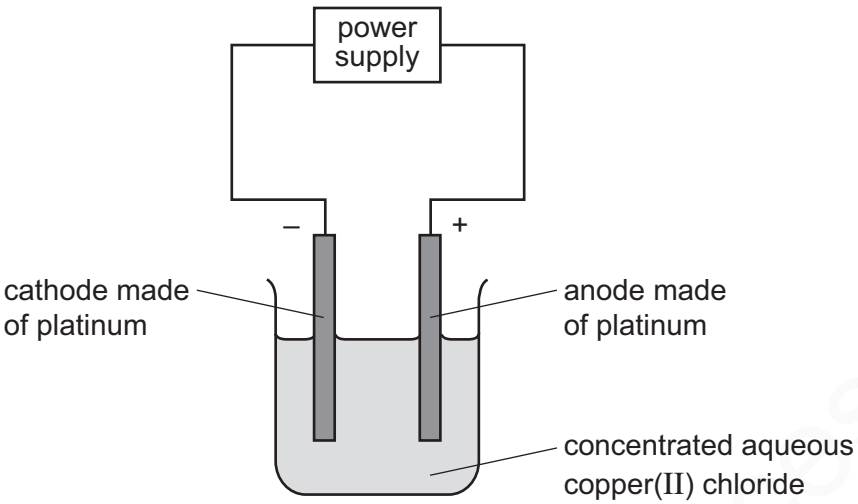
ELECTROLYSIS OF CONC SOLUTIONS

1 Solutions of ionic compounds can be broken down by electrolysis.

(a) Concentrated aqueous copper(II) chloride was electrolysed using the apparatus shown.



The ionic half-equations for the reactions at the electrodes are shown.

negative electrode: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

positive electrode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

(i) Platinum is a solid which is a good conductor of electricity.

State **one** other property of platinum which makes it suitable for use as electrodes.

.....

..... [1]

(ii) State what would be **seen** at the positive electrode during this electrolysis.

.....

..... [1]

(iii) State and explain what would happen to the mass of the negative electrode during this electrolysis.

.....

.....

..... [2]

(iv) The concentrated aqueous copper(II) chloride electrolyte is green.

Suggest what would happen to the colour of the electrolyte during this electrolysis.
Explain your answer.

.....

.....

..... [2]

(v) Identify the species that is oxidised during this electrolysis.
Explain your answer.

species that is oxidised .....

explanation .....

.....
[2]

MARKING SCHEME:

(a)(i)	inert / unreactive / does not react with chlorine	**1**
(a)(ii)	bubbles / fizzing / effervescence	**1**
(a)(iii)	**M1** increases **M2** (solid) copper deposited	**2**
(a)(iv)	**M1** colour fades / becomes pale(r) / becomes colourless / becomes lighter **M2** copper (ions) removed (from solution)	**2**
(a)(v)	**M1** species oxidised: chloride (ions) / Cl^- **M2** explanation: loss of electrons / increase in oxidation state	**2**

2 This question is about electrolysis.

(a) (i) What is meant by the term *electrolysis*?

.....

..... [2]

(ii) Name the type of particle responsible for the conduction of electricity during electrolysis in:

the metal wires .....

the electrolyte .....
[2]

(b) The table gives information about the products of the electrolysis of two electrolytes. Platinum electrodes are used in each case.

(i) Give **two** reasons why platinum is suitable to use as an electrode.

1 .....

2 .....
[2]

(ii) Complete the table.

electrolyte	observation at the anode (+)	name of product at the anode (+)	observation at the cathode (–)	name of product at the cathode (–)
concentrated aqueous potassium chloride			bubbles of colourless gas	
aqueous copper(II) sulfate	bubbles of colourless gas			

[6]

[Total: 12]

MARKING SCHEME:

<table>
<tr><td>(a)(i)</td><td>M1 breakdown of an ionic compound when molten or in aqueous solution
M2 (using) electricity / electric current</td><td>2</td></tr>
<tr><td>(a)(ii)</td><td>M1 electron(s)
M2 ion(s)</td><td>2</td></tr>
<tr><td>(b)(i)</td><td>M1 inert / unreactive
M2 conducts electricity</td><td>2</td></tr>
<tr><td>(b)(ii)</td><td>
<table>
<tr><td>observation at anode(+)</td><td>name of product at anode(+)</td><td>observation at cathode(–)</td><td>name of product at cathode(–)</td></tr>
<tr><td>M1 green / yellow bubbles</td><td>M2 chlorine</td><td></td><td>M3 hydrogen</td></tr>
<tr><td></td><td>M4 oxygen</td><td>M5 pink / brown solid</td><td>M6 copper</td></tr>
</table>
</td><td>6</td></tr>
</table>

3 A sample of concentrated hydrobromic acid, HBr(aq), was electrolysed using platinum electrodes.
The concentration of the hydrobromic acid was 8.89 mol / dm^3.

(i) Calculate the concentration of the HBr(aq) in g / dm^3.

concentration of HBr(aq) = ... g / dm^3 [1]

(ii) Explain why concentrated HBr(aq) can conduct electricity.

.....

.....

..... [2]

(iii) Magnesium is **not** a suitable material from which to make the electrodes.

Explain why.

.....

..... [1]

(iv) Predict the product formed at the anode when concentrated HBr(aq) is electrolysed.

..... [1]

(v) Write the ionic half-equation for the reaction occurring at the cathode.

..... [2]

MARKING SCHEME:

(i)	720(.09)	**1**
(ii)	(it contains) ions (1) (ions) are able to move (1)	**2**
(iii)	magnesium is not inert	**1**
(iv)	bromine / Br_2	**1**
(v)	H^+ and $e^{(-)}$ on LHS (1) fully correct, i.e.: $2H^+ + 2e^- \rightarrow H_2$ (1)	**2**