Science Autumn Term 2 – Chemistry: Electrolytic Processes & Obtaining and Using Metals (C10 & 11)

Section A: Vocabulary

Tier 3 Vocabulary

anion	A negatively charged ion, formed by gaining electrons (usually a non-metal ion).
anode	Positive electrode.
cathode	Negative electrode.
cation	A positively charged ion formed by losing electrons.
electrode	A rod made of a metal or graphite that carries the current into or out of the electrolyte.
electrolysis	The process in which energy transferred by a direct electrical current decomposes electrolytes.
electrolyte	An ionic compound that is molten or dissolved in water.
oxidation	A reaction in which oxygen is added to a chemical substance; loss of electrons by an atom or negative ion.
reduction	A reaction in which oxygen is lost by a chemical substance; gain of electrons by an atom or negative ion.
displacement reaction	A reaction where a more reactive element takes the place of a less reactive element in a compound.
redox	A reaction in which oxidation and reduction take place.

Tier 2 Vocabulary

inert	An electrode that is unreactive, such as graphite or platinum.
ore	A rock that contains a high concentration of a metal or metal compound.
rusting	The reaction between iron, air and water to form hydrated iron(III) oxide (rust).
corrosion	A reaction in which a metal reacts with air and sometimes water to form a metal oxide or hydroxide.

Section B: Big Ideas

C10: Electrolytic Processes

- **Cations** are positive ions and are attracted to the negative **cathode**.
- **Anions** are negative ions and are attracted to the positive **anode**.

Higher Tier

These changes are represented by **half equations**, which show the change at each electrode.

Cathode reaction: $Zn^{2+} + 2e \rightarrow Zn$ reduction — ReduCtion takes place at the Cathode.

Anode reaction: $2Cl^- \rightarrow Cl_2 + 2e$ oxidation — OxidAtion takes place at the Anode.

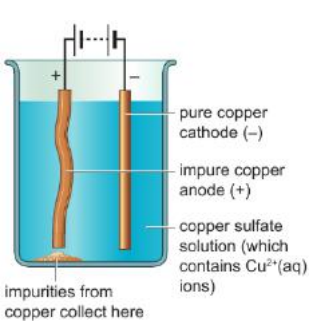
Note that two Cl^- ions are needed to form one chlorine molecule.

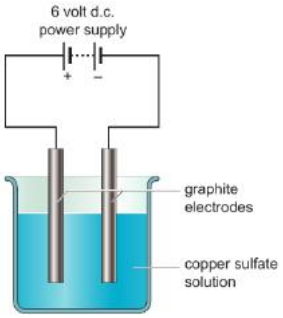
- **Electrolysis of molten ionic compounds can give different products to electrolysis of solutions of these same compounds. This is because in solution, water is also split by electrolysis into H^+ and OH^- ions.**

C11: Obtaining and Using Metals

Metal	Method of extraction
potassium	electrolysis of a molten compound
sodium	
calcium	
magnesium	
aluminium	
(carbon)	
zinc	heat an ore with carbon
iron	
copper	
silver	found as the uncombined element
gold	

Section C: Core Practical task





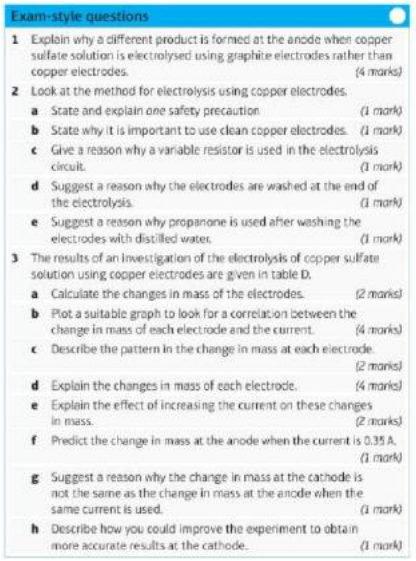
H

The half equation for the anode reaction is:

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

The half equation for the cathode reaction is:

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



Exam-style questions

1 Explain why a different product is formed at the anode when copper sulfate solution is electrolysed using graphite electrodes rather than copper electrodes. (4 marks)

2 Look at the method for electrolysis using copper electrodes.

a State and explain *one* safety precaution. (1 mark)

b State why it is important to use clean copper electrodes. (1 mark)

c Give a reason why a variable resistor is used in the electrolysis circuit. (1 mark)

d Suggest a reason why the electrodes are washed at the end of the electrolysis. (1 mark)

e Suggest a reason why propanone is used after washing the electrodes with distilled water. (1 mark)

3 The results of an investigation of the electrolysis of copper sulfate solution using copper electrodes are given in table D.

a Calculate the changes in mass of the electrodes. (2 marks)

b Plot a suitable graph to look for a correlation between the change in mass of each electrode and the current. (4 marks)

c Describe the pattern in the change in mass at each electrode. (2 marks)

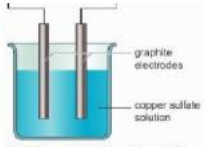
d Explain the changes in mass of each electrode. (4 marks)

e Explain the effect of increasing the current on these changes in mass. (2 marks)

f Predict the change in mass at the anode when the current is 0.35 A. (1 mark)

g Suggest a reason why the change in mass at the cathode is not the same as the change in mass at the anode when the same current is used. (1 mark)

h Describe how you could improve the experiment to obtain more accurate results at the cathode. (1 mark)



C electrolysis circuit for using graphite electrodes

Current (A)	0.2	0.3	0.4	0.5
Mass of anode at start (g)	2.77	2.68	2.53	2.36
Mass of anode at end (g)	2.69	2.55	2.36	2.15
Mass of cathode at start (g)	2.51	2.55	2.62	2.70
Mass of cathode at end (g)	2.58	2.66	2.76	2.87

D results of an electrolysis investigation