

## INTRODUCTION TO REDOX REACTIONS

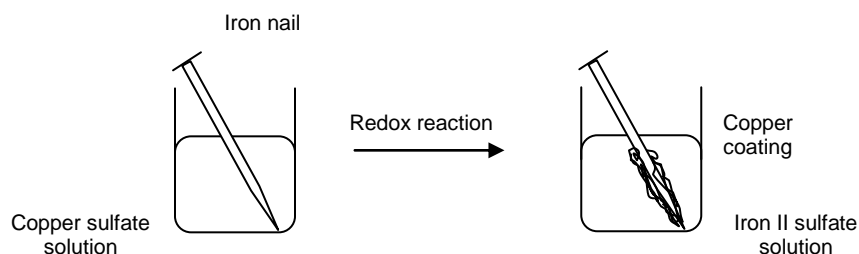
- *Explain the displacement from solution in terms of transfer of electrons.*

A displacement reaction occurs when an active metal is placed in a solution containing ions of a less active metal and the active metal displaces the less active metal from solution. This occurs because a more active metal atom loses one or more electrons and becomes a positive ion. The electrons are now available and are transferred to the ions of the less active metal resulting in them becoming metal atoms.

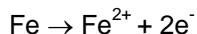
- *Identify the relationship between displacement of metal ions in solution by other metals to the relative activity of the metals.*

More active     $K > Na > Mg > Al > Zn > Cr > Fe > Ni > Sn$     Less active

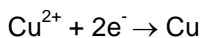
Of 2 metals, the more reactive metal is the one that will displace the other metal from a solution of its ions.



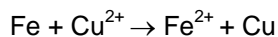
E.g. if an iron nail is placed in a solution of blue copper (II) sulfate, some of the iron nail is dissolved.



At the same time, the blue colour of the solution disappears and a dark copper coating appears on the nail surface.



The overall reaction is



- *Account for changes in the oxidation state of a species in terms of their loss or gain of electrons.*

The oxidation state of an atom is an arbitrary charge or number assigned to the atom according to a set of rules. Oxidation states are worked out by the following rules:

1. Uncombined elements have an oxidation state of 0. (E.g.  $Na=0$  and  $H_2=0$ )
2. Ions have an oxidation state equal to their ion. (E.g.  $Na^{+}=+1$  and  $S^{2-}=-2$ )
3. Oxygen in compounds have a charge of  $-2$  in oxides and  $-1$  in peroxides.
4. Hydrogen in compounds have a charge of  $+1$  when combined with non-metals and  $-1$  when combined with metals.
5. The oxidation state of a compound or polyatomic ion is the sum of all its atoms.

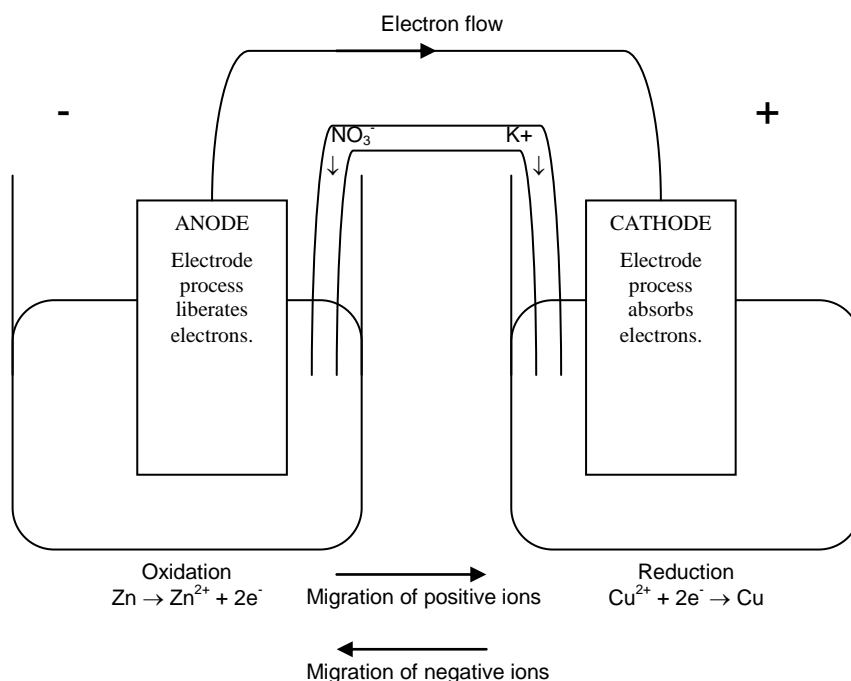
- *Describe and explain galvanic cells in terms of oxidation and reduction reactions.*

A galvanic (voltaic/electrochemical) cell allows a spontaneous redox reaction to take place in such a way that electricity is produced. The electrons that are transferred can pass through an external wire or circuit. It consists of 2 half cells each containing an electrode in an electrolyte solution. Oxidation takes place in one half, reduction in the other.

- *Outline the construction of galvanic cells and trace the direction of electron flow.*
- Two half cells, each containing an electrode (a conductive metal or graphite strip) in an electrolyte solution. Oxidation takes place in one half cell, reduction in the other.
  - A wire connects the two electrodes to allow the electrons to flow from one to another (an electric current).
  - A salt bridge connects the two solutions to maintain the balance of charge. The salt bridge is saturated with a substance such as KNO<sub>3</sub> that allows ions to flow from one container to the other, but does not react with any of the solution. The salt bridge completes the circuit and allows ions to move between each half-cell.

When a galvanic cell produces electricity:

1. One electrode liberates electrons, which flow out of the metal of the electrode and into the external circuit.
2. These electrons flow through the metallic conductor of the external circuit to the other electrode.
3. The reactions of the other electrode consume these electrons.
4. Ions move through these solutions and connecting salt bridge to maintain electrical neutrality.



- *Define the terms anode, cathode, electrode and electrolyte to describe galvanic cells.*

Anode: the electrode at which oxidation takes place. As electrons are generated by oxidation, the terminal value of the anode is marked as a negative.

Cathode: the electrode at which reduction takes place because electrons are accepted in reduction the terminal of the cathode is marked positive.

Electrodes: the conductors of a cell that get connected to the external circuit are called the electrode.

Electrolyte: an electrolyte is a substance which in solution or molten conducts electricity.