OXIDATION REDUCTION

Introduction

An **oxidation-reduction reaction**, also known as a **redox reaction** is a reaction that occurs when electrons transfer from one atom to another. The **oxidation** reaction is when an atom loses an electron i.e. becomes positive while the **reduction** reaction is when an atom gains an electron i.e. becomes negative. Both reactions are complimentary: one can't occur without the other.

The atom that gets reduced (gains electrons) is known as the **oxidizing agent** and the atom that get oxidized (loses electrons) is known as the **reducing agent**. Since they are complimentary reactions, the numbers of electrons gained is always equal to the number of electrons lost. For a redox equation to be balanced, the number of electrons transferred in each half-reaction must be the same. This is a **single displacement redox reaction**.

For example, in the following reaction:

$$Fe_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + 2Ag_{(s)}$$

$Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^{-}$ is the oxidation half-reaction

$2Ag^{+} + 2e^{-} \rightarrow 2Ag_{(s)}$ is the reduction half-reaction

In order to balance an equation, the half-reaction method is used. The are specific steps involved which are:

1. Write the net ionic equation
2. Write the each half-reaction
3. Balance the atoms and charges
4. Adjust coefficients so that electrons are balanced
5. Combine the half reactions and put back in the spectator ions

In this experiment, you will be using copper (II) sulfate, $CuSO_4$ and elemental iron, **Fe** to see what an oxidation-reduction reaction looks like in real time.

Purpose

To visualise the principles of redox reactions using copper (II) sulfate and iron.

Hypothesis

What is your hypothesis concerning the reaction that will occur between the iron and the copper (II) sulfate?

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Materials

- 2 non-galvanized iron nails
- $CuSO_4$, 1.0M
- 25mL graduated cylinder
- 150mL beaker
- Sandpaper
- Timer
- Tweezers
- Balance
- Wash bottle
- Paper Towels

Procedure

1. Label 150mL beaker $CuSO_4$.
2. Add 25mL of $CuSO_4$ to beaker from stock solution.
3. Clean 2 iron nails with sandpaper, water and paper towels.
4. Determine the mass of the nails.
5. Record observations.
6. Carefully place nails into $CuSO_4$ solution.
7. Record observations.
8. Using tweezers, remove nails from solution.
9. Carefully scrape nails with tweezers to remove brown solid.
10. Rinse with water and dry.
11. Determine new mass of the nails.

Data

Initial

Mass of nails: ____

Colour of nails: _______________________________________

Colour of $CuSO_4$: _____________________________________

2 minutes

Colour of nails: ____

Colour of $CuSO_4$: ______________________________________

5 minutes

Colour of nails: ____

Colour of $CuSO_4$: ______________________________________

10 minutes

Mass of nails: ____

Colour of nails: ____

Colour of $CuSO_4$: ______________________________________

General observations: what else do you notice is happening to the nails and the solution during the 10 minutes

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Results

1. What is being formed on the nails? ____

2. Which is the:

Reducing agent _______________________________________

Oxidizing agent _______________________________________

3. Did the mass of the nails increase or decrease? Explain why.

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4. Balance the redox equation using the half-reaction method. Don't forget to label which is the oxidation and which is the reduction half-reaction:

$$\mathbf{Fe_{(s)} + CuSO_{4\,(aq)} \rightarrow Cu_{(s)} + Fe_2(SO_4)^3{}_{(aq)}}$$