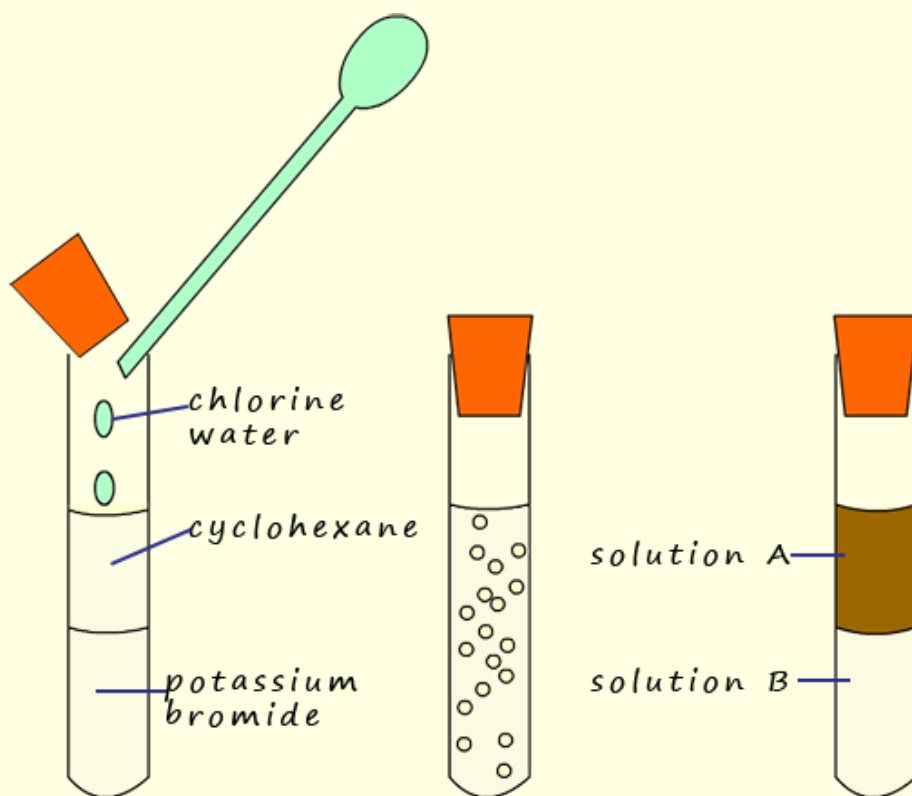Oxidation, reduction and redox reactions

1. Write a simple easy to remember definition for the following key words:

- Reduction
- Oxidation
- Reducing agent
- Oxidising agent
- Redox reaction
- Spectator ion

2. Magnesium reacts with chlorine to form magnesium chloride.

a. Write a balanced symbolic equation for this reaction.

b. Write 2 separate half equations to show that this reaction is a redox reaction.

c. Combine the two separate half-equations to get the overall symbolic equation for this reaction.

d. What is the reducing and oxidising agents in this reaction?

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3. Chlorine will displace bromide ions from a potassium bromide solution. This is a displacement reaction.

a. What is a displacement reaction?

b. Write a balanced symbolic equation to show this displacement reaction.

c. Write 2 separate half-equations to show the oxidation and reduction reactions taking place in this redox or displacement reaction.

d. What are the reducing and oxidising agents in this reaction?

e. An outline of this dispalcement reaction is outlined in the diagram below:


i. Why is cyclohexane added to the test-tube?

ii. Name solutions A and B shown in the diagram?

4. The diagram opposite shows a small piece of sodium burning on a burning spoon.

a. Write a balanced symbolic equation with state symbols to show the combustion of sodium metal to form sodium oxide.

b. Write 2 half-equations to show the oxidation and reduction reactions taking place.

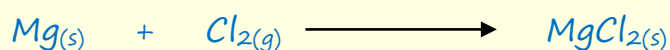c. Explain using oxidation states why this reaction is a redox reaction.
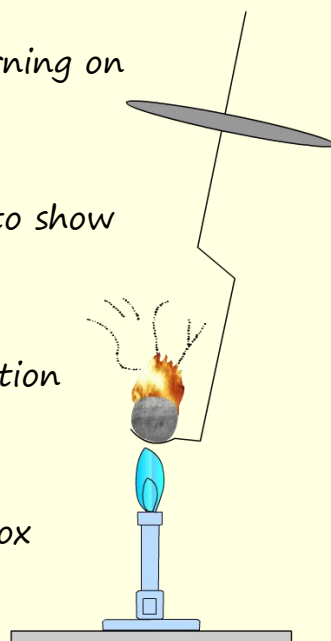
Answers

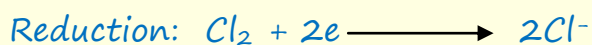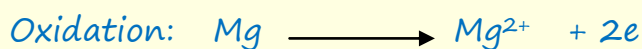1. Write a simple easy to remember definition for the following key words:

   - Reduction– gain of electrons, loss of oxygen, addition of hydrogen
   - Oxidation– loss of electrons, addition of oxygen or any very electronegative element, loss of hydrogen
   - Reducing agent – electron donor
   - Oxidising agent – electron acceptor
   - Redox reaction – reaction where one substance is reduced and another oxidised
   - Spectator ion – ion that remains unchanged during a reaction, usually only present to balance off charges.

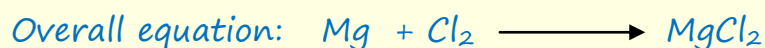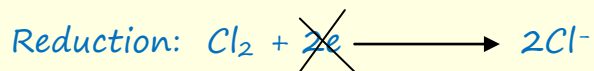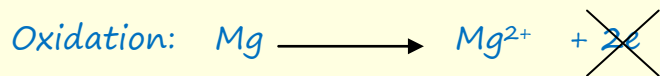2. Magnesium reacts with chlorine to form magnesium chloride.

a. Write a balanced symbolic equation for this reaction.

$$Mg_{(s)} \quad + \quad Cl_{2(g)} \longrightarrow \quad MgCl_{2(s)}$$

b. Write 2 separate half equations to show that this reaction is a redox reaction.

Oxidation: $Mg \longrightarrow Mg^{2+} + 2e$

Reduction: $Cl_2 + 2e \longrightarrow 2Cl^-$

c. Combine the two separate half-equations to get the overall symbolic equation for this reaction.

Oxidation: $Mg \longrightarrow Mg^{2+} + \cancel{2e}$

Reduction: $Cl_2 + \cancel{2e} \longrightarrow 2Cl^-$

Overall equation: $Mg + Cl_2 \longrightarrow MgCl_2$

Simply cancel out the electrons, which should be balanced to get the overall equation.

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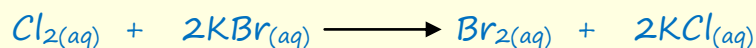d. What is the reducing and oxidising agents in this reaction?

Reducing agent is the electron donor, it is the magnesium metal.

Oxidising agent is the electron acceptor, in this case it is the chlorine.

3. Chlorine will displace bromide ions from a potassium bromide solution. This is a displacement reaction.

a. What is a displacement reaction? More reactive halogen will remove a less reactive halogen from its solution or compound.

b. Write a balanced symbolic equation to show this displacement reaction.

$$Cl_{2(aq)} + 2KBr_{(aq)} \longrightarrow Br_{2(aq)} + 2KCl_{(aq)}$$

c. Write 2 separate half-equations to show the oxidation and reduction reactions taking place in this redox or displacement reaction.

Reduction: $Cl_2 + 2e \longrightarrow 2Cl^-$
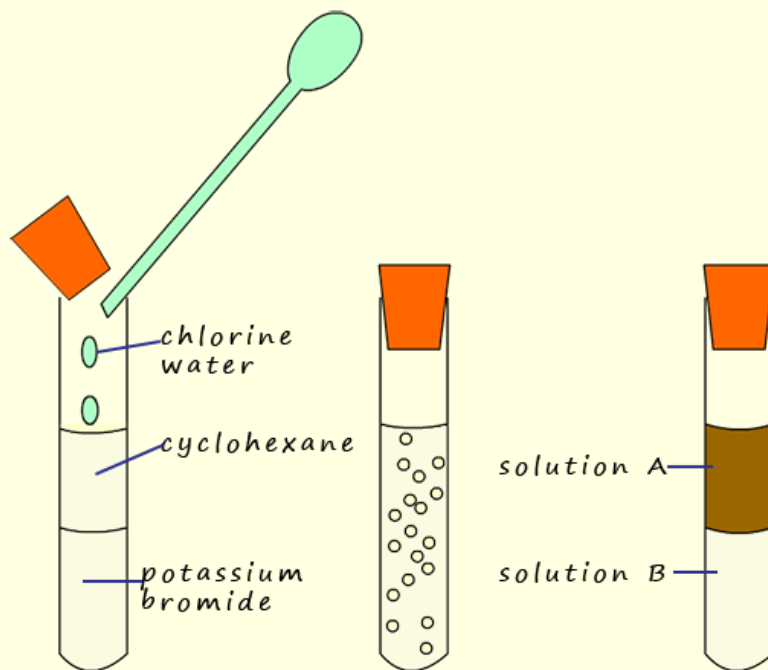
oxidation: $2Br^- - 2e \longrightarrow Br_2$

d. What are the reducing and oxidising agents in this reaction?

Reducing agent is bromide ion

Oxidising agent is chlorine

e. An outline of this dispalcement reaction is outlined in the diagram below:


i.   Why is cyclohexane added to the test-tube? Halogens are much more soluble in organic solvents than in water and also give bright clear colours in organic solvents.
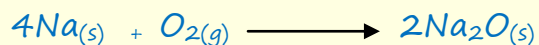
ii. Name solutions A and B shown in the diagram?

Solution A- bromine in cyclohexane layer

Solution B- potassium chloride solution

4. The diagram opposite shows a small piece of sodium burning on a burning spoon.
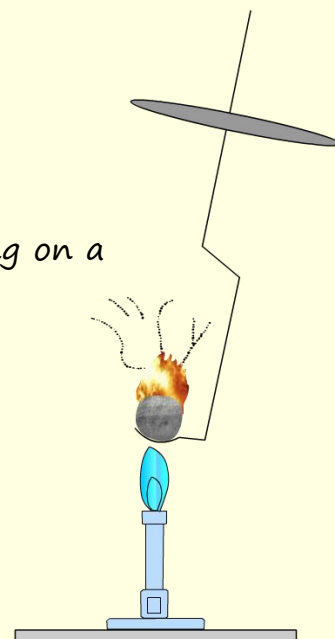
a. Write a balanced symbolic equation with state symbols to show the combustion of sodium metal to form sodium oxide.

$$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$$

b. Write 2 half-equations to show the oxidation and reduction reactions taking place.

Oxidation: $4Na \longrightarrow 4Na^+ + 4e$

Reduction: $O_2 + 4e \longrightarrow 2O^{2-}$
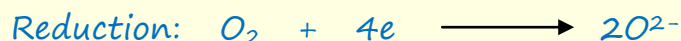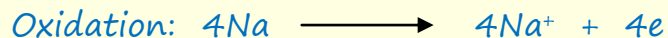
c. Explain using oxidation states why this reaction is a redox reaction.

Sodium and oxygen are both elements so their oxidation number is 0. After they have reacted oxidation number of sodium is +1, since it loses 1e. The oxidation number of the chloride ion is −1, since it gains one electron. So the sodium is oxidised and the chlorine reduced, it's a redox reaction.