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FREE LEARNING NOTES FOR ZAMBIA

FORM 2

Chemistry

Redox reactions: oxidation, reduction and how to test for them

Lesson notes for learners · Competence-Based Curriculum

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Bleach can turn clothes white quickly, and a vitamin C tablet stops a lemon drink from turning brown. Both are examples of electrons moving from one substance to another. In this note you learn what a redox reaction is, what oxidising and reducing agents do, and the colour changes that help you identify them in the laboratory.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Explain that oxidation and reduction happen together in a redox reaction
- Say what an oxidising agent and a reducing agent do
- Identify an oxidising agent using potassium iodide and starch
- Identify a reducing agent using acidified potassium dichromate and acidified potassium permanganate
- Give everyday examples of oxidising and reducing agents

KEY WORDS

redox reaction	a chemical reaction in which oxidation and reduction happen at the same time
oxidation	the loss of electrons by a substance
reduction	the gain of electrons by a substance
oxidising agent	a substance that makes another substance lose electrons while it gains electrons, so it is reduced
reducing agent	a substance that gives electrons to another substance
starch solution	a solution that turns blue-black when iodine is present

1 Redox reactions: electrons on the move

A redox reaction is a chemical reaction in which oxidation and reduction occur simultaneously. They happen at the same time because both involve the transfer of electrons: the electrons lost by one substance must be gained by another substance.

A substance that loses electrons is oxidised. A substance that gains electrons is reduced. You cannot have one without the other.

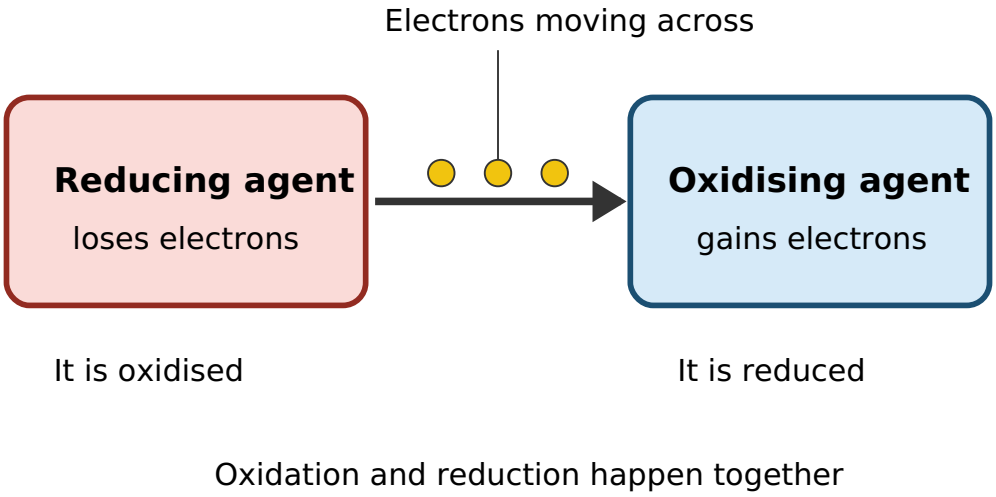

Figure 1. Electrons move from the reducing agent to the oxidising agent

2 Oxidising and reducing agents

An oxidising agent causes another substance to lose electrons, while the oxidising agent itself gains electrons. In the process it is reduced. A reducing agent does the opposite: it donates electrons to other substances.

Oxidising agents are useful in everyday life. Bleach turns things white and disinfects surfaces. Reducing agents are also useful: vitamin C, for example, helps to stop a drink from turning brown and so helps to preserve food by preventing oxidation.

3 Testing for an oxidising agent

To test a substance, place about 2 cm^3 of potassium iodide solution in a test tube, add a few drops of the solution you are testing, then add a few drops of starch solution and shake gently. If the substance is an oxidising agent it takes electrons from the iodide ions (I^-) and turns them into iodine (I_2). The iodine reacts with the starch to give a blue-black colour. So a blue-black colour means the substance is an oxidising agent.

Examples of substances to test include acidified potassium permanganate, chlorine water, hydrogen peroxide and dilute nitric acid. Always use distilled water as a control, wear goggles and a laboratory coat, and dispose of the chemicals safely.

4 Testing for a reducing agent

To test for a reducing agent, use an acidified oxidising agent whose colour changes when it gains electrons. In Part A, place 2 cm³ of acidified potassium dichromate in a test tube and add a few drops of the test solution, such as iron(II) sulphate. If the orange colour turns green, the substance is a reducing agent. In Part B, use acidified potassium permanganate and add a few drops of a test substance such as ethanol. If the purple colour turns colourless or pale pink, the substance is a reducing agent.

Waste containing chromium must be disposed of properly.

Test reagent	Colour change	What it shows
Potassium iodide with starch	Colourless to blue-black	The substance is an oxidising agent
Acidified potassium dichromate	Orange to green	The substance is a reducing agent
Acidified potassium permanganate	Purple to colourless or pale pink	The substance is a reducing agent

Figure 2. Colour changes used to identify agents

WORKED EXAMPLE

A few drops of a test solution are added to acidified potassium permanganate and the purple colour turns colourless. What can you say about the test solution?

Purple to colourless means the permanganate has lost its purple colour

This colour change is the test for a reducing agent

So the test solution is a reducing agent, and it donated electrons

TRY THIS

In small groups, wearing goggles and laboratory coats, test two or more solutions with potassium iodide and starch, and with acidified potassium dichromate or permanganate. Use distilled water as a control. Record each starting and final colour in a table and state whether each solution is an oxidising agent or a reducing agent.

REMEMBER

- A redox reaction is one in which oxidation and reduction occur together
- Oxidation is loss of electrons and reduction is gain of electrons
- An oxidising agent gains electrons and is itself reduced
- A reducing agent donates electrons
- Blue-black with potassium iodide and starch shows an oxidising agent
- Orange to green with dichromate, or purple to colourless with permanganate, shows a reducing agent

? Check yourself

1. What is a redox reaction?
2. What happens to a substance that is oxidised?
3. What is an oxidising agent?
4. What colour change in the potassium iodide and starch test shows an oxidising agent?
5. What colour change shows a reducing agent when acidified potassium dichromate is used?
6. You are a learner at a school in Luangwa. Your teacher gives you two unlabelled solutions, X and Y. When you add starch and potassium iodide to X, a blue-black colour appears. When you add Y to acidified potassium permanganate, the purple colour disappears. (a) What is X? (b) What is Y? (c) Explain
7. At home you squeeze lemon into water and notice that the drink goes brown when left out, but a drink with a vitamin C tablet stays clear. (a) Which of the two is acting as a reducing agent? (b) Explain what a reducing agent does. (c) Say why this property is useful in food.

ANSWERS

1. A chemical reaction in which oxidation and reduction occur at the same time because electrons are transferred.
2. It loses electrons.
3. A substance that causes another substance to lose electrons while it gains electrons, so it is reduced.
4. A blue-black colour.
5. Orange to green.
6. (a) X is an oxidising agent. (b) Y is a reducing agent. (c) In the first test X takes electrons from the iodide ions, turning them into iodine. In the second test Y gives electrons to the permanganate, so the purple colour is lost.
7. (a) The vitamin C. (b) A reducing agent donates electrons to other substances. (c) It helps prevent oxidation, which helps to preserve food.

Written by 25Schools to follow the Form 2 Chemistry syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.