

### The scenario

<b>Subject</b>	pH-dependent $\text{KMnO}_4$ reactions
<b>Length</b>	4,5 min.
<b>Main objectives</b>	Understanding redox reactions
<b>Detailed objectives</b>	<p>Observation of changes occurring during the reaction</p> <p>Understanding the influence of pH on the reduction of manganate(VII) ions</p> <p>Learning equation notation of the reaction in ionic form</p> <p>Learning and understanding of the electron balance of oxidation-reduction reactions</p>
<b>Structure and description of experiments:</b>	
<b>Introduction</b>	<p>Description: Redox reactions are oxidation-reduction reactions. Oxidation and reduction are chemical processes that occur when atoms or molecules exchange electrons and change the oxidation state of the atoms of the chemical elements. Oxidation is the loss of electrons, while reduction is the acceptance of electrons by an atom or molecule. Oxidation and reduction processes occur simultaneously and neither can occur without the other.</p>
<b>Main subject</b>	<p>Description: Learning about the oxidation and reduction reactions on the example of the <math>\text{KMnO}_4</math> reaction. Studying <math>\text{KMnO}_4</math> reaction in the presence of hydrogen and hydroxide ions, and water.</p>
<b>Part 1</b>	<p><b>Equipment:</b> test tubes, Pasteur pipettes, automatic pipette</p> <p><b>Reagents:</b> 0,1 M <math>\text{KMnO}_4</math>, 1 M <math>\text{H}_2\text{SO}_4</math>, 5 M <math>\text{NaOH}</math>, 1 M <math>\text{Na}_2\text{SO}_3</math></p> <p><b>Description of the exercise:</b> Pipette 2 ml of 0.1 M <math>\text{KMnO}_4</math> into three test tubes. To the first add 2 mL of 1 M sulfuric acid solution, to the second 2 mL of water, and to the third 2 mL of 5 M <math>\text{NaOH}</math> solution. Then pour 1 mL of 1 M <math>\text{Na}_2\text{SO}_3</math> solution into each of them using an automatic pipette. Note the observations. After completing the experiment, transfer the contents of the test tubes to the appropriate waste containers.</p> <p><b>Questions:</b></p> <ol style="list-style-type: none"> <li>Note the observations of the transformations taking place</li> <li>Write down the equations of reactions taking place in each test tube</li> <li>What manganese compounds were formed in test tubes 1 and 2?</li> <li>How does pH affect the reduction of manganate(VII) ions?</li> <li>What role does sodium sulphate(IV) play in the reactions?</li> </ol> <p><b>Conclusions:</b> Manganese compounds present in the +VII oxidation state are strong oxidants, however, their oxidizing properties depend on the pH of the solution. Manganate(VII) ions in an acidic environment are reduced to <math>\text{Mn(II)}</math> ions, which can be observed after the violet solution becomes discoloured; in a neutral environment they are reduced to</p>

	<p>Mn(IV) in the form of a brown <math>\text{MnO}_2</math> precipitate; in an alkaline environment, they are reduced to ions (<math>\text{MnO}_4^{2-}</math>) changing the colour of the solution from violet to green.</p>
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**Level:** Primary school