Coordination compounds I

1. Execution of the exercise

Attention! - Depending on the teacher's decision, test tubes can be used instead of porcelain plates.

1.1. Evaluation of the complexation reaction based on the change in color.

1.1.1. Add one drop of the solution of the following ions Fe^{3+}, Ni^{2+}, Co^{2+}, Cu^{2+} to the recesses in the porcelain plate in which one drop of NH_4SCN solution is placed. Observe the colors of the solutions obtained.

1.1.2. Add one drop of the solution of the following ions Zn^{2+}, Cd^{2+}, Cu^{2+}, Ni^{2+} and Co^{2+} to the recesses in the porcelain plate in which one drop of NH_3aq solution is placed. Observe the colors of the solutions obtained.

1.2. Gradual formation of complexes.

1.2.1. Up to four tubes containing 2-4 cm^3 of Co^{2+} solution, add approximately 0,5; 1; 2 and 4 cm^3 of NH_4SCN solution. After assessing the intensity of the color, dilute each solution to an equal volume. Re-evaluate the intensity of the solution's color.

1.2.2. Add 1 cm^3 concentrated HCl and 1-2 drops of NH_4SCN solution to a test tube containing 1-2 drops of Fe^{3+} solution. After observing the color of the complex, fill the test tubes with water to an equal volume. Take up to four test tubes about 1, 2, 3 and 15 cm^3 of the solution obtained and fill with water to an equal volume.

1.3. Buffer solution of a complex compound.

1.3.1. To a test tube containing 0,5 - 1 cm^3 EDTA solution and 2 - 3 drops of NH_4SCN solution, add the solution containing Fe^{3+} ions carefully dropwise until a red color appears (determining the sensitivity of the complexation reaction).

1.3.2. Prepare a series of Fe^{3+} solutions at concentrations of 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} and 10^{-7} mol/dm^3 using successive dilutions method. Then add 2 drops of NH_4SCN solution to 6 wells of the porcelain plate. Then add one drop of the adequately diluted Fe^{3+} solution (10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} or 10^{-6} mol/dm^3). Based on the observation of the color, assess the sensitivity of the NH_4SCN solution to Fe^{3+} ions.

1.3.3. Prepare a series of Fe^{3+} solutions at concentrations of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6} mol/dm^3 using successive dilutions method. Prepare 8 cm^3 of each solution. Then add 1 cm^3 of NH_4SCN saturated solution and 1 cm^3 of concentrated HCl to each test tube and shake thoroughly (iron standard solutions were obtained). Then add 1 cm^3 of NH_4SCN saturated solution and 1 cm^3 of concentrated HCl to 8 cm^3 of tap water. Based on the observation of the color of iron standard solutions obtained and the color of tap water answer the question: how much iron (µg) is in a glass of tea (250 cm^3)?

1.3.4. Add approximately 9 cm^3 of water to a test tube containing approx. 1 cm^3 of Cu^{2+} solution. For a further dilution of the resulting solution in a ratio of 1:10, prepare a series of four Cu^{2+} solutions of decreasing concentration. Add a few drops of 2M NH_3 aq to each of the tubes. Compare the intensity of the color solution.

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2. Compilation of results

- Write complexation reactions and fill in the table below. Based on the observation of the intensity of coloring and on the basis of the literature, write chemical formulas of possible complex compounds obtained in the experiment and determine their stability by providing the pK (-log β) value.
- Present on the graph (using the literature) why the solution is a buffer for iron ions.
- Evaluate the sensitivity of iron ions and copper ions by providing the approximate limiting concentration of these ions.

No.	Me^{+n}	Complex formula	Colour	-log β
1.	Fe^{3+}			
2.	Ni^{2+}			
3.	Co^{2+}			
4.	Cu^{2+}			
1.	Zn^{2+}			
2.	Cd^{2+}			
3.	Cu^{2+}			
4.	Ni^{2+}			
5.	Co^{2+}			

3. Conclusion

For each of the above mentioned points, give a succinct conclusion resulting from the experiment.

4. The scope of the theory

- Structure of the coordination compounds
- Formation constant for coordination compounds
- Nomenclature of coordination compounds
- The color of ligands and complexes
- Masking reactions

5. Literature

- M. D. Joesten, J. L. Wood, World of Chemistry, second edition, Thomson, USA 1996
- G. Charlot, Quantitative inorganic anaysis, John Wiley & Sons inc. , London 1954
- (https://archive.org/details/in.ernet.dli.2015.151602)
- D. W. Oxtoby, N. H. Nachtrieb, Principles of modern Chemistry, Saunders College Publishing, USA 1996

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