

Reactions in the acid-base system

1. Execution of the exercise

1.1. Titration of a strong base with a strong acid.

Pour 25 cm³ of 0.1 M NaOH and 25 cm³ of distilled water using a measuring cylinder into a beaker containing a magnetic stirrer. Add 5 to 10 drops of the indicator chosen by the instructor (bromothymol blue, methyl orange, phenolphthalein or methyl red) to the solution. Start to mix, immerse the electrode and titrate with a burette with 0.1 M HCl noting pH-meter indication after addition of every 1 cm³. When pH will be close to 5 titrate adding 0.5 cm³ portions. At the same time observe and record changes in the color of the solution. After reaching pH 3.5-4 stop the titration.

1.2. Titration of a strong base with a strong acid against other indicators.

The titration should be performed in the same way as in section 1.1. using other available indicators.

1.3. Titration of a strong base with a weak acid.

Titrate 0.1 M NaOH with 0.1 M CH₃COOH solution.

Perform the next steps as in section 1.1.

1.4. Titration of a weak base with a strong acid.

Titrate 0.1 M NH₃ aq. with 0.1 M HCl solution.

Perform the next steps as in section 1.1.

2. Compilation of results

- the results of the measurements should be presented in the form of a table (dependence of added acid (cm³) and pH). On their basis, draw graphs of the solution pH depending on the volume of the titrator. In the graphs mark the neutralization point and the equivalent saturation point. Write a short characterization of the titration curves.



- based on the observation of the color change of solutions during the titration performed according to points 1.1, 1.2. or 1.3., 1.4., give the pH range of the color change of the indicators used and assess their suitability for determining equivalence saturation points for a given titration system.

3. Conclusions

To be prepared by students.

4. The scope of the material:

- Brönsted theory of acids and bases
- the ionic product of water. The concept of pH
- reactions of acids with bases:
 - strong acid – strong base
 - strong acid – weak base
 - weak acid – weak base
 - weak acid – strong base
- pH indicators
- buffers

5. Literature

- M. D. Joesten, J. L. Wood, *World of Chemistry*, second edition, Thomson, USA 1996
- G. Charlot, *Quantitative inorganic analysis*, 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

