pH scale

1. Execution of the exercise

1.1. pH scale

1.1.1. Transfer 5 cm^3 of 0.1 M HCl into a 50 cm^3 measuring flask and fill with **distilled water** to the mark - after mixing, pour the solution into a small beaker (0.01 M HCl is obtained). Next, transfer 5 cm^3 of 0.01 M HCl into a 50 cm^3 volumetric flask and fill with **distilled water** to the mark - after mixing, pour the solution into a small beaker (0.001 M HCl is obtained). In the same way 0.0001 M HCl solution should be prepared. Measure pH of all prepared solutions.

Use the same procedure to dilute 0.1 M NaOH solution. Measure pH of all prepared solutions.

WARNING!

For dilutions use distilled water only!

1.1.2. In the same way as in point 1.1.1 prepare, dilute, measure and note the pH for the 0.1 M CH_3COOH solution.

1.2. Color changes of natural indicators at different pH

WARNING!

Do not pour solutions with a magnetic dipole into the sink! Recover the dipole!

1.2.1. Weigh 0.2 grams of Na_2CO_3; NaCl; $SnCl_2$ into three separate small beakers. Add red cabbage brew to half of the volume and dilute it with distilled water – note the resulting colors of the solutions.

1.2.2. Transfer 15 cm^3 of 0.1 M NaOH solution into the beaker containing a magnetic dipole. Then add 50 $cm^3$of red cabbage brew. Switch on the magnetic stirrer, immerse the electrode **(the end of the electrode should be placed 1-2 cm above the bottom of the beaker so that the rotating magnetic dipole does not destroy the tip!)** and slowly add from the burette 0.1 M HCl solution (use 0.5 or 1 cm^3 portions) while simultaneously reading the pH of the solution. Add 0.1 M HCl and read the pH until it reaches about 3. During the addition of acid observe

and note color changes of the titrated solution and note pH readings for every permanent color changes occurring.

2. Compilation of results

Molar concentration of HCl:	0.1	0.01	0.001	0.0001
pH				
Molar concentration of NaOH:	0.1	0.01	0.001	0.0001
pH				
Molar concentration of CH_3COOH:	0.1	0.01	0.001	0.0001
pH				

- justify that a mixture of acids of different strength behaves like a multiproton acid.
- present the results from exercise 1.1. in the form of a graph showing the pH as a function of the negative logarithm of the acid (base) concentration.
- present in the table the pH ranges during the titration and corresponding color changes of the red cabbage brew.
- determine the reaction of salt solutions from point 1.2.1 knowing the colors of the titrated solution from point 1.2.2.
- give examples and briefly discuss a few other natural indicators.

3. Conclusion

To be prepared by students.

4. The scope of the material

- The concept of acid and base. Theories of acids and bases. The role of the solvent.
- The ionic product of water. The concept of pH.
- pH values of acid and alkali solutions.
- pH indicators.
- Reactions of acids and bases.
- Multiprotic acids and bases.

5. Literature

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