Titration II. (permanganometry)

I) Determining the exact concentration of a KMnO₄ solution

The concentration of a KMnO₄ solution prepared from solid permanganate salt can not be determined simply from the weigh of the salt since the permanganate oxidizes the organic impurities in the water, and the formed manganese dioxide catalyses the decomposition of KMnO₄ represented by the following equation:

\[ 4 \text{KMnO}_4 + 2 \text{H}_2 \text{O} = 4 \text{MnO}_2 + 4 \text{KOH} + 3 \text{O}_2 \]

Sodium oxalate or oxalic acid can be used to determine the exact concentration:

\[ 2 \text{KMnO}_4 + 5 (\text{COOH})_2 + 3 \text{H}_2 \text{SO}_4 = 2 \text{MnSO}_4 + \text{K}_2\text{SO}_4 + 10 \text{CO}_2 + 8 \text{H}_2\text{O} \]

Additional indicator is not needed, the disappearance of the intense purple color of the permanganate ions indicates the endpoint.

Steps of the exercise:

- ~0.63 g (COOH)₂ · 2H₂O is weighed on an analytical balance with the accuracy of 0.0001g and 100.0 cm³ of solution is prepared from it in a volumetric flask.
- 10.0 cm³ of solution is transferred to 3 Erlenmeyer flasks with a pipette. The solutions are acidified with ~5 cm³ of 20% sulfuric acid.
- The burette is rinsed with a few cm³ of the permanganate solution and the level is set to 0.0.
- The oxalic acid solutions are warmed up to ~60 °C. In the beginning the permanganate solution is added very slowly (dropwise) since the reaction is catalyzed by the Mn(II) ions, later the reaction becomes very fast. Titirating is continued until the last drop of KMnO₄ retains it's color and the solution stays pink.

II) Determination of the level of impurity in Fe(NH₄)₂(SO₄)₂ · 6H₂O

KMnO₄ oxidizes Fe(II) ions according to the following equation:

\[ 10 \text{FeSO}_4 + 2 \text{KMnO}_4 + 8 \text{H}_2 \text{SO}_4 = 5 \text{Fe}_2(\text{SO}_4)_3 + \text{K}_2\text{SO}_4 + 2 \text{MnSO}_4 + 8 \text{H}_2\text{O} \]

Titirate the given sample with the KMnO₄ solution from the first exercise in the presence of phosphoric acid (the phosphate complex of Fe(III) ions is colourless, so the yellow coloration of the Fe(III) ions does not disturb the end point detection.)