5.4 EXERCISE 4 – manganate (VII) and dichromate (VI) titrations

1. Ammonium iron (II) sulphate crystals have the following formula: $(NH_4)_2SO_4.FeSO_4.nH_2O$. In an experiment to determine n, 8.492g of the salt were dissolved and made up to 250 cm^3 of solution with distilled water and dilute sulphuric acid. A 25 cm^3 portion of the solution was further acidified and titrated against potassium manganate (VII) solution of concentration 0.0150 $moldm^{-3}$. A volume of 22.5 cm^3 was required. Determine n.

2. Calculate x in the formula $FeSO_4.xH_2O$ from the following data: 24.4 g of iron (II) sulphate crystals were made up to 1 dm^3 of aqueous solution acidified with sulphuric acid. 25.0 cm^3 of the solution required 16.6 cm^3 of 0.022M $K_2Cr_2O_7$ for complete reaction.

3. A solution of hydrogen peroxide of volume 25 cm^3 was diluted to 500 cm^3. A 25.0 cm^3 portion of the diluted solution was acidified and titrated against 0.0150 $moldm^{-3}$ potassium permanganate solution, and 45.7 cm^3 were required. Calculate the concentration of the original hydrogen peroxide solution before dilution, given that hydrogen peroxide is oxidized according to the following equation:
   $H_2O_2(aq) \rightarrow 2H^+(aq) + O_2(g) + 2e$

4. An steel wire (steel is mostly iron) of mass 3.225g was dissolved in dilute sulphuric acid and the solution made up to 250 cm^3. A 25 cm^3 portion of this solution was further acidified and titrated against potassium dichromate (VI) of concentration 0.031 $moldm^{-3}$. The volume required was 31.0 cm^3. Calculate the percentage of iron in the steel wire.

5. The ethanedioate ion, $C_2O_4^{2-}(aq)$ is a reducing agent: $C_2O_4^{2-}(aq) \rightarrow 2CO_2(g) + 2e$
   A sample of ethanedioic acid, $H_2C_2O_4.xH_2O$, weighing 2.24 g was dissolved in water and the solution made up to 250 cm^3. 25 cm^3 samples of the solution were taken and the ethanedioate in the solution required 35.6 cm^3 of 0.020M potassium manganate (VII) for reaction.
   Calculate the value of x.

6. 25.0 cm^3 of a 0.1 $moldm^{-3}$ solution of KNO_2 is completely oxidized by 50.0 cm^3 of 0.0200 $moldm^{-3}$ potassium manganate (VII) solution. To what oxidation number was the N oxidized?