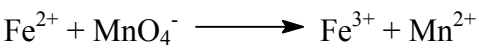
Chemistry 1210 Normality/Redox Problems

1) A sample of iron ore weighing 0.2792 grams was dissolved in dilute acid solution, and all of the iron was converted to Fe(II) ions. The solution required 23.30 mL of 0.0971 N $KMnO_4$ for titration according to the following unbalanced reaction:

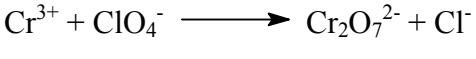


$$Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$$

Calculate the percentage by mass of iron in the ore. **[45.3%]**

2) Oxidation of 25.0 mL of a solution containing H_2SO_3 (to H_2SO_4) requires 22.2 mL of 0.0862 M $K_2Cr_2O_7$ in acidic solution (the $Cr_2O_7^{-2}$ is converted to Cr^{+3}). Calculate the molar concentration of H_2SO_3. **[0.230 M]**

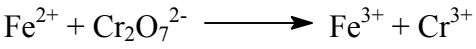
3) From the following incomplete and unbalanced equation



$$Cr^{3+} + ClO_4^- \longrightarrow Cr_2O_7^{2-} + Cl^-$$

determine the equivalent mass of the ClO_4^- ion as a function of its molar mass. **[1/8]**

4) Calculate the molarity of $K_2Cr_2O_7$ if 60.00 mL is consumed in a titration with 20.00 mL of 0.1800 N $FeSO_4$ according to the following reaction in acid solution: **[0.01000 M]**



$$Fe^{2+} + Cr_2O_7^{2-} \longrightarrow Fe^{3+} + Cr^{3+}$$

5) Iodate ion, IO_3^-, oxidizes SO_3^{2-} to SO_4^{2-} in acidic solution. A 100.0 mL sample of solution containing 1.390 g of KIO_3 reacts with 32.5 mL of 0.500 M SO_3^{2-}. What is the final oxidation number of the iodine after the reaction has occurred? **[0]**

6) A quantity of 25.0 mL of a solution containing both Fe^{2+} ions and Fe^{3+} ions is titrated with 23.0 mL of 0.100 N $KMnO_4$ (in dilute sulphuric acid). As a result, all of the Fe^{2+} ions are oxidized to Fe^{3+}. The Fe^{3+} ions are then all reduced to Fe^{2+} ions by zinc metal. Finally, 25.0 mL of the solution containing only Fe^{2+} ions required 40.0 mL of the same $KMnO_4$ solution for oxidation to Fe^{3+}. Calculate the molar concentration of Fe^{2+} and Fe^{3+} in the original sample. **[Fe^{2+}: 0.0920 M; Fe^{3+}: 0.068 M]**

7) A 0.9768 g quantity of Fe(II) salt consumes 32.33 mL of 0.1037 N $K_2Cr_2O_7$. Calculate the percent by mass of Fe^{2+} ion in the salt. **[19.17%]**

8) Oxalic acid ($H_2C_2O_4$) can be oxidized by $KMnO_4$.

a) Balance the following equation in acidic solution:

$H_2C_2O_4 + KMnO_4 \longrightarrow Mn^{2+} + CO_2$

$\mathbf{6H^+ + 5H_2C_2O_4 + 2KMnO_4 \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O + 2K^+}$

b) For the reaction in (a), complete the following:

1 M $KMnO_4$ = ? N $KMnO_4$ **[5]**
1 M $H_2C_2O_4$ = ? N $H_2C_2O_4$ **[2]**

c) If a 1.00 g sample of $H_2C_2O_4$ requires 24.0 mL of 0.0500 N $KMnO_4$ solution to reach an equivalence point, what is the percent by mass of $H_2C_2O_4$ in the sample? **[5.40%]**