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 KMnO₄ for titration according to the following unbalanced reaction:

\[
\text{Fe}^{2+} + \text{MnO}_4^- \rightarrow \text{Fe}^{3+} + \text{Mn}^{2+}
\]

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

2) Oxidation of 25.0 mL of a solution containing H₂SO₃ (to H₂SO₄) requires 22.2 mL of 0.0862 M K₂Cr₂O₇ in acidic solution (the Cr₂O₇²⁻ is converted to Cr³⁺). Calculate the molar concentration of H₂SO₃. [0.230 M]

3) From the following incomplete and unbalanced equation

\[
\text{Cr}^{3+} + \text{ClO}_4^- \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{Cl}^-
\]

determine the equivalent mass of the ClO₄⁻ ion as a function of its molar mass. [1/8]

4) Calculate the molarity of K₂Cr₂O₇ if 60.00 mL is consumed in a titration with 20.00 mL of 0.1800 N FeSO₄ according to the following reaction in acid solution: [0.01000 M]

\[
\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Fe}^{3+} + \text{Cr}^{3+}
\]

5) Iodate ion, IO₅⁻, oxidizes SO₃²⁻ to SO₄²⁻ in acidic solution. A 100.0 mL sample of solution containing 1.390 g of KIO₅ reacts with 32.5 mL of 0.500 M SO₃²⁻. 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 Fe²⁺ ions and Fe³⁺ ions is titrated with 23.0 mL of 0.100 N KMnO₄ (in dilute sulphuric acid). As a result, all of the Fe²⁺ ions are oxidized to Fe³⁺. The Fe³⁺ ions are then all reduced to Fe²⁺ ions by zinc metal. Finally, 25.0 mL of the solution containing only Fe²⁺ ions required 40.0 mL of the same KMnO₄ solution for oxidation to Fe³⁺. Calculate the molar concentration of Fe²⁺ and Fe³⁺ in the original sample. [Fe²⁺: 0.0920 M; Fe³⁺: 0.068 M]

7) A 0.9768 g quantity of Fe(II) salt consumes 32.33 mL of 0.1037 N K₂Cr₂O₇. Calculate the percent by mass of Fe²⁺ ion in the salt. [19.17%]
8) Oxalic acid (H$_2$C$_2$O$_4$) can be oxidized by KMnO$_4$.

a) Balance the following equation in acidic solution:

$$\text{H}_2\text{C}_2\text{O}_4 + \text{KMnO}_4 \rightarrow \text{Mn}^{2+} + \text{CO}_2$$

$$6\text{H}^+ + 5\text{H}_2\text{C}_2\text{O}_4 + 2\text{KMnO}_4 \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O} + 2\text{K}^+$$

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

1 M KMnO$_4$ = ? N KMnO$_4$ [5]
1 M H$_2$C$_2$O$_4$ = ? N H$_2$C$_2$O$_4$ [2]

c) If a 1.00 g sample of H$_2$C$_2$O$_4$ requires 24.0 mL of 0.0500 N KMnO$_4$ solution to reach an equivalence point, what is the percent by mass of H$_2$C$_2$O$_4$ in the sample? [5.40%]