CHEM1902/1904 Problem Sheet 11 (Week 13)

Work through the ChemCAL modules *" Reaction Rates and Chemical Kinetics 1"* and *"Reaction Rates and Chemical Kinetics 2*"

1. What are the systematic names of (a) $K_2[PtF_6]$ and (b) $[CoCl_2(NH_3)_4]Cl{\cdot}2H_2O$?

2. What is the formula for (a) tetraamminezinc(II) sulfate-2-water
(b) tetraaquaoxalatochromium(III) ion?

3. Without consulting data tables, write the ground state electronic configuration of the following atoms and ions. For example, Ti is $[Ar]4s^2 3d^2$.

(a) Mn (b) Cr (c) Ni^{2+} (d) Fe (e) Fe^{3+} (f) Cu^{2+} (g) Zn^{2+}

4. How many isomers are possible for the square planar complex ion $[Pt(NH_3)_2Cl_2]$?

5. Which one of the following compounds is a coordination isomer of $[Cr(H_2O)_5Cl]SO_4$?

(a) $[Cr(H_2O)_6]Cl_3$
(b) $[Cr(H_2O)_6]SO_4$
(c) $[Cr(H_2O)_5SO_4]Cl$
(d) $[Cr(H_2O)_5Cl]Cl_2$

6. Alfred Werner, one of the founders of the field of coordination chemistry, prepared a series of platinum complexes that contained ammonia and chloride ions. One of these had the empirical formula $PtCl_4.4NH_3$ and when reacted with silver nitrate released two chloride ions per formula unit.

(a) Write the structural formula of this compound and write the name of this compound.
(b) Draw the possible structures of the metal complex.
(c) What types of isomers can be formed by a compound with this empirical formula?
(d) What is the d electron configuration of the Pt in this complex?

7. Experiments on the reaction below gave the following initial rate data.

$$4Fe^{2+} + O_2 + 4H^+ \rightarrow 4Fe^{3+} + 2H_2O$$

Experiment	$[Fe^{2+}]$ / mol L^{-1}	$[O_2]$ / mol L^{-1}	$[H^+]$ / mol L^{-1}	Rate = $-d[O_2]/dt$ / mol L^{-1} s^{-1}
1	1×10^{-3}	1×10^{-3}	0.1	5×10^{-4}
2	2×10^{-3}	2×10^{-3}	0.1	8×10^{-3}
3	2×10^{-3}	1×10^{-3}	0.2	8×10^{-3}
4	2×10^{-3}	2×10^{-3}	0.2	1.6×10^{-2}

(a) What is the rate equation for the reaction?

(b) What is the value of the rate constant, k, for this reaction?
(c) What is the initial rate of formation of Fe^{3+} in experiment 3?
(d) Calculate the rate of lose of Fe^{2+} ions when $[Fe^{2+}] = [O_2] = 4 \times 10^{-3}$ mol L^{-1} and $[H^+] = 0.1$ mol L^{-1}.

8. The half-life for the first order decomposition of $N_2O_5(g)$ is 6.00×10^4 s at 20 °C.

(a) Calculate the rate constant, k, at this temperature.
(b) What percentage of the N_2O_5 molecules will have reacted after one hour?

9. Dinitrogen tetroxide decomposes according to the equation below.
At 30 °C, the value of k is 5.1×10^6 s^{-1}. At 50 °C, the value of k is 1.9×10^7 s^{-1}.
What are the activation energy, E_a, and pre-exponential factor, A, for this reaction?

$N_2O_4(g) \rightarrow 2NO_2(g)$ Rate $= -d[N_2O_4(g)]/dt = k[N_2O_4(g)]$