1. Write the electron configurations for the following molecules and calculate the bond order in each molecule: (a)CO (b)ClO^-. (8%)

2. Describe what happens to the energies of the 3d atomic orbitals in a tetrahedral crystal field. (6%)

3. Predict the geometry around the central atom in the following molecules: (a)SF_5^- (b)SO_4^{-2} (c)IF_3. (9%)

4. $(CH_3)_2CHMgBr$ is reacted firstly with $CH_3CH_2COCH_3$, and then water is added. Write down the structure of the final product, and name this compound. (10%)

5. Calculate the pH of an 0.023 M solution of saccharin (HSc), if K_a is 2.1×10^{-12} for this artificial sweetener. (10%)

6. Consider the decomposition of $CaCO_3(s)$ into $CaO(s)$ and $CO_2(g)$ at 1 atm.

	ΔH_f^o (kJ/mol)	S_{298}^o (J/mol,K)
$CaCO_3(s)$	-1206.9	92.9
$CaO(s)$	-635.5	40.0
$CO_2(g)$	-393.51	213.6

(a)What's the minimum temperature at which you would conduct the reaction?
(b)What's the equilibrium vapor pressure of $CO_2(g)$ at 298 K? (15%)

7. Three moles of an ideal gas at 25 °C expand from a volume of 1 L to a volume of 6 L at a constant pressure of 1 atm. If no heat is gained or lost during this process, caculate the final temperature and the enthalpy change. (10%)

8. Assume that we start with a Daniel cell at standard-state conditions (E^o= 1.10 V): Zn I Zn^{+2}(1M) II Cu^{+2}(1M)I Cu
Calculate the cell potential when the reaction has reached 99.9999% completion. (8%)

9. Calculate the solubility of AgBr in 1 M $S_2O_3^{-2}$.
(AgBr: $K_{sp}= 5.0 \times 10^{-13}$; $Ag(S_2O_3)_2^{-3}$: $K_f= 2.9 \times 10^{13}$) (10%)

10. The rate equation for a certain reaction 2 A + B ==> C is found to be
$d[C]/dt = k [A] [B]$.
If $[A]_0 = [B]_0$ and $[C]_0= 0$, derive an expression of ln ([B]/[A]) as a function of time. How long will it take for half of A being consumed? (14%)