1. Answer the following questions (20% 4 points each).
   (a) What is common ion effect? What is buffer solution.
   (b) Write down the structure of Teflon and n-octyl acetate.
   (c) What are the three laws of thermodynamics?
   (d) Write down the major structure of Nucleic acid and Enzyme.
   (e) What is green-house effect? What are green house gas?

2. What are the bonding theories used to describe the bonding of transition metal complexes? (10%)

3. An organic compound contains C, H, N and O. Combustion of 0.1023 g of the compound in excess oxygen yielded 0.2766 g of CO_2 and 0.0991 g of H_2O. A sample of 0.4831 g of the compound was analyzed for nitrogen. At STP, 27.6 mL of dry N_2 was obtained. In a third experiment the density of the compound as a gas was found to be 4.02 g/L at 127°C and 265 torr. What are the empirical formula and the molecular formula of the compound. (10%)

4. Acrylic acid ($CH_2=CHCO_2H$) is a precursor for many important plastics. K for acrylic acid is 5.6×10^{-5}.
   (a) Calculate the pH of a 0.10 M solution of acrylic acid.
   (b) Calculate the [H^+] necessary to ensure that the percent dissociation of a 0.10 M solution of acrylic acid is less than 0.010%.
   (c) Calculate the pH of 0.050 M solution of sodium acrylate ($NaC_3H_3O_2$). (10%).

5. Predict the sign of $\Delta S°$ for each of the following changes.(10%)
   (a) $AgCl(s) \longrightarrow Ag^+(aq) + Cl^-(aq)$
   (b) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$
   (c) $Na(s) + 1/2Cl_2(g) \longrightarrow NaCl(s)$
   (d) $HCl(g) \longrightarrow H^+(aq) + Cl^-(aq)$
   (e) $N_2(g) + O_2(g) \longrightarrow 2NO(g)$

6. A solution containing a 3+ metal ion is electrolyzed by a current of 5.00 A for 10.0 min. What is the identity of the metal if 1.19 g of metal is plated out? (5%).

7. The ionization energy of gold is 890.1 KJ/mol. Is light with a wavelength of 225 nm capable of ionizing a gold atom in the gas phase? why? (5%).

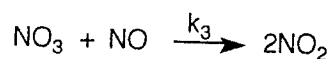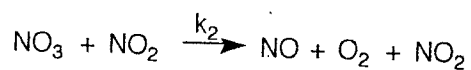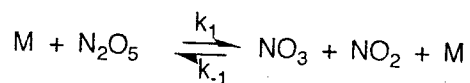8. Draw Lewis structures and predict the molecular structure of the following:(10%)
   (a) OCl_2. (b) XeF_4. (c) IF_3. (d) BH_2^-. (e) AsF_5.

9. The gas-phase decomposition $2N_2O_5 \longrightarrow 4NO_2 + O_2$ is first order but not unimolecular. A possible mechanism is

$$M + N_2O_5 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} NO_3 + NO_2 + M$$

$$NO_3 + NO_2 \overset{k_2}{\longrightarrow} NO + O_2 + NO_2$$

$$NO_3 + NO \overset{k_3}{\longrightarrow} 2NO_2$$

   Apply the steady-state hypothesis to the concentrations of the intermediate NO_3 and NO and drive the rate law for the decomposition of N_2O_5.(10%)

10. Use the band model to explain why each of the following increases the conductivity of a semiconductor.(10%)
    (a) Increasing the temperature.
    (b) Irradiating with light
    (c) Adding an impurity.