1. What is the kinetic theory of gases?　How does it explain the ideal gas laws? (10 points)

2. Write Lewis structures that obey the octet rule for the following species.　Assign the formal charge for each atom.
   (a) $POCl_3$ (4 points)　　(b) SO_2Cl_2 (3 points)
   (c) NO_4^{3-} (3 points).

3. You have the following reagents on hand:

Solids (pK$_a$ of acid form is given)	solutions
Benzoic acid (4.9)	5.0 M HCl
Sodium acetate (4.74)	1.0 M acetic acid
Potassium fluoride (3.14)	2.6 M NaOH
Ammonium chloride (9.26)	1.0 M HOCl (7.46)

   What combinations of reagents would you use to prepare buffers at the following pH values?
   (a) 3.0　(b) 7.0　(c) 5.0　(d) 9.0　(10 points)

4. Compare the relative stability of the following species and calculate their bond order, indicate their magnetic property (that is paramagnetic or diamagnetic): O_2, O_2^-, O_2^+, O_2^{2-}. (10 points).

5. Combustion of table sugar produces $CO_2(g)$ and $H_2O(l)$. When 1.46 g of table sugar is combusted in a constant volume (bomb) calorimeter, 24.0 kJ of heat is liberated.
   (a) Assuming that table sugar is pure sucrose, $C_{12}H_{22}O_{11}(s)$, write the balanced equation for the combustion reaction. (4 points)
   (b) Calculate ΔE for the combustion reaction of sugar. (3 points)
   (c) Calculate ΔH for the combustion reaction of sugar. (3 points)

6. The hydrocarbon derivatives are molecules that are fundamentally hydrocarbons but that have additional atoms or groups of atoms called functional groups. Please name five types of the hydrocarbon derivative and briefly describe their properties (10 points)

7. What are the general properties of the transition metals (10 points)

8. The reaction

$$I^-(aq) + OCl^-(aq) \longrightarrow IO^-(aq) + Cl^-(aq)$$

was studied and the following data were obtained:

$[I^-]_0$ (mol/L)	$[OCl^-]_0$ (mol/L)	Initial Rate (mol/L. s)
0.12	0.18	7.91×10^{-2}
0.06	0.18	3.95×10^{-2}
0.03	0.090	9.88×10^{-3}
0.24	0.090	7.91×10^{-2}

(a) What is the rate law? (5 points)
(b) Calculated the rate constant. (5 points)

9. What reaction will take place at the cathode and the anode when each of the following is electrolyzed?
   (a) Molten KF (3 points)
   (b) 1.0 M KF solution　(3 points)
   (c) 1.0 M H_2O_2 solution containing 1.0 M HCl (4 points)

10. (a) Each human DNA molecule contains roughly 5 x 10^9 base pairs.　The spacing between base pairs along a given chains is 340 pm.　If a single human DNA molecule was stretched to its full length, how long would it be? (5 points)
    (b) The compound cis-platin appears to kill cancer cells by inhibiting DNA synthesis.　Given the following structural information about cis-platin,
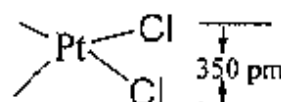
cis-platin

information form (a), and the fact that the chloride ion is easily displaced by other donor molecules in cis-platin, speculate on how cis-platin may interact with DNA. (5 points)