中國文化大學 99 學年度碩士班考試入學招生考試

系所組：化學系應用化學碩士班

日期節次：99 年 3 月 13 日第 2 節 11:00 -12:30

科目：**物理化學**

1. Please give brief explanation for three principal laws of thermodynamics. (10 pts)

2. Consider the species O_2^+, O_2, O_2^-, O_2^{2-}. (15 pts)

   (a) Give the MO configurations and bond orders for O_2^+, O_2, O_2^-, O_2^{2-} ?

   (b) Arrange the species in order of increasing bond length?

   (c) Which of these species will exhibit paramagnetism? Explain.

3. What would be the ground electronic state term symbols for (a) N_2, (b) N_2^+, and (c) NO, please also predict their corresponding bond orders and magnetism. (15 pts)

4. How many normal modes of vibration are there for the following molecules:

   (a) C_6H_6, (b) $C_6H_6CH_3$, (c) CO_2 (d) NH_3 ? (10 pts)

5. With the temperature maintained at 0 ^{0}C, 2 mol of an ideal gas are allowed to expand against a piston that supports 2 bar pressure. The initial pressure of the gas is 10 bar and the final pressure is 2 bar. (30 pts)

   (1) How many energy is transferred to the surroundings during the expansion?

   (2) What is the change in the internal energy and the enthalpy of the gas?

   (3) How much heat has adsorbed by the gas?

5. For the process A → B, the value ΔG is 30 kJ at 25 °C, and 30.02 kJ at 26 °C. Please estimate ΔS for aforementioned process. (10 pts)

6. Calculate the change in G_m for ice at -10 °C, with density 917 kg/m^3, when the pressure is increased from 1.0 bar to 2.0 bar. (10 pts)