

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) $C_6H_5CH_3$, (c) CO_2 (d) NH_3 ? (10 pts)
5. With the temperature maintained at $0^\circ C$, 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 $A \rightarrow B$, the value ΔG is 30 kJ at $25^\circ C$, and 30.02 kJ at $26^\circ C$. Please estimate ΔS for aforementioned process. (10 pts)
6. Calculate the change in G_m for ice at $-10^\circ C$, with density 917 kg/m^3 , when the pressure is increased from 1.0 bar to 2.0 bar. (10 pts)