國立臺北科技大學 112 學年度碩士班招生考試

系所組別：3301、3302 材料科學與工程研究所

第一節　普通熱力學　試題

注意事項：

1. 本試題共 4 題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Please explain the following: (30%)
   (1) Can activity be higher than 1? Why? (5%)
   (2) Please write any chemical reaction that gives you a negative change of entropy and explain. (5%)
   (3) Please explain the cause of miscibility gap in a regular solution. (5%)
   (4) Please explain why gases always mix spontaneously. (5%)
   (5) Can materials be free of defects? Explain why? (5%)
   (6) Can ice become vapor? If yes, in what condition? (5%)

2. Regarding $CO + \frac{1}{2}O_2 = CO_2$ reaction, (total 20%)
   (1) Which direction does the reaction proceed with increasing temperature? Explain why. (5%)
   (2) Which direction does the reaction proceed with increasing pressure? Explain why. (5%)
   (3) By fixing CO_2/CO ratio at 99, above or below what temperature do you need to control in order to keep the partial pressure of oxygen below 10^{-12} atm? (10%)

$$C_{(s)} + \frac{1}{2}O_{2(g)} = CO_{(g)},\ \Delta G^{o}(J) = -111700 - 87.65T$$

$$C_{(s)} + O_{2(g)} = CO_{2(g)},\ \Delta G^{o}(J) = -394100 - 0.84T$$

3. At 305 K, 4 mole of N_2 stored in a 25 liter compartment of a container and 1 mole of O_2 is stored in another 25 liter compartment of the same container. When the separation is removed to mixed the two gases ideally together and make a total of 50 liter gas mixture. Please calculate the change of enthalpy, entropy, and Gibbs free energy. (20%)

4. Please calculate the changes of heat, work (done by or on the system), enthalpy, internal energy, and entropy for the each of the following processes for 1 mole of monatomic gas with c_v=1.5 R. The energy should only be expressed with metric unit of Joule and NOT other units. (30%)
   (1) Free expansion from 1 atm and 298 K to a volume 1.5 times its original volume. (10%)
   (2) Reversible adiabatic process back to 1 atm. (10%)
   (3) Isobaric process back to the original state in (1). (10%)

$$R = 8.314 \frac{J}{K \cdot atm}$$