國立臺北科技大學 114 學年度碩士班招生考試

系所組別：3300 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 10 題，每題 10 分，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。

Determine it's true or false and please **explain the reason** for the following 6 questions:

1. Helmholtz free energy of any material decreases with increasing temperature at constant volume. (10%)

2. Specific heat is an extensive property. (10%)

3. Entropy of material usually increases with pressure. (10%)

4. Oxidation of carbon is exothermic, therefore by increasing temperature, the more the carbon oxidizes. (10%)

5. Ice can sublimate into vapor in refrigerator. (10%)

6. Spinodal decomposition is a manifest of negative enthalpy and positive configurational entropy. (10%)

7. For a binary regular solution of $\Delta H_{mix} = 20004\ X_A X_B J$ that demonstrates miscibility gap in solid, which of the followings is or are correct? (10%)

   (1) The regular solution has a critical temperature at 930°C.

   (2) Activity coefficients must be between 0 and 1.

   (3) Activity of A is 0.5689 at T=1200°C and X_B=0.8.

   (4) The two solid phases under miscibility gap have the same type of crystal structures.

   (5) None of the above is correct.

8. Given that density of $H_2O_{(l)}$ is 1 g/cm³ and of $H_2O_{(s)}$ is 0.91 g/cm³, and ΔH_m=6008 J if not considering the difference of c_p for water and ice. Among the following equations, which might best describe the relation of ice melting temperature with pressure? (10%)

   (1) P (atm) = 33308 ln(T [K]) -186857.6

   (2) P (atm) = -T (K) +1

   (3) P (atm) = -T (K) + 272.15

   (4) P (atm) = -122 T (K) + 33325.3

   (5) P (atm) = 122 T (K) – 33323.3

9. Calculate the change of enthalpy for 1 mole of Fe from 1 atm and 298 K to 100 atm and 500 K given that: $c_{p,Fe(\alpha)} = 37.12\ \frac{J}{K-mole}$, $\alpha = 35\ \frac{ppm}{K}$, $\rho = 7.85\ \frac{g}{cm^3}$, $Atomic\ weight = 55.85$. (10%)

10. What is the condition for pressure of CO_2 to be captured by CaO and form $CaCO_3$ at room temperature (25°C)? Do you expect higher or lower pressure is required if capturing at higher temperatures? (10%)

$$\Delta G_{f,CaO} = -634171 + 103.375\ T\ (J/mole)$$
$$\Delta G_{f,CO_2} = -394100 - 0.84\ T\ (J/mole)$$
$$\Delta G_{f,CaCO_3} = -1203083 + 252.851\ T\ (J/mole)$$