國立台灣科技大學九十五學年度碩士班招生試題

系所組別： 材料科技研究所碩士班

科　　目： 熱力學

Closed Book!!!可使用本校所發之電子計算機。

總分 100 分。

選擇題、計算題或證明題等答案請填寫在答案卷上。

1. Gibbs phase rule is an equation that expresses the equilibrium state for the system. The mathematic formula is F=C-P+2. Please answer following questions.

   a. What is the meaning of F?

   (A) Force, (B) Faraday constant, (C) Degree of freedom, (D) Equilibrium factor.

   b. C means

   (A) Numbers of components, (B) Numbers of systems, (C) Compositions, (D) Current.

   According to the unary system phase diagram as shown in Figure 1. Answer Question c to e.

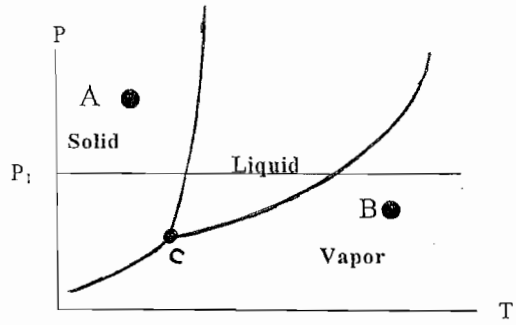

Figure 1

   c. What values of F for point B

   (A) 0, (B)1, (C) 2, (D) 3.

   d. If point C is triple point in this system, the degree of freedom of point C is

   (A) 0, (B)1, (C) 2, (D) 3.

   e. For the point B, which state of this material has minimum Gibbs free energy?

   (A) Solid state, (B)Liquid state, (C) Vapor state.

(each 4 points)

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2. An ideal gas undergoes the following sequence of mechanically reversible process:
   (a). From the initial state of 70℃ and 1 bar, it is compressed adiabatically to 150℃.
   (b). It is then cooled from 150 to 70℃ at constant pressure.
   (c). Finally, it is expanded isthermally to its original state.
   Take C_v=1.5R, C_p=2.5R. Then calculate W and ΔH for the entire cycle. $R = 8.314\ J/mol.K$
   (1) W **(5 points)**

   (2) ΔH **(5 points)**

(3) If the process are carried out irreversibly but so as to accomplish excatly the same changes of state (i.e., the same changes in P, T, U and H), then the value of Q and W are different. Calculate values of Q (for the entire cycle) for an efficiency of 80 percent for each step. **(10 points)**

3. This is isothermal section of the ternary A-B-C system (as shown in Figure 2).
   Please answer following question. **(5 points)**
   (a). What is the composition of the point X?
   (b). The point X is in the three-phase region, and in this tie triangle consists of α, β and γ. Can you use the lever rule to determine the relative amount for point X in terms of α, β, and γ. **(10 points)**
   (c). Then, use this proportion to recalculate the composition of point X in terms of A, B and C again. The answer is the same that you obtained previously. **(5 points)**

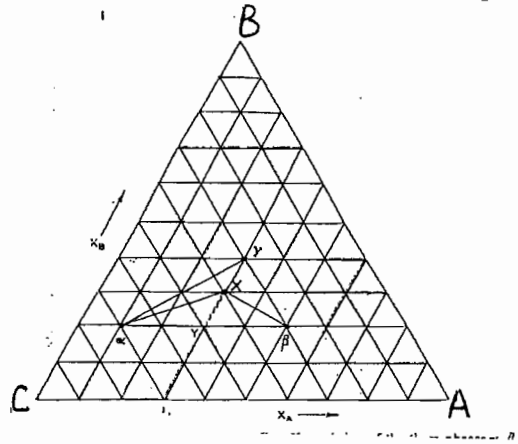

Figure 2 The isothermal section of the ternary A-B-C system.

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4. Show that

$$\overline{M}_1 = M + x_2 \frac{dM}{dx_1}$$

$$\overline{M}_2 = M - x_1 \frac{dM}{dx}$$

where M can express as G , H, S or any thermodynamics properties. **(20 points)**

5. Determine the reaction heat of the following reaction at temperature T K,

$$M_{(l)} + 1/2O_{2(g)} = MO_{(l)}$$

where the reaction temperature T comparing with melting points of $T_{m,Mo}$ and $T_{m,M}$ is like $T > Tm_{,MO} > Tm_{,M}$

Illustrate the diagram of relationship of H and T, then explain each reaction process. **(20 points)**

PS: You can assume or define any thermodynamics properties in this question you need for answer this question.

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