

# 國立宜蘭大學

## 111 學年度研究所碩士班考試入學

### ※物理化學 (含熱力學與動力學)試題

(化學工程與材料工程學系碩士班)

准考證號碼：

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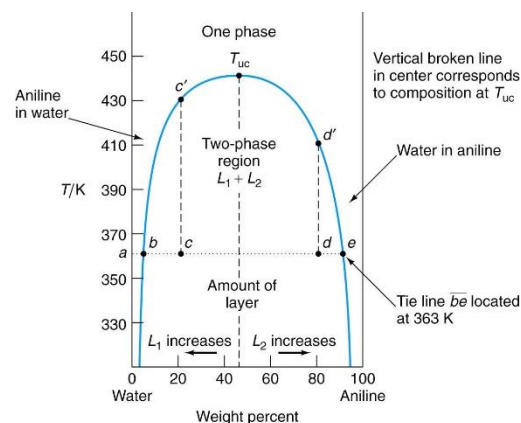
### 《作答注意事項》

- 1.請先檢查准考證號碼、座位號碼及答案卷號碼是否相符。
- 2.考試時間：100 分鐘。
- 3.本試卷共有 8 題，共計 100 分。
- 4.請將答案寫在答案卷上。
- 5.考試中禁止使用手機或其他通信設備。
- 6.考試後，請將試題卷及答案卷一併繳交。
- 7.本考科可使用電子計算機（廠牌、功能不拘）。

共有 8 題, 共計 100 分。

1. Explain the following items: (10%)
  - (a) Law of corresponding states
  - (b) Joule-Thomson coefficient
  - (c) Chemical potential
  - (d) The second law of thermodynamic
  - (e) Ideal solutions
2. Three moles of an ideal gas expand isothermally and reversibly from 90 L to 300 L at 300 K. Calculate the  $w$ ,  $q$ ,  $\Delta H$ ,  $\Delta S$ , and  $\Delta G$  for this system. (15%)
3. (a) A reaction  $A + B \leftrightarrow Z$  has an equilibrium constant of  $4.5 \times 10^4 \text{ dm}^3 \text{ mol}^{-1}$  at 300 K, and a  $\Delta H^\circ$  value of  $-40.2 \text{ kJ mol}^{-1}$ . Calculate the entropy change for the reaction at 300 K. (5%)
  - (b) If the  $\Delta H^\circ$  and  $\Delta S^\circ$  values are temperature independent, at what temperature is the equilibrium constant equal to 1? (5%)
4. The vapor pressure for pure water at 22.0 °C is 19.827 mmHg and at 30.0 °C is 31.824 mmHg. Use these data to calculate the change in enthalpy per mol for the vaporization process. (10%)
5. Calculate the mole fraction, activity, and activity coefficients for water when 11.5 g NaCl are dissolved in 100 g water at 298 K. The molecular weight of NaCl is  $58.5 \text{ g mol}^{-1}$ . The vapor pressure is 95.325 kPa. (15%)

6. (a) Calculate the ratio of the mass of the water-rich layer ( $L_1$ ) to that of the aniline-rich layer ( $L_2$ ), for a 20-wt% water-aniline mixture at 363K. The compositions along the tie line be are maintained at 363K. The composition at  $c$  is 20%; for  $L_1$  at  $b$ , it is 8%; and for  $L_2$  at  $e$ , it is 90%. (5%)
  - (b) What are the compositions of  $L_1$  and  $L_2$  at this temperature? (10%)



7. A sample of milk kept at 25°C is found to sour 40 times as rapidly as when it is kept at 4°C. Estimate the activation energy for the souring process. (10%)
8. (a) Derive the half-life of a first-order reaction is  $t_{1/2} = \frac{\ln 2}{k}$ . (5%)
  - (b) A substance decompose at 600 K with a rate constant of  $3.72 \times 10^{-5} \text{ s}^{-1}$ . Calculate the half-life of the reaction. (5%)
  - (c) What fraction will remain undecomposed if the substance is heated for 3 h at 600 K? (5%)