# 國 立 宜 蘭 大 學
# 114 學年度碩士班考試入學招生

---

※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：

---

## 《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 9 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. 本試卷採雙面影印，請勿漏答。

8. 本考科可使用電子計算機（廠牌、功能不拘）。

1. Explain the following items:

  (a) Boyle's law　(4%)

  (b) The van der Waals equation of state　(4%)

  (c) Boyle temperature　(4%)

  (d) Efficiency of a reversible Carnot engine　(4%)

  (e) The colligative properties　(4%)

2. An ideal gas at 298.15 K and 1 bar is expanded in a reversible adiabatic process to a final pressure of 1/2 bar. Calculate $q$ per mol, $w$ per mole, and $\Delta U$. (assume: $C_v = \frac{3}{2}R$, $C_p = \frac{5}{2}R$)　(10%)

3. One mole of an ideal gas is compressed isothermally and reversibly at 100 °C from a pressure of 2 bar to 10 bar. Calculate (a) $q$, (b) $w$, (c) $\Delta H$, (d) $\Delta S$, and (e) $\Delta G$ of this process.　(10%)

4. (a) Derive the Gibbs-Helmholtz equation $[\frac{\partial}{\partial T}(\frac{\Delta G}{T})]_P = -\frac{\Delta H}{T^2}$ from $(\frac{\partial \Delta G}{\partial T})_P = -\Delta S$.　(5%)

  (b) Derive the van't Hoff equation $\frac{d\ln K_P^o}{d(\frac{1}{T})} = -\frac{\Delta H^o}{R}$ from Gibbs-Helmholtz equation.　(5%)

5. The boiling point of hexane at 101.325 kPa is 341.9 K. What is the boiling point at 100 kPa? (Given: The vapor pressure of hexane at 322.8 K is 53.32 kPa.)　(5%)

6. (a) Determine the amount and composition (in percentage) of each phase in a Cu-40% Ni alloy at 1300 °C and 1250 °C. (5%)

  (b) Determine the degree of freedom of a Cu-40% Ni alloy at 1300 °C and 1250°C.　(5%)
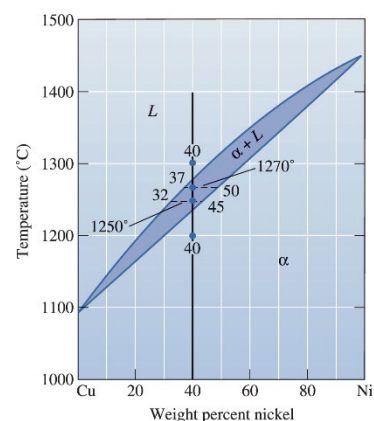
7. (a) Derive the second-order equation of A+B→Z. The initial concentrations of A and B are both $a_0$.　(5%)

   (b) Derive the second-order equation of A+B→Z. The initial concentrations of A and B are $a_0$ and $b_0$, respectively.　(10%)

8. A reaction has a rate constant of $k= 1.77 \times 10^{-6}$ dm$^3$ mol$^{-1}$ s$^{-1}$ at 25 °C and an activation energy of 2000 J mol$^{-1}$.

   (a) What order is the reaction? (Explain why)　(5%)

   (b) What is the value of the rate constant at 100 °C?　(5%)

9. (a) Derive the half-life of a first-order reaction is $t_{1/2} = \frac{\ln 2}{k}$.　(5%)

   (b) The half-life of $^{60}$Co is $1.9 \times 10^3$ days. What is the rate constant for the decay process?　(5%)

〈試題到此結束〉