

國立宜蘭大學

103 學年度轉學招生考試

(考生填寫)

准考證號碼：

物理化學試題

《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：80 分鐘。
- 3.本試卷共有 7 題，共計 100 分。
- 4.請將答案寫在答案卷上（於本試題上作答者，不予計分）。
- 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.本考科可自行攜帶使用非程式型(不具備儲存程式功能)之電子計算機。

1. Explain the following items: (a) Ideal gas, (b) First law of thermodynamics, (c) Second law of thermodynamics, (d) Chemical potential, (e) Degrees of freedom, (f) Phase rule. (20%)
2. Exactly one mole of an ideal monatomic gas at 25.0 °C is cooled and allowed to expand from 1.00 dm³ to 10.00 dm³ against an external pressure of 1.00 bar. Calculating the final temperature, and q , W , ΔU , and ΔH . (Assume the C_V value of the ideal gas is $\frac{3}{2}R$.) (10%)
3. Initially at 300K and 1 bar pressure, 1 mol of an ideal gas undergoes an irreversible isothermal expansion in which its volume is doubled, and the work it performs is 500 J mol⁻¹. What are the values of q , ΔU , ΔH , ΔG , and ΔS ? (10%)
4. (a) Derive that the entropy change per mol of mixture gas is $\Delta S = -R(x_1 \ln x_1 + x_2 \ln x_2)$. (5%)
(b) Exactly one liter of a 0.100 M solution of a substance A is added to 3.00 liters of a 0.050M solution of a substance B. Assume ideal behavior and calculate the entropy of mixing. (10%)
5. (a) Derive the Gibbs-Helmholtz equation is $\left[\frac{\partial}{\partial T} \left(\frac{\Delta G^\circ}{T} \right) \right]_P = -\frac{\Delta H^\circ}{T^2}$. (10%)
(b) Derive the van't Hoff equation $\frac{d \ln K_p^\circ}{d(1/T)} = -\frac{\Delta H^\circ}{R}$ from Gibbs-Helmholtz equation. (5%)
6. (a) Derive the Clausius-Clapeyron equation is $\ln \frac{P_2}{P_1} = \frac{\Delta_{\text{vap}} H_m}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$. (5%)
(b) The vapor pressure of *n*-propanol is 1.94 kPa at 293K and 31.86 kPa at 343K. What is the enthalpy of vaporization? (10%)
7. (a) Derive the half-life of a first-order reaction is $t_{1/2} = \frac{\ln 2}{k}$. (5%)
(b) The half-life for the first-order decomposition of N₂O₅ is 2.05 × 10⁴ s. What is the rate constant of this decomposition process? How long will it take for a sample of N₂O₅ to decay to 60% of its initial value? (10%)