

國 立 宜 蘭 大 學

1 0 5 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：

《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 6 題，共計 100 分。
- 4.請將答案寫在答案卷上。
- 5.考試中禁止使用大哥大或其他通信設備。
- 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) First, second and third laws of the thermodynamics, (b) Clausius-Clapeyron equation, (c) Carnot Cycle, (d) Explosion limit, (e) Nernst equation. (20%)
2. Derive the Gibbs phase rule $F = C - P + 2$. (F: number of degree of freedom, C: component number, P: phase number) (15%)
3. 2.50 mol of an ideal gas with $C_{v,m} = 12.47 \text{ J/mol}\cdot\text{K}$ is expanded adiabatically against a constant external pressure of 1.00 bar. The initial temperature and pressure of the gas are 325 K and 2.5 bar, respectively. The final pressure is 1.25 bar. Calculate the final temperature, q, w, ΔU and ΔH . (20%)
4. Toluene (methylbenzene) and water are immiscible. If boiled together under an atmospheric pressure of 755 Torr at 83°C , what is the weight ratio of toluene to water in the distillate? The vapor pressure of pure toluene and water at 83°C are 322 Torr and 400.6 Torr, respectively. (15%)
5. Two moles of water at 50°C are placed in a refrigerator which is maintained at 5°C . Taking the heat capacity of water as $75.3 \text{ J/K}\cdot\text{mol}$ and independent of temperature, calculate the entropy change for the cooling of the water to 5°C . Also calculate the entropy change in the refrigerator, and the net entropy change. (15%)
6. Carbon-14 is a radioactive nucleus with a half-life of 5760 years. Living matter exchanges carbon with its surroundings (for example, through CO_2) so that a constant level of Carbon-14 is maintained, corresponding to 15.3 decay events per minute. Once living matter has died, carbon contained in the matter is not exchanged with surroundings, and the amount of Carbon-14 that remains in the dead material decreases with time due to radioactive decay. Consider a piece of fossilized wood that demonstrates 2.4 Carbon-14 decay events per minute. How old is the wood? (15%)