

國立臺北科技大學 100 學年度碩士班招生考試

系所組別：3712 有機高分子研究所甲組

第二節 物理化學 試題 (選考)

第一頁 共一頁

注意事項：

1. 本試題共 6 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Explain the following terms: (40%, each 5%)
 - (1) Arrhenius law
 - (2) collision mean free path
 - (3) de Broglie equation
 - (4) internal energy
 - (5) Langmuir isotherm
 - (6) Schrödinger equation
 - (7) tunneling
 - (8) perturbation theory
2. Please calculate the Helmholtz energy change for the reversible isothermal compression process of 1 mol of an ideal gas from 100.0 L to 22.4 L at 298 K. (10%)
3. For an adiabatic and reversible change in 1 mole of an inert monoatomic gas, the pressure changes from 2.44 to 0.338 atm. If the initial temperature is 339 K, please find the final temperature. (10%)
4. (a) Please determine the energies of the first and the third levels of a electron in a box with a width of 10 Å. (4%) (b) Please find the average value of the position of an electron having the lowest energy level in a particle-in-a-box. (6%)
5. (1) Please write down the van der Waals equation, the approximate equation of state for real gas. (4%) (2) Explain the physical meaning of two new terms involved in van der Waals equation for correcting the real gas behavior from ideal gas. (6%) (3) There is 131 g of Xenon gas in a vessel of 1.0 L at 25 °C. Please calculate pressure it would exert if it behaved as van der Waals gas. (Xe: atomic weight 131, Van der Waals coefficients, $a = 4.137 \text{ atm L}^2 \text{ mol}^{-3}$, $b = 5.16 \times 10^{-2} \text{ L mol}^{-1}$) (10%)
6. Prove the Clausius inequality. (10%)

Appendix:

Gas constant in various units

R

8.314 47 J K⁻¹ mol⁻¹
8.205 74 × 10⁻² L atm K⁻¹ mol⁻¹
8.314 47 × 10⁻² L bar K⁻¹ mol⁻¹
8.314 47 Pa m³ K⁻¹ mol⁻¹
62.364 L Torr K⁻¹ mol⁻¹
1.987 21 cal K⁻¹ mol⁻¹

Planck's constant: 6.626 × 10⁻³⁴ J.s

Electron mass: 9.109 × 10⁻³¹ kg