

國立臺北科技大學 103 學年度碩士班招生考試

系所組別：3712 分子科學與工程系有機高分子碩士班甲組

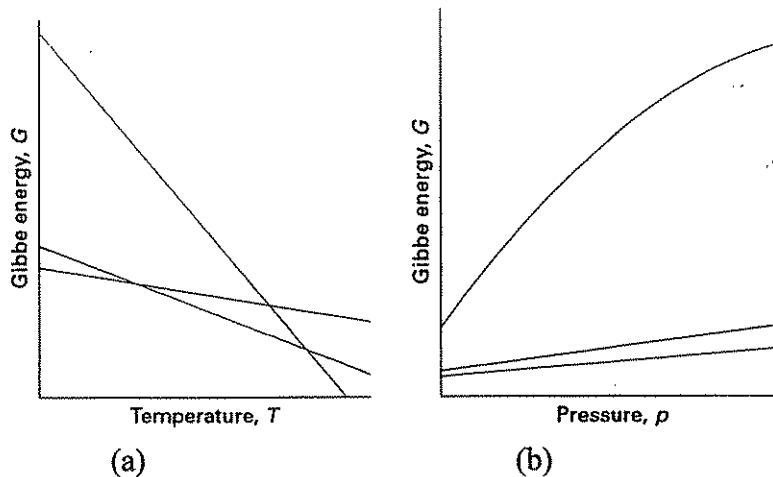
第三節 物理化學 試題 (選考)

第一頁 共二頁

注意事項：

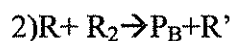
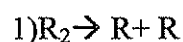
1. 本試題共 6 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Real gases show deviations from the perfect gas law because molecules interact with each other. (1) Please describe the two fundamental interaction when molecules are almost in contact. (5%) (2) Indicate and explain the correction factors you would need to take into account the interactions of the molecules and write out the entire van der waals equation. (10%) (3) Estimate the molar volume of CO_2 at 500 K and 100 atm by treating it as a van der Waals gas. (10%)
2. (1) Calculate ΔS (for the system) when the state of 2.00 mol N_2 (assuming to be ideal gas molecules, $C_{v,m} = \frac{5}{2}R$) is changed from 25 °C , 1.50 atm to 135 °C, 7.00 atm. (10%) (2) Please rationalize the sign of ΔS . (10%)
3. (1) The below figure (a) on the left hand side shows the variation of the Gibbs energy as a function of temperature for solid, liquid, and gas. Please indicate which line corresponds to each of the different state and explain your answer. (10%) (2) The below figure (b) on the right hand side shows the variation of the Gibbs energy as a function of pressure for solid, liquid, and gas. Please indicate which line corresponds to each of the different state and explain your answer. (10%) 請將原圖繪製於答案卷上作答。



4. A nitrogen molecule is confined in a cubic box (volume 1.00 m^3). Assuming that the molecule has an energy equal to $\frac{3}{2}kT$ at $T = 300\text{K}$ what is the value of $n = (n_x^2 + n_y^2 + n_z^2)^{1/2}$ for this molecule? (5%) What is the energy separation between the levels n and $n+1$? (5%) What is its de Broglie wavelength? (5%) Would it be appropriate to describe this particle as behaving classically?(5%)

5. Consider the following mechanism for the thermal decomposition of R_2 :



Where R_2 , P_A , P_B are stable hydrocarbons and R and R' are radicals. Find the dependence of the rate of decomposition of R_2 on the concentration of R_2 . (5%)

6. (1) Please calculate the collision flux (the number of collisions with the area in a given time interval divided by the area and the duration of the interval) when $P = 10^{-6}$ Torr, and $T = 300 \text{ K}$, for CO. ($1 \text{ Torr} = 1.333 \times 10^{-2} \text{ N cm}^{-2}$). (5%) (2) Estimate the time taken to adsorb one monolayer of CO at 10^{-6} Torr on copper surface. (5%)

Reference Data

$$h: 6.626 \times 10^{-34} \text{ JS}$$

$$k: 1.381 \times 10^{-23} \text{ JK}^{-1}$$

注意：背面尚有試題

Table I van der Waals coefficients

	$a/(\text{atm dm}^6 \text{ mol}^{-2})$	$b/(10^{-2} \text{ dm}^3 \text{ mol}^{-1})$
Ar	1.337	3.20
CO ₂	3.610	4.29
He	0.0341	2.38
Xe	4.137	5.16