

國立臺北科技大學九十九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 9 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。

Gas constant (R): $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Planck constant (h): $6.626 \times 10^{-34} \text{ J s}$

Electron mass: $9.11 \times 10^{-31} \text{ kg}$

$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$

$\int x(\sin bx)^2 dx = x^2/4 - (\cos 2bx)/8b^2 - (x \sin 2bx)/4b$

1. Explain the following terms: (20%, each 4%)
 - (1) Reduced pressure
 - (2) The Joule-Thomson effect
 - (3) Zero-point energy
 - (4) Electron Spectroscopy
 - (5) Tunnelling
2. How much work would have been done if 0.5 mol of a gas is reversibly compressed from an initial volume of 2.0 L to a final volume of 0.50 L at 300 K if the gas
 - (1) were ideal, (5%), and
 - (2) obeys the modified van der Waals equation of $P(V_m - b) = RT$ ($b = 0.02 \text{ L mol}^{-1}$). (5%)
3. One mole of an ideal gas is reversibly and isothermally compressed from a volume of 25.0 L to a volume of 10.0 L at 300 K. Please:
 - (1) calculate ΔS , $\Delta S_{\text{surroundings}}$, and ΔS_{total} . (9%)
 - (2) Is this a spontaneous process? (3%)
4. Use Trouton's rule to predict the standard molar enthalpy of vaporization of bromine given that it boils at 59.2 °C. (8%)
5. Please give an physical explanation for the fact that heat capacity at constant pressure is always larger than that at constant volume. (10%).

6. The isotope $^{32}\text{P}_{15}$ emits radiation and has a half-life of 14.3 days. Please calculate
 - (1) the decay constant in the unit of s^{-1} (5%), and
 - (2) the percentage of the initial activity remains after 10 days. (5%)
7. For an electron confined in a 1 nm long one-dimensional box, how many energy levels are there with energy between 10 and 100 eV? (10%)
8. Listed below is the data for adsorption of CO on charcoal at 273 K. If the adsorption follows the Langmuir adsorption isotherm,

P/kPa	13.3	26.7	40.0	53.3	66.7	80.0	93.3
V/cm ³	10.2	18.6	25.5	31.5	36.9	41.6	46.1

- (1) please find the equilibrium constant K. (8%)
 - (2) what is the physical meaning of K. (2%)
9. A particle is confined to a box of length a , and the system wave function is $\psi(x) = (2/a)^{1/2} \sin(\pi x/a)$.
 - (1) Is this state an eigenfunction of the position operator? (3%)
 - (2) Calculate the average value of the position $\langle x \rangle$ that would be obtained for a large number of measurements. (7%)