中國文化大學 103 學年度碩士班考試入學招生考試

系所組：化學系應用化學碩士班

日期節次：103 年 3 月 15 日第 2 節 11:00~12:30

科目：物理化學

1. Derive the result of $[z, \widehat{p_y}]$, where $\widehat{p_y}$ is an operator of momentum (10%)

2. Explain that O_2 is paramagnetic or diamagnetic by a diagram of molecular orbitals. (10%)

3. A first-order reaction of reactant A is 25% complete in 20 seconds. What will be the concentration at the end of the next 20 seconds if the initial concentration of A is $[A]_0$? (10%)

4. One mole of an ideal gas is reversibly and isothermally compressed from 20.0 L to 10.0 L at 300 K, calculate (a) ΔU and (b) ΔS. (10% for each)

5. A two-dimensional free rigid rotor has wavefunction $\Phi(\phi) = Ae^{im_l\phi}$
   (a) Prove that m_l must be integers. (10%)
   (b) Find the normalization constant A. (10%)

6. An ideal solution has two liquid components A and B with x_A and x_B being their mole fractions, respectively. Using the concept of chemical potentials to find (a) $\Delta_{mix}G$ and (b) $\Delta_{mix}S$. (10% for each)

7. Show that $\left(\frac{\partial U}{\partial S}\right)_V = T$. (10%)