

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)  $\Delta U$  and (b)  $\Delta S$ . (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)  $\Delta_{\text{mix}}G$  and (b)  $\Delta_{\text{mix}}S$ . (10% for each)
7. Show that  $\left(\frac{\partial U}{\partial S}\right)_V = T$ . (10%)

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