

系所組：化學系應用化學碩士班

日期節次：100年3月20日第2節 11:00-12:30

科目：物理化學

1. A first order reaction is 20% complete in 50 min. What would be the concentration at the end of another 40 min if the initial concentration of the reactant is $4.0 \times 10^3 \text{ mol dm}^{-3}$? What is the half-life of this reaction? (20%)
2. The wavefunction of hydrogen 3s orbital is $\frac{1}{\sqrt{243}} \left(\frac{1}{a_0}\right)^{3/2} (6 - 6\rho + \rho^2)e^{-\rho/2}$ with $\rho = \frac{2r}{3a_0}$, where are the nodes? (10%)
3. Is O_2 paramagnetic or diamagnetic? Give your explanation with molecular orbitals. (20%)
4. Derive the Clapeyron equation for liquid-solid phase equilibrium in terms of $\Delta_{\text{fus}}H$ and $\Delta_{\text{fus}}V$, where V means volume. (20%)
5. Given the $\Delta_f G^\circ$ at 25°C of $\text{AgCl}_{(s)} = -109.8 \text{ kJ/mol}$, of $\text{Ag}^+_{(aq)} = 77.1 \text{ kJ/mol}$, and of $\text{Cl}^-_{(aq)} = -131.3 \text{ kJ/mol}$, calculate the K_{sp} of $\text{AgCl}_{(s)} \leftrightarrow \text{Ag}^+_{(aq)} + \text{Cl}^-_{(aq)}$ at the same temperature. (20%)
6. Assume CO is a quantum simple harmonic oscillator having a force constant of 1902 Newton/m, what is its zero point energy? (10%)