中國文化大學 101 學年度碩博士班甄試入學招生考試

系組：化學系應用化學碩士班日期 100 年 11 月 23 日　節次：第 1 節

科目：　綜合化學

1. A one-dimensional box is located from x=0 to x=L. The potential energies at the boundaries are ∞, but 0 inside the box. Now a particle is confined in the box and its wavefunction is $\Psi = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$, why should n be nonzero integers? (10%)

2. Acetic acid has $K_a = 1.8\times10^{-5}$, now mix 500 ml of 0.1M acetic acid and 500 ml of 0.1M sodium acetate to prepare a buffer solution, what will be the change of pH after the buffer is added with 100 ml of 0.1M HCl? (10%)

3. With the VSEPR model, please predict the structure of XeF_4. (10%)

4. An aqueous solution gives rise to an osmotic pressure of 4.00 atm at 27°C, what is the molarity of that solution? (10%)

5. Complete the following reactions：(5% for each)

   (a) $CH_3CONHCH_3 + H_2O \xrightarrow{H^+} ?$

   (b) $C_6H_6 + SO_3 \xrightarrow{H_2SO_4} ?$

6. Is O_2 paramagetic or diamagnetic? why? (10%)

7. The rate constants for $2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$ are 3.7×10^{-5} s^{-1} at 25°C and 1.7×10^{-3} s^{-1} at 55°C. What is the activation energy in kJ/mol? (10%)

8. Why do cylindrical carbon nanotubes really exist while cylindrical silicon nanotubes may not? (10%)

9. F^- is a weak field ligand and CN^- is a strong field ligand, why is CoF_6^{3-} high spin and $Co(CN)_6^{3-}$ low spin according to the crystal field theory? (10%)

10. What is transcription of DNA? What is translation of RNA? (5% for each)