●不可使用電子計算機

Chemistry (不可使用電子計算機)

1. Describe the contributions of these scientists to our knowledge of atomic structure: J. J. Thomson, R. A. Millikan, Ernest Rutherford and James Chadwick. (8 points)

2. (A) How many grams of sodium hydroxide are required to prepare a 250-mL solution whose concentration is 2.5 M? (4 points) (B) Describe how you would prepare 500-mL of 2.5 M sodium hydroxide solution, starting with a 7.5 M stock solution of sodium hydroxide. (5 points)

3. When administered intravenously to rats, procaine and cocaine have LD_{50} values of 50 mg/kg and 17.5 mg/kg, respectively. (a) What is the LD_{50} value? (4 points) (b) Which is more toxic? Explain. (4 points)

4. At 373K the vapor pressures of benzene and toluene are 1344 and 557 mmHg respectively. The two liquids from ideal solution upon mix. If such a solution, boils at 1 atm and 373K, calculate the mole fractions of benzene of this liquid and the corresponding vapor mixture. (10 points)

5. What fraction of chlorous acid, $HClO_2$, dissociates in water if a solution that contains 6.00 g of $HClO_2$ in 94.0 g of water has a freezing point of 271.0K? (Cl: 35.5) (10 points)

6. What pressure would have to be applied to the solution side of a semi permeable membrane separating pure water from a 0.25 M aqueous solution of sucrose to prevent solvent flow from taking place? Assume the temperature to be 25°C. (10 points)

7. Describe the four laws of thermodynamics as simple possible. (8 points)

8. At the first order reaction, A $\longrightarrow$ products, the initial concentration of A is 1.56 M and 0.896 M after 48.0 minutes. What is the half-life of the reaction, in min? (10 points)

9. Calculate the $[H^+]$ in a 100 mM solution of HCN, $Ka = 6.4\times10^{-10}$. (8 points)

10. An aqueous solution of ethanol (C_2H_5OH) and acetic acid (CH_3COOH), each at initial concentration of 0.81 M, is heated to 100°C. At equilibrium, the acetic acid concentration is 0.748 M. Calculate K for the reaction. (10 points)

$$C_2H_5OH_{(aq)} + CH_3COOH_{(aq)} \rightleftharpoons CH_3COOC_2H_{5(aq)} + H_2O_{(l)}$$

11. (A) Explain the reason for the formation of double-helix structure of DNA. (4 points) (B) What is the general structure of α-amino acids. (5 points)