國立中央大學八十八學年度轉學生入學試題卷

化學系　二年級　　科目：普通化學　　共 2 頁 第 1 頁

1. Rust stains can be removed by washing a surface with a dilute solution of oxalic acid ($H_2C_2O_4$). The reaction is

$$Fe_2O_3(s) + H_2C_2O_4(aq) \rightarrow Fe(C_2O_4)_3^{3-}(aq) + H_2O(l) + H^+(aq)$$

   (a) Is this an oxidation-reduction reaction?
   (b) What mass of rust can be removed by 1.0 L of 0.14 M solution of oxalic acid。(10 points)

2. Urea (H_2NCONH_2) is used extensively as a nitrogen source in fertilizers. It is produced commercially from the reaction of ammonia and carbon dioxide:

$$2NH_3(g) + CO_2(g) \xrightarrow[\text{Pressure}]{\text{Heat}} H_2NCONH_2(s) + H_2O(g)$$

Ammonia gas at 223°C and 90. atm flows into a reactor at a rate of 500. L/min. Carbon dioxide at 223°C and 45. atm flows into the reactor at a rate of 600. L/min. What mass of urea is produced per minute by this reaction assuming 100% yield? (10 points)

3. How to define the sizes of orbitals ? Why? (10 points)

4. Describe the bonding in the CO_3^{2-} ion using the localized electron model. How would the molecular orbital model describe the π-bonding in this species? (10 points)

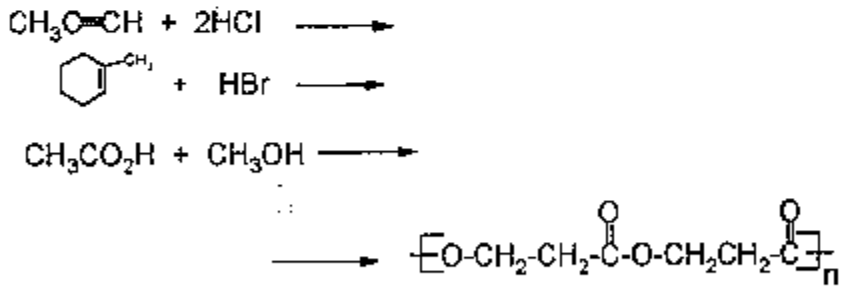
5. A 1.60 g sample of a mixture of naphthalene ($C_{10}H_8$) and anthracene ($C_{14}H_{10}$) is dissolved in 20.0 g benzene (C_6H_6). The freezing point of the solution is 2.81°C. What is the composition as mass percent of the sample mixture? The freezing point of benzene is 5.51°C, and K_f is 5.12°C·kg/mol. (10 points)

6. Many biochemical reactions that occur in cells require relatively high concentrations of potassium ion (K^+). The concentration of (K^+) in muscle cells is about 0.15 M. The concentration of (K^+) in blood plasma is about 0.0050 M. The high internal concentration in cells is maintained by pumping K^+ from the plasma. How much work must be done to transport 1.0 mol K^+ from the blood to the inside of a muscle cell at 37°C, normal body temperature? When 1.0 mol K^+ is transferred from blood to the cells, do any other ions have to be transported? Why or why not? (10 points)

7. What is electrolysis? List at least 4 commercial electrolytic processes. (10 points)

8. Draw structures of each of the following. (10 points)
   (a) Trisethylenediaminenickel(II) bromide
   (b) Trans-dichlorobisethylenediamincobalt(II)
   (c) Trans-tetraamminechloronitritocobalt(III) ion
   (d) Ammine trichloroplatinate(II) ion

9. Finishing the following reaction equations (10 points)



10. What structural features are characteristic of detergent molecules? How does hard water affect the cleaning efficiency of soap? Write a balanced equation to illustrate your answer. (10 points)