# 國立成功大學 80 學年度生理研究所考試(普通化學 試題)



(1)The label on a commercially available concentrated hydrochloric acid solution reads "37.4% HCl by weight, density 1.18g/ml". Calculate the molality and mole fraction of HCl in this solution. (The molecular weight of HCl is 36.5 g/mol). (8%)

(2)In a binary solution of $CS_2$ and acetone, in which the mole fraction of $CS_2$ is 0.062, the partial vapor pressure of $CS_2$ and acetone are, respectively, 110.7 and 331.0 mmHg. At the same temperature, the pure vapor pressure of pure $CS_2$ and acetone are, respectively, 512.3 and 343.8 mmHg.
(a)Calculate the mole fraction of acetone in the vapor phase.
(b)Does the solution exhibit a positive or a negative deviation from Raoult's law?
(c)Is the mixing of $CS_2$ and acetone an endothermic or exothermic process? (8%)

(3)A 60.0-ml sample of 0.1 F $N_2H_4$ is titrated with 0.15 F HCl. The $K_b$ for $N_2H_4$ is $3.0\times10^{-6}$.
The titration reaction is

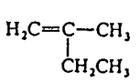
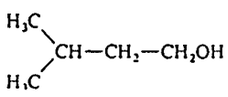
$$N_2H_4(aq) + H_3O^+(aq) \;<==>\; N_2H_5^+(aq) + H_2O$$

(a)Calculate the PH when 20.0 ml of 0.15 F HCl have been added.
(b)Calculate the PH at the equivalence point. (8%)

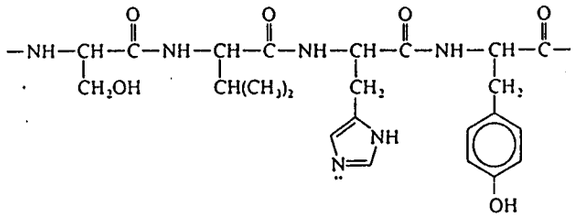
(4)The decomposition of ammonium hydrosulfide

$$NH_4HS(s) \;<==>\; NH_3(g) + H_2S(g)$$

is an endothermic reaction. A 0.103 mole sample of solid $NH_4HS$ is placed in evacuated 3.0 liter vessel at 25 °C. After equilibrium, the total pressure inside the vessel is found to be 0.659 atm. Some solid $NH_4HS$ remains in the flask.
(a)Calculate $K_p$ for this reaction.
(b)What percentage of the solid placed in the flask has decomposed?
(c)Will the number of moles of $NH_4HS$ in the vessel increase, decrease, or remain the same, if the volume of the vessel is halved?
(d)Will the concentration of $NH_4HS$ in moles per liter increase, decrease, or remain the same, if the volume of the vessel is halved? (14%)

(5)Give the systematic names of the following molecules:
(a) 
(b)  (6%)

(6)Draw the structure of amino acids needed to make the piece of a peptide shown. Which side chains that extended from the peptide linkages are hydrophilic? (8%)



(7)Write down the two possible mechanisms for the elimination of the water molecule when the methanol and acetic acid react. Describe how the isotopic tracer technique can be used to determine the correct mechanism. (10%)

(8)For a biology project you are growing certain microorganisms that can only survive in a medium at PH=8.54. You decide to use an $NH_3/NH_4NO_3$ buffer. What must be the molar ratio of $NH_3$ to $NH_4NO_3$ in your buffer? (6%)

(9)A study of the rate of formation of molecular iodine by the reaction $2\,I(g) \rightarrow I_2(g)$ in the presence of argon produced the following data:

| Experiment Number | Initial concentrations $[I]_o$ (M) | $[Ar]_o$ (M) | Initial Rate (mol/L sec) |
|---|---|---|---|
| 1 | $1.0\times10^{-5}$ | $1.0\times10^{-3}$ | $8.70\times10^{-4}$ |
| 2 | $2.0\times10^{-5}$ | $1.0\times10^{-3}$ | $3.48\times10^{-3}$ |
| 3 | $4.0\times10^{-5}$ | $1.0\times10^{-3}$ | $1.39\times10^{-2}$ |
| 4 | $1.0\times10^{-5}$ | $5.0\times10^{-3}$ | $4.35\times10^{-3}$ |
| 5 | $2.0\times10^{-5}$ | $5.0\times10^{-3}$ | $1.74\times10^{-2}$ |

Determine the order and the specific rate constant of this reaction. (10%)

(10)What's the activation energy of a reaction if the rate doubles when the temperature is increased from 20 to 30 °C? (6%)

(11)Consider the cell: $Co(s)\,|\,Co^{+2}(C_1)\,||\,Ni^{+2}(C_2)\,|\,Ni(s)$ at 25 °C.
(a)Write the net cell reaction.
(b)If $\Delta\varepsilon^o_{cell} = 0.05$ V, calculate $K_{eq}$. (8%)

(12)The radioactive isotope $^{32}P$ has a half-life of 14.3 days. Suppose we have been doing experiments with $^{32}P$ and accumulate waste material that has an activity of $1\times10^{-3}$ curie. According to the safety rule, the waste material cannot be disposed until the activity has fallen to $1.0\times10^{-8}$ curie. How long must we store the waste in a lead container before it is safe to dispose of it? (8%)