IV. 일반화학2
1. 교재 : Chemistry
   (제9판, 저자: Zumdahl)

2. 시험 범위 : Chapter12. Chemical Kinetics ~
   Chapter22. Organic and Biological Molecules
   (참고: Chapter 19는 범위가 아님)

3. 문제 및 답변 언어 : 영어로 문제 출제 및 영어로 답변
4. 출제 경향 및 안내 사항 : 객관식, 단답식, 주관식 풀이식으로 출제됨 (기출 문제 참조)
1. Fill the blanks with 'T' for correct description or 'F' for false one in the following statements. [5 pt each]

(T) Crystal lattice energy is always negative.
(F) Nitrous acid is one of the strong acids.

2. Fill the blanks in the following statements. [5 pt]

(Thermodynamics) is the study of the energy transfers accompanying physical and chemical processes.

3. Select correct answer for the following questions. [10 pt]

(c) Estimate the temperature at which $\Delta G = 0$ for the following reaction.

\[
\text{NH}_3(g) + \text{HCl}(g) \rightarrow \text{NH}_4\text{Cl}(s)
\]

$\Delta H = -176 \text{ kJ}; \ \Delta S = -284.5 \text{ J/K}

(a) 467 K  (b) 582 K  (c) 619 K  (d) 634 K  (e) 680 K

4. Draw structure of following organic compound. [10 pt]

2,4-dimethylbenzoic acid.

[answer]

5. Calculate pH and concentration of $S^{2-}$, [$S^{2-}$] of 0.10 $M$ H$_2$S solution. For the H$_2$S, $K_a$ values are as following. $K_{a1} = 1.0 \times 10^{-7}$, $K_{a2} = 1.0 \times 10^{-19}$. [20 pt]

[answer]

Because $K_a$ for H$_2$S is so small, we can ignore the H$^+$ contribution from the $K_a$ reaction.

\[
\begin{align*}
\text{H}_2\text{S} & \rightarrow \text{H}^+ \quad \text{HS}^- \\
\text{Initial} & \quad 0.10 \ M \quad -0 \quad 0 \\
\text{Result} & \quad 0.10-x \quad x \quad x \\
K_{a1} = 1.0 \times 10^{-7} & = \frac{x^2}{0.10-x} = \frac{x^2}{0.10} \\
\Rightarrow & \quad x = [\text{H}^+] = 1.0 \times 10^{-4} \quad \text{; assumptions good.}
\end{align*}
\]

\[\text{pH} = -\log(1.0 \times 10^{-4}) = 4.00\]

Use the $K_{a1}$ reaction to determine [S$^{2-}$].

\[
\begin{align*}
\text{HS}^- & \rightarrow \text{H}^+ \quad \text{S}^{2-} \\
\text{Initial} & \quad 1.0 \times 10^{-4} \ M \quad 0 \quad 0 \\
\text{Equil.} & \quad 0.0 \times 10^{-4}-x \quad 1.0 \times 10^{-4}+x \quad x \\
K_{a1} = 1.0 \times 10^{-19} & = \frac{0.0 \times 10^{-4} \times x}{(1.0 \times 10^{-4}+x)} = \frac{0.0 \times 10^{-4} M}{1.0 \times 10^{-4}} \\
\Rightarrow & \quad x = [S^{2-}] = 1.0 \times 10^{-12} \ M \quad \text{; assumptions good.}
\end{align*}
\]