CH103 General Chemistry II

2018 Fall semester Quiz 1

Date: September 17 (Mon), ***Time: 19:00~19:45***

Professor Name	Class	Student I.D. Number	Name

[General rule]
Only answer, without explanation: 0 point,
풀이 없이 답만 쓰면 0점
Right value with wrong unit or without unit: – 1points
답의 값은 맞지만 단위가 틀리거나, 없을 경우 -1점
Right answer with different explanation from the answer sheet that's reasonable: full points
식이 채점기준과는 조금 다르지만 맞는 풀이이고 답이 정확한 경우 만점
Correct significant figures not necessary
정확한 유효숫자를 안맞춰도 됨.

1. Potassium perchlorate, $KClO_4$, has a K_{sp} at 25℃ of 1.07×10^{-2}. (total 8 points)

a) Write down the solubility equilibrium, including the state symbol. (2 pts)

$KClO_{4(s)} \rightleftharpoons K^+_{(aq)} + ClO_4^-{}_{(aq)}$

Correct equations with correct state symbols : 2 pts

Only correct equation : 1pt

b) Write down the expression for the solubility product from part (a). (2 pts)

$K_{sp} = [K^+]\,[ClO_4^-]$

No partial points

c) Compute its solubility in grams per liter of solution. (Molar mass of potassium perchlorate is 138.55 $gmol^{-1}$). (4 pts)

$K_{sp} = [K^+]\,[ClO_4^-] = S^2 = 1.07\times10^{-2}$ ……. 1 pt for this concept

S= 0.103mol/L ……1 pt for the right S value

S= (0.103 mol of $KClO_4$ / L) × (138.55g $KClO_4$ / 1 mol) = 14.3g / L ……. 2 pt for the final answer

2. This question is about common ion effect. (total 10 points)

a) Explain common ion effect (2 pts)

When there is an common ion in solution and solid salt to be dissolved, the solubility of the salt is depressed

- If a student understood this concept, give full points

b) The solubility product of nickel(II) hydroxide, $Ni(OH)_2$, at 25℃ is 1.6×10^{-16}. Calculate the molar solubility of nickel (II) hydroxide in pure water at 25℃. (3 pts)

$K_{sp} = [Ni^{2+}]\,[OH^-]^2 = 1.6\times10^{-16}$ ……. 1 pt for right K_{sp}

$(S)(2S)^2 = 1.6\times10^{-16}$

$S = 3.4\times10^{-6}$

Solubility is 3.4×10^{-6} mol/L in pure water ……. 2 pts for right answer

c) Calculate the molar solubility of nickel (II) hydroxide in 0.100M of NaOH. (5 pts)

b) The presence of a common ion (the OH^- ion) reduces the solubility of the nickel(II) hydroxide. Set up the usual three-line table:

	$Ni(OH)_2(s) \rightleftharpoons$	$Ni^{2+}(aq) +$	$2\,OH^-(aq)$
Init. Conc. (mol L^{-1})	—	0	0.100
Change in Conc. (mol L^{-1})	—	$+z$	$+2z$
Equil. Conc. (mol L^{-1})	—	z	$0.100 + 2z$

$K_{sp} = [Ni^{2+}]\,[OH^-]^2 = S(0.100+2S)^2 = 1.6\times10^{-16}$ …… can come to this equation, give 3 pts

$(0.100)^2\,(S) = 1.6\times10^{-16}$ …

$S = 1.6\times10^{-14}$ mol/L …….. 2pts for the right answer

3. Compare the solubility of $Zn(OH)_2$ in pure water with that in a solution buffered at pH 6.00. Please state in which of the two solutions (pure water or pH 6.00 solution) is $Zn(OH)_2$ more soluble. (total 7 points)

- In Pure water,

$K_{sp} = 4.5\ \times10^{-17} = (S)(2S)^2 = 4S^3$

$S = 2.2\times10^{-6}$ M ……. 2 pts for the right answer, partial point (1 pt) can be given when a student wrote down K_{sp} equation correctly but made calculation mistake.

In pH 6.00 solution, $[OH^-] = 1.0\times10^{-8}$ M

So, $[Zn^{2+}] = \frac{K_{sp}}{[OH^-]^2} = 4.5\times10^{-17} / (1.0\times10^{-8})^2 = 0.45$M ….. 2 pts

S = 0.45 mol/L …….1 pt if right answer written.

Zinc (II) hydroxide is more soluble in pH 6.00 solution! … 1 pt

4. silver chloride is dissolved in 1.0L of a 1.0M NH_3 solution, forming of the complex ion $Ag(NH_3)_2^+$. (total 7 pts)

   $K_{sp} = 1.6\times\ 10^{-10}$, $K_f = 1.7\times\ 10^7$

a) Write balanced chemical equation and calculate the equilibrium constant. (3 pts)

$AgCl + 2NH_3 \rightleftarrows Ag(NH_3)_2^+ + Cl^-$ ……. 2 pt (0.5 pts for each)

$K=K_{sp} * K_f = 2.7\times\ 10^{-3}$ …….1 pt

b) Calculate how many grams of silver chloride will dissolve in the given condition. (4 pts) molar mass of AgCl = 143.3 $gmol^{-1}$

$[Ag(NH_3)_2^+] = x$, then $[NH_3] = 1.0-2x$, $[Cl^-] = x$

$2.7\times\ 10^{-3} = x^2/(1.0-2x)^2$ x= 0.047 …….2 pts

0.047 mol of AgCl dissolves per liter

0.047 mol * 143.3$gmol^{-1}$ = 6.7g …….2 pts

5. For each of the following ionic compounds, state whether the solubility will increase, decrease, or remain unchanged as a solution at pH 7 is made acidic and describe briefly why. (total 8 points, each 2)

a) $Ca_3(PO_4)_2$

Increase, A higher concentration of H_3O^+ drives the dissolution by removing product PO_4^{3-} ion as HPO_2^{4-} ion.

b) PbI_2

Unchanged, The anion is an weak base. It has little interaction with H_3O^+ even at high concentration of H_3O^+

c) $SrCO_3$

Increase. CO_3^{2-} reacts with H_3O^+ to give HCO_3^-

d) MgF_2

Increase. F^- reacts with H_3O^+ to give HF.