BIRZEIT UNIVERSITY

**Analytical Chemistry**

**CHEM234**

**Sec 1**

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Homework3

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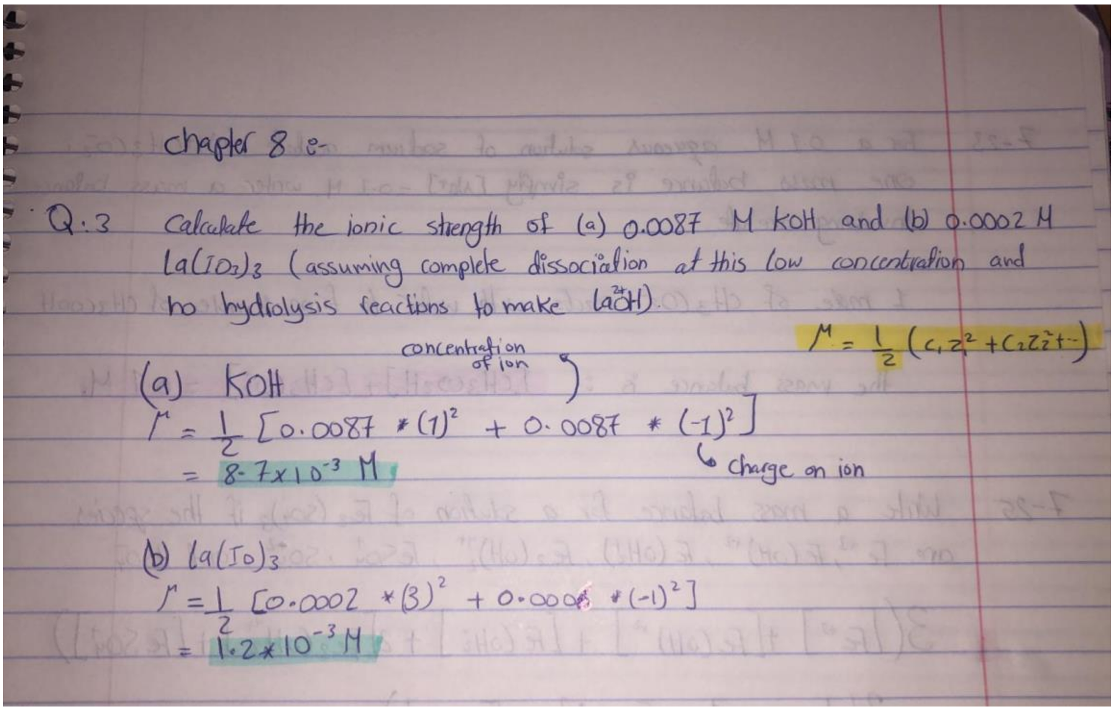
**Chapter 7: Systematic treatment of equilibrium Same as chapter 08 at the 9th edition.**

**7-3:**

**(a): 8.7 * $10^{-3}$ M**

**(b): 1.2 * $10^{-3}$ M**



chapter 8 :-

Q.3 Calculate the ionic strength of (a) 0.0087 M KOH and (b) 0.0002 M $La(IO_3)_3$ (assuming complete dissociation at this low concentration and no hydrolysis reactions to make $LaOH^{2+}$).

$\mu = \frac{1}{2}(c_1 z_1^2 + c_2 z_2^2 + \ldots)$

(a) KOH

$\mu = \frac{1}{2}[0.0087 * (1)^2 + 0.0087 * (-1)^2]$ (concentration of ion; charge on ion)

$= 8.7 \times 10^{-3}$ M

(b) $La(IO)_3$

$\mu = \frac{1}{2}[0.0002 * (3)^2 + 0.0006 * (-1)^2]$

$= 1.2 \times 10^{-3}$ M

**7-7:**

7-7 calculate the activity coefficient of $Al^{+3}$ when $\mu = 0.083$ M by linear interpolation in table 7-1

slope $= \frac{\Delta y}{\Delta x}$

$$\left(\frac{0.083 - 0.05}{0.1 - 0.05}\right) = \left(\frac{y - 0.245}{0.18 - 0.245}\right)$$

$$0.66 * -0.065 = y - 0.245$$

$$\underset{+0.245}{-0.0429} = \underset{+0.245}{y - 0.245}$$

$$y = 0.2021 \approx 0.20_2$$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**7-9:**

7-9 Including activity coefficients, find [$Hg_2^{+2}$] in saturated $Hg_2Br_2$ in 0.00100 M KBr.

$$Hg_2Br_2 \rightleftharpoons Hg_2^{+2} + 2Br^{-1}_{aq}$$

$$Ksp = [Hg_2^{+2}] * \gamma_{Hg_2^{+2}} * [Br^-]^2 * \gamma_{Br^-}^2$$

$$5.6 * 10^{-23} = [Hg_2^{+2}] * 0.867 * (0.00100)^2 (0.964)^2$$

$$[Hg_2^{+2}] = \frac{5.6 \times 10^{-23}}{8.057 \times 10^{-7}}$$

$$[Hg_2^{+2}] = 6.95 \times 10^{-17} = 7.0 \times 10^{-17} M$$

**7-11:** **Final result = 2.07**

7-11 Find the activity coefficient of $H^+$ in a solution containing 0.010 M HCl plus 0.040 M $KClO_4$. What is the pH of the solution?

→ $0.010 + 0.040 = 0.050 M = \mu$ (Ionic strength).

→ So from table (7-1 or 8-1) the activity coefficient of $H^+ = 0.86$

→ $pH = -\log[H^+]\gamma_{H^+} = -\log[(0.010)(0.86)] = -\log[8.6 \times 10^{-3}]$

$$= 2.065 \approx 2.07$$

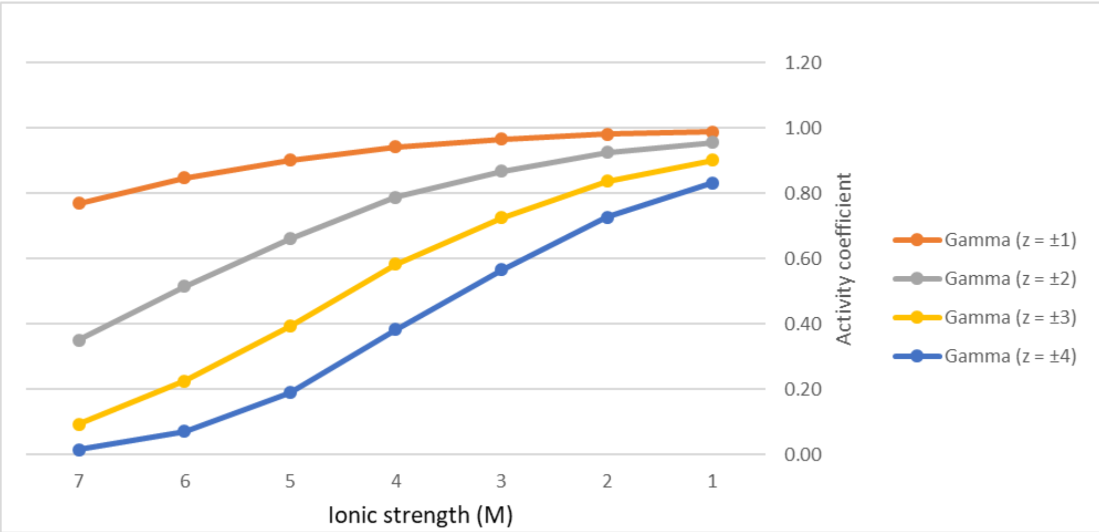
**7-14:** Extended Debye-Hückel equation. Use Equation 7-6 to calculate the activity coefficient as a function of ionic strength (μ) for μ = 0.0001, 0.000 3, 0.001, 0.003, 0.01, 0.03, and 0.1 M.

(a) For an ionic charge of ±1 and a size α = 400 pm, make a table of γ (= 10^(log γ)) for each value of μ

(b) Do the same for ionic charges of ±2, ±3, and ± 4.

(c) Plot γ versus log μ to obtain a graph similar to Figure 7-4

| | A | B | C | D | E |
|---|---|---|---|---|---|
| **1** | **Ionic strength** | **Gamma (z = ±1)** | **Gamma (z = ±2)** | **Gamma (z = ±3)** | **Gamma (z = ±4)** |
| **2** | **0.0001** | **0.988** | **0.955** | **0.901** | **0.831** |
| **3** | **0.0003** | **0.980** | **0.924** | **0.836** | **0.727** |
| **4** | **0.001** | **0.965** | **0.867** | **0.725** | **0.565** |
| **5** | **0.003** | **0.942** | **0.787** | **0.583** | **0.383** |
| **6** | **0.01** | **0.901** | **0.660** | **0.393** | **0.190** |
| **7** | **0.03** | **0.847** | **0.515** | **0.225** | **0.071** |
| **8** | **0.1** | **0.769** | **0.350** | **0.094** | **0.015** |



**7-23:**

7-23 For a 0.1 M aqueous solution of sodium acetate, $Na^+CH_3CO_2^-$, one mass balance is simply $[Na^+] = 0.1$ M. write a mass balance involving acetate.

1 mole of $CH_3CO_2^-$ reacts with water to from 1 mole of $CH_3COOH$

the mass balance is :- $[CH_3CO_2H] + [CH_3CO_2^-] = 0.1$ M.

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**7-25:**

7-25 Write a mass balance for a solution of $Fe_2(SO_4)_3$ if the species are $Fe^{+3}$, $Fe(OH)^{+2}$, $Fe(OH_2^+)$, $Fe_2(OH)_2^{4+}$, $FeSO_4^+$, $SO_4^{-2}$, and $HSO_4^-$

$$3([Fe^{+3}] + [Fe(OH)^{+2}] + [Fe(OH_2^+] + 2[Fe_2(OH_2^{4+}] + [FeSO_4^+])$$

$$= 2([FeSO_4^+] + [SO_4^{-2}] + [HSO_4^-]).$$

Because He's contains 2 Fe