Calculations Involving Bases

Section 8.5

Approach bases the same way as acid problems…

(1) For a **strong base** (Arrhenius base):

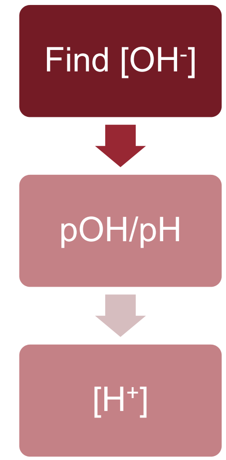
$BOH \rightarrow B^+ + OH^-$ (100%)

Assume stoichiometric quantities for [BOH], $[B^+]$, and $[OH^-]$

(2) For a **weak base** (Bronsted-Lowry):

$B_{(aq)} + H_2O_{(l)} \rightleftharpoons BH^+_{(aq)} + OH^-_{(aq)}$ (partial)

Use $K_b = \dfrac{[BH^+][OH^-]}{[B]}$



Example 1. Find the pH a 0.020 mol/L $Ca(OH)_{2\,(aq)}$ solution

$$Ca(OH)_{2\,(aq)} \rightarrow Ca^{2+}_{(aq)} + 2\,OH^-_{(aq)}$$

Solution

1. Find $[OH^-]$
   Use molar ratios

   $[OH^-] = 2\,[Ca(OH)_2] = 2(0.020) = 0.040$ mol/L

2. Calculate $[H^+]$

   Since the $K_b >> K_w$, assume the contribution of $[OH^-]$ from autoionization is negligible.

   $\therefore [H^+] = \dfrac{K_w}{[OH^-]} = \dfrac{1.0 \times 10^{-14}}{0.040} = 2.5 \times 10^{-13}$ mol/L

3. Find pH

   pH = -log $[H^+]$ = - log (2.5×10^{-13}) = **12.60**

Example 2. Calculate the pH of a 0.100 mol/L solution of hydrazine, $N_2H_{4\,(aq)}$, a weak base. The K_b for hydrazine is 1.7×10^{-6}.

1. Write the ionization equation

   $N_2H_{4\,(aq)} + H_2O_{(l)} \rightleftharpoons N_2H_5^+{}_{(aq)} + OH^-_{(aq)}$

2. Determine which reaction dominates.

   Since the $K_b >> K_w$, assume the contribution of $[OH^-]$ from autoionization is negligible. Ionization of N_2H_4 dominates.

3. Set up ICE table

	N_2H_4	H_2O	$N_2H_5^+$	OH^-
I	0.100	-	0	0
C	- x	-	+ x	+ x
E	0.100 – x	-	x	x

	N_2H_4	H_2O	$N_2H_5^+$	OH^-
E	0.100 – x	-	x	x

❹ Use K_b to solve find [OH-]

$$K_b = \frac{[N_2H_5^+][OH^-]}{[N_2H_4]}$$

$$1.7 \times 10^{-6} = \frac{(x^2)}{(0.100-x)} \cong \frac{(x^2)}{(0.100)}$$

$\frac{0.100}{K_b} >> 100$

$$x \cong 4.1 \times 10^{-4} \text{ mol/L}$$

$\frac{x}{0.100} = 0.41\%$

Assumption was valid!

❺ Use $[OH^-]$ to find pOH

pOH = - log$[OH^-]$

pOH = -log(4.1×10^{-4} mol/L) = 3.38

❻ Use pOH to find pH

pH = 14.00 – pOH = 14.00 – 2.38

pH = 10.62

Homework

- Pg. 529 #1-3
- Pg. 530 #1-7, 9, 10