

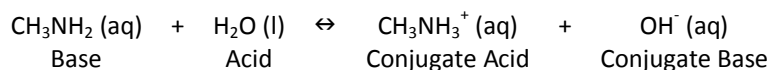
Pre-AP Chemistry/AP Chemistry
Unit #12—Acids and Bases

Solving for pH of a Weak Base

- Step 1: Write the Ionization Reaction and Identify Acid, Base, Conjugate Acid, and Conjugate Base.
 Step 2: Write the Base Equilibrium Expression.
 Step 3: Use ICE Chart
 Step 4: Solve for “x” using the Base Equilibrium Expression.
 Step 5: Solve for pH, pOH, [H⁺], and [OH⁻] at Equilibrium.
 Step 6: Solve for Percent Ionization of the [OH⁻].

Write the ionization reaction, K_b and calculate pH, pOH, [H⁺], [OH⁻] and the percent ionization of a 0.350 M aqueous solution of methylamine where the K_b = 4.38 x 10⁻⁴.

- Step 1: Write the Ionization Reaction and Identify Acid, Base, Conjugate Acid, and Conjugate Base



- Step 2: Write the Acid Equilibrium Expression

$$K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]}$$

- Step 3: Use ICE Chart

| | CH ₃ NH ₂ (aq) | CH ₃ NH ₃ ⁺ (aq) | OH ⁻ (aq) |
|---------------------------|--------------------------------------|---|----------------------|
| Initial Concentration | 0.35 M | 0 M | 0 M |
| Change in Concentration | -x M | + x M | + x M |
| Equilibrium Concentration | 0.35 M | x M | x M |

- Step 4: Solve for “x” using the Acid Equilibrium Expression.

$$K_b = \frac{[x][x]}{[0.35]} = 4.38 \times 10^{-4}$$

$$x^2 = 1.533 \times 10^{-4} \text{ M}$$

$$x = 0.012 \text{ M} = [\text{OH}^-]_{\text{eq}} = [\text{CH}_3\text{NH}_3^+]_{\text{eq}}$$

- Step 5: Solve for pH, pOH, [H⁺], and [OH⁻] at Equilibrium.

$$[\text{H}^+]_{\text{eq}} = 10^{-(12.093)} = 8.072 \times 10^{-13} \text{ M}$$

$$\text{pH} = 14 - 1.907 = 12.093$$

$$\text{pOH} = -\log [0.012] = 1.907$$

$$[\text{OH}^-]_{\text{eq}} = 0.012 \text{ M}$$

- Step 6: Solve for Percent Ionization of the [OH⁻].

$$\frac{0.012 \text{ M}}{0.350 \text{ M}} \times 100 = 3.4 \% \text{ OH}^-$$

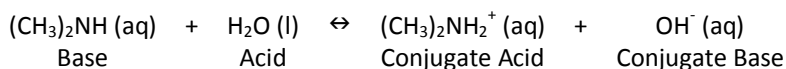
Pre-AP Chemistry/AP Chemistry
Unit #12—Acids and Bases

Solving for K_b of a Weak Acid

- Step 1: Write the Ionization Reaction and Identify Acid, Base, Conjugate Acid, and Conjugate Base.
 Step 2: Write the Base Equilibrium Expression.
 Step 3: Find the concentration of the $[\text{OH}^-]_{\text{eq}}$ through pH
 Step 4: Use ICE Chart
 Step 5: Solve for K_b
 Step 6: Solve for pH, pOH, $[\text{H}^+]$, and $[\text{OH}^-]$ at Equilibrium.
 Step 7: Solve for Percent Ionization of the $[\text{OH}^-]$.

The pH of a 0.500 M solution of dimethylamine, $(\text{CH}_3)_2\text{NH}$, is 12.25. What is the K_b , pH, pOH, $[\text{H}^+]$, and $[\text{OH}^-]$ at equilibrium and percent ionization?

- Step 1: Write the Ionization Reaction and Identify Acid, Base, Conjugate Acid, and Conjugate Base.



- Step 2: Write the Base Equilibrium Expression.

$$K_b = \frac{[(\text{CH}_3)_2\text{NH}_2^+] [\text{OH}^-]}{[(\text{CH}_3)_2\text{NH}]}$$

- Step 3: Find the concentration of the $[\text{OH}^-]_{\text{eq}}$ through pH

$$\begin{aligned} \text{pOH} &= 14 - 12.25 = 1.75 \\ [\text{OH}^-]_{\text{eq}} &= 10^{-(1.75)} = 0.018 \text{ M} \end{aligned}$$

- Step 4: Use ICE Chart

| | $(\text{CH}_3)_2\text{NH (aq)}$ | $(\text{CH}_3)_2\text{NH}_2^+ \text{ (aq)}$ | $\text{OH}^- \text{ (aq)}$ |
|---------------------------|---------------------------------|---|----------------------------|
| Initial Concentration | 0.100 M | 0 M | 0 M |
| Change in Concentration | - 0.018 M | + 0.018 M | + 0.018 M |
| Equilibrium Concentration | 0.482 M | 0.018 M | 0.018 M |

- Step 5: Solve for K_b

$$K_b = \frac{[0.004] [0.004]}{[0.096]} = 6.722 \times 10^{-4}$$

- Step 6: Solve for pH, pOH, $[\text{H}^+]$, and $[\text{OH}^-]$ at Equilibrium.

$$[\text{H}^+]_{\text{eq}} = 10^{-(12.25)} = 5.623 \times 10^{-13} \text{ M}$$

$$\text{pH} = 12.25 = 2.44$$

$$\text{pOH} = 14 - 2.44 = 1.75$$

$$[\text{OH}^-]_{\text{eq}} = 0.018$$

- Step 7: Solve for Percent Ionization of the $[\text{OH}^-]$.

$$\frac{0.018 \text{ M}}{0.100 \text{ M}} \times 100 = 3.6 \% \text{ OH}^-$$