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

Solving for pH, pOH, $[H^+]$, $[OH^-]$, and Ka/Kb for a Strong Acid or Strong Base

Step 1: Write the Ionization Reaction and Identify Acid, Base, Conjugate Acid, and Conjugate Base.
Step 2: Solve for pH, pOH, $[H^+]$, and $[OH^-]$ at Equilibrium.
Step 3: Solve for K_a or K_b
Step 4: Solve for Percent Ionization

In an experiment, a student is given 0.350 M hydrochloric acid, which is considered a strong acid. Calculate pH, pOH, $[H^+]$, and $[OH^-]$ at Equilibrium, as well as, the K_a and Percent Ionization.

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

$$\underset{\text{Acid}}{HCl\ (aq)} + \underset{\text{Base}}{H_2O\ (l)} \leftrightarrow \underset{\text{Conjugate Acid}}{H^+\ (aq)} + \underset{\text{Conjugate Base}}{Cl^-\ (aq)}$$

0.350 M 0.350 M 0.350 M

Step 2: Solve for pH, pOH, $[H^+]$, and $[OH^-]$ at Equilibrium.

$$[H^+]_{eq} = 0.350\ M$$

$$pH = -\log [0.350] = 0.456$$

$$pOH = 14 - 0.456 = 13.544$$

$$[OH^-]^{eq} = 10^{-(13.544)} = 2.857 \times 10^{-14}\ M$$

Step 3: Write Acid Equilibrium Expression and Solve for K_a.

$$K_a = \frac{[H^+]\ [Cl^-]}{[HCl]}$$

$$K_a = \frac{[0.350]\ [0.350]}{[0.350]} = 3.5 \times 10^{-1}$$

Step 4: Solve for Percent Ionization of the $[OH^-]$.

$$\frac{0.350\ M}{0.350\ M} \times 100 = 100\ \%\ H^+$$

In an experiment, a student is given 0.150 M sodium hydroxide, which is considered a strong base. Calculate pH, pOH, $[H^+]$, and $[OH^-]$ at Equilibrium, as well as, the K_b and Percent Ionization.

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

$$\underset{\text{Base}}{NaOH\ (aq)} + \underset{\text{Acid}}{H_2O\ (l)} \leftrightarrow \underset{\text{Conjugate Acid}}{Na^+\ (aq)} + \underset{\text{Conjugate Base}}{OH^-\ (aq)}$$

0.150 M 0.150 M 0.150 M

Step 2: Solve for pH, pOH, $[H^+]$, and $[OH^-]$ at Equilibrium.

$$[H^+]_{eq} = 10^{-(13.544)} = 6.667 \times 10^{-14}\ M$$

$$pH = 14 - 0.827 = 13.176$$

$$pOH = -\log [0.150] = 0.827$$

$$[OH^-]^{eq} = 0.150\ M$$

Step 3: Write Acid Equilibrium Expression and Solve for K_a.

$$K_b = \frac{[Na^+]\ [Oh^-]}{[NaOH]}$$

$$K_a = \frac{[0.150]\ [0.150]}{[0.150]} = 1.5 \times 10^{-1}$$

Step 4: Solve for Percent Ionization of the $[OH^-]$.

$$\frac{0.150\ M}{0.150\ M} \times 100 = 100\ \%\ H^+$$

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