Acid-Base Chemistry Review

- Arrenhius Concept of Acid and Bases (Old and Revised)
- Bronsted-Lowry Acid-Base Concept

(Identify acids/bases, amphiprotic)

- ~~Lewis Acid-Base Concept~~
- Conjugate Acids and Bases

(the stronger an acid, the weaker its conjugate base)

- Polyprotic Acids H_2SO_4 H_3PO_4
- Water Equilibrium
- Calculating K_a, K_b ($K_aK_b = K_w$)
- Predicting Acid-Base Equilibria
- Lab: Titrations

	Acids	Bases
Arrhenius	H	OH
Revised Arrhenius	H^+	OH^-
Bronsted-Lowry	Proton Donor	Proton Acceptor

Use the five-step method to predict the following acid-base equilibria:

Methanoic acid is added to a sodium hydrogen carbonate solution.

$HCOOH_{(aq)}$ and $NaHCO_{3(aq)}$

$HCOOH_{(aq)}$, $Na^+_{(aq)}$, $HCO_3^-{}_{(aq)}$, $H_2O_{(l)}$

SA – A B A/B

$HCOOH_{(aq)} + HCO_{3(aq)}^- \overset{>50\%}{\rightleftharpoons} HCOO^-_{(aq)} + H_2CO_{3(aq)}$

Calculate the pH and hydronium ion concentration if a 0.227 mol/L solution of benzoic acid is added to water.

$$C_6H_5COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons C_6H_5COO^-_{(aq)} + H_3O^+_{(aq)}$$

0.227 mol/L

$$K_a = \frac{[C_6H_5COO^-_{(aq)}][H_3O^+_{(aq)}]}{[C_6H_5COOH_{(aq)}]}, \quad [C_6H_5COO^-_{(aq)}] = [H_3O^+_{(aq)}].$$

$$K_a = \frac{[H_3O^+_{(aq)}]^2}{[C_6H_5COOH_{(aq)}]}$$

$$[H_3O^+_{(aq)}] = \sqrt{(6.3\times10^{-5})[0.227]}$$

$$[H_3O^+_{(aq)}] = 3.78\times10^{-3}\ M$$

$$pH = -\log[H_3O^+_{(aq)}]$$

$$pH = -\log[3.78\times10^{-3}]$$

$$pH = 2.422$$

Calculate the pOH and hydroxide ion concentration if a 0.350 mol/L solution of ammonia acting as a base, is added to water.

$$NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_4^+ + OH^-$$

0.350 mol/L

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$K_b = \frac{[OH^-]^2}{[NH_3]}$$

$$K_aK_b = K_w$$

$$K_b = \frac{1.0 \times 10^{-14}}{5.8 \times 10^{-10}}$$

$$K_b = 1.7 \times 10^{-5}$$

$$[OH^-] = \sqrt{(1.72 \times 10^{-5})[0.350]}$$

$$[OH^-] = 2.46 \times 10^{-3} M$$

$$pOH = -\log[OH^-]$$

$$pOH = -\log[2.46 \times 10^{-3}]$$

$$pOH = 2.610$$

Calculate the pH and hydronium ion concentration of a 0.350 mol/L solution of sulfuric acid.

$H_2SO_{4(aq)} \longrightarrow 2H^+_{(aq)} + SO^{2-}_{4(aq)}$

$0.350\ mol/L \qquad 0.700\ mol/L$

$pH = -\log[H_3O^+_{(aq)}]$

$pH = -\log[0.700]$

$pH = 0.155$

Calculate the pH and hydronium ion concentration of a 0.350 mol/L solution of sodium hydroxide.

$NaOH_{(aq)} \longrightarrow Na^+_{(aq)} + OH^-_{(aq)}$

0.350 mol/L 0.350 mol/L

$pOH = -\log[OH^-]$

$pOH = -\log[0.350]$

$pOH = 0.456$

$pH + pOH = 14.000$

$pH = 13.544$

$[H_3O^+] = 10^{-pH}$

Predicting Acid-Base Reactions

1. List all entities (ions, atoms, or molecules) initially present.

2. Identify all possible acids and bases, using Bronsted-Lowry definition.

3. Identify the strongest acid and strongest base, using table of acids and bases.

4. Transfer one proton from the acid to the base and predict the conjugate acid and conjugate base as products.

5. Predict the position of the equilibrium.

Worksheet