

Chemistry 3.6

Aqueous Systems

Buffer solutions

Common weak acid and base

Weak acid

Most Organic acid



Some inorganic acid

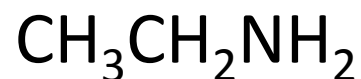


Conjugate acid

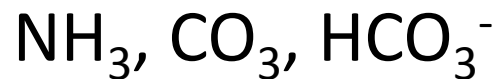


Weak base

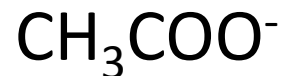
Most organic Amine



Some Inorganic base



Conjugate base



Buffer solution

- **Buffer solution** is a **mixture of weak acid** and its **conjugate base**. (CH_3COOH and CH_3COO^-)
- **Or vice versa**, a mixture of **weak base** and its **conjugate acid**. (NH_3 and NH_4^+)
- Because both **acid and base** is present in the **mixture**, therefore its able to **maintain** a reasonable **constant pH** on addition of small amounts of H^+ or OH^- .

Example

- A buffer solution of ammonia (**NH₃**) and ammonium chloride (**NH₄Cl**)
 - NH₄⁺ is the conjugate acid of NH₃
- When small amount of sodium hydroxide (**OH⁻**) is added



- When small amount of HCl (**H⁺**) is added



- In both scenarios, there are **no overall change** in **[H⁺]** and **[OH⁻]** so no pH changed.

How to make buffer solution

- There are two possible ways to prepare a buffer solution

1. Mix a **weak acid** (or weak base) with its **conjugate base** (or conjugate acid)

Example: **NH₄Cl** mixed with **NH₃**

2. React some (usually 1/2) of the weak acid (or weak base) with a strong base (or strong acid) to create a mixture of weak acid and its conjugate base

Example: **CH₃COOH** + NaOH → **NaCH₃COO** + H₂O

Calculations

- Many ways to approach a buffer calculation
- Simplest way is to use the K_a expression

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

- Another way is to use the formula

This formula is mathematically the same as above

(see whiteboard)

$$pH = pK_a + \log \frac{[Base]}{[Acid]}$$