

# 18.2 BUFFER SOLUTIONS

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# What is a Buffer Solution?

- **Definition:** solution that resists a change in pH when a small amount of an acid or base is added to them.

## Made of:

- weak acid and its conjugate base from a salt
  - Ex:  $\text{CH}_3\text{COOH}/\text{CH}_3\text{COONa}$
- Weak base and its conjugate acid from a salt
  - Ex:  $\text{NH}_3/\text{NH}_4\text{Cl}$

# Acidic Buffer Solutions

- $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$
- Get a significant amount of  $\text{CH}_3\text{COO}^-$  from the sodium ethanoate.
- Describe what happens:
  - a) When a small amount of HCl is added
  - b) When a small amount of NaOH is added

# Basic Buffer Solution

- $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$
- Get significant amount of  $\text{NH}_4^+$  from ammonium chloride salt
- Describe what happens:
  - a) When a small amount of HCl is added
  - b) When a small amount of NaOH is added

# Making Buffer Solutions

- Most useful when concentration of acid and base are equal
- And  $\text{pH} = \text{pKa}$
- Can add acid/base and its salt or acid/base and small amount of strong base/strong acid

# Solving Problems for Buffer Solutions

- Use the  $K_a$  or  $K_b$  equilibrium equations!

\*Henderson-Hasselbalch equation:

$$\text{pH} = \text{p}K_a + \log \left( \frac{[\text{A}^-]}{[\text{HA}]}\right)$$

$$\text{pOH} = \text{p}K_b + \log \left( \frac{[\text{HB}^+]}{[\text{B}]}\right)$$

# Example 1

- Solid sodium ethanoate is added to  $0.20 \text{ mol dm}^{-3}$  ethanoic acid until the concentration of the salt is  $0.050 \text{ mol dm}^{-3}$ . Given that the  $K_a$  for ethanoic acid is  $1.74 \times 10^{-5} \text{ mol dm}^{-3}$ . Calculate the pH of the buffer solution formed.

## Example 2

- Will 30 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> CH<sub>3</sub>COOH (K<sub>a</sub> = 1.74 x 10<sup>-5</sup> mol dm<sup>-3</sup>) and 10 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> NaOH produce a buffer solution and if so what will be its pH?