Session 2
09/03/2025

1. Define Bronsted Acid and Bronsted Base

Bronsted Acid: proton donor
Bronsted Base: proton acceptor

2. Write down a basic chemical equation & label the conjugate pairs. Using HA, B, A, and BH.

$$\underbrace{\underset{\text{acid}}{HA} + \overbrace{\overset{\text{base}}{B} \rightarrow \underset{\text{CB}}{A^-}}^{}}_{\text{conjugate pair}} + \underset{\text{CA}}{BH^+}$$

conj. pair

3. Define Ka.

Dissociation of an acid.

4. How do we know if an acid is weak or not? Define strong acid and weak acids.

pKa: weak acid dissociation constant.
Strong acids: total dissociation. This means they give up H+ ions more easily.
Weak acids: partial dissociation. They can also reassociate.

5. What is so special about water in terms of biochemistry?

- Water willingly accepts protons from weak bases
- Water is used in anything to do with biology
- Water can be used as an acid or base—why? It's neutrality (pH of 7)

6. Write the chemical equation for the ionization of water.

$H_2O \rightarrow H^+ + OH^-$

7. What is Keq? How do we solve for this?

- represents the ratio of product concentrations to reactant concentrations
- $Keq = \frac{[products]}{[reactants]}$

8. What is Kw?

Dissociation of water.

$$Kw = Keq[H_2O] = 1 \times 10^{-14} M^2$$

9. Derive the Henerson Hasselbach equation.

$$Keq = \frac{[products]}{[reactants]}$$

$$Keq = \frac{[A^-][H_3O^+]}{[HA][H_2O]}$$

$$Keq[H_2O] = \frac{[A^-][H_3O^+]}{[HA]}$$

$$H_3O^+ - H_2O = H^+$$

$$Ka = \frac{[A^-][H^+]}{[HA]}$$

$$\log Ka = \log\frac{[A^-]}{[HA]} + \log[H^+]$$

$$\log Ka = \log\frac{[A^-]}{[HA]} - pH$$

$$pKa = -\log Ka$$

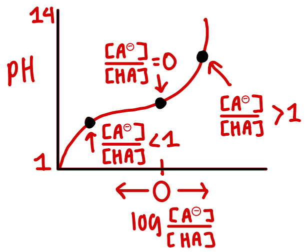
$$-pKa = \log\frac{[A^-]}{[HA]} - pH$$

$$pH = pKa + \log\frac{[A^-]}{[HA]}$$

10. Define pH and list the formula used to calculate it.

Negative lof of H3O+ in a solution
pH = -log[H3O+]

11. Draw and label the pKa dissociation curve. How does the curve change as concentration changes?



as the concentration of base increases, so does the pH!!

as the concentration of acid increases, the pH decreases.

Practice Problems

1. Calculate the pH of a mixture of 0.25 M acetic acid and 0.20 M sodium acetate. The pKa of acetic acid is 4.76.

pH = pKa + log [acetate] / [acetic acid]
= 4.76 + log 0.20 / 0.25
= 4.76 – 0.097
= 4.66

2. Calculate the ratio of lactic acid and lactate required in a buffer system of pH 4.9. The pKa of lactic acid is 3.86.

pH = pKa + log [lactate] / [lactic acid]
rearrange to:
log [lactate] / [lactic acid] = pH + pKa
= 4.90 – 3.86 = 1.04
[lactate] / [lactic acid] = antilog 1.04
= 11.0

3. Calculate the pH of a solution containing 150 ml of 0.3 sodium benzoate and 220 ml of 0.4 benzoic acid, AFTER the addition of 42 ml of 0.1 M KOH. pKa of benzoic acid is 4.2.

step 1) $M = \frac{mol}{L}$
$0.3 = \frac{x}{.15}$
mol = .045 sodium benzoate

step 2) $M = \frac{mol}{L}$
$0.4 = \frac{x}{.22}$
mol = .088 benzoic acid

step 3) $M = \frac{mol}{L}$
$.01 = \frac{x}{.042}$
mol = .0042 KOH

strong base!!

step 4) $pH = pka + \log \frac{[base]}{[acid]}$
$pH = 4.5 + \log \frac{.045 + .0042}{.088}$
$\boxed{pH = 4.25}$

Additional Notes

- Remember that strength of acid is derived from pKa

- Bigger Ka means H_3O^+ and A^- are in higher concentrations and HA is dissociating more.

- A smaller pKa = a stronger acid (and vice versa)

- If pKa = pH, then the ratio of acid & base are equal