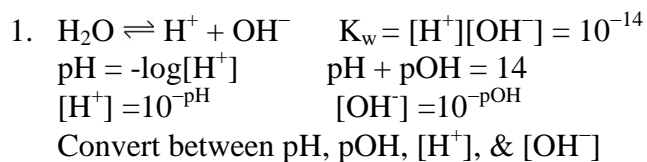
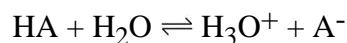


18 • Acid-Base Equilibria

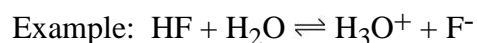
BLUFFER'S GUIDE



2. Acid Ionization Constant (K_a):



$$K_a = [\text{A}^-][\text{H}_3\text{O}^+]/[\text{HA}]$$



$$K_a = [\text{F}^-][\text{H}_3\text{O}^+]/[\text{HF}]$$

3. Typical question: Given K_a and the starting concentrations of acid, find concentrations (or pH) of $[\text{H}^+]$ at equilibrium.

Example: K_a for acetic acid = 1.8×10^{-5} .

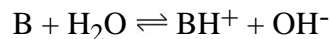
Find the pH of 0.100M acetic acid.

4. Polyprotic Acids: H_3PO_4 , H_2SO_4 , $\text{H}_2\text{C}_2\text{O}_4$, etc. The 1st dissociation is strong for H_2SO_4 . When using Hess's Law with a polyprotic acid: $K_{\text{overall}} = K_{a1} \times K_{a2}$
 Calculating pH, use K_{a1}

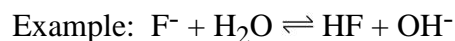
5. Bronsted-Lowry Definitions.

Acids = H^+ donors; Bases = H^+ acceptors
 Conjugate acid-base pairs.

6. Base Ionization Constant (K_b):



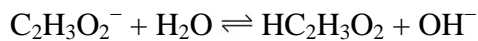
$$K_b = [\text{BH}^+][\text{OH}^-]/[\text{B}]$$



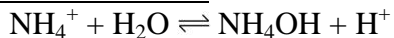
$$K_b = [\text{HF}][\text{OH}^-]/[\text{F}^-]$$

7. Salt solns can have pH's $\neq 7$ (hydrolysis)

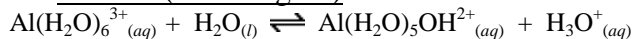
Ions from weak acids \rightarrow basic solutions



Ions from weak bases \rightarrow acidic solutions



Cations (2+ or higher) \rightarrow acidic solutions



8. $K_a \times K_b = K_w = 10^{-14}$

only applies for **conjugate** acids & bases!

Example: $K_a \text{HC}_2\text{H}_3\text{O}_2 = 1.8 \times 10^{-5}$

$K_b \text{C}_2\text{H}_3\text{O}_2^- = 10^{-14} / 1.8 \times 10^{-5}$

9. Percent ionization =

$$[\text{H}^+]_{\text{equilibrium}} / [\text{HA}]_{\text{initial}} \times 100$$

10. Acid Strength: know the 6 strong acids: HCl, HBr, HI, HNO₃, HClO₄, and H₂SO₄ (removal of the first H⁺ only)

(a) binary acids - acid strength increases with increasing size and electronegativity of the "other element". (NOTE: Size predominates over electronegativity in determining acid strength.)

Examples: $\text{H}_2\text{Te} > \text{H}_2\text{O}$ & $\text{HF} > \text{NH}_3$

(b) Oxoacids - Acid strength increases with increasing:

(1) electronegativity

(2) number of bonded oxygen atoms

(3) oxidation state of the "central atom".

Example: HClO₄ or [O₃Cl(OH)]

is very **acidic**

NaOH is very **basic**

Acid strength also increases with **decreasing** radii of the "central atom".

Example:

HOCl (bond between Cl and OH is covalent--making HOCl **acidic**)

HOI (bond between I and OH is ionic--making HOI **basic**)

11. Lewis Acids and Bases:

(This applies to coordinate covalent bonds.)

Lewis Acid--electron pair acceptor

Lewis Base--electron pair donor

"Have Pair... Will Share" – Lewis Base

In complex ion formation, metal ions are Lewis acids, and ligands are Lewis bases.

Example: $\text{Cu}^{2+} + 4\text{NH}_3 \rightleftharpoons \text{Cu}(\text{NH}_3)_4^{2+}$

Cu^{2+} acts as an acid; NH_3 acts as a base.

12. Strong Bases: hydroxide ion (OH^-), amide ion, (NH_2^-), hydride ion (H^-), methoxide ion, (CH_3O^-)