

Acids and Bases

Definitions	Acid	Base
1. Bronsted-Lowry	H ⁺ donor	H ⁺ acceptor
2. Lewis	e ⁻ acceptor	e ⁻ donor

Typical Acid/Base Reaction:



K_{eq} for this example K_a for this example:

$$K_{eq} = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{H}_2\text{O}][\text{HA}]} \quad K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

In general:

- Strong acid → Weak conj. base
- Weak acid → Strong conj. base
- Strong base → Weak conj. acid
- Weak base → Strong conj. acid

Predicting equilibria:

Start by labeling the pK_as in the reaction (see list)

Reaction Arrows:

- R₂N arrows point towards the side with the weaker acid (higher pK_a)

Is it reversible or irreversible?

- Look at the difference of pK_as between reactants/products
- $\Delta \text{pK}_a > 8 \Rightarrow$ irreversible rxn
- $\Delta \text{pK}_a < 8 \Rightarrow$ reversible rxn

Example: Predict equilibrium using pK_as, is it reversible or irreversible?



Acidities **4.2**

1. Label pK_as
2. Know arrows will point towards weaker acid (higher pK_a), so left
3. Is it reversible or irreversible? (25-16 > 8), so irreversible
4. Final arrows: \rightarrow

Things to know about acid/base reactions:

Equilibrium constant (K_{eq}) = ratio that tells the position of a chemical equilibrium

$$K_{eq} = \frac{[\text{products}]}{[\text{reactants}]}$$

Trends:

- K_{eq} > 1 \Rightarrow Favors products
- K_{eq} = 1 \Rightarrow At equilibrium
- K_{eq} < 1 \Rightarrow Favors reactants (non doesn't work)

Acid Dissociation Constant (K_a): measure of acid strength

$$K_a = K_{eq} [\text{H}_2\text{O}]$$

Trends:

- $\uparrow K_a =$
 - Strong acid
 - Full dissociation
 - High [products] (large numerator)
- $\downarrow K_a =$
 - Weak acid
 - Partial/incomplete dissociation
 - High [reactants] (large denominator)

$$\text{pK}_a = -\log K_a$$

Trends:

- $\downarrow \text{pK}_a =$ Strong acid $\uparrow \text{pK}_a =$ Weak acid
- $\uparrow \text{pK}_a =$ Weak acid $\downarrow \text{pK}_a =$
 - $\text{pK}_a < 1 \Rightarrow$ Strong acid
 - $\text{pK}_a 1-3 \Rightarrow$ Moderately strong acid
 - $\text{pK}_a 3-5 \Rightarrow$ Weak acid
 - $\text{pK}_a > 5 \Rightarrow$ Very weak acid

pK_as to Know

- sp³ C-H 51
- sp² C-H 44
- sp C-H 25
- Water H₂O = 16 (15.7)
- Ethanol OH = 16 (15.9)
- Ammonia NH₃ 38
- Acetic Acid CO₂H = 5 (4.76)
- HCl -7

Study Guide Chemistry Acids And Bases

James E. Brady, John R. Holum



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