

Chapter 2. Acids and Bases

Learning objectives:

1. Recognize acid and base.
2. Complete the reaction between acid and base, and recognize the relationship between acid and conjugate base, and base and conjugate acid.
3. Use pK_a or pH values to predict the dominant product(s) for an acid-base reaction.
4. Predict the order of acidity and basicity using electronegativity and resonance.
5. Recognize Lewis acid and base, and complete the reaction between Lewis acid and base by moving electrons.

Sections to be covered (in the order of delivery):

- 2.1 An introduction to acids and bases
- 2.2 pK_a or pH
- 2.3 Organic acids and bases
- 2.4 How to predict the outcome of an acid-base reaction
- 2.5 How to determine the position of equilibrium
- 2.6 How the structure of an acid affect its pK_a
- 2.7 How pH affects the structure of an organic compound
- 2.8 Buffer solutions
- 2.9 Lewis acids and bases

Recommended additional problems

21, 22, 25, 29, 30, 32, 35

2.1 An introduction to acids and bases

Arrhenius Acids and Bases

Acid: substance that dissolves in water that produces H^+ ion.

Base: substance that dissolves in water that produces OH^- ion.

Bronsted-Lowry Acids and Bases

Acid: proton (H^+) donor

Base: proton (H^+) acceptor

Examples:

2.2 pK_a or pH

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

$$pK_a = -\log K_a$$

very strong acids	$pK_a < 1$	(extremely weak conjugate bases)
moderate strong acids	$pK_a = 1-3$	(very weak conjugate bases)
weak acids	$pK_a = 3-5$	(weak conjugate bases)
very weak acids	$pK_a = 5-15$	(moderate strong conjugate bases)
extremely weak acids	$pK_a > 15$	(strong conjugate bases)

2.3 Organic acids and bases

Know carboxylic acids, carboxylates, and carboxyl group

2.4 How to predict the outcome of an acid-base reaction

2.5 How to determine the position of equilibrium

Use pK_a or pH values to predict the dominant product(s) for an acid-base reaction.

Examples

(i)

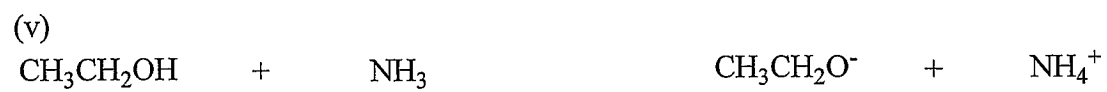


(ii)



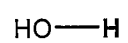
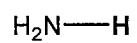
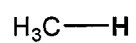
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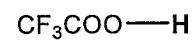
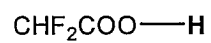
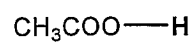


2.6 How the structure of an acid affect its pK_a

A. Electronegativity (inductive effect)



B. Inductive Effect



2.7 How pH affects the structure of an organic compound

2.8 Buffer solutions

2.9 Lewis acids and bases

Acid: electron pair acceptor (A^+ , E^+) **electrophile**

Base: electron pair donor ($B:^-$) **nucleophile**

Examples: