

## Chemistry 1506: Allied Health Chemistry 2

### Section 6: Amines and Amides

#### Functional Groups with Single Bonds to Nitrogen

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## Section 6.1 Amines

### ❖ Amine Classification

#### ❖ Ammonia

#### ❖ 1°, Primary Amine

#### ❖ 2°, Secondary Amine

❖ 3°, Tertiary Amine

❖ 4°, Quaternary Ammonium Salts

- ❖ IUPAC Nomenclature
  - ❖ Named as Alkyl Amines (multiple words)
  - ❖ Dimethyl Amine
  
  
  
  
  
  
  
  
  
  
- ❖ Methyl Ethyl Amine
  
  
  
  
  
  
  
  
  
  
- ❖ Tetramethyl Ammonium Chloride

❖ Aromatic Amines

❖ Aniline (coal tar)

❖ N-methyl-N-ethyl aniline

- ❖ Heterocyclic Amines
  - ❖ Pyridine ( $C_5H_5N$ , coal tar)
  
  
  
  
  
  
  
  
  
  
  - ❖ Piperidine ( $C_5H_{11}N$ )
  
  
  
  
  
  
  
  
  
  
  - ❖ Pyrimidine (1,3- $C_4H_4N_2$ )
  
  
  
  
  
  
  
  
  
  
  - ❖ Pyrrole ( $C_4H_5N$ )
  
  
  
  
  
  
  
  
  
  
  - ❖ Pyrrolidine ( $C_4H_9N$ )

## ❖ Properties

- ❖ Relatively high **Mp** and **Bp**
  - ❖ Polar
  - ❖ Hydrogen Bonding Donor
  - ❖ Hydrogen Bonding Acceptor
- ❖ Solubility
- ❖ Stench!
  - ❖ Putrescine
    - ❖  $\text{H}_2\text{N}-(\text{CH}_2)_4-\text{NH}_2$
  - ❖ Cadaverine
    - ❖  $\text{H}_2\text{N}-(\text{CH}_2)_5-\text{NH}_2$

## ❖ Hydrogen Bonding

- ❖ H-bonding donors and H-Bonding acceptors

## Section 6.2 Amino Acids having Amine/Heterocyclic Containing Side Chains

### ➤ Amino Acids (Building Blocks of Proteins)

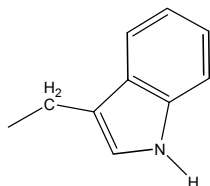
➤ Generic AA =  $\text{H}_2\text{N}-\text{CHR}-\text{CO}_2\text{H}$

### ➤ Lysine (basic)

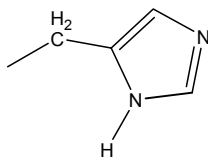
➤  $\text{R} = \text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2-\text{NH}_2$

### ➤ Tryptophan (neutral polar)

➤ Nitrogen is in “aromatic” bond



### ➤ Histidine (basic)



### ➤ Arginine (basic)

➤  $\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}-\text{C}(=\text{NH}_2)-\text{NH}_2$





- ❖ Amines plus Alkyl Halides
  - ❖ Generic (Nucleophilic Attack and Deprotonation)
  
- ❖  $\text{NH}_3$  plus Alkyl Halides
  
  
  
  
  
  
  
  
  
  
- ❖  $\text{NH}_2\text{R}$  plus Alkyl Halides
  
  
  
  
  
  
  
  
  
  
- ❖  $\text{NHR}_2$  plus Alkyl Halides

- ❖  $\text{NR}_3$  plus Alkyl Halides
- ❖ no deprotonation possible

## Section 6.4 Amides

- ◆ Generic Structures
  
  
  
  
  
  
  
  
  
  
- ◆ Properties
  - ◆ Mp and Bp
    - ◆ Polarization of Bonds
    - ◆ Hydrogen Bonding
  - ◆ Lone Pairs
  - ◆ Neither Acidic or Basic

- ◆ IUPAC Nomenclature

- ◆ anamide

- ◆ examples

- ◆ Butanamide

- ◆ Benzamide

- ◆ N,N-dimethylbutanamide

## Section 6.5 Amide Reactions

- ◆ Direct Synthesis from Carboxylic Acids and Amines

- ◆ Acid/Base reaction

- ◆ Thermolysis

- ◆ Synthesis from Acid Chlorides

- ◆ Synthesis from Anhydrides

- ◆ Nylon 66

- ◆ Synthesis by Direct Reaction of **Carboxylic Acids** and **Amines**

- ◆ Synthesis from **Acid Chlorides** and Amines

- ◆ Related to **Protein Backbones**

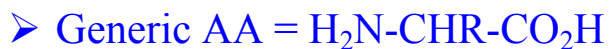
- ◆ **Polyamides** with Side Chains

- ◆ Hydrolysis of Amides
  - ◆ Acidic Hydrolysis ( $\text{H}_3\text{O}^+$  or  $\text{H}^+/\text{H}_2\text{O}$ )
  - ◆ Basic Hydrolysis ( $\text{OH}^-/\text{H}_2\text{O}$ )



## Section 6.6 Amino Acids having Amide Containing Side Chains

➤ Amino Acids (Building Blocks of Proteins)



➤ Asparagine (neutral polar)



➤ Glutamine (neutral polar)



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