

Fundamentals of Organic Chemistry

The background features a light-colored, hand-drawn style illustration of a chemistry laboratory. It includes various pieces of glassware such as test tubes, flasks, and beakers, some on stands. A prominent feature is a large DNA double helix structure. There are also several petri dishes, some containing what appear to be bacterial cultures. The overall theme is scientific and educational, related to organic chemistry.

CHEM 245 (2 + 0)

5. Amines

Learning Objectives

Chapter ten discusses the amines and by the end of this chapter the students will:

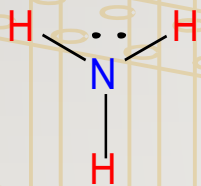
- Know the structure and classification of amines
- Know the naming rules for amines.
- Know the physical properties of amines
- Know the effect of lone pair of electrons of N atom on basic properties of amines
- Know the different methods used in synthesis of amines
- Know the reactions of amines; in addition to behaving as bases amines can be nucleophiles.

Structure and classification of amines

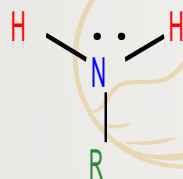
Amines: is a class of organic compounds that contain the NH_2 group, Amines are derivatives of ammonia

Nitrogen atom with a lone pair of electrons, making amines both basic and nucleophilic

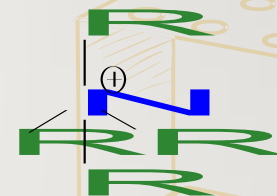
Classification of Amines



Ammonia



Primary Amine (1°)



Quaternary Ammonium Ion (4°)

Common Nomenclature Of Amines

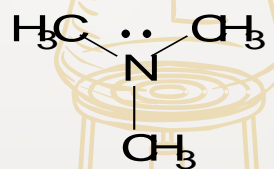
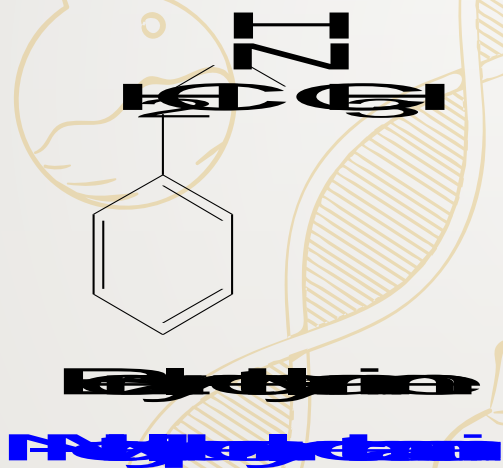
- The common names of amines by listing the names of the groups surrounding the nitrogen (in alphabetical order) and adding the suffix amine.
- IUPAC Names of Primary Amines :

If the compound does not contain a functional group except amino group, then the compound is named by finding the longest alkane chain containing the amino group and replacing the e in the IUPAC name by the suffix amine

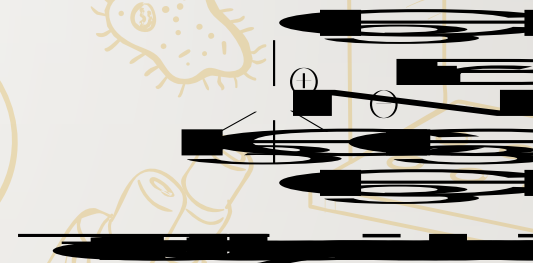
However if the compound contain other functional groups then the order of precedence determines which group are named with prefix or suffix. (see the precedence table on slide 7)

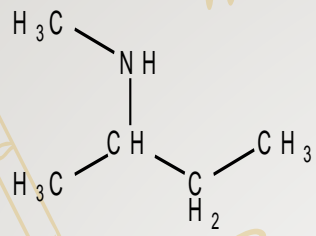
The highest precedence group takes the appropriate suffix with all other groups taking the prefix (es), however = or \equiv bonds only take suffix form (ene, yne respectively).

In **secondary** and **tertiary** amines: use the **italic capital letter "N"** to show the location of an alkyl group that is attached to the nitrogen atom (The smaller alkyl groups on the amine nitrogen are designated as substituents and given the locate N).

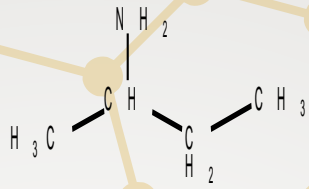


Trimethylamine

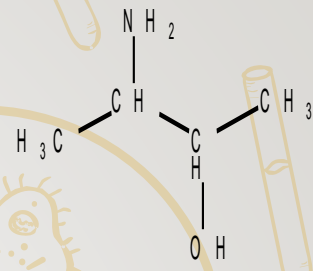




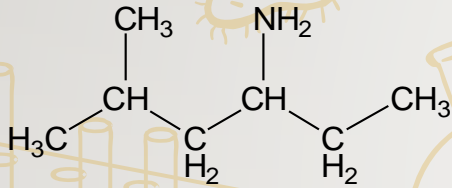
N-methylbutan-2-amine
sec-Butyl-methyl-amine



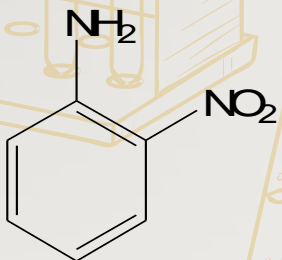
Butan-2-amine
(2-Butaneamine)
sec-Butylamine



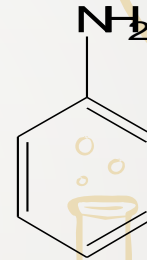
3-Amino-butan-2-ol
(3-Amino-2-butanol)



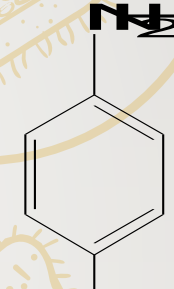
5-Methylhexan-3-amine
(5-Methyl-3-hexanamine)



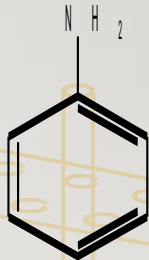
o-Nitroaniline
(2-Nitro-phenylamine)



Aniline
(Phenylamine)



4-Methyl-phenylamine
(p-Toluidine)



4-methylaniline
p-Toluidine
p-Tolylamine

Precedence Order of Functional Groups

Class	Functional group	Prefix	suffix
Carboxylic acids Cyclic alkanes or alkenes with COOH group	COOH		oic acid carboxylic acid
Aldehydes Cyclic alkanes or alkenes with CHO group	-CHO	Formyl	al Carbaldehyde
ketone	-C=O	oxo	one
Alcohols	-OH	hydroxy	ol
Amines	-NH ₂	amino	amine
Aromatic ring with R,C=C, C=C, OR, X Aromatic ring with OH, NH ₂ , CHO, CO,COOH, COOR	C ₆ H ₅ -CH ₂	--- Phenyl Benzyl	Benzene -
Ethers	-OR	alkoxy	-
Alkenes and aAlkynes	= & ≡ bonds	-	ene & yne

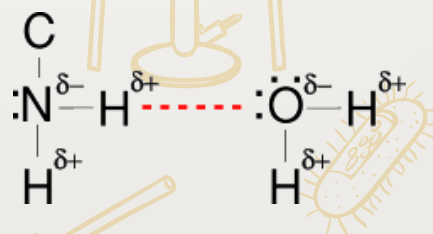
Physical properties of Amines

Polarity :

- Because they possess a polar N-H bond, because N is more electronegative than H or C.

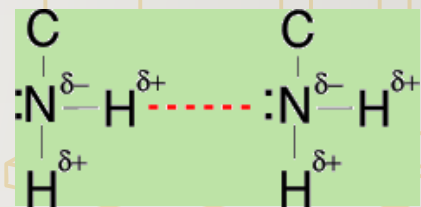
Solubility :

- All amines are capable of forming hydrogen bonds with water so they are soluble in water. But aromatic amines are insoluble in water.



Boiling point

- Because they possess a polar N-H bond, primary and secondary amines are capable of forming intermolecular hydrogen bonds among their molecules; therefore they have:
- higher boiling points than alkanes but lower than alcohols (alcohols form stronger H-bonds than amines). because N is less electronegative than O, so N-H bond is less polar than O-H bond.
- Tertiary amines can not form H-bonds among their molecules and their molecules are more branched thus they have the lowest boiling points among amines.



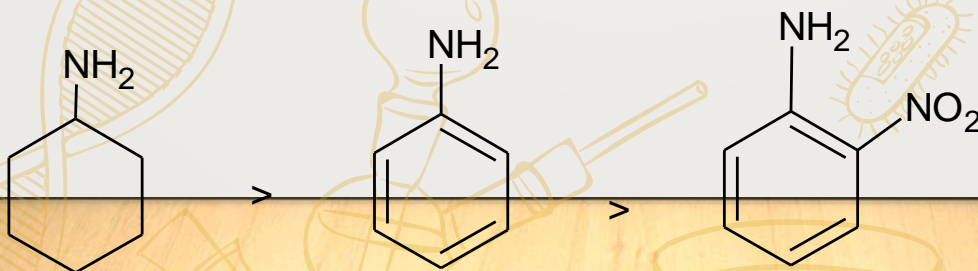
Basicity of Amines

- Amines basic because N has non bonded pair of electrons which can be donated to an acid to form ammonium salt.



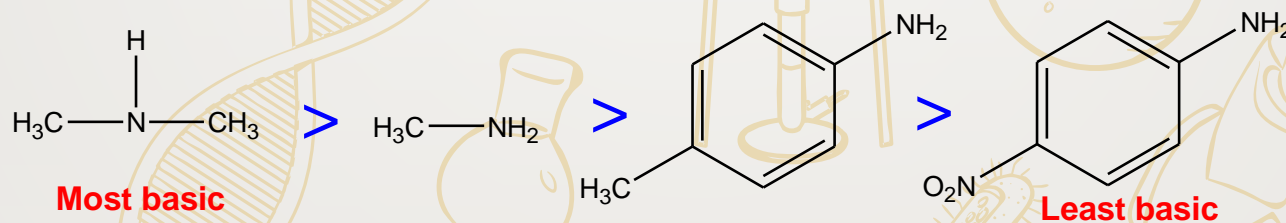
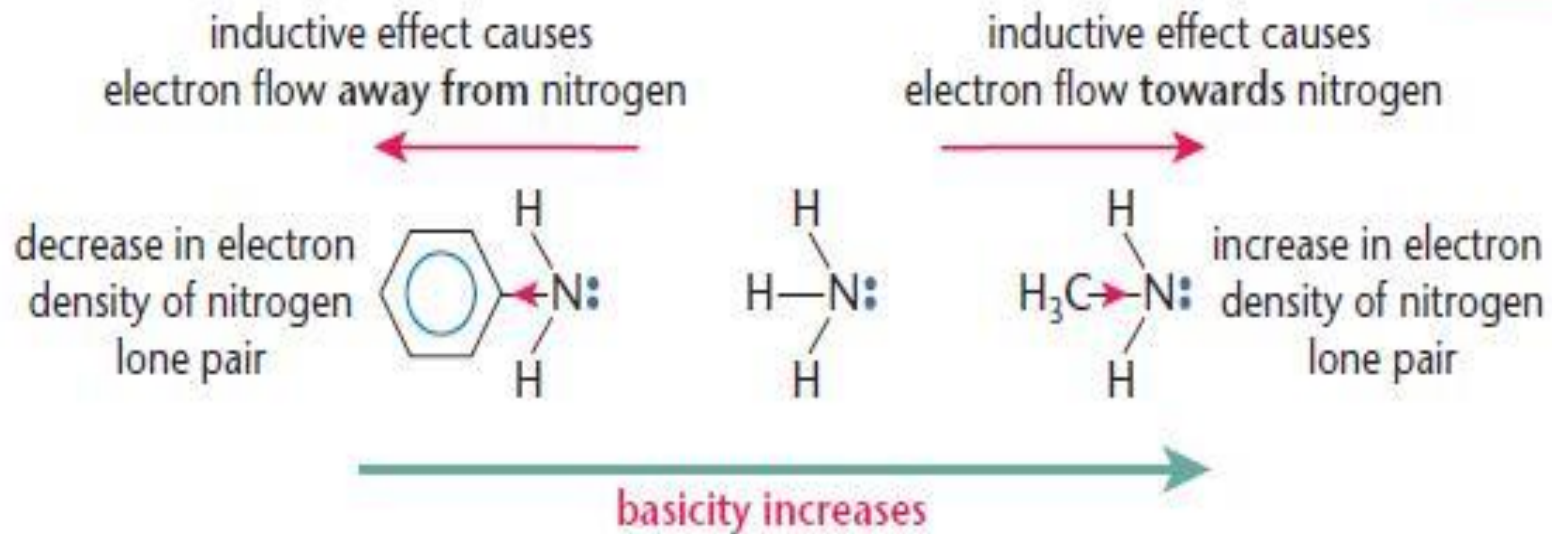
- base strength depend on the degree of availability of the non bonded electron pair (**electron density** on N is lowered effectively) on N: $\text{CH}_3\text{-NH-CH}_3 > \text{NH}_2\text{-CH}_3 > \text{NH}_3$
- Aliphatic amines are considerably more basic than aromatics amines.

due to lone pair of electrons on N is involved in aromaticity



- Electron-donating groups, e.g. alkyl groups, increase the basic strength.
- Electron-withdrawing groups, e.g. C_6H_5 , decrease the basic strength.

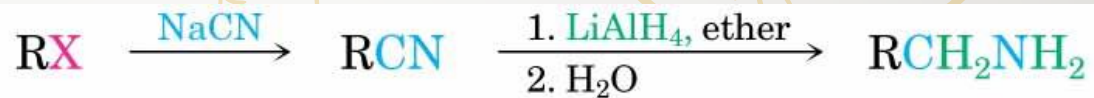
KEY POINT



Preparation of amines

1) Reduction of nitro compounds, nitriles, amides, and oximes

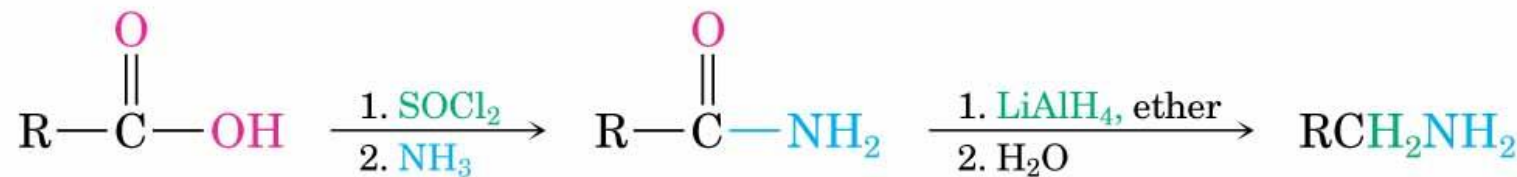
Nitrile



Alkyl halide

1° amine

Amides

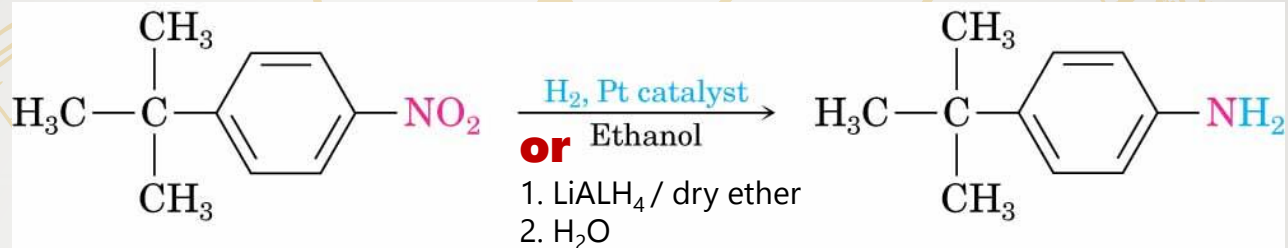


Carboxylic acid

1° amine

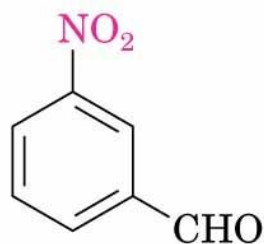
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Nitro compounds

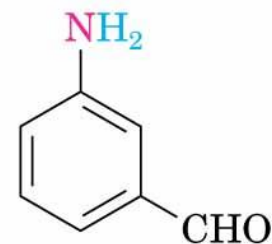
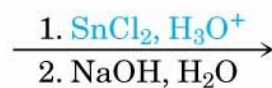


p-tert-Butylnitrobenzene

p-tert-Butylaniline (100%)



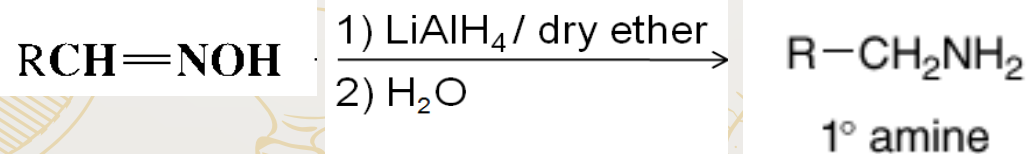
m-Nitrobenzaldehyde



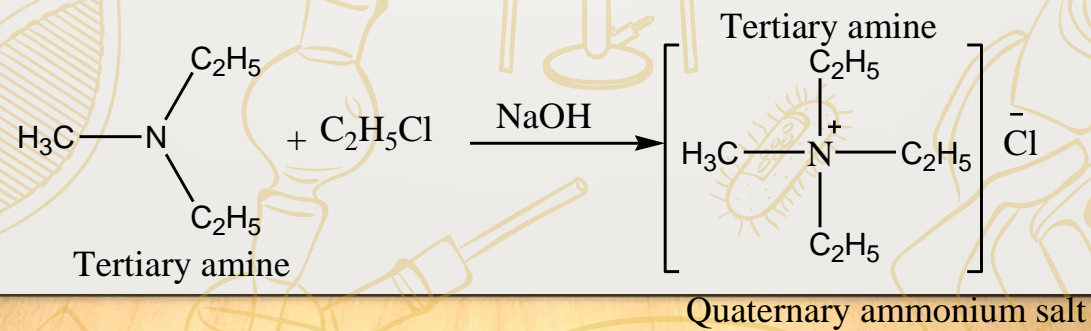
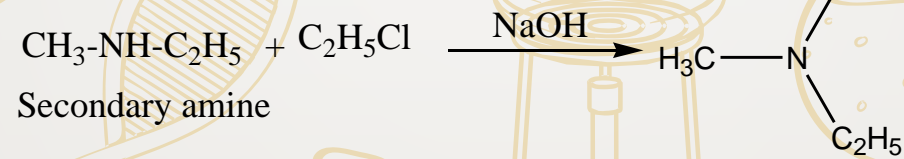
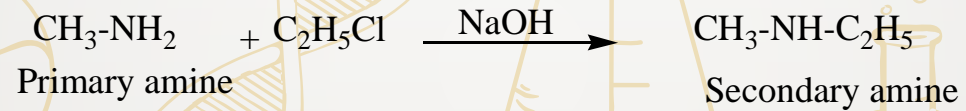
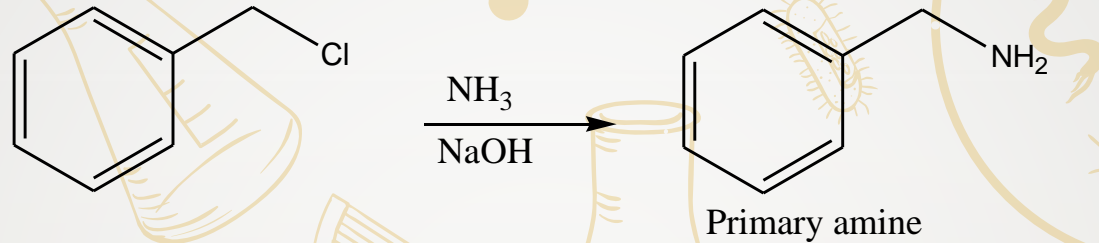
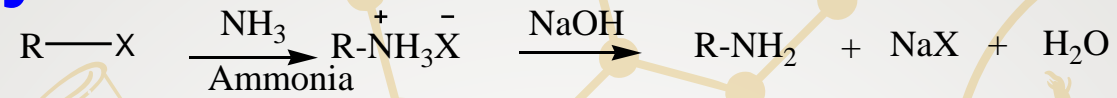
m-Aminobenzaldehyde
(90%)

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Oxime

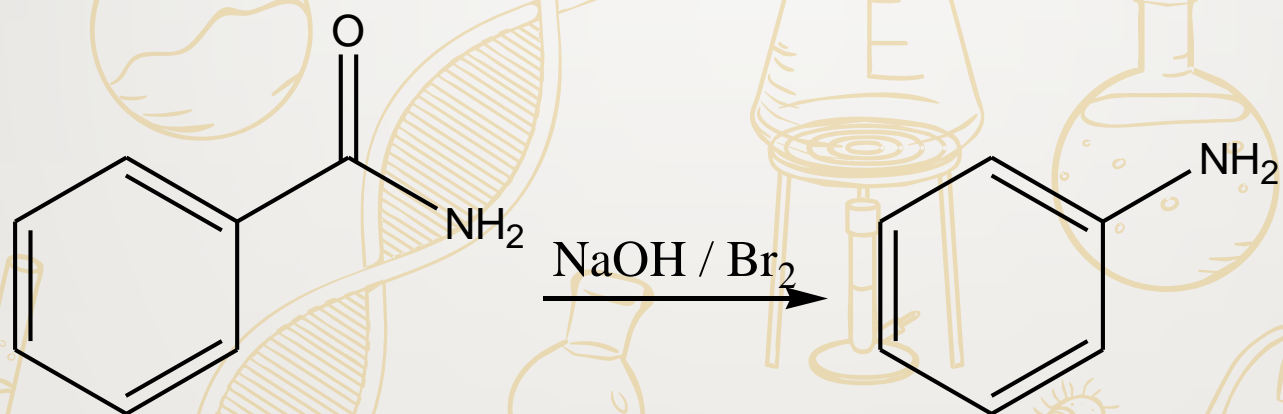
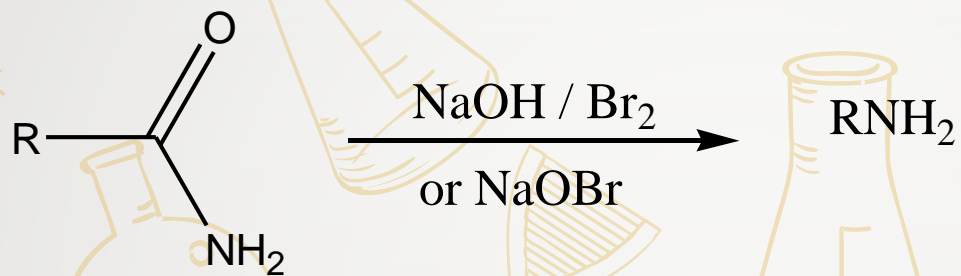


2- Alkylation of ammonia

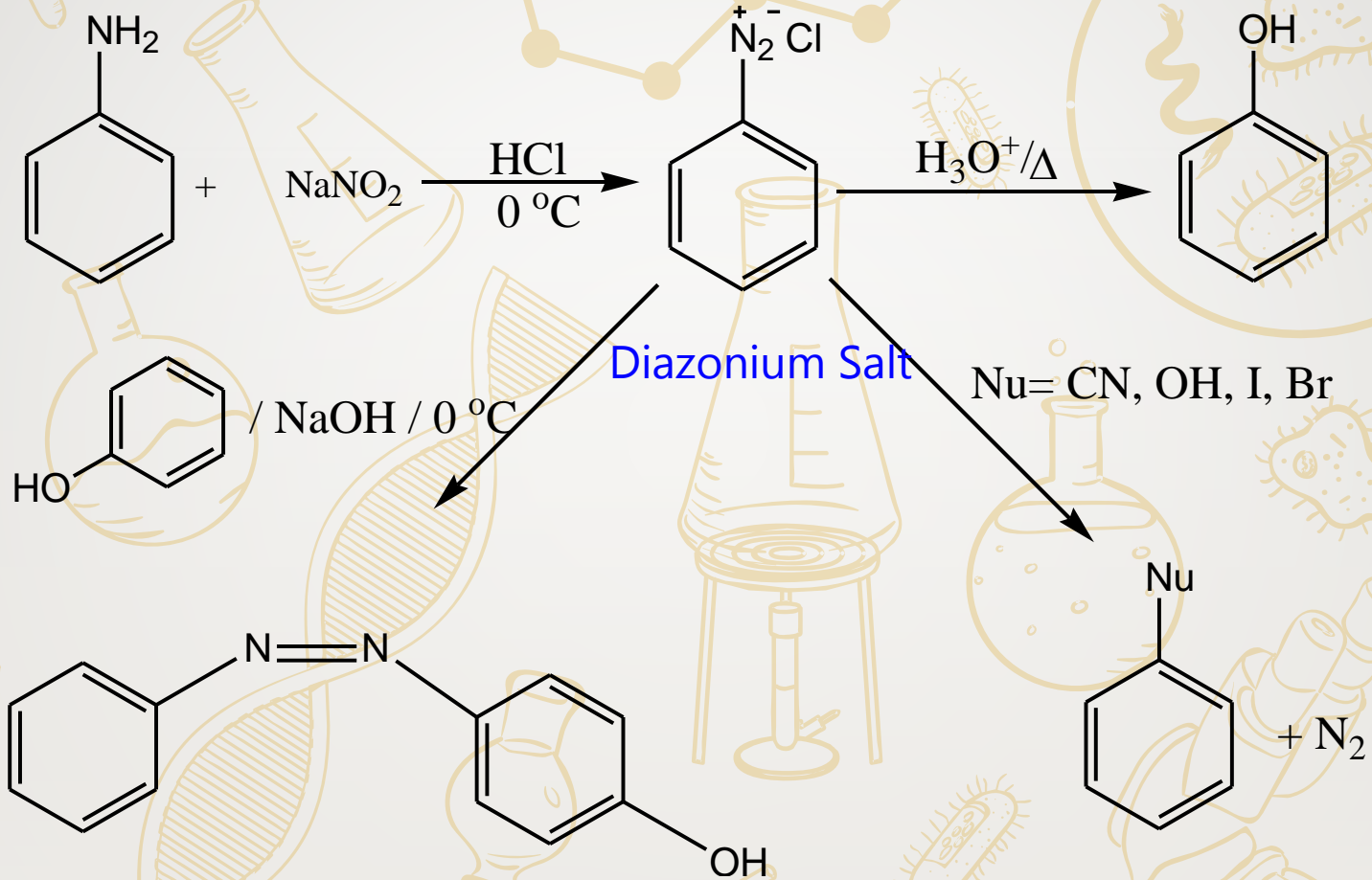


3- Hoffman degradation of Amides

Convert **Amide** to Primary amine by reduce 1 carbon atom.



Reaction of Amines with Nitrous Acid (diazotization)



Azo Compound

Reactions Of Amines

