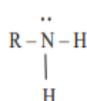


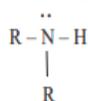
## Compounds of Carbon Containing Nitrogen

### AMINES

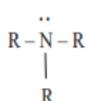
- Amines constitute an important class of organic compounds derived by replacing one or more hydrogen atoms of  $\text{NH}_3$  molecule by alkyl/aryl group(s).



A primary amine

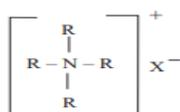


A secondary amine



A tertiary amine

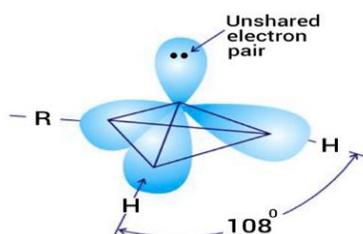
- If four alkyl groups are attached to the nitrogen atom, then the quaternary ammonium ion or salt is formed.



A quaternary ammonium salt

### Structure of Amines

- The nitrogen atom in amine is  $\text{sp}^3$  hybridised. The three hybrid orbitals are involved in bond formation and one hybrid atomic orbital contains the lone pair of electrons, giving the pyramidal geometry of amines.



### IUPAC Nomenclature of Amines

- The ending  $-e$  in the name of the corresponding alkane is changed to amine.
- Secondary and tertiary amines are named by using the prefix N for each substituent on the nitrogen atom.

Compounds	IUPAC name	Common name
$\text{CH}_3\text{NH}_2$	Methanamine	Methyl amine
$\text{CH}_3\text{CH}_2\text{NH}_2$	Ethanamine	Ethyl amine
$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$	Propan-1-amine	Propyl amine
$\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{NH}_2 \\   \\ \text{CH}_3 \end{array}$	2-Methyl propan-1-amine	—
	Benzenamine	Aniline

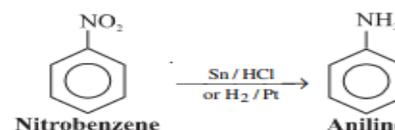
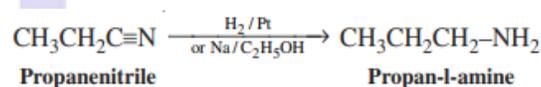
### Preparation of Amines

#### (i) From alkyl halides

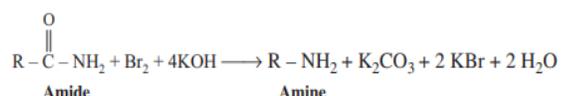
- Alkyl halides react with ammonia to form primary amines.



#### (ii) By reduction of nitriles (cyanides), amides and nitro compounds



#### (iii) By Hofmann bromamide reaction

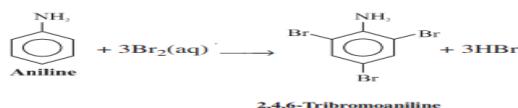


### Physical Properties of Amines

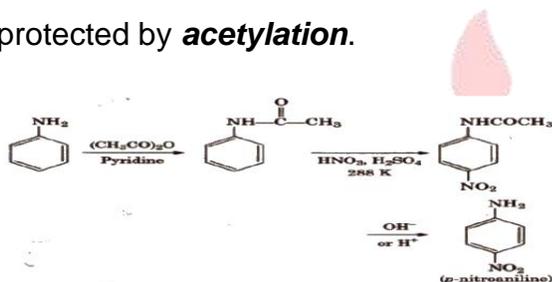
- The lower aliphatic amines are gaseous in nature. They have a fishy smell.
- Primary amines with three or four carbon atoms are liquids at room temperature whereas higher ones are solids.
- Aniline and other arylamines are generally colorless. However, they get



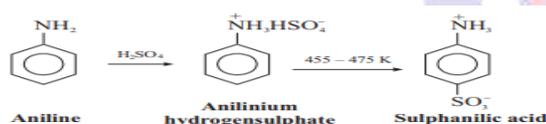
(a) **Halogenation:** Aniline on treatment with an aqueous solution of bromine gives **2,4,6-tribromoaniline**.



(b) **Nitration:** Nitration Direct nitration of aniline is not possible as it is susceptible to oxidation, thus amino group is first protected by **acetylation**.



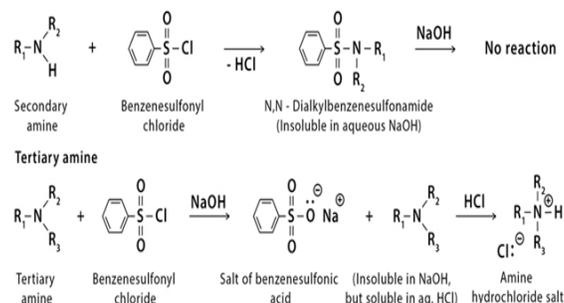
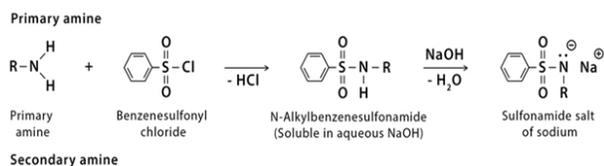
(c) **Sulphonation:** Sulphonation is carried out in the presence of sulphuric acid.



### Uses of Amines

- Amines are used in making azo-dyes and nylon apart from medicines and drugs.
- They are widely used in developing chemicals for crop protection, medication and water purification.
- They also find use in products of personal care.
- Ethanol amines are the most common type of amine used in the global market.

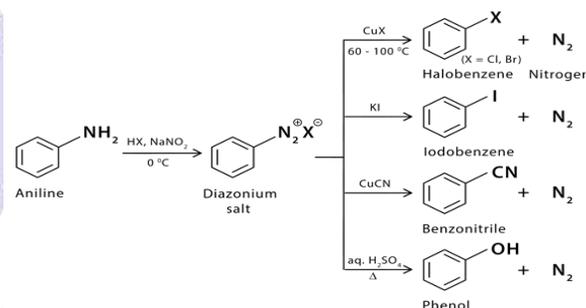
### Identification of Primary, Secondary and Tertiary amines



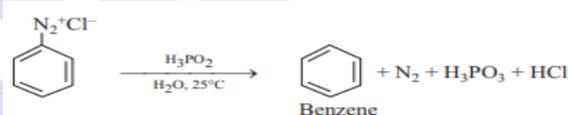
### DIAZONIUM SALTS: REACTIONS AND IMPORTANCE IN SYNTHETIC CHEMISTRY

#### (i) The Sandmeyer reaction

- In this reaction, the arene diazonium salts are reacted with cuprous bromide, cuprous chloride and cuprous cyanide in the presence of HBr, HCl and HCN, respectively.

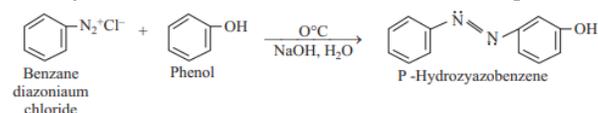


#### Replacement of diazonium group by a hydrogen atom



#### Coupling Reactions of Arenediazonium Salts

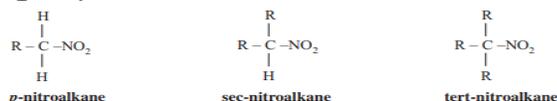
- Arene diazonium salts react with phenols and tertiary aryl amines to give azo compounds which are known as **azo dyes**.



### NITRO COMPOUNDS

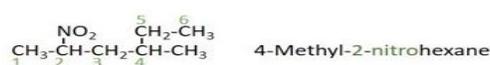
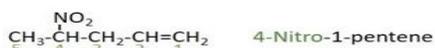
- Nitro compounds are those derivatives of hydrocarbons in which a hydrogen atom

is replaced by a nitro ( $-\text{NO}_2$ ) group.



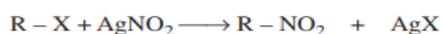
## IUPAC Nomenclature of Nitro Compounds

- Nitro compounds are named by prefixing the word nitro before the name of the parent hydrocarbon.

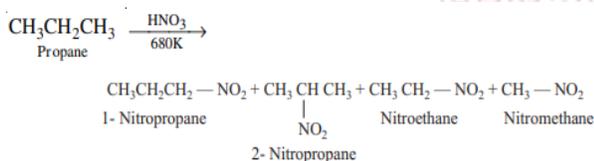


## Preparation of Nitro Compounds

### (i) From alkyl halides



### (ii) By nitration of alkanes

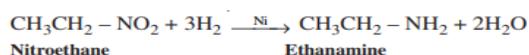


## Physical Properties of Nitro Compounds

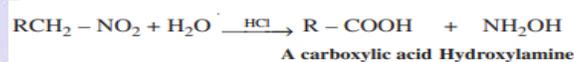
- Physical state, color, odour:** Nitroalkanes are colorless, pleasant smelling liquids.
- Boiling point:** Both nitroalkanes and nitroarenes are highly polar compounds and thus have strong dipole-dipole interactions.

## Chemical Properties of Nitro Compounds

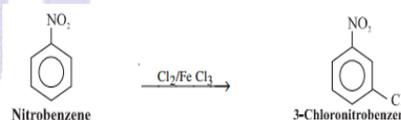
### (i) Reduction



### (ii) Hydrolysis



### (iii) Ring substitution in aromatic nitro compounds



## Test Yourself

**Question:** Why is an alkylamine more basic than ammonia?

**Answer:** Due to electron releasing inductive effect (+I) of alkyl group, the electron density on the nitrogen atom increases and thus, it can donate the lone pair of electrons more easily than ammonia.

**Check Yourself**

1. Nitrogen atom of amino group is ..... hybridised.  
(A)  $sp$  (B)  $sp^2$  (C)  $sp^3$  (D)  $sp^3d$
2.  $C_3H_8N$  cannot represent  
(A)  $1^\circ$  ammine  
(B)  $2^\circ$  ammine  
(C)  $3^\circ$  ammine  
(D) quaternary ammonium salt
3. When excess of ethyl iodide is treated with ammonia, the product is  
(A) Ethylamine  
(B) Diethylamine  
(C) Triethylamine  
(D) Tetraethylammonium iodide
4. Amides may be converted into amines by a reaction named after  
(A) Hofmann Bromide  
(B) Claisen  
(C) Perkin  
(D) Kekule
5. Reduction of  $CH_3CH_2NC$  with hydrogen in presence of Ni or Pt as catalyst gives  
(A)  $CH_3CH_2NH_2$   
(B)  $CH_3CH_2NHCH_3$   
(C)  $CH_3CH_2NHCH_2CH_3$   
(D)  $(CH_3)_3N$

**Stretch Yourself**

1. Arrange the following compounds in an increasing order of basic strengths in their aqueous solutions:  $NH_3$ ,  $CH_3NH_2$ ,  $(CH_3)_2NH$ ,  $(CH_3)_3N$
2. Give the IUPAC name of  $H_2N-CH_2-CH_2-CH=CH_2$ .
3. Give a chemical test to distinguish between ethylamine and aniline.
4. How may methyl bromide be preferentially converted to methyl isocyanide?
5. The conversion of primary aromatic amines into diazonium salts is known as?



## Answers

### Check Yourself

Answer: 1(C); 2(D); 3(D); 4(A); 5(B)

### Stretch Yourself

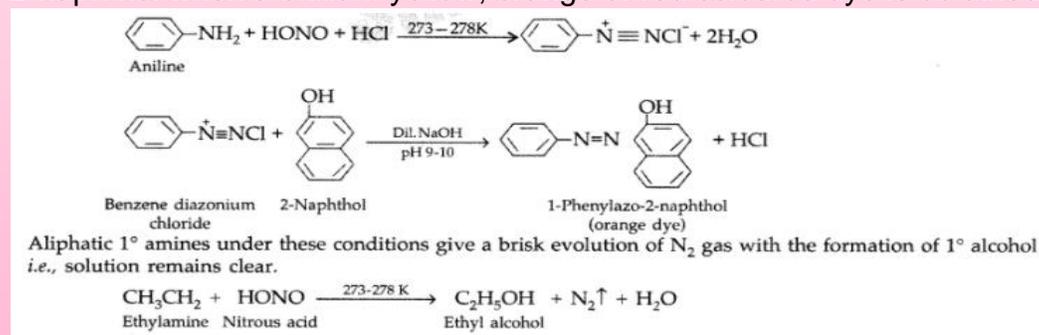
1.



2. IUPAC name: But-3-ene-1-amine.

3. Ethylamine and aniline:

By Azo dye test: It involves the reaction of any aromatic primary amine with  $\text{HNO}_2$  ( $\text{NaNO}_2 + \text{dil. HCl}$ ) at 273-278 K followed by treatment with an alkaline solution of 2-naphthol when a brilliant yellow, orange or red coloured dye is obtained.



4. Bit carbylamine reaction:



5. Diazotization.