

13/01/18

# ORGANIC COMPOUNDS CONTAINING NITROGEN

Functional Group	Class of Compounds	General formula	
$-N\overset{\cdot}{=}\overset{\cdot}{O}$	Nitro	$R-\ddot{N}O_2$	• Preparation and properties of amines
$-O\overset{\cdot}{N}\equiv O$	Nitrites	$R-O\overset{\cdot}{N}\equiv O$	• Preparation & properties of anilines.
$-\overset{\cdot}{N}H_2$	1° amine	$R-\overset{\cdot}{N}H_2$	• <u>Diazonium Salt</u> : Preparation & properties
$-\overset{\cdot}{N}H$	2° amine	$R-\overset{\cdot}{N}H$	
$\begin{array}{c} \overset{\cdot}{N} \\   \\ R \end{array}$	3° amine	$R_3\overset{\cdot}{N}$	
$-\overset{\oplus}{N}N^{\ominus}X^{\ominus}$	Diazonium halide Salts	$\text{C}_6H_5-N_2^+X^-$	
$-C\equiv N^-$	Cyanides	$RCN$	
$-N\equiv C$	Isocyanides	$R-NC$	

Due to presence of unshared pair of electron on Nitrogen atom they're pyramidal in shape according

VSEPR Theory

Nomenclature of Amines

IUPAC name

Amines	Common Name	IUPAC name
$CH_3\overset{\cdot}{N}H_2$	Alkyamine or Amino alkane Methyl amine or aminomethane	Methanamine
$CH_3CH_2\overset{\cdot}{N}H_2$	Ethyl amine or amino ethane	Ethanamine
$\begin{array}{c} CH_3 \\   \\ CH_2-NH_2 \\   \\ CH_3 \end{array}$	Isopropyl amine	Propan-2-amine or 2-propanamine
$CH_3CH_2-NH-CH_3$	N-methyl amino ethane or Ethyl methylamine	N-methyl ethanamine
$\begin{array}{c} CH_3 \\   \\ CH_2-N \\   \\ CH_3 \end{array}$	Triethyl amine or N,N-dimethylamino methane	N,N-dimethyl methanamine
$\begin{array}{c} C_2H_5 \\   \\ C_2H_5-N \\   \\ C_2H_5 \end{array}$	N-ethyl-N-methyl amino ethane	N-ethyl-N-methyl ethanamine
$\begin{array}{c} C_2H_5 \\   \\ C_2H_5-N \\   \\ C_2H_5 \end{array}$	Ethyldimethyl amine or N,N-dimethyl amino ethane	N,N-dimethyl ethanamine

<u>Amine</u>	<u>Common Name</u>	<u>IUPAC Name</u>
	Benzylamine or phenyl amino methane	phenylmethanamine
	$\beta$ -phenylethylamine or 2-phenylamino ethane	2-phenyl ethanamine
	$\gamma$ -phenyl propylamine or 1-amino-3-phenylpropane	3-phenyl propan-1-amin
	p-ethylaminobenzene	4-ethylbenzamine or 4-ethyl amino benzene
	N-methylaminobenzene	N-Methylbenzamine
	N,N-dimethylaminobenzene	N,N-dimethylbenzamine
	meta/3-Ethylaminotoluene	3-ethylbenzamine

### Physical properties of amines

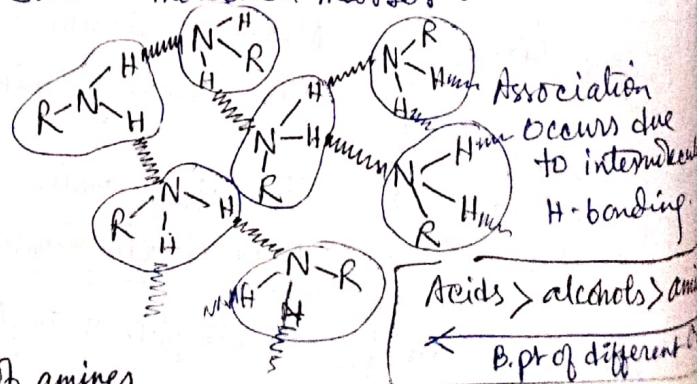
- Lower amines have smell of ammonia & are either gases or low boiling liquids.
- Boiling points :- With the increase in molecular weight the boiling point increases.  $\therefore \text{B.pt.} \propto \text{intermolecular H-bonding}$  Due to presence of intermolecular hydrogen bonding in amines it has relatively higher boiling point than the nonpolar compounds of similar molecular masses.

Therefore the order of boiling points of 3 classes of amines follows :

$$1^\circ > 2^\circ > 3^\circ$$

- Solubility :  $\propto \frac{1}{\text{Molecular mass of amines}}$

All three classes of amines are generally soluble in  $\text{H}_2\text{O}$  due to formation of intermolecular H-bonding with  $\text{H}_2\text{O}$ .

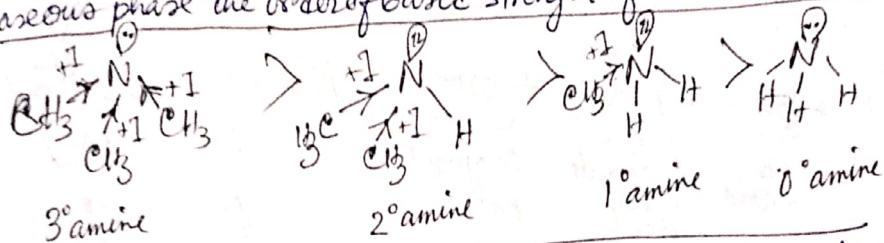


Acids > alcohols > amines  
B.pt of different

Due to larger size of benzene ring, aromatic amines are insoluble in H<sub>2</sub>O.

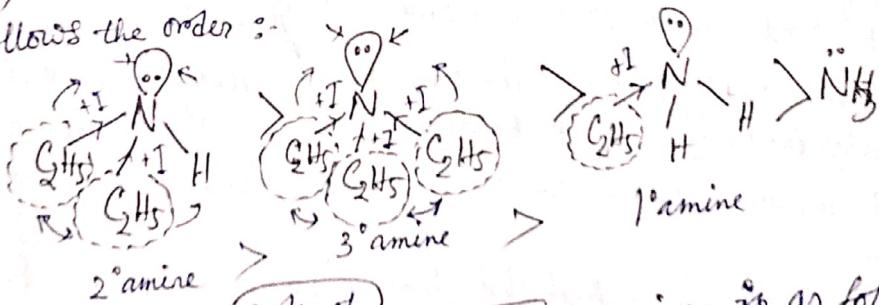
- Basic Character of aliphatic amines > All amines (1°, 2°, 3°) are basic in nature due to the presence of lone pair of electrons on the N-atom, therefore they act as Lewis bases.
  - Amines are stronger bases than water (H<sub>2</sub>O) but weaker than inorganic bases like (NaOH, Ca(OH)<sub>2</sub> etc.)
  - Basic character of amines can be compared on the basis of inductive effect (i.e +I effect) of alkyl groups, steric effect and resonance involvement of lone pair of electrons.

■ In gaseous phase the order of basic strength of amines is as follows :-

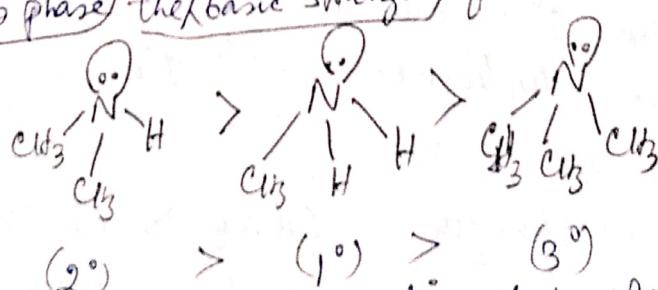


← Basic strength increases which can be explained on the basis of +I effect of methyl (-C<sub>2</sub>H<sub>5</sub>) groups.

■ If alkyl group is bigger than methyl (-C<sub>2</sub>H<sub>5</sub>) group e.g. - Ethyl (-C<sub>3</sub>H<sub>7</sub>), propyl (-C<sub>3</sub>H<sub>7</sub>) etc. there'll be some steric hindrance to H-bonding. Therefore basicity follows the order :-

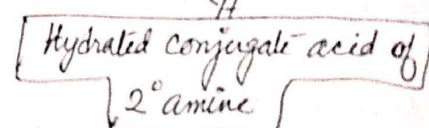
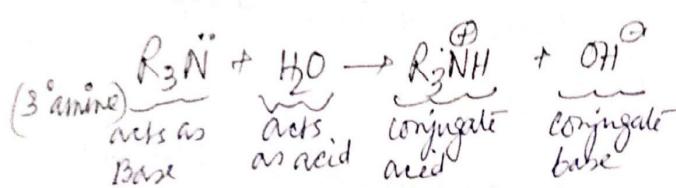
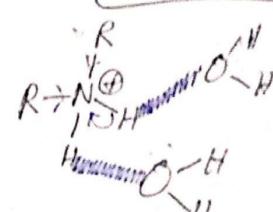
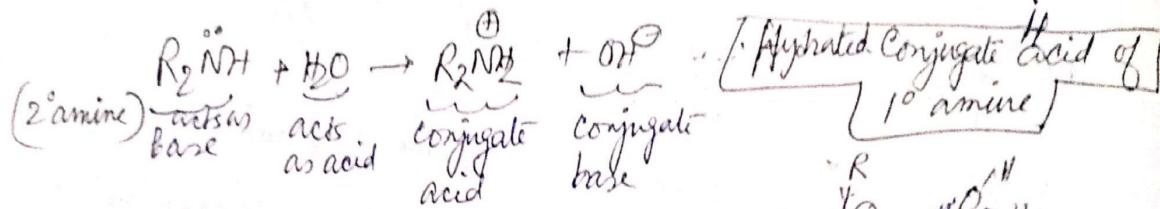
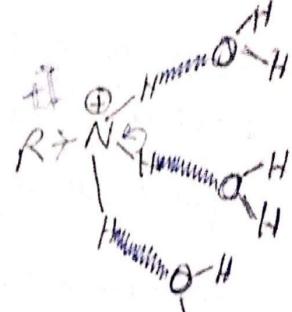
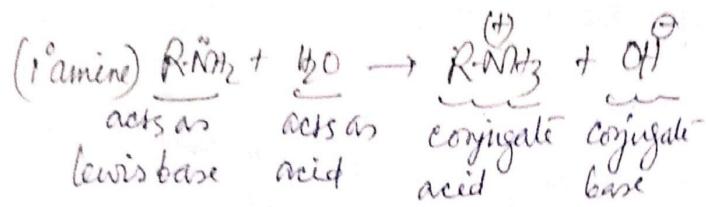


■ But in aqueous phase the basic strength of amines is as follows :-



This can be explained on the basis of solvation effects wherein tertiary amines after accepting a proton there is no longer H-atom to stabilise the +ve ion by H-bonding. Due to solvation effect & steric hindrance by alkyl group in aqueous phase, the order of basic strength is deviated from normal and shows the given order.

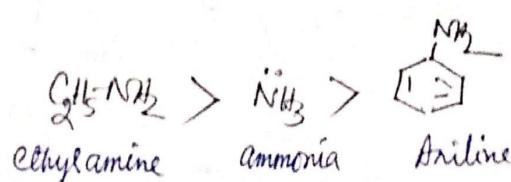
Explanation - The basic strength of amine in aqueous solution does not depend upon the electron density on N-atom but also depends upon the stability of conjugate acid formed by accepting a proton from the solution - which is known as Solvation effect.



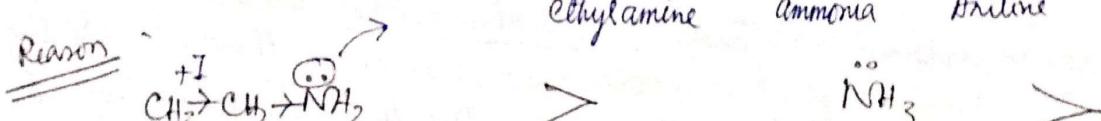
The conjugate acid (protonated amines) form H-bonds with water molecule and release energy (Hydration energy). Now greater the extent of H-bonding in protonated amine, more will be its stabilisation, i.e. compound will be more basic.

Thus  $3^{\circ}$  amine is less hydrated than  $2^{\circ}$  ammonium ion, which is less hydrated than  $1^{\circ}$  ammonium ion, hence in aqueous phase  $3^{\circ}$  amine is the least basic while  $2^{\circ}$  amine is the most basic.

The order of  
Generally basic strength

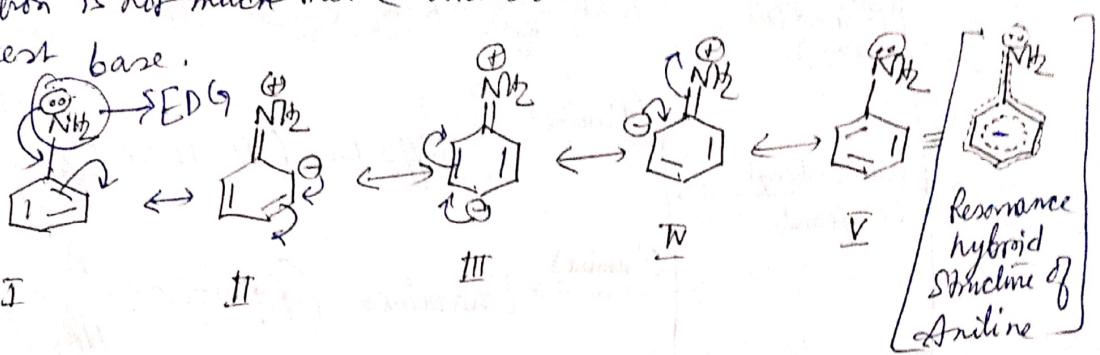


Reason



Increase of ethylamine the  $+I$  or electron pushing effect of ethyl group increases the availability of lone pair or unshared pair of electron on Nitrogen atom of amine group since it becomes more basic.

In case of aniline, the lone pair of electron on N atom involves resonance with the delocalisation of  $\pi$ -electron cloud of benzene ring. Since the lone pair of electron is not much more available on N-atom since it becomes weakest base.



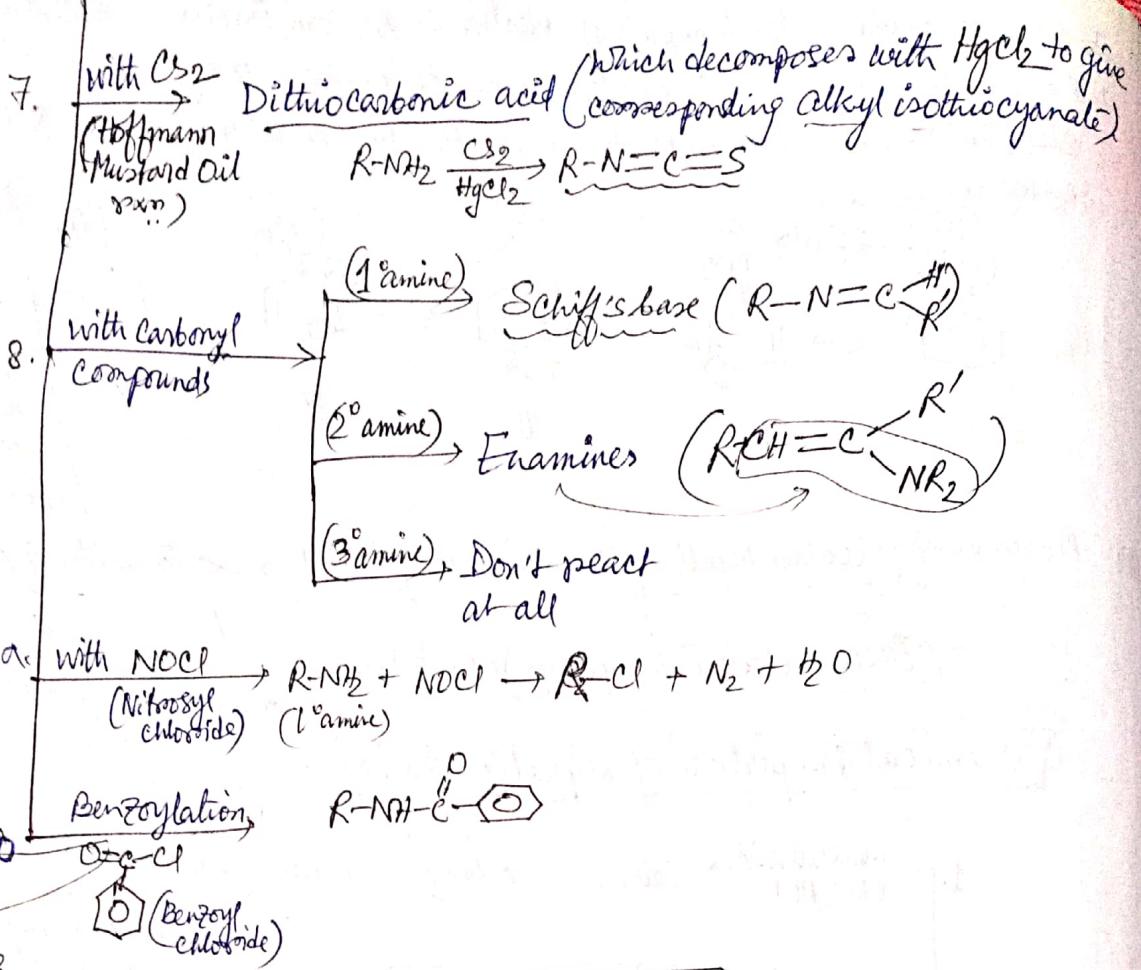
■ Presence of (Electron Repelling/Donating group) i.e. EDG  $\propto$  Basicity of amines

" " (Electron withdrawing group) i.e. EWG  $\propto$   $\frac{1}{\text{Basicity of amines}}$ .

### Chemical Properties of Aliphatic Amines

- Aliphatic Amines**
- Mineral acids like - HCl  $\rightarrow$  Salts i.e.  $R\overset{(+)}{\text{NH}_3}\overset{(-)}{\text{Cl}}$  amine hydrochloride  
NB \* It is not a suitable method to prepare 1° amine as we get a mixture of all three classes of amines from which it is very difficult to separate out our desired product
  - with Alkyl halide ( $R-X$ ) Hoffmann's ammonolysis
  - Acylation, impregnation of  $\text{RCOCl}$  or  $(\text{RCO})_2\text{O}$  alkanyl chloride acid anhydride  $\rightarrow$ 
    - (1° amine)  $\xrightarrow{(-\text{HCl})}$  N-Substituted amides
    - (2° amine)  $\xrightarrow{(-\text{HCl})}$  N,N-Disubstituted amides
    - (3° amine) No rxn (as no replaceable 'H' is seen on 'N' or)
  - with Nitrous ( $\text{HNO}_2$ ) acid \*  $\xrightarrow[(0^\circ - 5^\circ)]{R\text{NH}_2 + \text{HNO}_2 \xrightarrow[0^\circ - 5^\circ]{\text{Hg}} \text{ROH} + \text{N}_2}$ 
    - (1° amine)  $\rightarrow$  alcohols +  $\text{N}_2$
    - (2° amine)  $\rightarrow$  N-nitrosoamines (which are water insoluble yellow oily liquid)
    - (3° amine)  $\rightarrow$  Tertiary ammonium nitrite (soluble in water)
  - with Benzene Sulphonyl chloride  $\xrightarrow[\text{SO}_2\text{Cl}]{R\text{NH}_2}$ 
    - (1° amine)  $\rightarrow$  N-alkylbenzene Sulphonamide  $\xrightarrow[\text{NaOH}]{\text{R}_3\text{NH}-\text{NO}_2}$  soluble in NaOH
    - (2° amine)  $\rightarrow$  N,N-dialkylbenzene Sulphonamide  $\xrightarrow[\text{NaOH}]{\text{R}_2\text{NH}-\text{S}(=\text{O})_2\text{NR}_2}$  insoluble in NaOH
    - (3° amine) Don't react at all
  - $\text{CHCl}_3 + \text{alc. KOH} \xrightarrow{\text{(Carbylamine Rxn)}}$  Isocyanides or isonitriles (only 1° amines give this rxn)  

$$[\text{R-NH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow \text{R-NC} + 3\text{KCl} + 3\text{H}_2\text{O}]$$

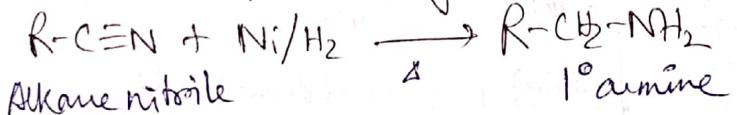


14/01/18

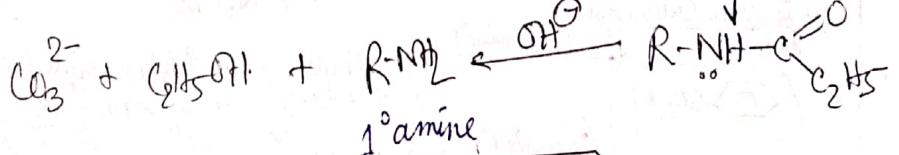
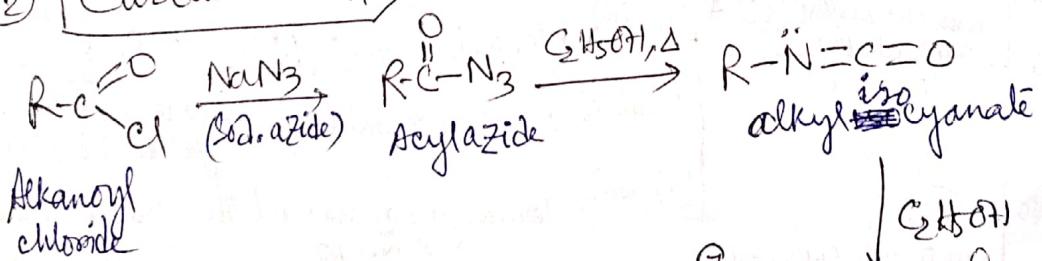
### Methods of Preparation

By the

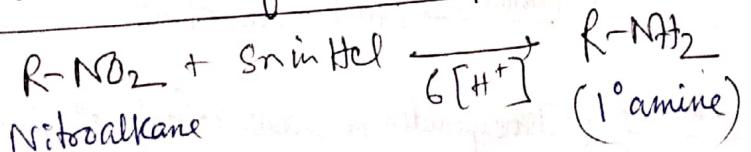
#### ① Reduction of Alkyl Cyanide



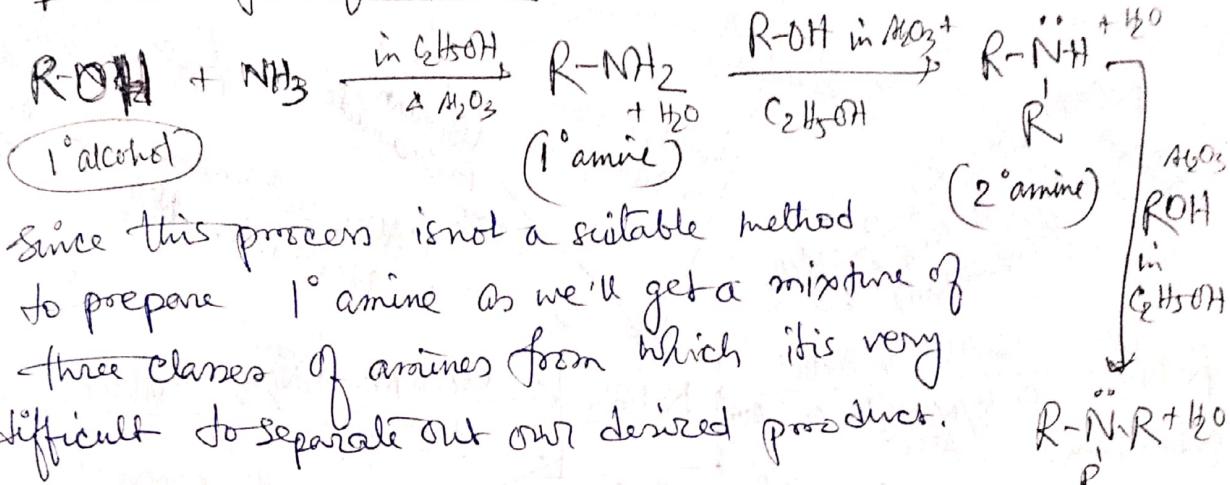
#### ② Curtius rxn.



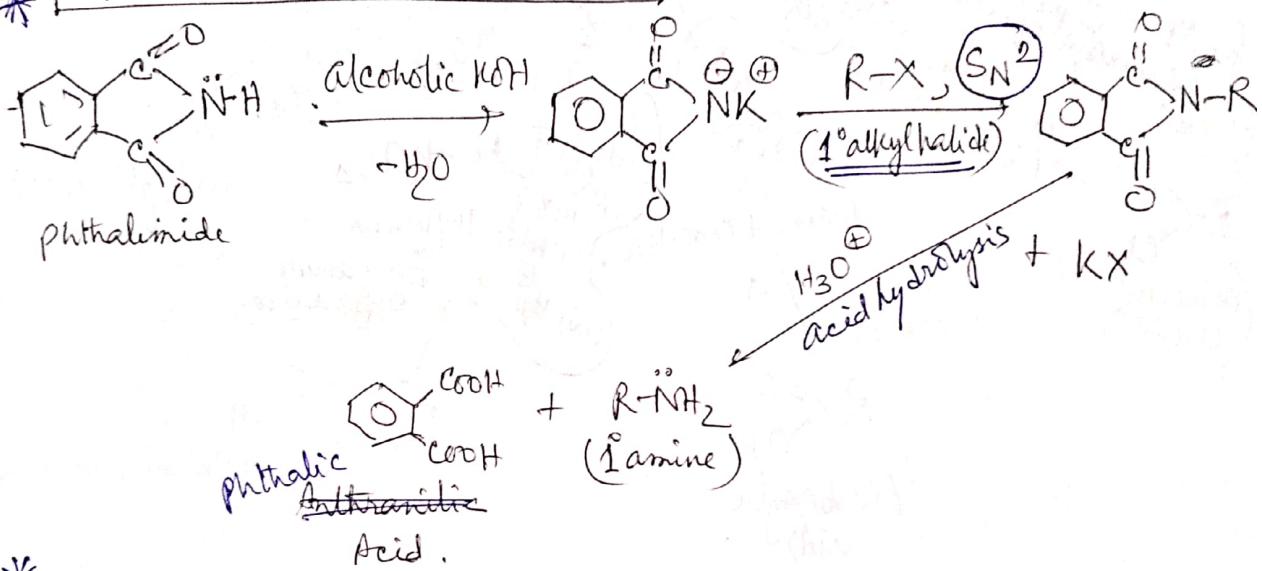
#### ③ By the reduction of nitro compounds



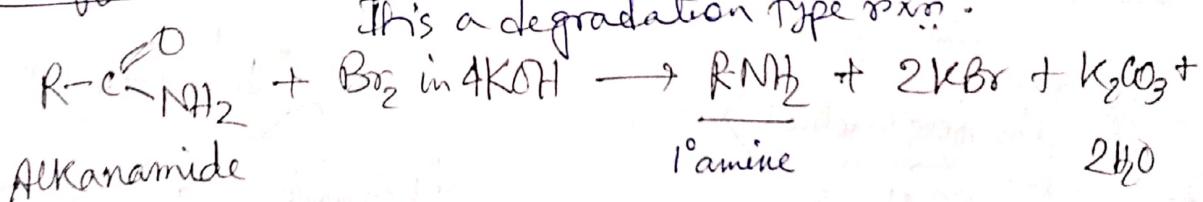
(4) Ammonolysis of alcohols



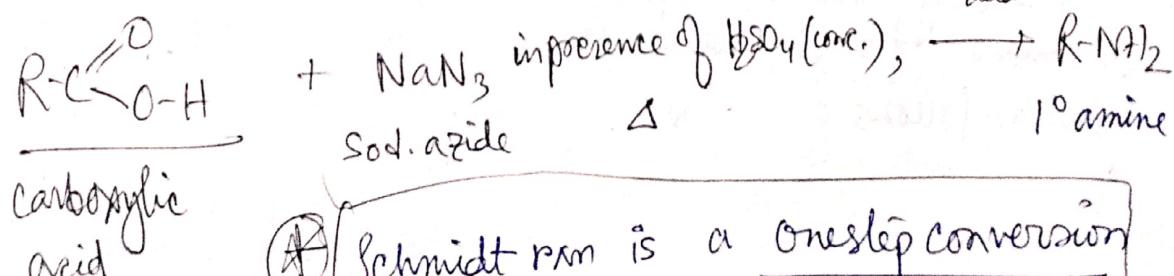
(5) Gabriel's phthalimide Rxn



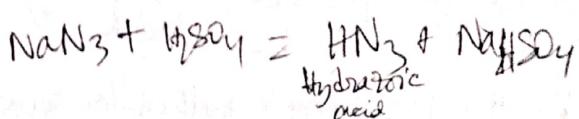
(6) Hoffmann's Bromamide Rxn



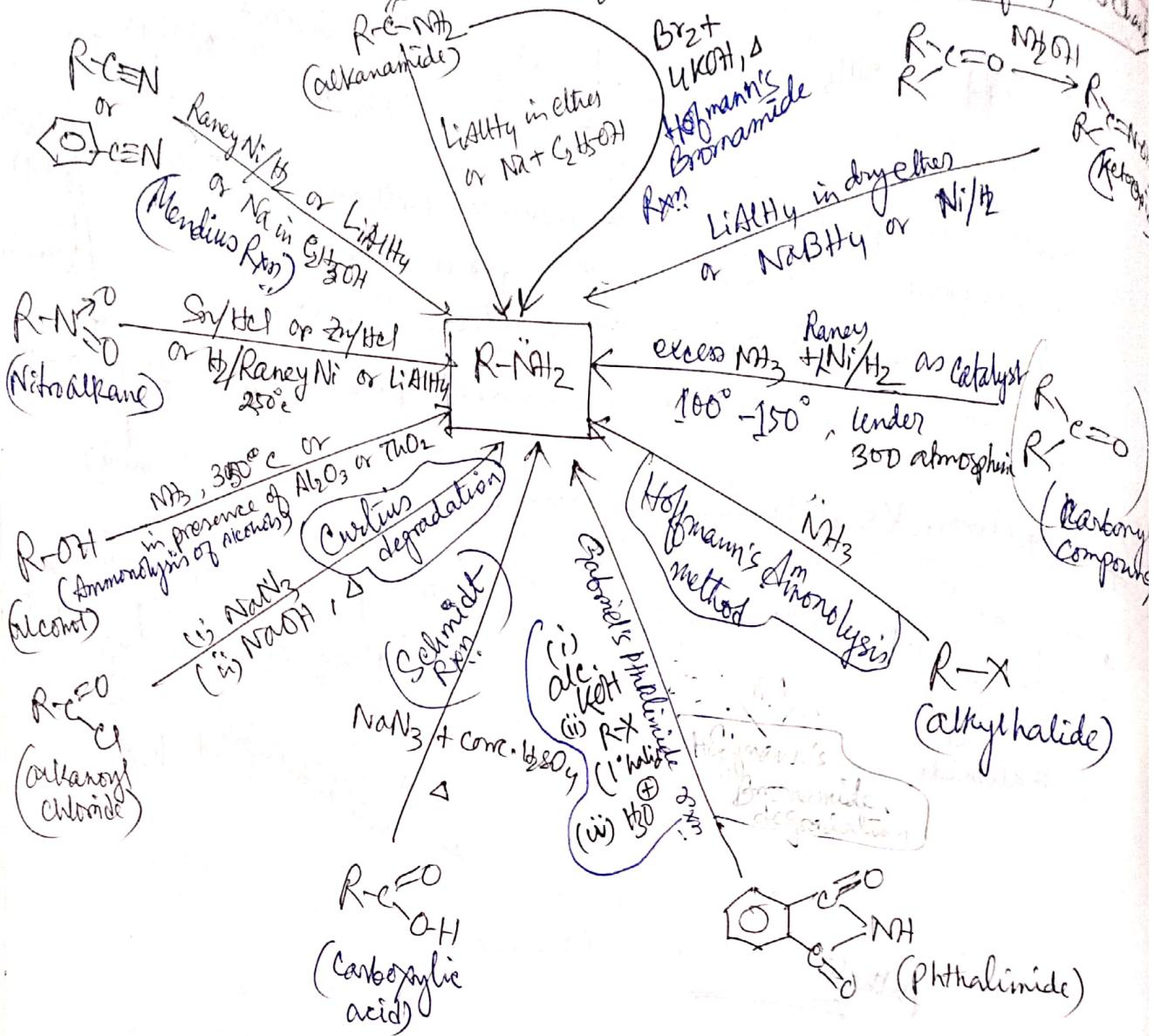
(7) Schmidt Rxn



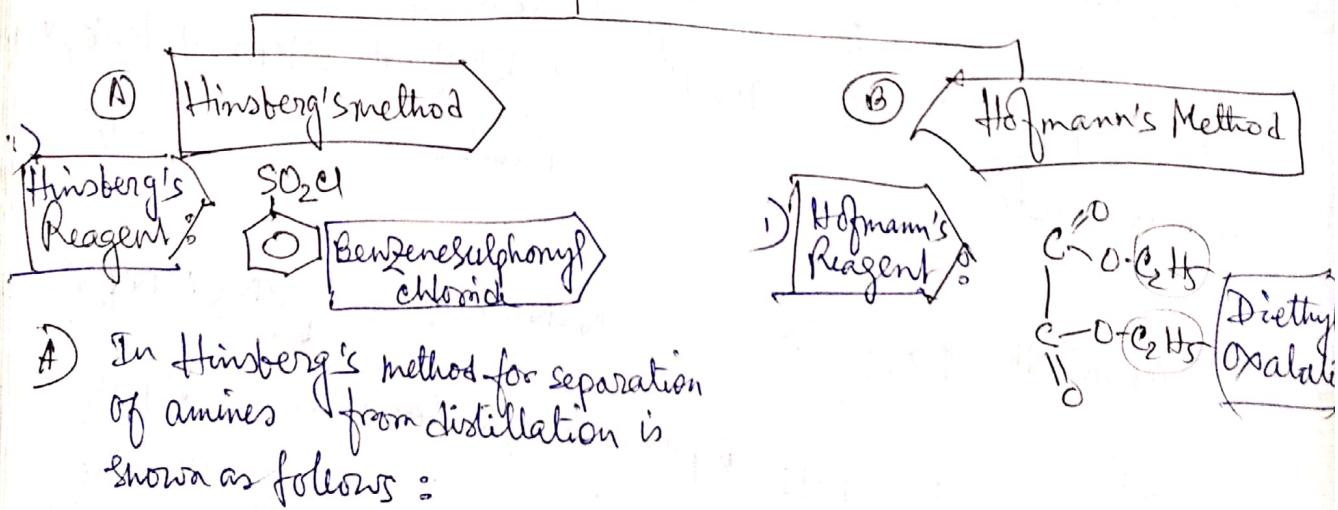
(A) Schmidt rxn is a onestep conversion of an acid directly into 1° amine.



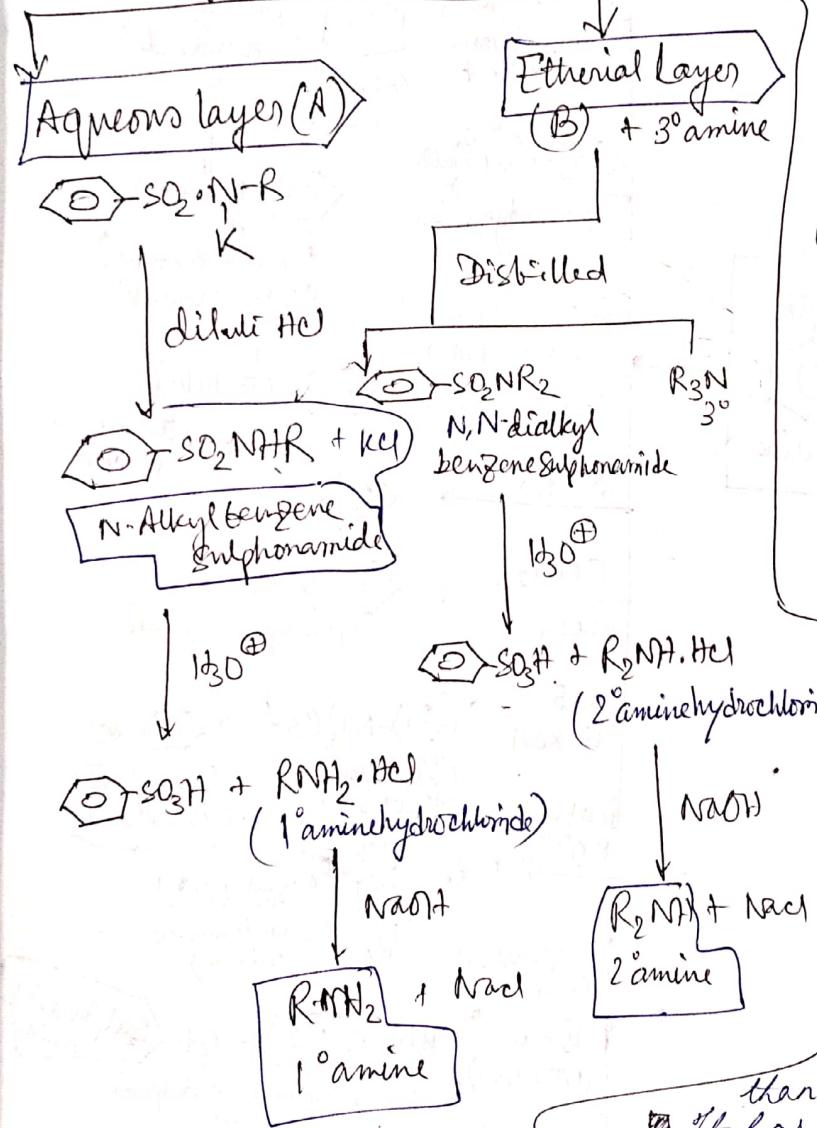
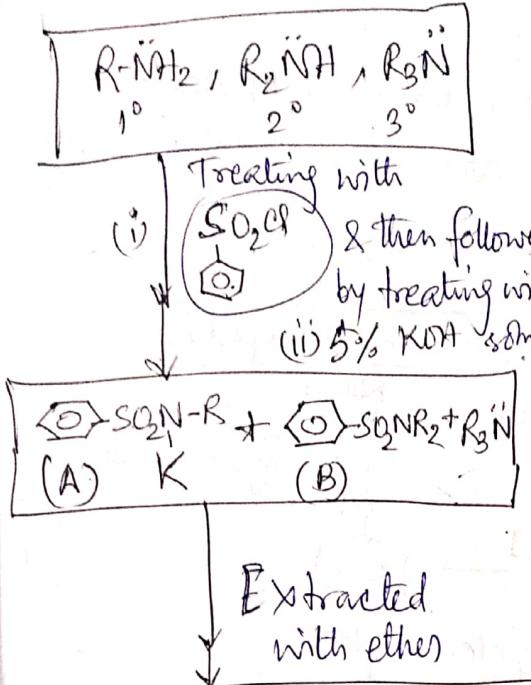
# General methods of preparation of Amines with the help of a flask



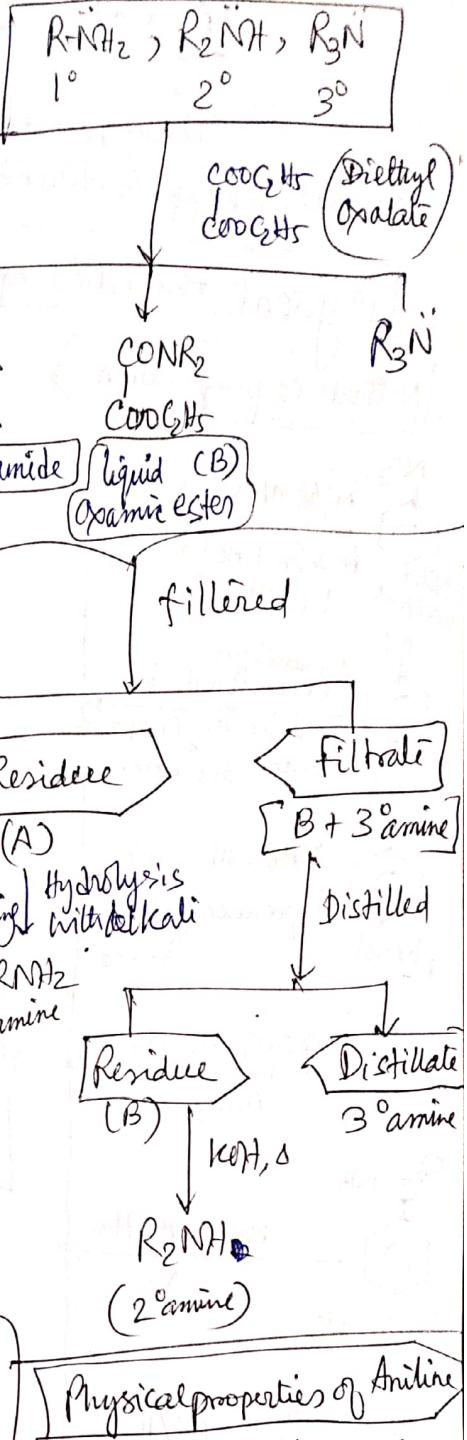
## Distinction (as well as Separation) between three classes of amines



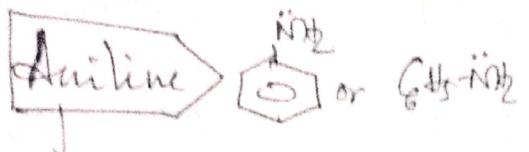
### Hinsberg's method



### Hoffmann's method



- Fresh aniline is a colourless oily liquid, on standing its colour becomes dark brown due to action of air and light.
- Its b.p. is  $183^\circ\text{C}$ .
- It is slightly heavier than  $\text{H}_2\text{O}$ .
- It has a characteristic odour which is not pleasant.
- It is slightly soluble in  $\text{H}_2\text{O}$  but readily soluble in organic solvent.
- It is steam volatile.
- It is toxic in nature.
- Its high b.p. due to the fact that presence of intermolecular  $\text{H}$ -bonding.

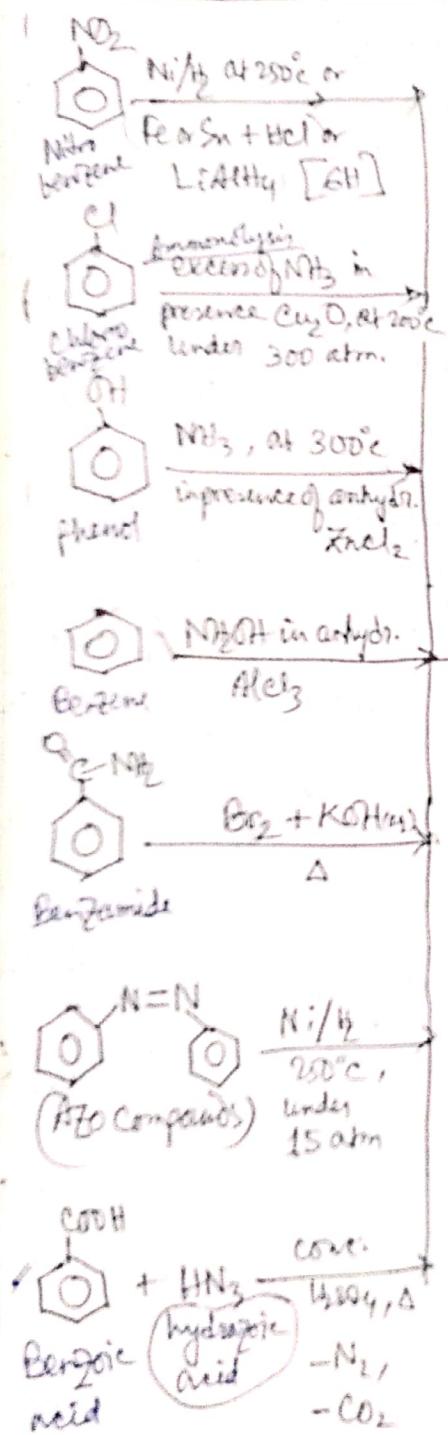


The aromatic or arylamine in which the N-atom of amino group is directly attached to aromatic ring.

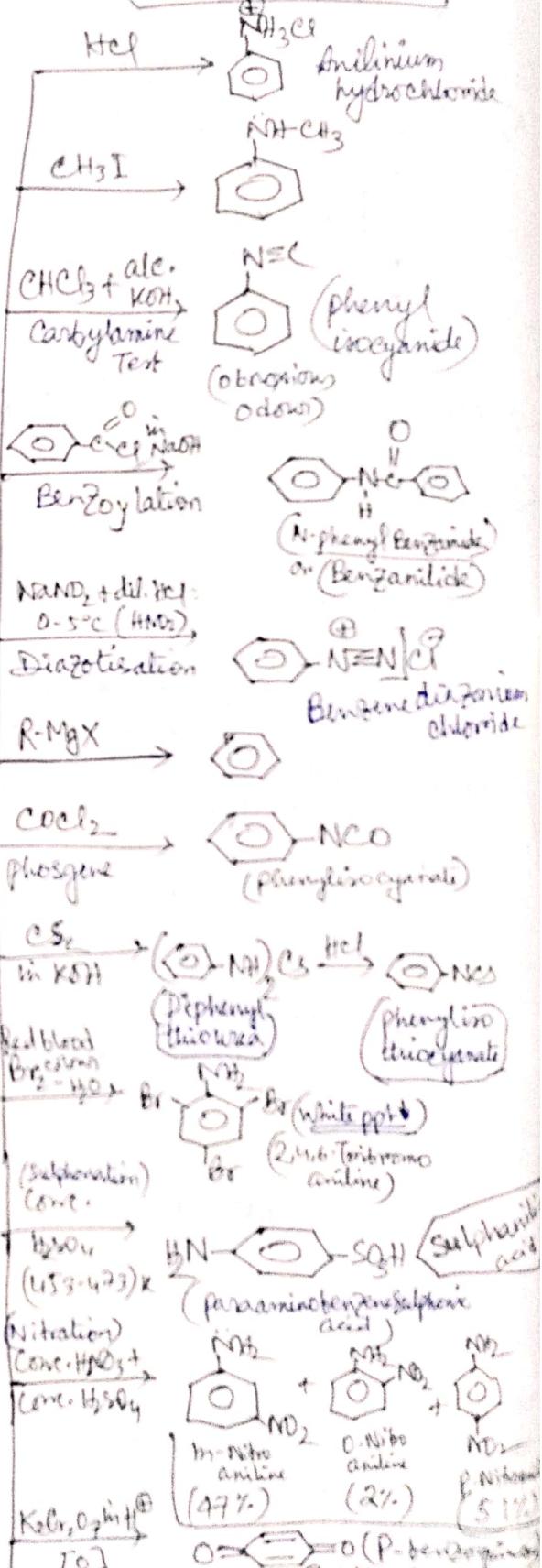
### Physical Properties of Aniline

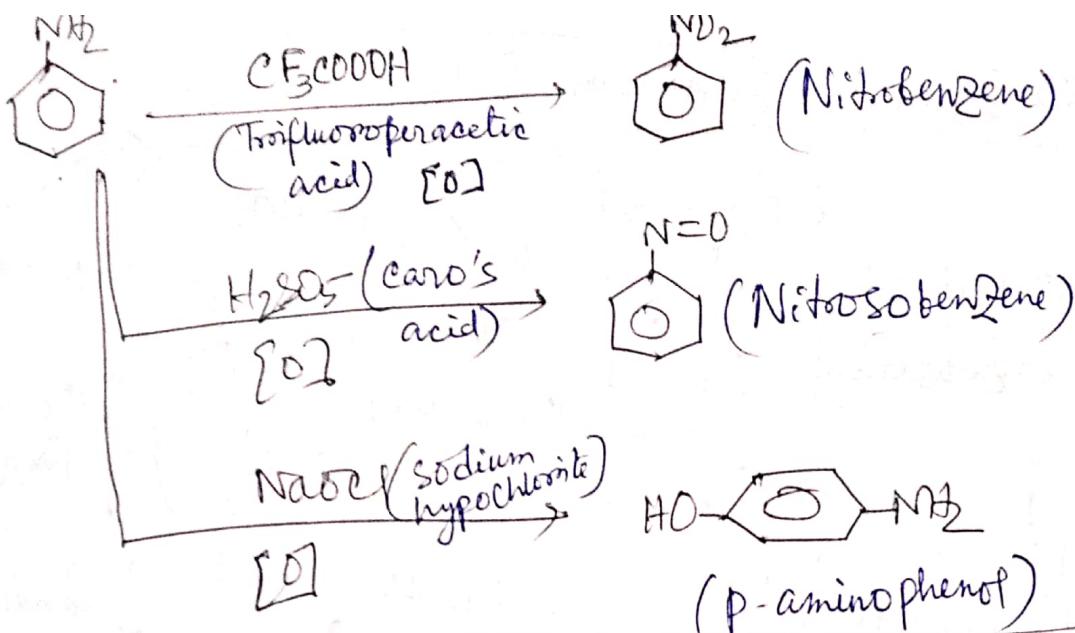
→ See previous page

### Methods of preparation

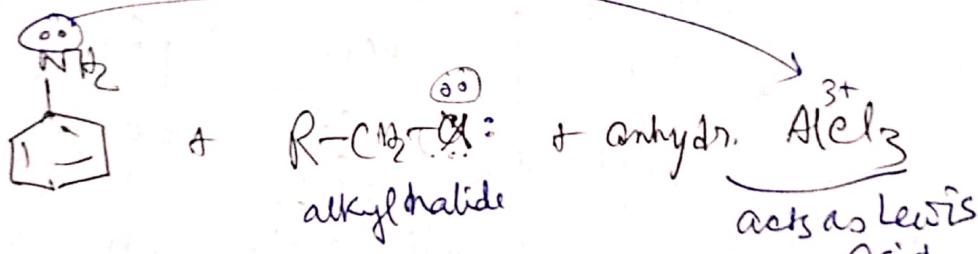


### Chemical Properties

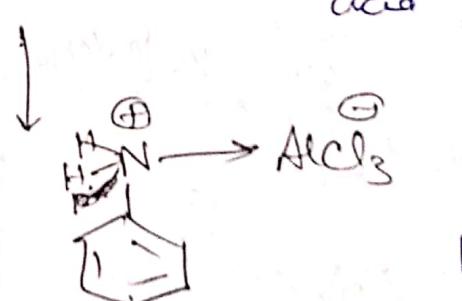




Aniline is a O/p orienting substance (i.e.  $-\text{NH}_2$  group is an activating group towards an electrophilic rxn) but yet it doesn't take part in Friedel-Craft's rxn. Explain why?



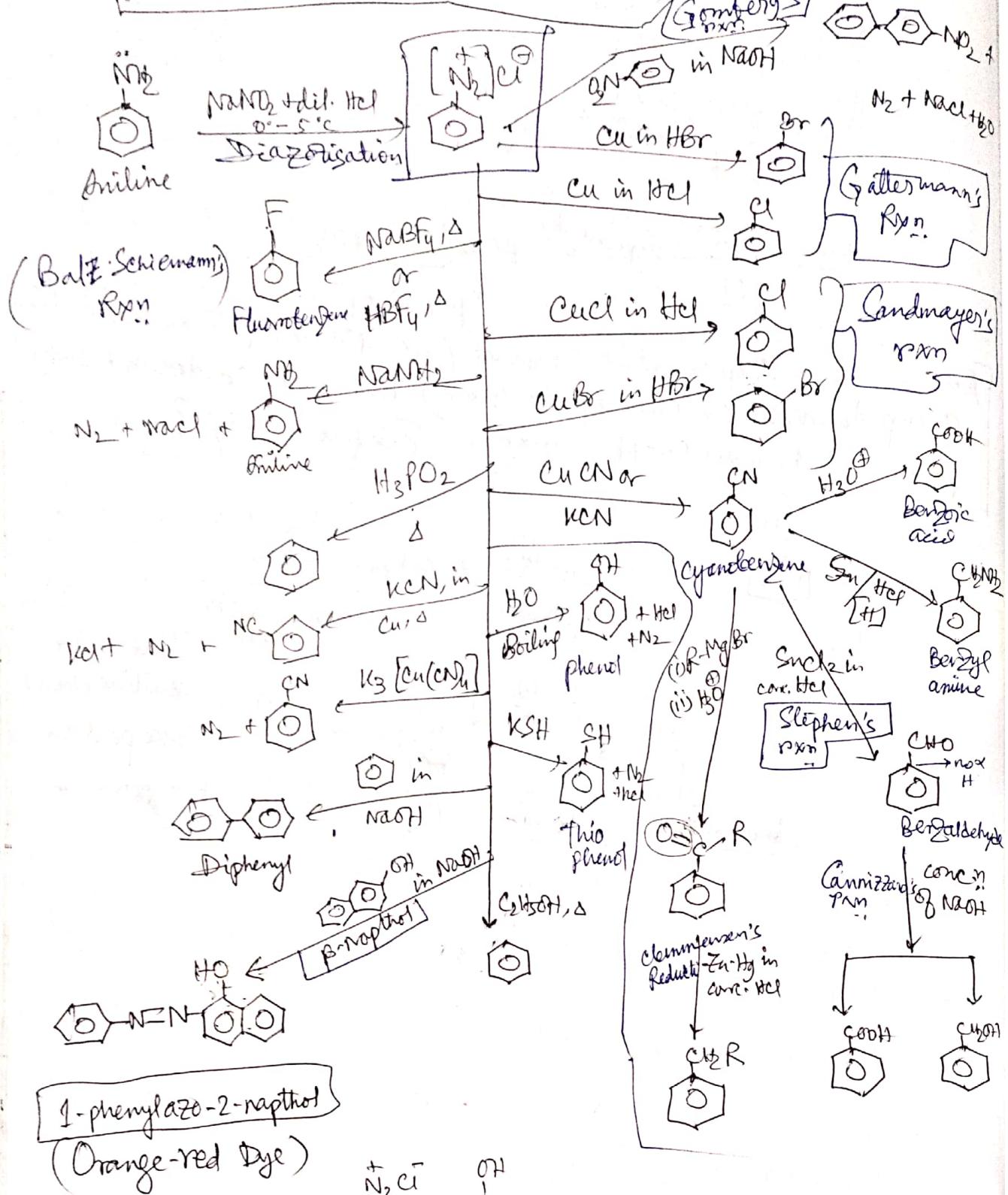
protonation of aniline takes place at first step & aniline becomes deactivated



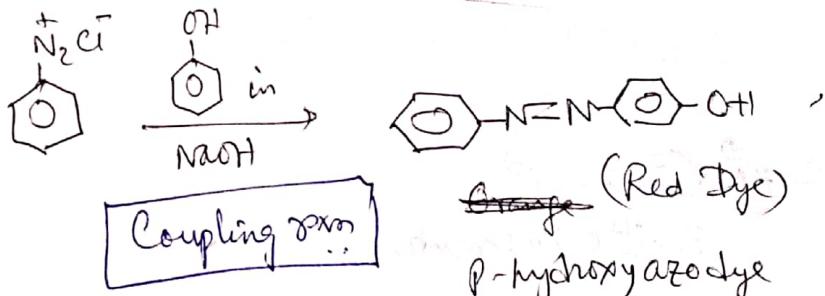
That's why aniline doesn't take part in F.C rxn.

Rxn

# Rxn. of Benzenediazonium Salt



1-phenylazo-2-naphthol  
(Orange-red Dye)



What happens when benzamide is made to react with  $\text{POCl}_3$ ?

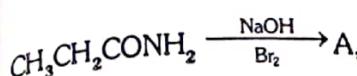
- a) aniline b) benzonitrile c) chlorobenzene d) benzyl amine.

$\text{POCl}_3$  ~~reacts~~ brings about dehydration of  $1^\circ$  amine

## AMINE

Among the following which one is not formed in Hoffmann degradation

- (1)  $\text{RNCO}$
- (2)  $\text{R}-\ddot{\text{N}}\text{H}_2$
- (3)  $\text{RCO}\text{NHBr}$
- (4)  $\text{RNC}$



Aqueous solution of A

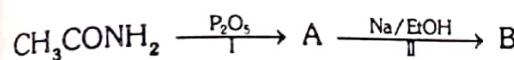
- (1) Turns blue litmus to red
- (2) Turns red litmus to blue
- (3) Does not affect the litmus
- (4) Decolourise the litmus

AM0001

Ethanamine can be obtained if the following compound is heated with  $[\text{KOH} + \text{Br}_2]$

- (1) Ethanamide
- (2) Methanamide
- (3) Propionamide
- (4) All the above

AM0002



Reaction II is called

- (1) Clemensen
- (2) Stephen
- (3) Mendius
- (4) Bauveault-blank reduction

CA0004

Tertiary amine is obtained in the reaction :-

- (1) Aniline  $\xrightarrow{\text{CH}_3\text{I}} \xrightarrow{\text{CH}_3\text{I}}$
- (2) Aniline  $\xrightarrow{\text{CH}_3\text{I}}$
- (3) Nitrobenzene  $\xrightarrow{\text{Sn}/\text{HCl}}$
- (4) None of the above

AM0007

$\text{C}_2\text{H}_5\text{NH}_2$  cannot be prepared by the reduction of

- (1)  $\text{C}_2\text{H}_5\text{NO}_2$
- (2)  $\text{CH}_3\text{CH}=\text{NOH}$
- (3)  $\text{C}_2\text{H}_5\text{NC}$
- (4)  $\text{CH}_3\text{CN}$

AM0008

## Build Up Your Understanding

7. Gabriel reaction for the synthesis of amines, involves the use of

- (1) 1° amide
- (2) 2° amide
- (3) Imides
- (4) Aliphatic amide

AM0009

8. Gabriel phthalimide reaction is used in the synthesis of

- (1) Primary aromatic amines
- (2) Secondary amines
- (3) Primary aliphatic amines
- (4) Tertiary amines

AM0010

9. The reaction :  $[\text{C}_2\text{H}_5\text{Br} + \text{NH}_3]$  is in fact an example of

- (1) Ammonolysis only
- (2) Nucleophilic substitution only
- (3) Ammonolysis as well as nucleophilic substitution
- (4) None

HD0011

10. Melting points are normally the highest for

- (1) Tertiary amides
- (2) Secondary amides
- (3) Primary amides
- (4) Amines

GC0012

11. Solubility of ethylamine in water is due to

- (1) Low molecular weight
- (2) Ethyl group is present in ethyl alcohol
- (3) Formation of H-bonding with water
- (4) Being a derivative of ammonia

GC0013

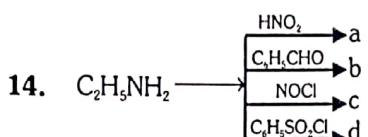
12. Which of the following compound liberates  $\text{CO}_2$  when treated with  $\text{NaHCO}_3$

- (1)  $\text{CH}_3\text{COCH}_2\text{NH}_2$
- (2)  $\text{CH}_3\text{NH}_2$
- (3)  $(\text{CH}_3)_4\text{NOH}^+$
- (4)  $\text{CH}_3\text{NH}_3^+\text{Cl}^-$

PO0014

13. The product obtained by the alkaline hydrolysis of  $\text{C}_2\text{H}_5-\text{N}=\text{C}=\text{O}$  when treated with t-butyl magnesiumbromide, the compound obtained will be  
 (1) t-butylamine      (2) n-butylamine  
 (3) Isobutane          (4) n-butane

AM0015



Which product is a Schiff's base :-

- (1) a      (2) b      (3) c      (4) d

AM0016

15. Acidic nature of amino group is shown by the reaction :-  
 (1)  $\text{R}-\text{NH}_2 + \text{NOCl} \rightarrow \text{RCI} + \text{N}_2 + \text{H}_2\text{O}$   
 (2)  $2\text{RNH}_2 + 2\text{Na} \rightarrow 2\text{RNH.Na} + \text{H}_2$   
 (3)  $\text{RCH}_2\text{NH}_2 + \text{HNO}_2 \rightarrow \text{RCH}_2\text{OH} + \text{N}_2 + \text{H}_2\text{O}$   
 (4)  $\text{R.NH}_2 + \text{HCl} \rightarrow \text{RNH}_3^+ \text{Cl}^-$

AM0017

16. The reagent used in the conversion of  $\text{C}_2\text{H}_5\text{NH}_2$  to  $\text{C}_2\text{H}_5\text{Cl}$  would be  
 (1)  $\text{SO}_2\text{Cl}_2$       (2)  $\text{SOCl}_2$   
 (3) NOCl                (4) All

AM0018

17. Hydrogen attached to nitrogen is released in the reaction  
 (1)  $\text{RCONH}_2 + \text{NaNH}_2$   
 (2)  $\text{RNH}_2 + \text{Na}$   
 (3) Both the above  
 (4) None of the above

GC0019

18. If primary amines are treated with ketones the product is  
 (1) Urea                (2) Guanidine  
 (3) Amide              (4) Schiff's base

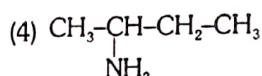
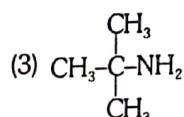
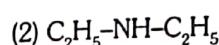
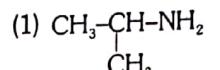
CC0020

19. Reactants of reaction - I are  
 $\text{CH}_3\text{CONH}_2, \text{KOH}, \text{Br}_2$   
 Reactants of reaction-II are  
 $\text{CH}_3\text{NH}_2, \text{CHCl}_3, \text{KOH}$   
 The intermediate species of reaction-I and reaction-II are respectively

- (1) Carbonium ion, carbene  
 (2) Nitrene, carbene  
 (3) Carbene, nitrene  
 (4) Carbocation, carbanion

AM0021

20. This compound does not respond to carbylamine reaction :-



AM0023

21. Blue litmus can be turned to red by the compound  
 (1) ROH                (2)  $\text{RNH}_2$



AM0024

22. Which one of the following amine compound gives alcohol with  $\text{HNO}_2$  :-  
 (1) N,N-Dimethylaniline    (2) Benzylamine  
 (3) N-methylaniline        (4) Aniline

AM0026

**ANILINE**

23.  $\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow{\text{Br}_2/\text{CCl}_4}$  ? The product is :-

- (1) Only o- bromoaniline  
 (2) 2, 4, 6-tribromoaniline  
 (3) o-and p-bromoaniline  
 (4) Only p-bromoaniline

AM0028

24. Aniline is purified by :-

- (1) Azeotropic distillation  
 (2) Steam distillation  
 (3) distillation in presence of magnesium  
 (4) Fractional distillation

GC0030

Reaction  $C_6H_5NH_2 + HAuCl_4 \longrightarrow$

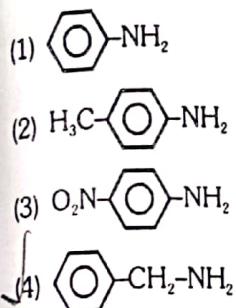
- $[C_6H_5NH_3]^+AuCl_4^-$  shows ... behaviour of aniline :-  
 (1) Acidic (2) Neutral  
 (3) Basic (4) Amphoteric

GC0031

16. Aniline on treatment with bromine water yields white precipitate of :-  
 (1) o-Bromoaniline  
 (2) p-Bromonailine  
 (3) 2, 4, 6-Tribromoaniline  
 (4) m-Bromoaniline

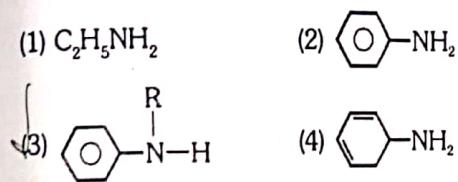
AH0032

17. Which compound does not show diazo reaction:-



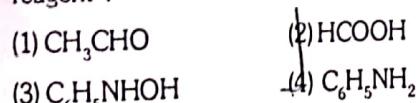
AM0033

28. Which of the following amines give N-nitroso derivative with  $NaNO_2$  and  $HCl$  :-



AM0034

29. Which of the following does not reduce Tollen's reagent :-



PO0036

30. Aniline can be obtained by :-

- (1) Benzoyl chloride and ammonia  
 (2) Reduction of benzamide  
 (3) Phenol and ammonia in presence of  $ZnCl_2$   
 (4) Benzoic anhydride and ammonia

AM0037

31. Aniline on direct nitration produces :-

- (1) o-Nitroaniline  
 (2) m-Nitroaniline  
 (3) p-Nitroaniline  
 (4) All

AH0038

32. Nitration of acetanilide followed by hydrolysis gives  
 (1) o-Nitroaniline only  
 (2) p-Nitroaniline only  
 (3) o- & p-Nitroaniline  
 (4) o-Nitroanilinium ion

AH0039

33.  $C_6H_5NH_2 \xrightarrow[0-5^\circ C]{NaNO_2/HCl} A$ , Which is the incorrect structure of the product 'A' :-

- (1)  $[C_6H_5-N\overset{\oplus}{=}\overset{\ominus}{N}]Cl$   
 (2)  $[C_6H_5\overset{\oplus}{N}_2]Cl$   
 (3)  $[C_6H_5-\overset{\oplus}{N}\equiv\overset{\ominus}{N}]Cl$   
 (4)  $[C_6H_5-N\overset{\oplus}{\equiv}\overset{\ominus}{N}]Cl$

AM0040

34. Chloroform and ethanolic KOH is used as a reagent in the following reaction :-

- (a) Hoffmann carbylamine reaction  
 (b) Hoffmann degradation reaction  
 (c) Reimer-Tiemann reaction  
 (d) Hoffmann mustard oil reaction

Code is :-

- (1) Only for a (2) Only for a and b  
 (3) Only for b and d (4) Only for a and c

AM0041

35. Acetanilide when treated with bromine in acetic acid mainly gives :-

- (1) o-Bromoacetanilide  
 (2) N-Bromoacetanilide  
 (3) p-Bromoacetanilide  
 (4) m-Bromoacetanilide

AH0042

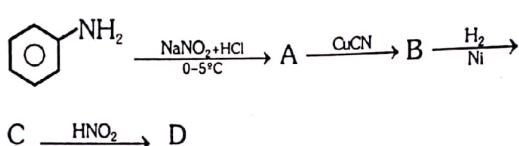
36. Aromatic nitriles (ArCN) are not prepared by reaction

- (1)  $\text{ArX} + \text{KCN}$
- (2)  $\text{ArN}_2^+ + \text{CuCN}$
- (3)  $\text{ArCONH}_2 + \text{P}_2\text{O}_5$
- (4)  $\text{ArCONH}_2 + \text{SOCl}_2$

AM0043

**NITRO GROUP, CYANIDE & ISOCYANIDE**

37. Aniline in a set of reactions yielded end product D



The structure of the product D would be

- (1)  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$
- (2)  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$
- (3)  $\text{C}_6\text{H}_5\text{NHOH}$
- (4)  $\text{C}_6\text{H}_5\text{NHCH}_2\text{CH}_3$

AM0044

38.  $\phi-X \xrightarrow{\text{NaNO}_2/\text{HCl}} \text{C}_6\text{H}_5\text{N}_2\text{Cl} \xrightarrow[\Delta]{\text{Water}} \phi-Y$ ,

In the above sequence X and Y are :-

- (1) o-, p- and m-directing
- (2) o-, p- and o-, p-directing
- (3) m and m directing
- (4) m and o, p directing

AM0046

39. Which of the following compound gives an explosive on decarboxylation :-

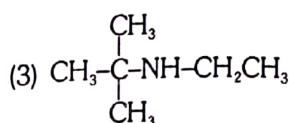
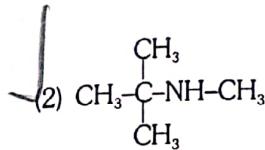
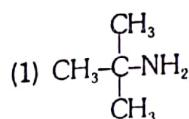
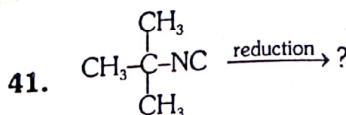
- (1) 2,4,6-Trinitrobenzoic acid
- (2) 2,4-Dinitrobenzoic acid
- (3) o-Aminobenzoic acid
- (4) o-Hydroxybenzoic acid

AM0047

40. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was:-

- (1) Methylisocyanate
- (2) Methylamine
- (3) Ammonia
- (4) Phosgene

AM0048



- (4) None

AM0049

42. Reaction of RCN with sodium and alcohol leads to the formation of :-

- |                               |  |
|-------------------------------|--|
| (1) $\text{RCONH}_2$          | (2) $\text{RCOO}^- \text{NH}_4^+$        |
| (3) $\text{RCH}_2\text{NH}_2$ | (4) $\text{R}(\text{CH}_2)_3\text{NH}_2$ |

AM0050

43.  $\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow{\text{SnCl}_2/\text{HCl}} \text{A} \xrightarrow[0^\circ\text{C}]{\text{NaNO}_2/\text{HCl}} \text{B}$ ; In the above sequence Benzene from B, is suitably obtained by using :-

- |                    |                             |
|--------------------|-----------------------------|
| (1) Ethanol        | (2) $\text{H}_3\text{PO}_2$ |
| (3) Both the above | (4) Methanol                |

AM0051

44. Which reagent is used to get iodo benzene from benzene diazonium acid sulphate  $[\text{C}_6\text{H}_5\text{N}_2\text{HSO}_4]$ :

- |                           |                    |
|---------------------------|--------------------|
| (1) $\text{CuBr}, \Delta$ | (2) Cu powder + HI |
| (3) $\text{KI}, \Delta$   | (4) None           |

AM0052

45. Which of the following is used as a solvent in the Friedel-Crafts reaction :-

- |             |                  |
|-------------|------------------|
| (1) Toluene | (2) Nitrobenzene |
| (3) Benzene | (4) Aniline      |

AH0053

46. In the Sandmeyer's reaction,  $\text{--N}=\text{N--X}$  group of diazonium salt is replaced by :-
- (1) Halide group
  - (2) Nitro group
  - (3)  $\text{--OH}$  group
  - (4)  $\text{--NHNH}_2$  group

AM0055

**EXERCISE-I (Conceptual Questions)****ANSWER KEY**

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	4	2	3	3	1	3	3	3	3	3	3	4	3	2	2
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	3	3	4	2	2	4	2	2	2	3	3	4	3	4	3
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	4	3	1	4	3	1	1	2	1	1	2	3	3	3	2
Que.	46														
Ans.	1														