PHA284

Organic Chemistry II

Ankara University
Faculty of Pharmacy
Department of Pharmaceutical Chemistry

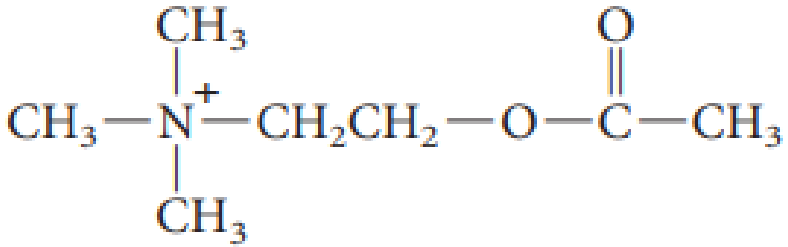
AMINES

AMINES

$$R-NH_2$$

putrescine

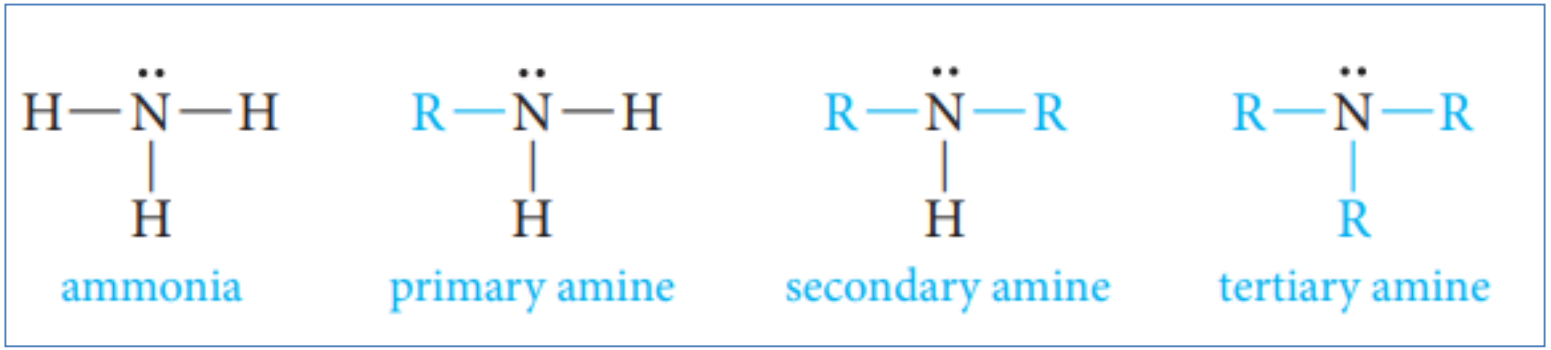
1,6-diaminohexane



acetylcholine

Classification of Amines

Amines are organic bases derived from ammonia.



Nomenclature

$CH_3CH_2NH_2$	$(CH_3CH_2)_2NH$	$(CH_3CH_2)_3N$
ethylamine	diethylamine	triethylamine
(primary)	(secondary)	(tertiary)

$CH_3CH_2NH_2$	$CH_3\overset{1}{C}H_2\overset{2}{C}H(NH_2)\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_3$	
aminoethane	2-aminopentane	*cis*-1,3-diaminocyclobutane

Physical Properties

Physical State:

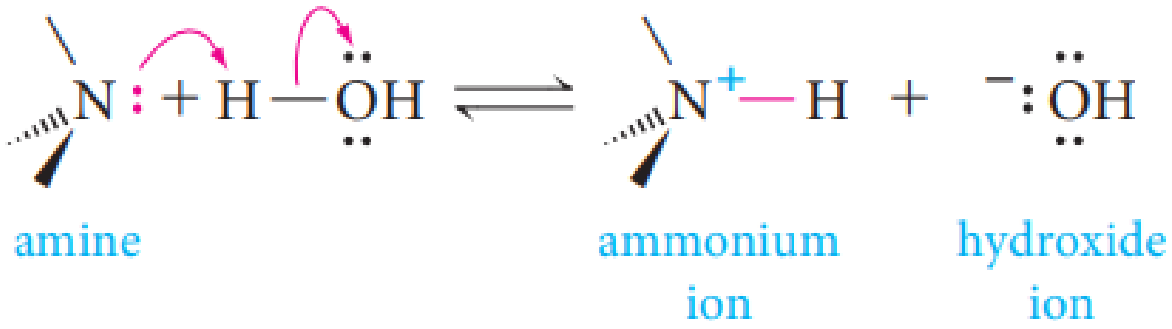
- **Methylamine** and **ethylamine** are **gases**,
- **Primary amines with three or more carbons** are **liquids**.
- Small members have typical ammonia smell.

Physical Properties

Solubility:

- All three classes of amines can form hydrogen bonds with the -OH group of water (that is, O-H· · ·N).
- Primary and secondary amines can also form hydrogen bonds with the oxygen atom in water: N-H· · ·O.
- Thus, most simple amines with up to **five or six carbon atoms** are either completely or appreciably **soluble in water**.

Basicity of Amines



Amines are more basic than water. They accept a proton from water, producing hydroxide ion, so their solutions are basic.

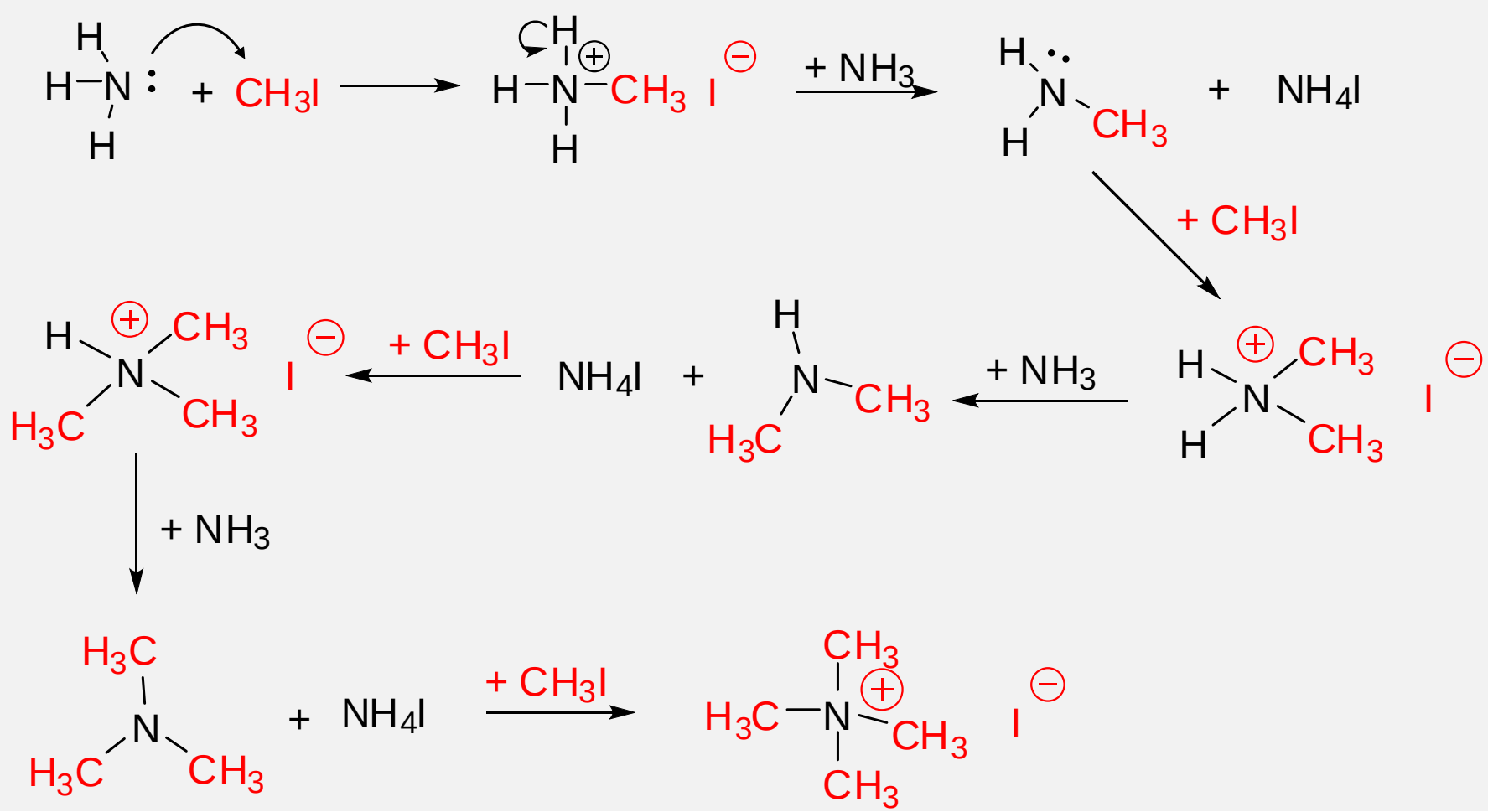
Basicity of Amines

Alkylamines are approximately 10 times as basic as ammonia.

Amine	pK_b
NH_3	4.70
CH_3NH_2	3.36
$(CH_3)_2NH$	3.29
$(CH_3)_3N$	4.23

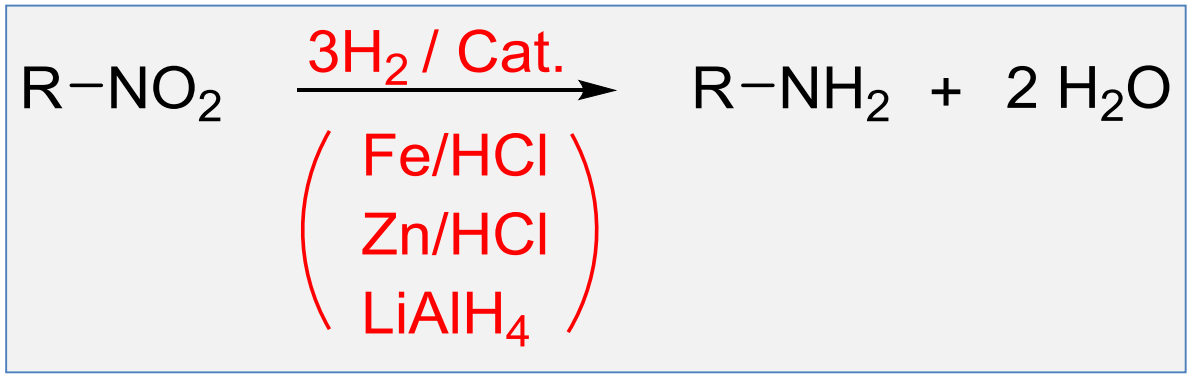
Preparation of Amines

i. Alkylation of ammonia and amines:



Preparation of Amines

ii. Reduction of nitrogen compounds:

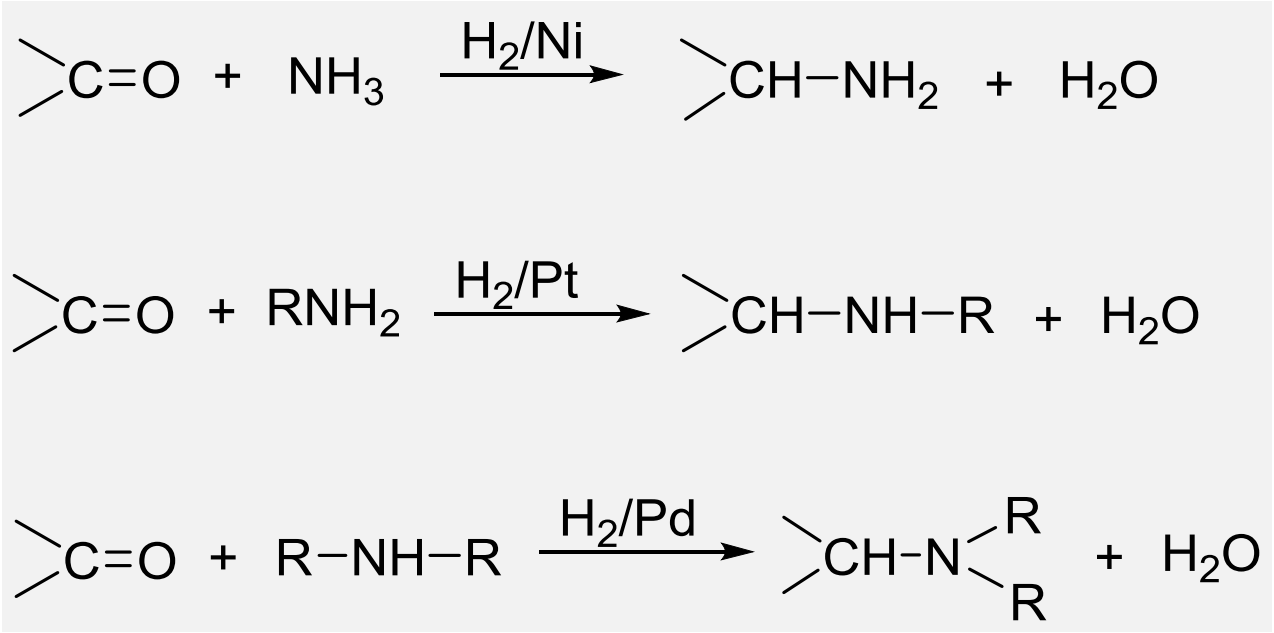


Preparation of Amines

iii. Reduction of ciyanides:

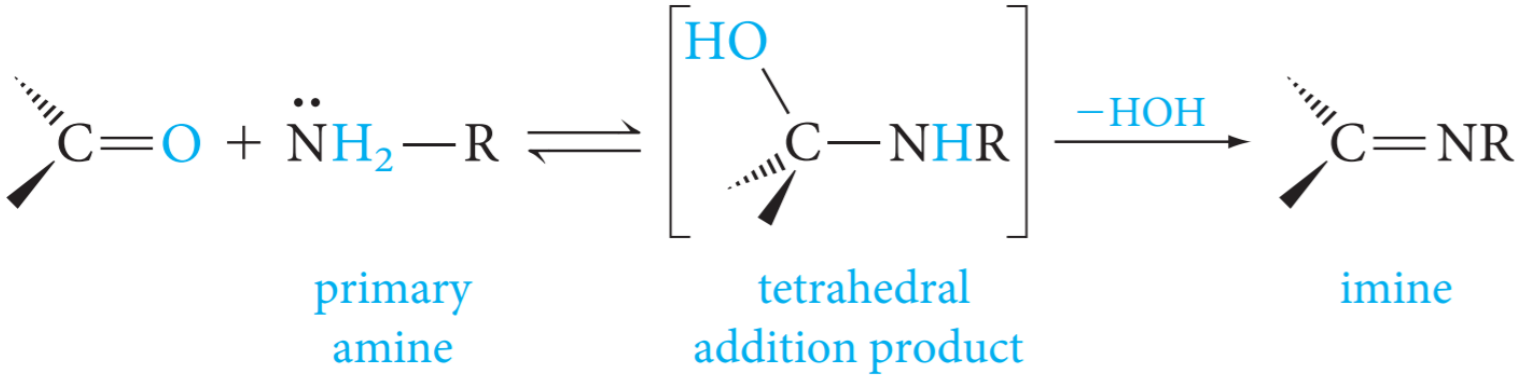
Preparation of Amines

iv. Reductive amination:



Reactions of Amines

i. Addition to aldehydes and ketones:



- Other ammonia derivatives containing an -NH_2 group react with carbonyl compounds similarly to primary amines.

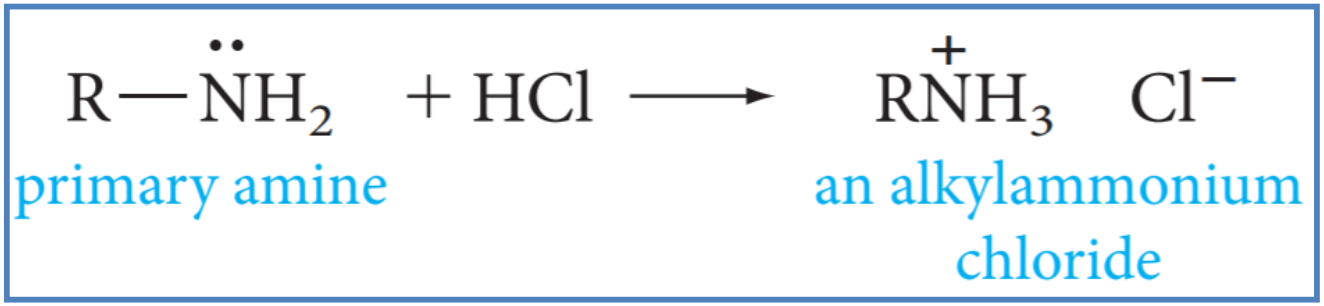
Table. Nitrogen Derivatives of Carbonyl Compounds

Formula of ammonia derivative	Name	Formula of carbonyl derivative	Name
RNH_2 or $ArNH_2$	primary amine	$>C{=}NR$ or $>C{=}NAr$	imine
NH_2OH	hydroxylamine	$>C{=}NOH$	oxime
NH_2NH_2	hydrazine	$>C{=}NNH_2$	hydrazone
$NH_2NHC_6H_5$	phenylhydrazine	$>C{=}NNHC_6H_5$	phenylhydrazone

Reactions of Amines

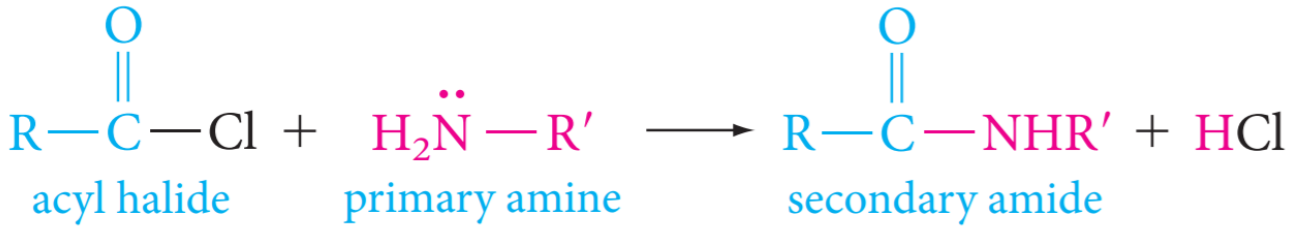
Reaction with acids:

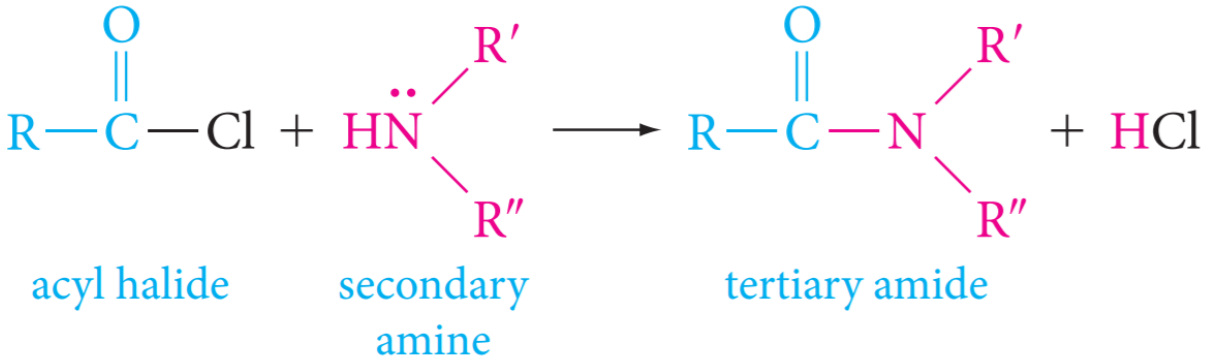
Amines react with acids to form alkyl ammonium salts.



Reactions of Amines

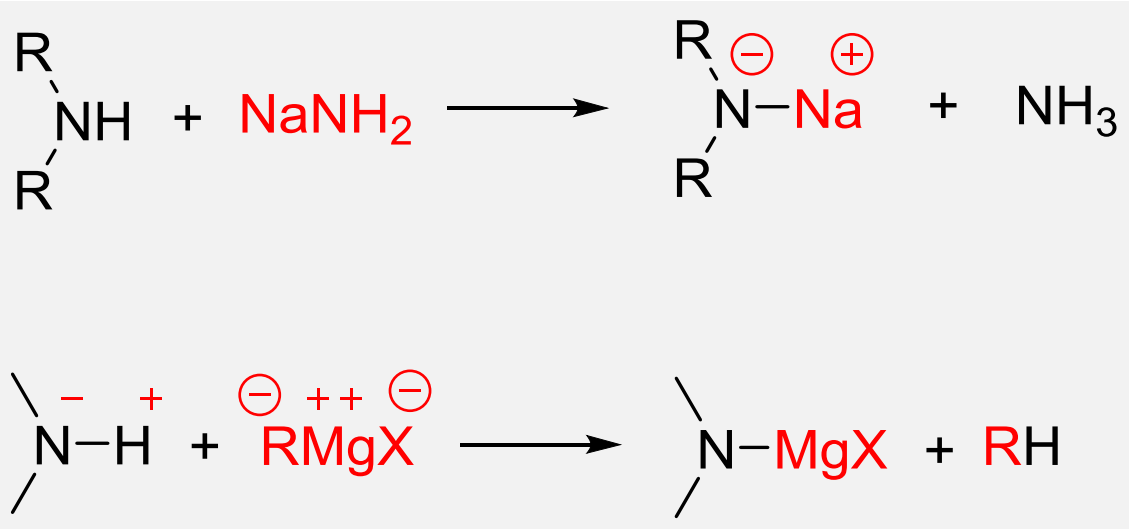
Acylation with acid derivatives:





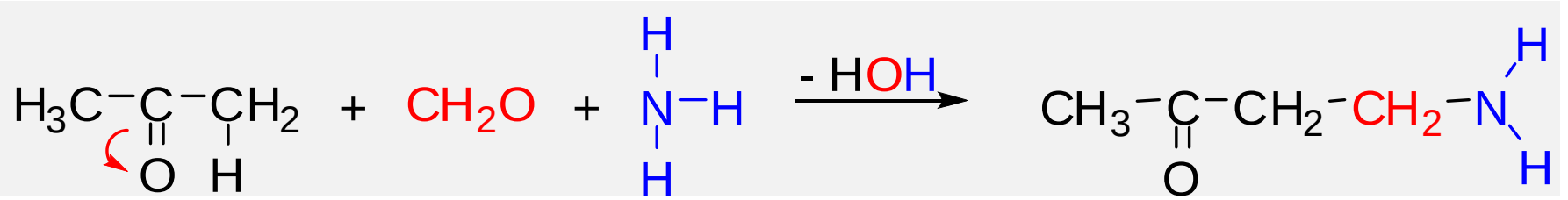
Reactions of Amines

Reaction of amine hydrogen



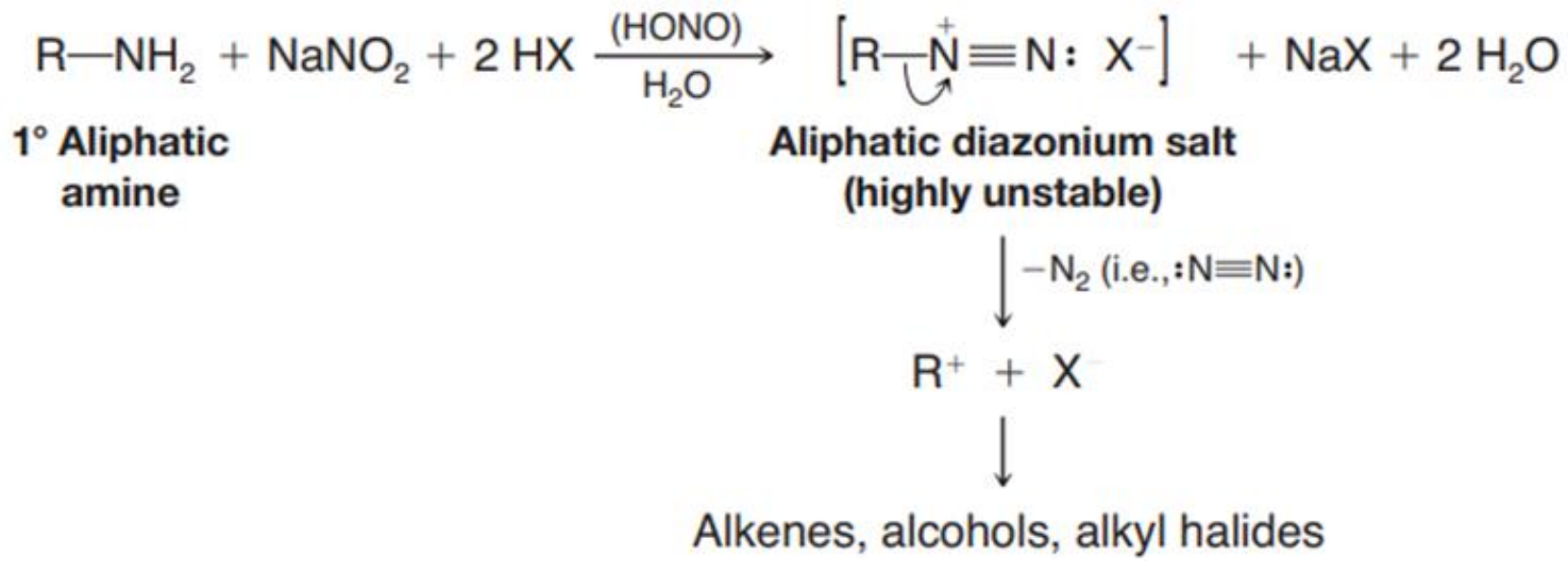
Reactions of Amines

Mannich Reaction (Amino methylation)



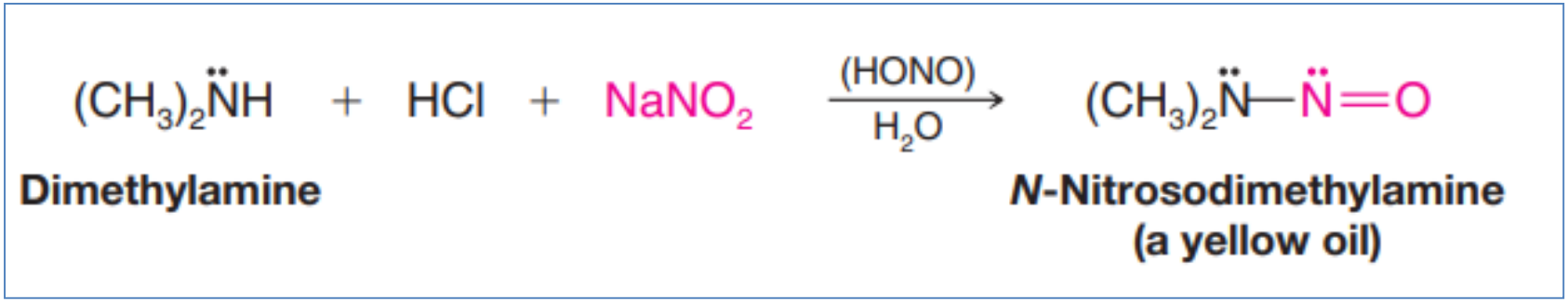
Reactions of Amines

Reaction with nitrous acid



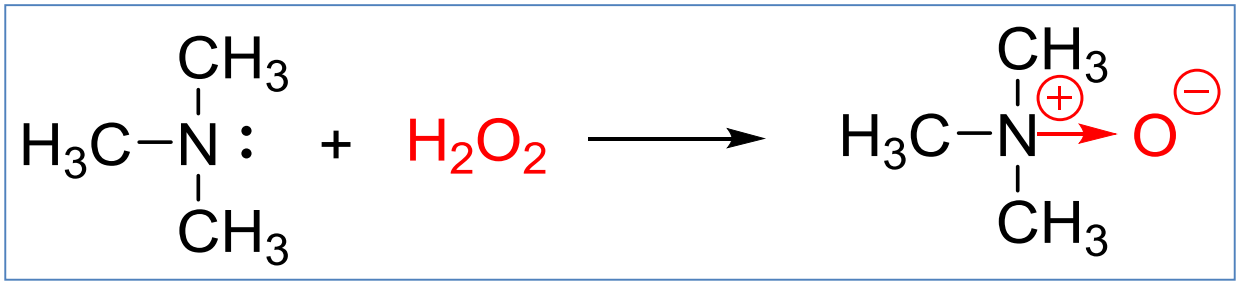
Reactions of Amines

Reaction with nitrous acid



Reactions of Amines

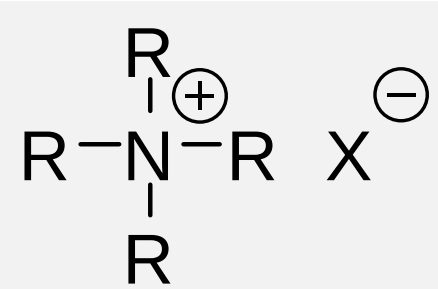
Oxidation:

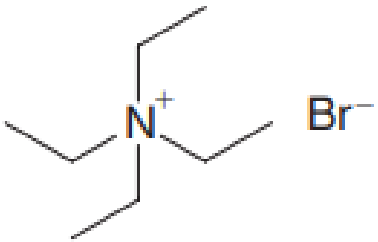


Quaternary Ammonium Compounds

Quaternary Ammonium Compounds

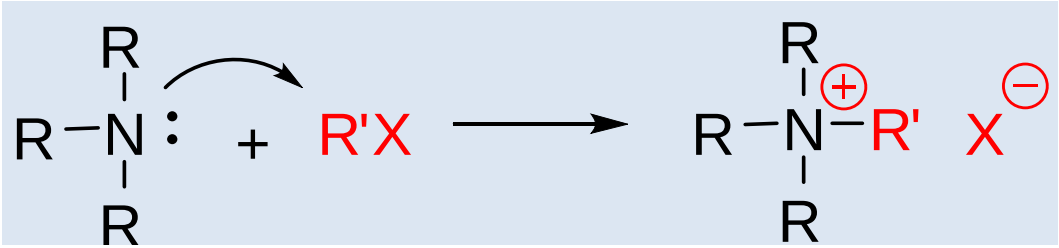
- Tertiary amines react with primary or secondary alkyl halides and the products are quaternary ammonium salts.

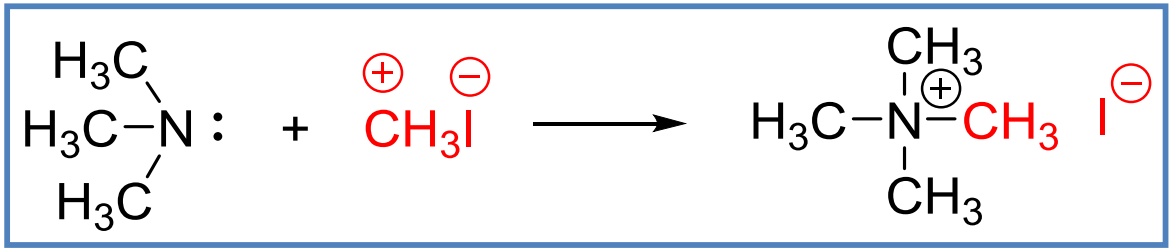




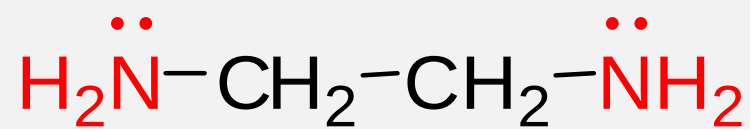
Tetraethylammonium bromide (a quaternary ammonium salt)

Preparation





DIAMINES

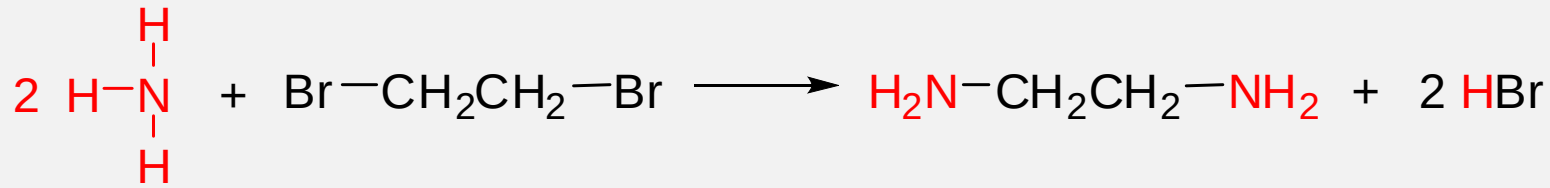


ethane-1,2-diamine

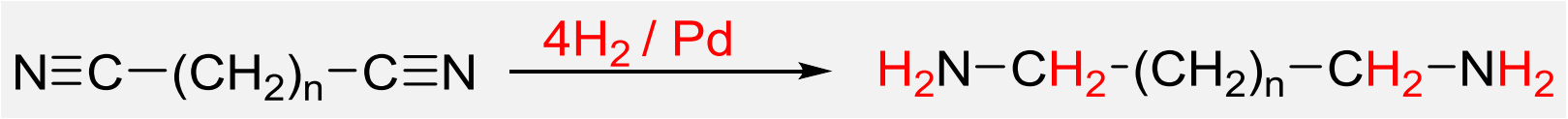
1,2-diamino ethane

Preparation

1) Nucleophilic substitution

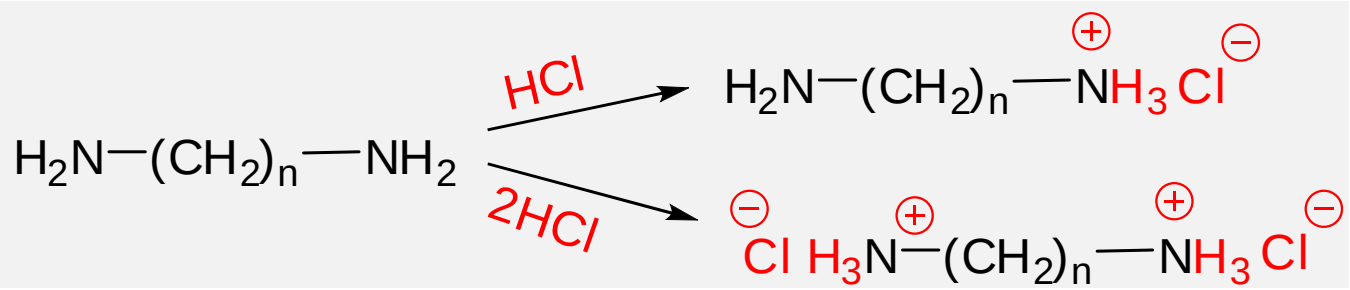


2) Hydrogenation of nitriles:

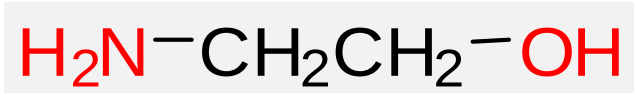


Reactions

Basicity

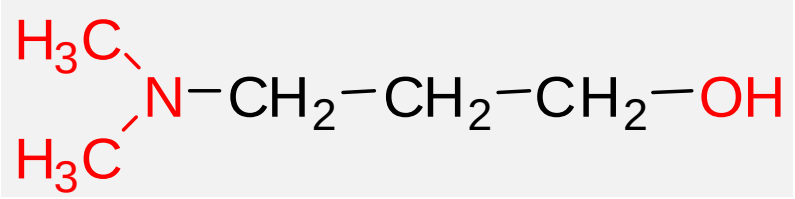


Amino Alcohols



2-aminoethan-1-ol

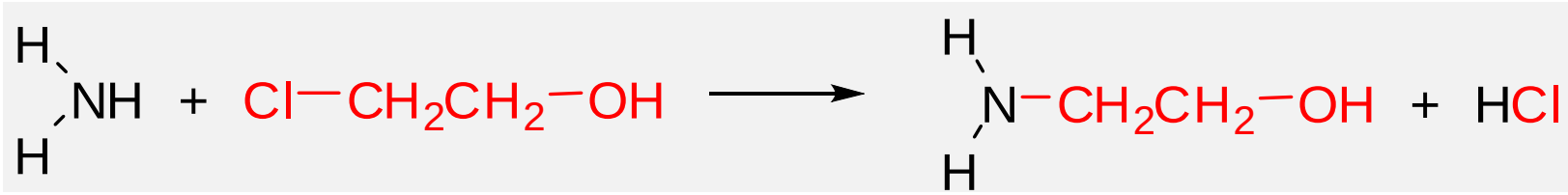
Ethanolamine

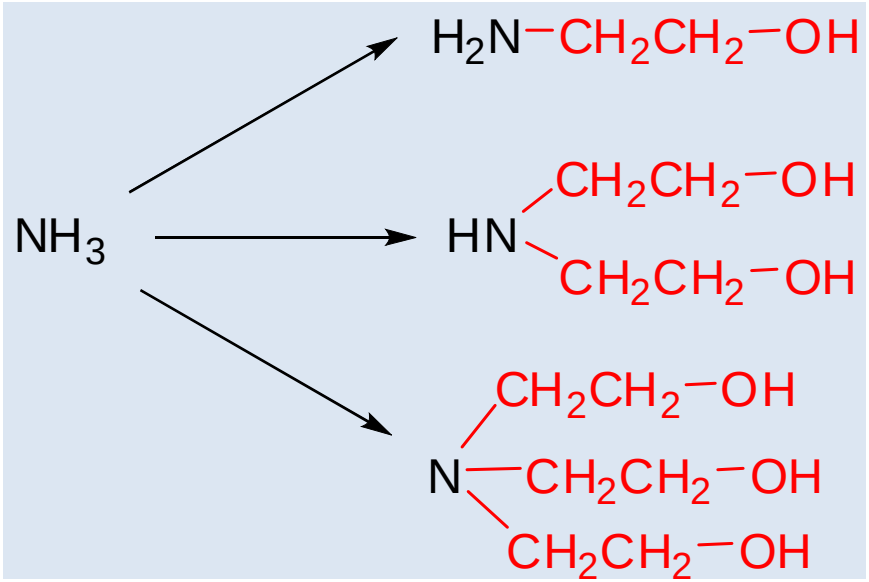


3-(dimethylamino)propan-1-ol

Preparation

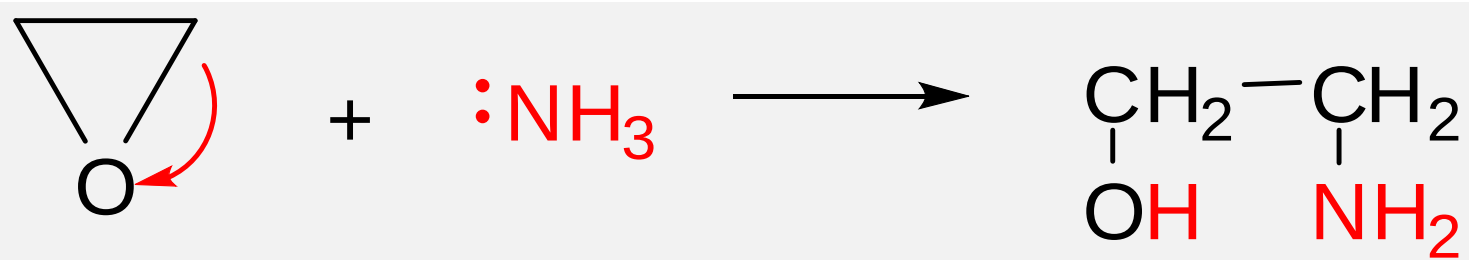
1)





Preparation

2)



References

- ***Organic Chemistry 11e***, T.W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder, John Wiley & Sons, Inc., 2014, ISBN 978-1-118-13357-6 (cloth) Binder-ready version ISBN 978-1-118-14739-9
- ***Organic Chemistry: A Short Course, 13th Ed.***, D.J. Hart, C.M. Hadad, L.E. Craine, H. Hart, Brooks/Cole, Cengage Learning, 2012, ISBN-13: 978-1-111-42556-2
- ***Organic Chemistry, 6th Ed***., L. G. Wade, Pearson Education, Inc., 2006, ISBN 0-13-147871-0
- ***Organic Chemistry, 2nd Ed.,*** Jonathan Clayden, Nick Greeves, and Stuart Warren,, Oxford University Press, 2012, ISBN: 9780199270293
- ***Organic Chemistry***, Mukherjee, S.M., et al., New Age International Ltd, 2008. ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/ankara/detail.action?docID=3017383.