

# ALIPHATIC NITROGEN COMPOUNDS

DIAMIDE

# UREA (CARBAMIDE)

- ❖  $\text{HN}_2\text{CONH}_2$
- ❖ DIAMIDE OF CARBONIC ACID
- ❖ Decomposition proteins
- ❖ Occurs in urine
- ❖ First laboratory method is synthesised by Wholer(1828)

# preparation

- ❖ From urine
- ❖ Wholer's syntheis
- ❖ Laboratory method
- ❖ manufacture

# From urine

- ❖ By evaporating it to a small bulk
- ❖ Nitrate is added to precipitate sparingly soluble urea nitrate
- ❖  $\text{NH}_2\text{CONH}_2 \cdot \text{HNO}_3$
- ❖ Liberation with barium carbonate.
- ❖  $2\text{OC}(\text{NH}_2)_2 \cdot \text{HNO}_3 + \text{BaCO}_3 \rightarrow 2\text{CO}(\text{NH}_2)_2 + \text{Ba}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$

# Wholer's synthesis

- ❖ Evaporating the solution of potassium cyanate and ammonium sulphate
- ❖ Ammonium cyanate is formed
- ❖ It undergoes molecular rearrangement
- ❖  $\text{NH}_4\text{CNO} \rightarrow \text{NH}_2\text{CONH}_2$

# Laboratory method

- ❖ By the action of ammonia on carbonyl chloride or ethyl carbonate.

# Manufacture

- By partial hydrolysis of cyanamide
  - Cyanamide is obtained from calcium cyanamide.
  
- By allowing liquid carbon dioxide and liquid ammonia to interact in an autoclave when ammonium carbamate is formed.
  - heated to 400-450 K under 35 atmosphere pressure to give urea in about 40 percent yields.

- $\text{CaC}_2 \rightarrow \text{CaNCN} \rightarrow \text{H}_2\text{NCN} \rightarrow \text{NH}_2\text{CONH}_2$
- $2\text{NH}_3 + \text{CO}_2 \rightarrow \text{NH}_2\text{COONH}_4 \rightarrow \text{NH}_2\text{CONH}_2 + \text{H}_2\text{O}$



# properties

## physical properties

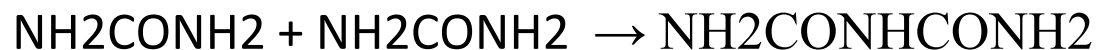
- ❖ colourless, odourless solid in water and alcohol
- ❖ insoluble in ether.

# chemical properties

- ❖ basic nature
- ✓ neutral but it behaves as if it were a very weak monoacid base.
- ✓ concentrated solution of urea reacts with strong nitric acid as well as concentrated solution of oxalic acid to give sparingly soluble urea nitrate  $\text{CO}(\text{NH}_2)_2 \cdot \text{HNO}_3$  and urea oxalate  $[\text{CO}(\text{NH}_2)_2]_2 \cdot \text{H}_2\text{C}_2\text{O}_4$  respectively.

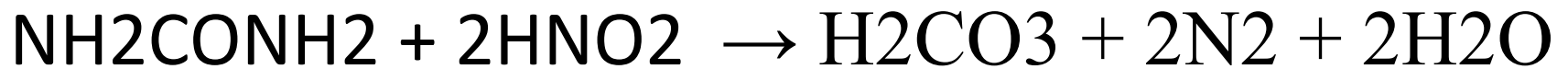
## ❖ biuret reaction

- ✓ when heated gently, urea loses a molecule of ammonia to give biuret.



❖ Reaction with nitrous acid

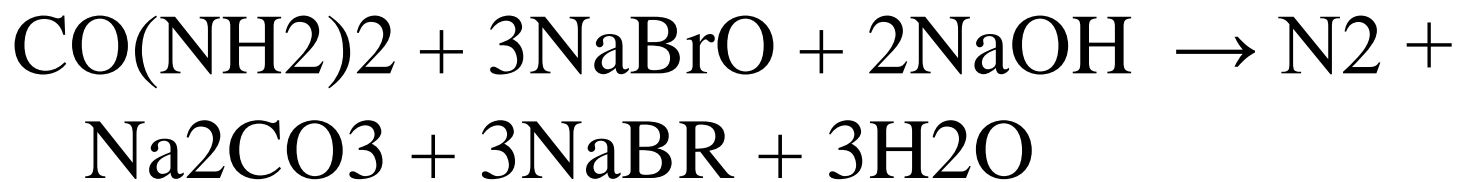
urea reacts with nitrous acid with liberation of nitrogen and carbon dioxide.



- Hydrolysis

on boiling with aqueous alkalis or acids or water under pressure urea hydrolyses to give carbon dioxide and ammonia.

- action of alkaline hypochlorite or hypobromite  
when urea is treated with excess of alkaline hypochlorite or hypobromite, nitrogen is evolved.



- Acetylation

urea reacts with acid chlorides and acid anhydrides to form ureides, i.e., with acetyl chloride it gives acetylurea