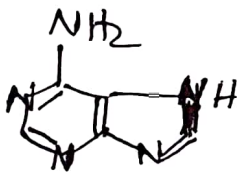


Semester - II

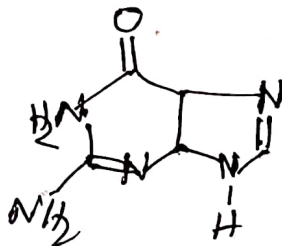
Nucleotides and Nucleic Acids

The basic unit of all the organisms i.e. cell consists of a Nucleus and extranuclear parts. Nucleus contains chromosomal material, which is the genetic unit of heredity. These are in the form of nucleoproteins, which are made up of proteins and nucleic acids. These nucleic acids store genetic information -- DNA - deoxyribonucleic acid, RNA - Ribonucleic acid. Each of these consists of three basic components: (1) Purine & Pyrimidine bases, (2) Sugars which may be ribose or deoxyribose, (3) phosphoric acid units.

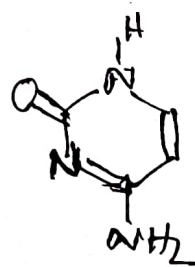
Purine & Pyrimidine Bases: Each nucleic acid contain four purine or pyrimidine bases out of the following five -



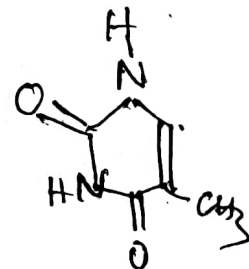
Adenine



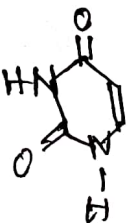
Guanine



Cytosine



Thymine



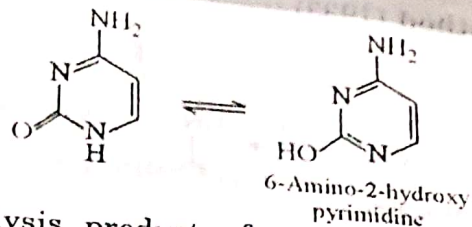
Uracil

Adenine and Guanine are purine bases,

Cytosine, Thymine and Uracil are pyrimidine bases

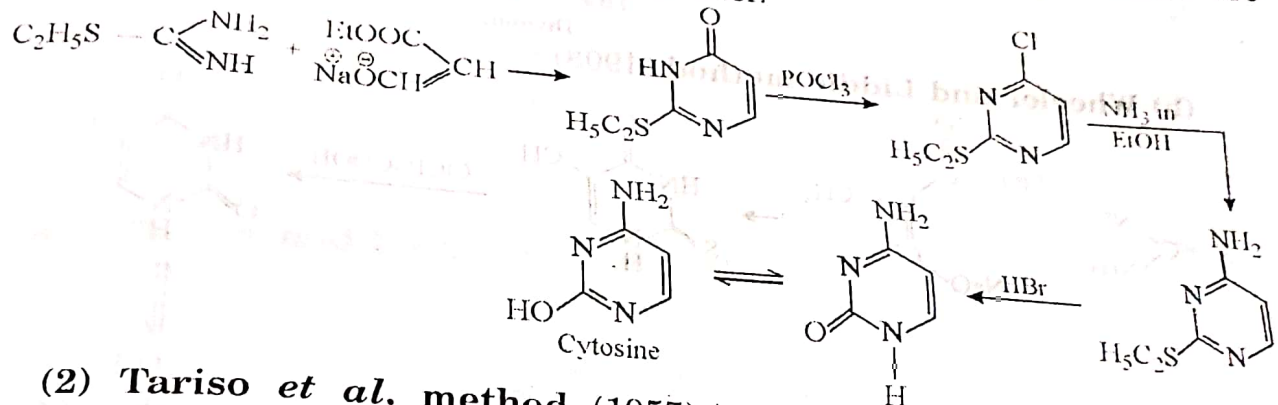
Hydrolysis of Nucleic acids proceeds in three steps →

(1) Cytosine

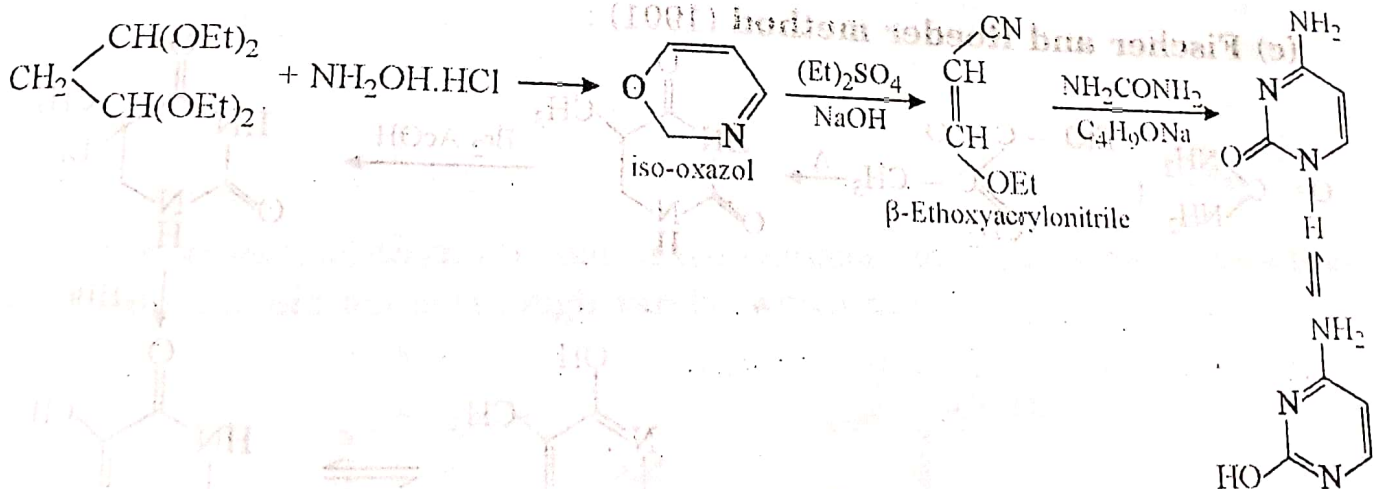


Cytosine, a hydrolysis product of nucleic acids can be synthesised by following methods :

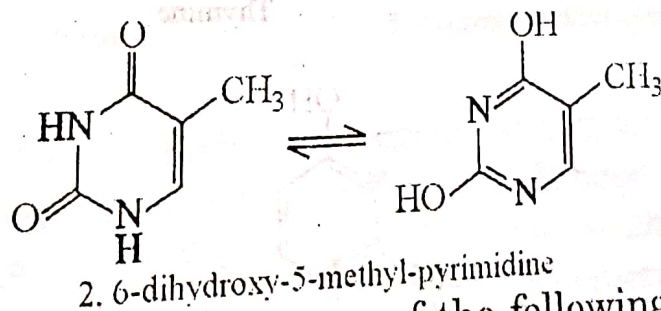
(1) **Wheeler and Johnson method (1903)** : Here starting materials are S-Ethylisothiurea and sodioformylacetic ester.



(2) **Tariso et al. method (1957)** : In this method starting material *iso*-oxazol is prepared from malodialdehyde acetal and hydroxyl amine yield cytosine.



(2) Thymine



Thymine can be synthesised by any of the following methods :

Nucleic Acids $\rightarrow$ Nucleotides $\rightarrow$ Nucleoside + phosphoric acid
 $\swarrow$
 Purine or Pyrimidine bases
 + Sugar.

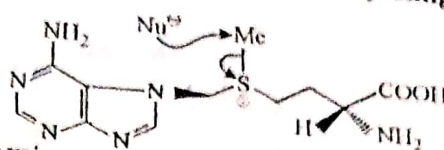
Nucleotides and Nucleosides

The basic unit of all the organisms is cell. Inside of a nucleus and cytoplasm, there are certain chemical material, which is the basic unit of heredity. These are in the form of nucleotides, which are made up of phosphate, sugar and nucleic acid. These nucleic acids are of two types - DNA - deoxyribonucleic acid and RNA - ribonucleic acid. Each of these consists of basic components: (1) Purine & Pyrimidine bases, (2) Sugar which may be ribose or deoxyribose, (3) Phosphoric acid unit.

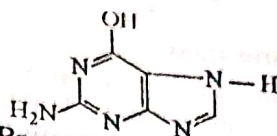
Purine & Pyrimidine bases: Each nucleic acid consists of purine & pyrimidine bases out of the



SAM is a sulphonium salt and is attacked by nucleophiles. Different nucleophiles attack SAM, thus it is nature's methylating agent.



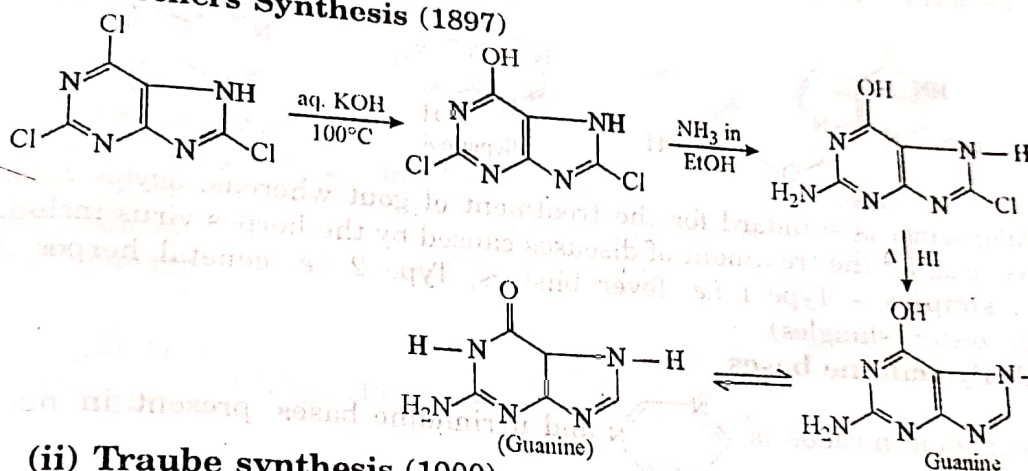
(b) Guanine [2-Amino-6-hydroxypurine]



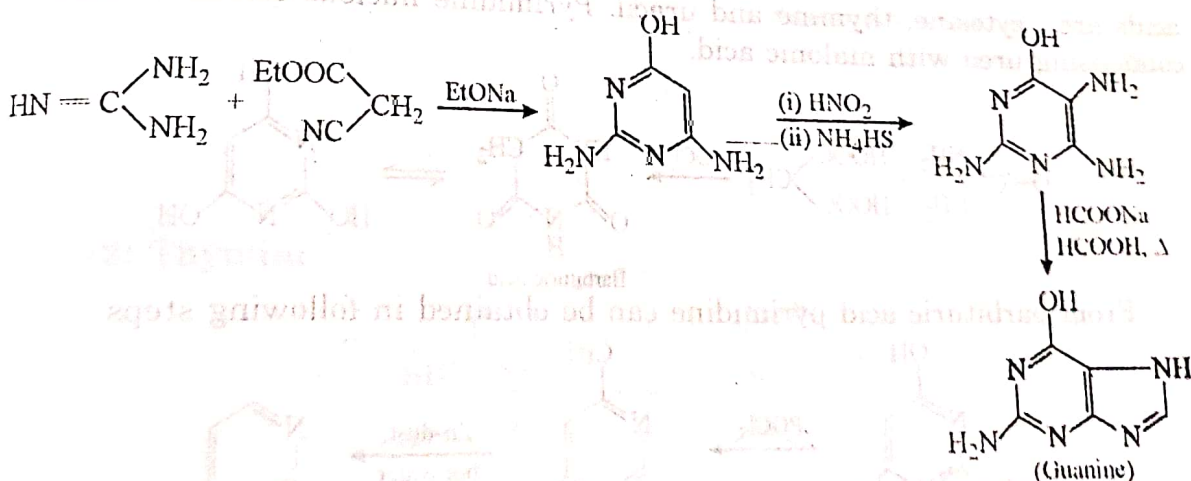
Sources of Guanine : Pancreas of cattles, in guano and certain fish scales
[m.p. 360°d]

Synthesis of Guanine

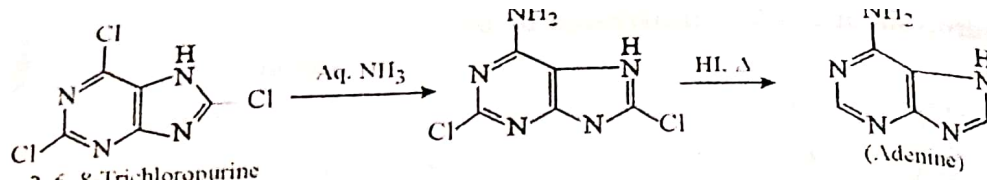
(i) Fischers Synthesis (1897)



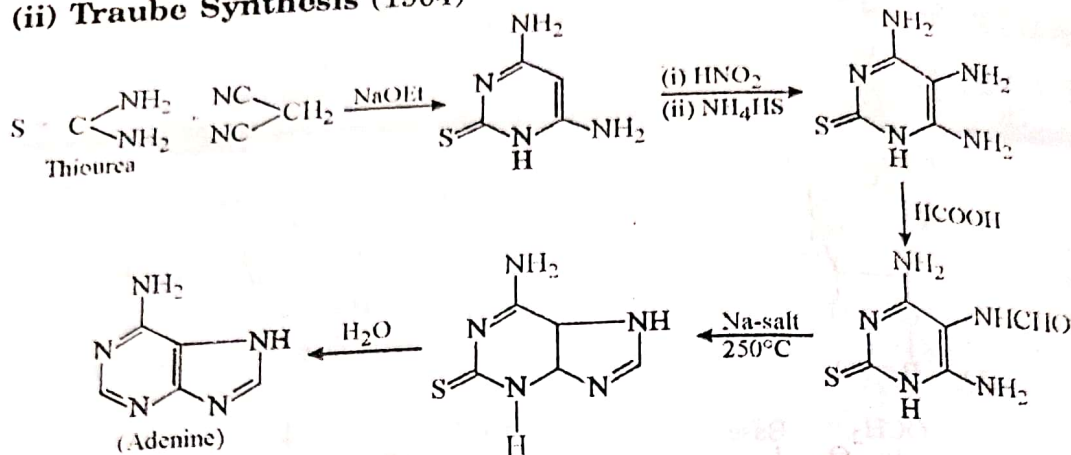
(ii) Traube synthesis (1900) :



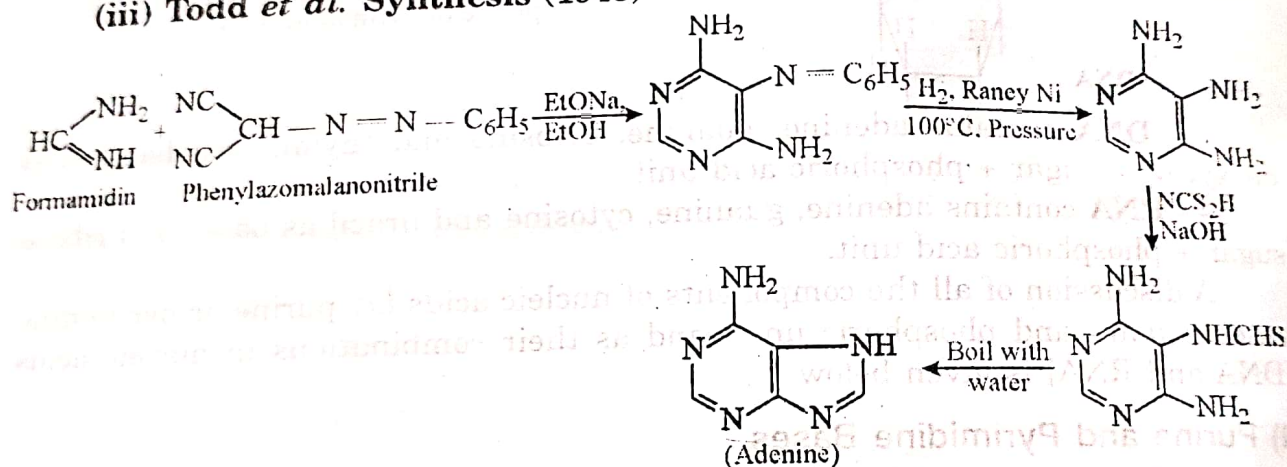
Importance : It is a part of DNA and RNA. Its related compounds are theobromine and caffeine which are dimethylated and trimethylated purines. Theobromine is present in chocolate; whereas caffeine is found in tea and coffee. Both are stimulants. Theobromine gets methylated to give caffeine by nature's methylating agent SAM. Methylation occurs at nitrogen as it preserves aromaticity.



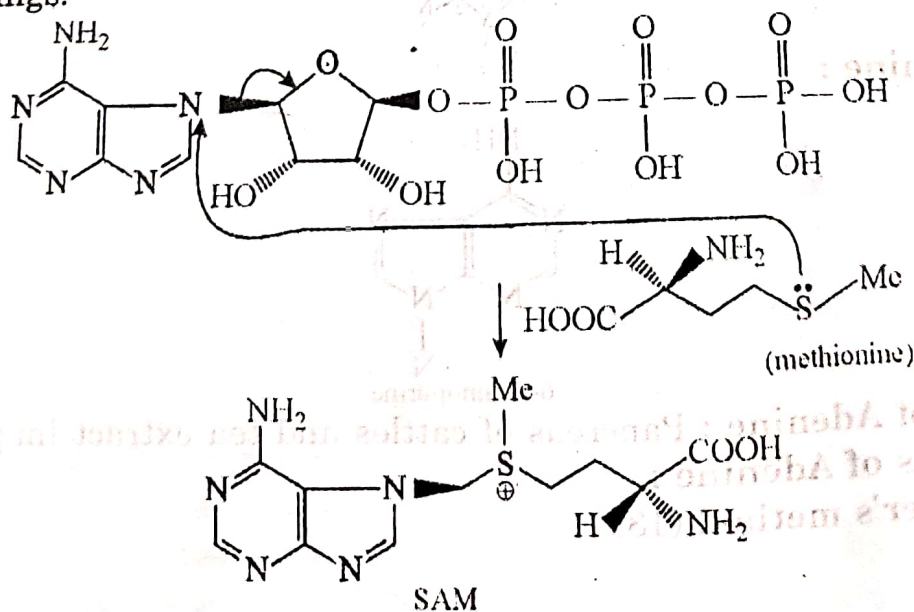
(ii) Traube Synthesis (1904)



(iii) Todd et al. Synthesis (1943)

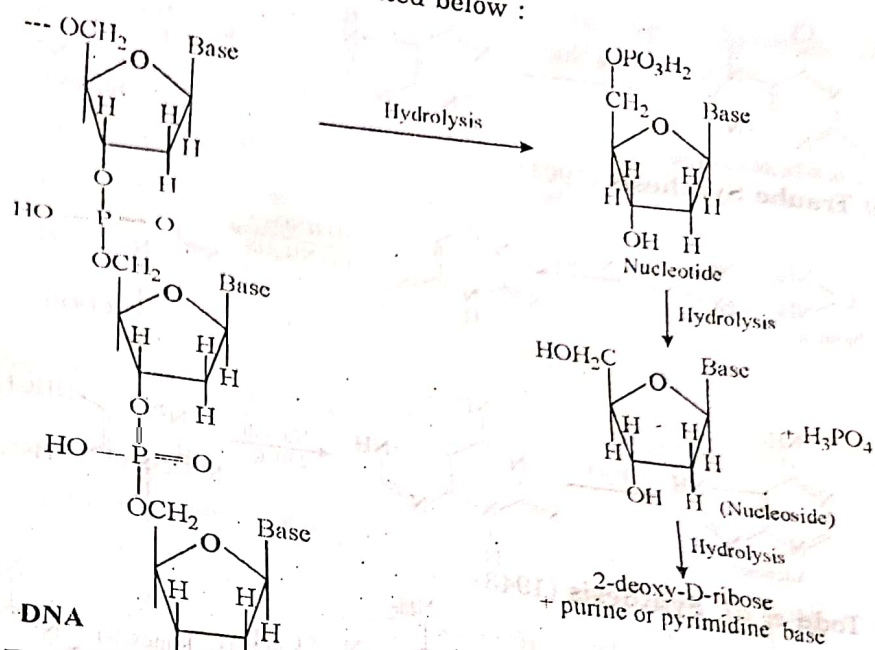


Importance : It is a part of DNA and RNA. Adenosine triphosphate (ATP), source of energy for living beings, also contains it and ATP gets converted into S-Adenosyl methionine (SAM) by methylation with amino acid methionine inside the living beings.



NUCLEOTIDES AND NUCLEIC ACIDS

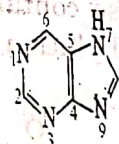
Hydrolysis of DNA is illustrated below :



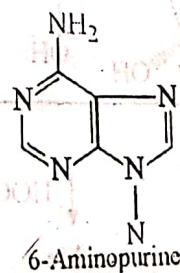
- DNA contains adenine, guanine, cytosine and thymine as bases and deoxyribose sugar + phosphoric acid unit.
 - RNA contains adenine, guanine, cytosine and uracil as bases and ribose sugar + phosphoric acid unit.
- A discussion of all the components of nucleic acids i.e. purine or pyrimidine bases, sugars and phosphoric units and as their combinations in nucleic acids [DNA and RNA] is given below :

(I) Purine and Pyrimidine Bases

(A) **Purine bases** : Purine is a cyclic diureide



(a) **Adenine** :

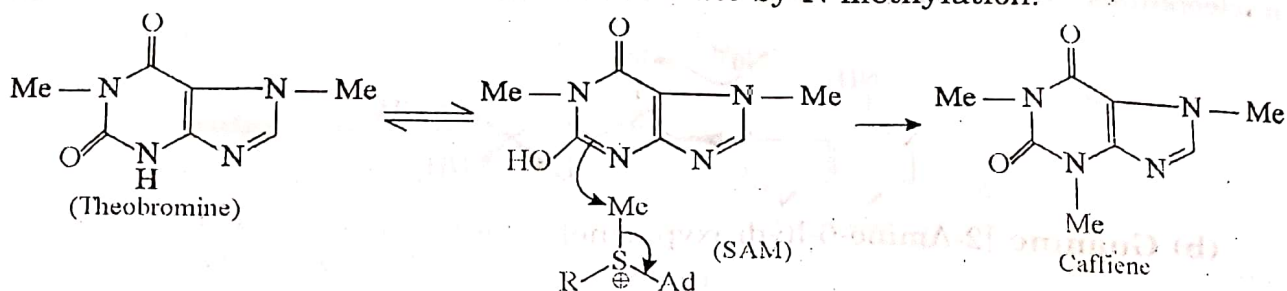


Source of Adenine : Pancreas of cattles and tea extract [m.p. = 3

Synthesis of Adenine :

(i) **Fischer's method (1897)**

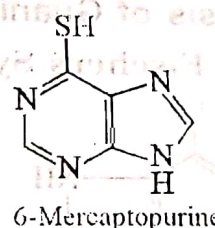
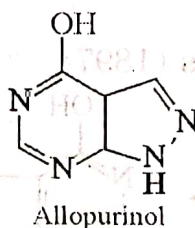
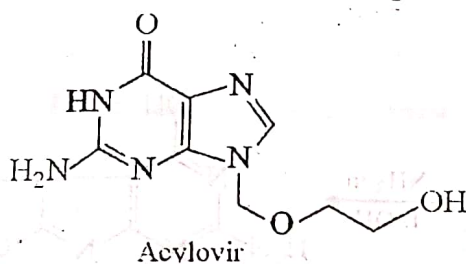
ring as well as amide functionality. It is also because enzyme involved brings both molecules in correct orientation to react by N-methylation.



Medical Applications of Purine bases :

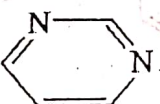
6-Mercaptopurine possess antitumor and antileukemic activities was revealed by Gertrude Elion and George Hitchings (1950). It is used in combination with other chemotherapeutic agents for the treatment of leukemia in children with promising results.

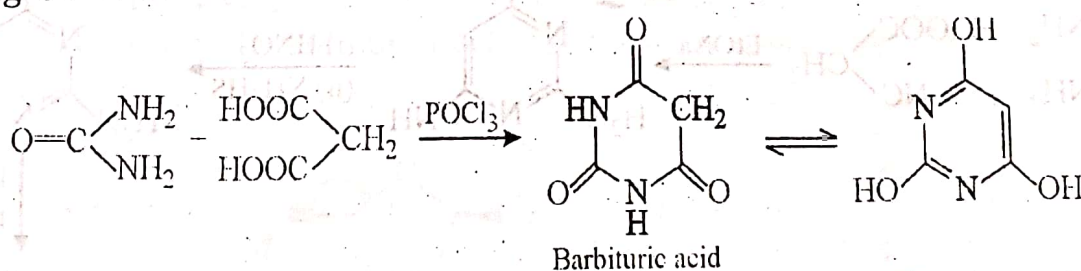
Following purines have good medicinal values :



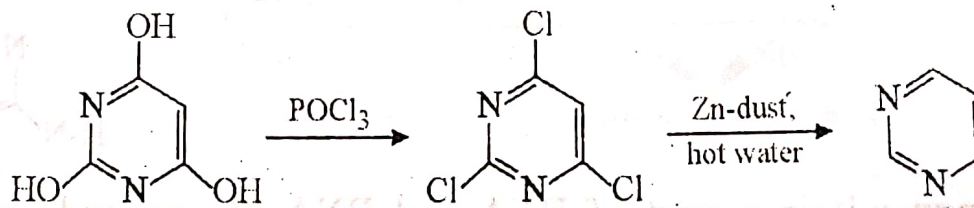
Allopurinol is standard for the treatment of gout whereas, acyclovir, is an effective drug for the treatment of diseases caused by the herpes virus including **herpes simplex** - Type I i.e. fever blisters, Type 2 i.e. genital herpes and varicella-zoster (shingles).

(B) Pyrimidine bases

Pyrimidine nucleus is  and pyrimidine bases present in nucleic acids are : cytosine, thymine and uracil. Pyrimidine nucleus can be created by condensing urea with malonic acid.



From barbituric acid pyrimidine can be obtained in following steps :



Pyrimidine bases present in nucleic acids are described below :