HETEROCYCLIC COMPOUNDS

are organic compounds containing at least one element other than carbon, such as ……..…., ……..... or ……..… within a *ring structure*. The stem '-*cyclic*' implies a .... structure, whereas '*hetero*' refers to an atom other than carbon, as above.

Heterocyclic compounds include …………………………………………… (= *green-plant pigment*), …………………....……......…… (= *it combines reversibly with oxygen and is thus very important in the transportation of oxygen to tissues*), …............………......…………. (= *a blue dye used to make jeans*), tryptophan (=…………….…….……..), and certain polymers. Heterocyclic rings also include pyridoxine (= *vitamin …..……*), vitamin E, …………....………………….....……. (= *a bitter substance derived from certain cinchona barks and used in medicine to treat malaria*), ...………..……….…...........……… (= *the substance in tobacco to which smokers can become addicted*) and …………………...........….... (= *a substance extracted from opium which was used in medicine as an analgesic, an anesthetic, or a sedative*). Some antibiotics (e.g., penicillin) have two different heteroatoms in their rings. Other important heterocyclic compounds are pyrimidine and purine (the parent compounds of the …………………………………………..), purines include ....……………… (= *a bitter alkaloid responsible for the stimulant action of tea, coffee, and cocoa*) and related compounds; barbiturates are derivatives of barbituric acids, they have e.g.sedative and anesthetic effects on CNS and they are used as drugs.
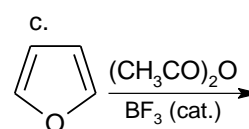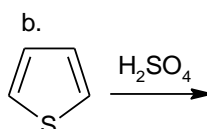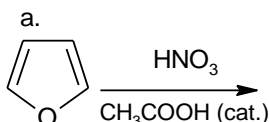
Classification of heterocycles:

5-membered with one heteroatom

FURAN	THIOPHENE	PYRROLE

They have AROMATIC CHARACTER - the heteroatom tends to donate electrons into the π-electron system. Undergo S_E, mainly to the position 2.

1. *Write down the formulae of the products of the following reactions:*

a.

$$\xrightarrow[\text{CH}_3\text{COOH (cat.)}]{\text{HNO}_3}$$

b.

$$\xrightarrow{\text{H}_2\text{SO}_4}$$

c.

$$\xrightarrow[\text{BF}_3 \text{ (cat.)}]{(\text{CH}_3\text{CO})_2\text{O}}$$

PYRROLE

2. *Pyrrole has very low basicity compared to conventional amines. Can you guess why?*

Colourless, toxic, smelly liquid with narcotic effects, occurs in coal tar (černouhelný ....)

Derivatives of pyrrole:

- PORPHIN = biologically important heterocyclic compound of a characteristic chemical structure that includes **four pyrrole groups** linked by carbon atoms to form a large flat ring.

- PORPHYRINS are derived from porphin. As biological pigments, they are responsible for many of the vivid colours in living organisms, where they often occur combined with metal ions.
  - chlorophylls - metal ion = _____
  - haem group – metal ion = _____
  - vitamin B12 – metal ion = _____

- INDOLE – benzoderivate of pyrrole

  It occurs naturally in human faeces and has an intense fecal odor. At very low concentrations, however, it has a flowery smell, and is a constituent of many flower scents (such as orange blossoms) and perfumes. It also occurs in coal tar.

  The most famous derivatives:
  the amino acid tryptophan (the precursor of neurotransmitter serotonin)
   the plant hormone Auxin (indole-3-acetic acid, IAA)
   indigo.

6-membered with one heteroatom

	Liquid with unpleasant smell – it is used for denaturing EtOH for industrial purposes.
	Very good non-polar solvent of organic substances.
PYRIDINE	

HETEROCYCLIC COMPOUNDS

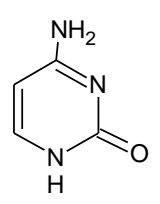The lone electron pair of nitrogen .... involved in the aromatic π-electron system → ....
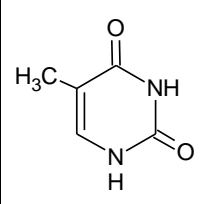character:

_____ + H_2O →
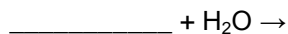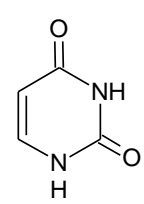
Pyridine derivatives:
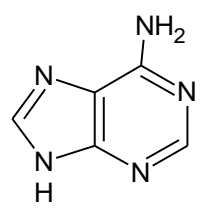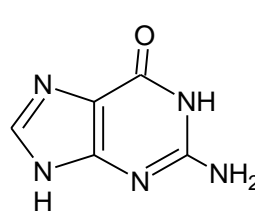
3. *Write the formula for nicotinic acid knowing its systematic name is pyridine-3-carboxylic acid*

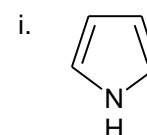|	
NICOTINIC ACID	NICOTINAMIDE

6-membered with two heteroatoms

PYRIMIDINE			

Condensed heterocycles

PURINE		

4. *Name the following heterocycles:*

a.

b.

c.

d.

e.

f.

g.

h.

i.
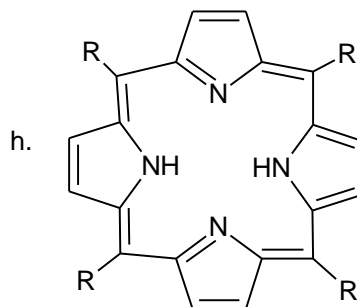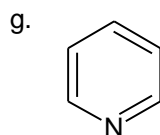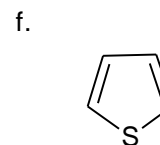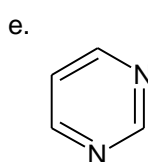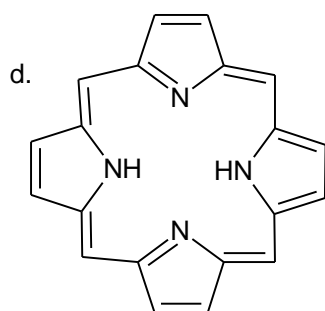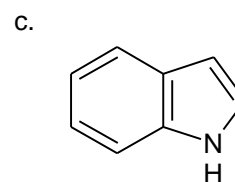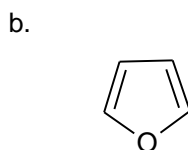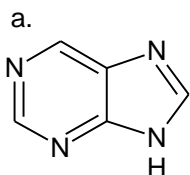
ALKALOIDS

= heterocyclic compounds containing basic .... atom, mostly of .... origin, with a .... taste

Physiological effects:

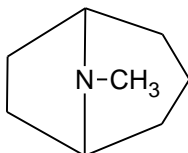- pharmacological effects:

  -
  -
  -
  -
  -
  -
  -

- toxins:

- recreational drugs:

Biological function:

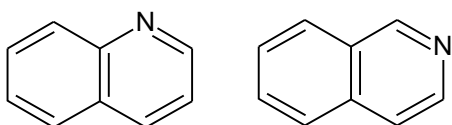**Classification:** according to the type of the heterocycle

1. **with pyridine cycle**
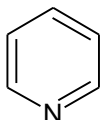
NICOTINE:

CONIINE:

2. **tropane alkaloids**

ATROPINE:

COCAINE:

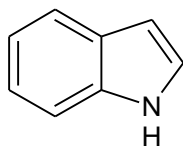3. **with quinoline and isoquinoline cycle**

QUININE:

Opium alkaloids

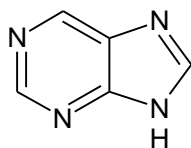**Opium =**

PAPAVERINE:

MORPHINE:

CODEIN:

4. **with indole cycle**

STRYCHNINE:

LYSERGIC ACID:

5. **with purine cycle**

CAFFEINE: