

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.

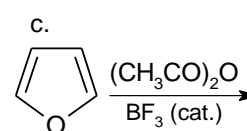
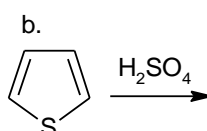
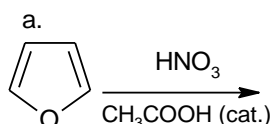
Classification of heterocycles:

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:



PYRROLE

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



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

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)

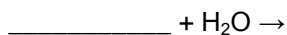
the plant hormone Auxin (indole-3-acetic acid, IAA)

indigo.

6-membered with one heteroatom

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

The lone electron pair of nitrogen involved in the aromatic π -electron system \rightarrow
character:

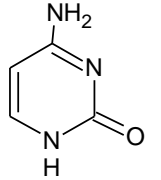
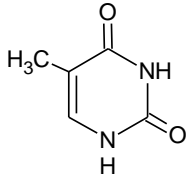
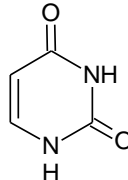


Pyridine derivatives:


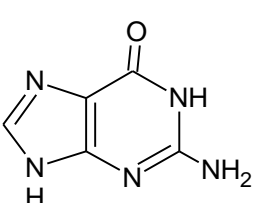
3. Write the formula for nicotinic acid knowing its systematic name is pyridine-3-carboxylic acid

NICOTINIC ACID	NICOTINAMIDE

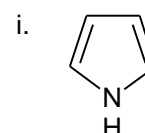
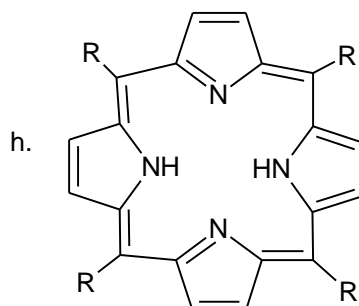
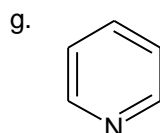
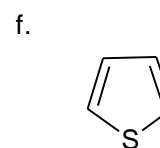
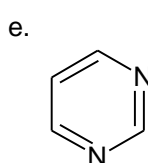
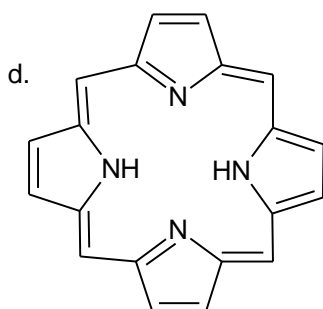
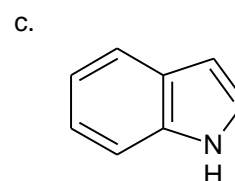
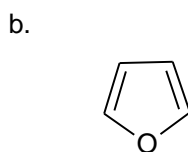
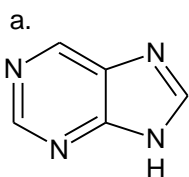
6-membered with two heteroatoms

			
PYRIMIDINE			

Condensed heterocycles

		
PURINE		

4. Name the following heterocycles:



ALKALOIDS

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

Physiological effects:

- pharmacological effects:

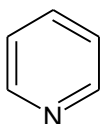
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- toxins:
- recreational drugs:

Biological function:

Classification: according to the type of the heterocycle

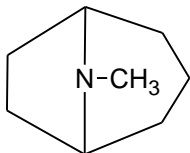
1. with pyridine cycle



NICOTINE:

CONIINE:

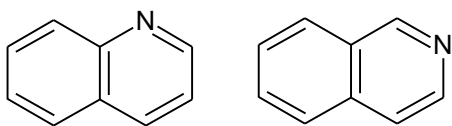
2. tropane alkaloids



ATROPINE:

COCAINE:

3. with quinoline and isoquinoline cycle



QUININE:

Opium alkaloids

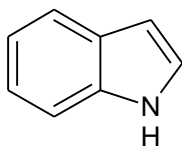
Opium =

PAPAVERINE:

MORPHINE:

CODEIN:

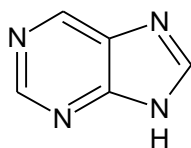
4. with indole cycle



STRYCHNINE:

LYSERGIC ACID:

5. with purine cycle



CAFFEINE: