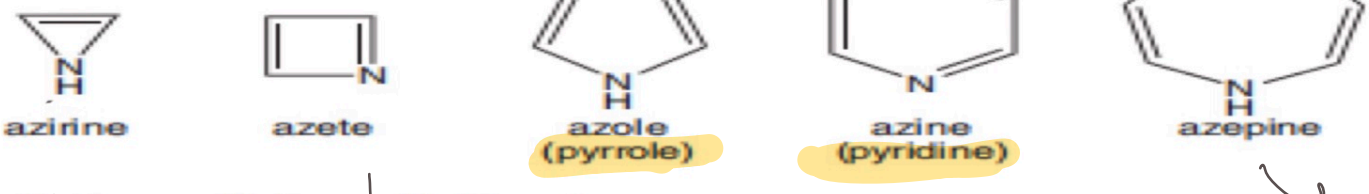
A. Nitrogen Heterocyclic Parents



N 3C unsat
Aza + ir + ine
Azirine

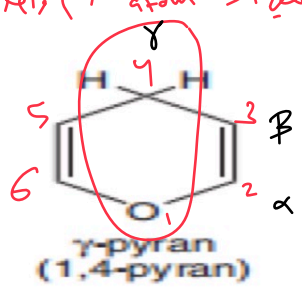
N 4C uns(4C)
Aza + et + e
Azete

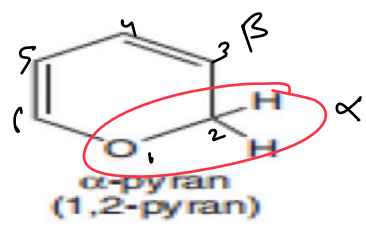
N 5C unsat(5C)
Aza + ol + e
Azole

N 6C unsat(6C)
Aza + in + e
Azine

N 7C unsat.(7C)
Aza + ep + ine
Azepine

B. Oxygen Heterocyclic Parents





O 3C unsat
oxa + ir + ine
oxirine / oxirene

O 4C unsat(4C)
oxa + et + e
oxete

O 5C unsat(5C)
oxa + ol + e
oxole

O 6C unsat
oxa + in + e
oxine

O 7C unsat
oxa + ep + ine
oxepine

1,2 - oxepine
1,2 - Pyran
α - pyran

ولكن هذا المركب fully unsaturated فلازم أعدد مكان اضافة ال 2H.

1,4 - oxine
1,4 - pyran
γ - Pyran

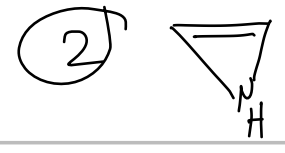
ملاحظة: ① في حال كان المركب non-fully unsaturated يعني أنا كسرت رابطة ثنائية وأضفت H نكون لازم أعدد مكان اضافة ال H بأرقام

② في حال كانت الكربونة يلي ضفت عليها H على نفس الرابطة مع الذرة الـ heteroatom يعتبر المركب fully unsaturated

مثال: (أضفنا H ولكن الكربونة المتصلة فيها مرتبطة بال O)

أشياء تعامل معاملة fully unsaturated:

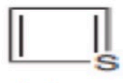
① (دائما متصلة بكربون متصلة جنب ال O)

② 

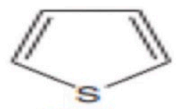
ملاحظة: غوردان اسمي هذا المركب لا يعتبر غير مشبع بشكل كامل (يعني ناقصة رابطة ثنائية) ولكن مع هيك انا اعتبرناه غير مشبع بشكل كامل لأنه مكان اضافة ال H على كربونة عالطرف رابطة مع الـ heteroatom (O).

C. Sulfur Heterocyclic Parents

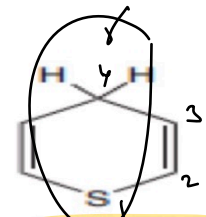
thiirene



thiete



thiole (thiophene)



γ-thiopyran

لما الحلقة كبرت صار صعب أحط رابطة ثنائية جنب الـ S.

S 3C fully unsaturated

Thia + ir + ine

Thiirine

/Thiirene

S 4C fully unsaturated (4C)

Thia + et + e

Thiete

S 5C unsaturated (5C)

Thia + ol + e

thiole

S 6C non-fully unsaturated

Thia + in + e

1,4 — thiine

γ - Thiine

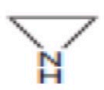
γ - thiopyran

D. Some Saturated Rings

N 3C saturated (N)

Aza + ir + idine

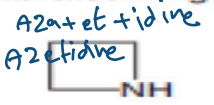
Az iridine



aziridine (ethyleneimine)

Aza + et + idine

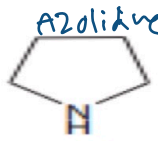
Azetidine



azetidine

Aza + ol + idine

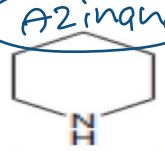
Azolidine



azolidine (pyrrolidine)

Aza + in + ane

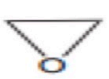
Azinane



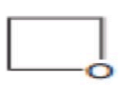
hexahydropyridine (piperidine)

hexahydropyridine

حلقة مشبعة جميع ذراته N

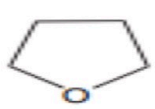


oxirane (ethylene oxide)



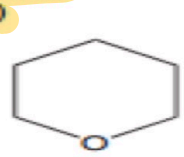
oxetane

oxa + et + ane



oxolane (tetrahydrofuran)

Oxa + ol + ane



oxane (tetrahydropyran)

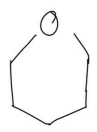
حلقة مشبعة جميعها O

oxa + in + ane

oxinane X

oxane

- Also, the name oxane, not oxinane, is used for the 6-membered ring with O present.
- Otherexceptions exist for P, As, and B rings, but they will not be given here.



oxane

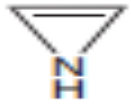
oxa + in + ane

oxinane

حلقة مشبعة ذراتها O

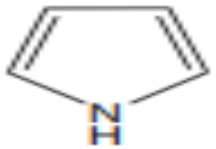
Table 2.2. IUPAC and Common Names for Monocyclic Heterocycles

A. Nitrogen Heterocyclic Parents

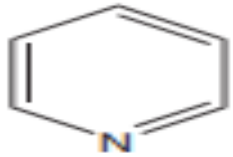


azirine

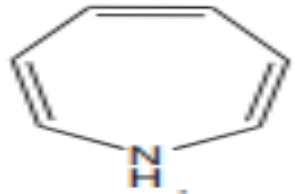
azete



azole
(pyrrole)



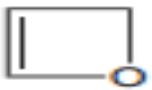
azine
(pyridine)



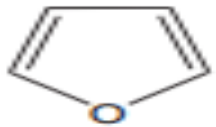
azepine

B. Oxygen Heterocyclic Parents

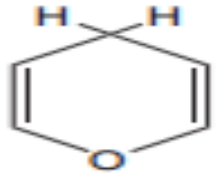
oxirene



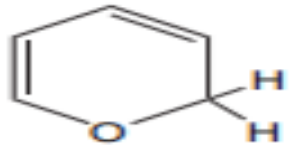
oxete



oxole
(furan)



γ-pyran
(1,4-pyran)

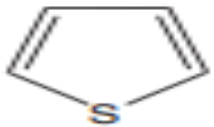


α-pyran
(1,2-pyran)

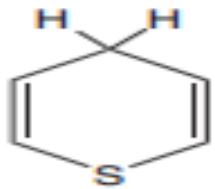
C. Sulfur Heterocyclic Parents

thiirene

thiete

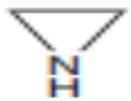


thiole
(thiophene)



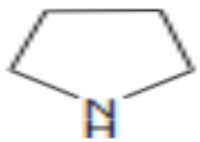
γ-thiopyran

D. Some Saturated Rings

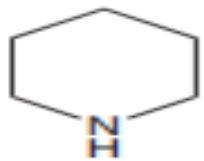


aziridine
(ethyleneimine)

azetidine

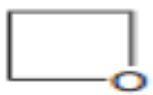


azolidine
(pyrrolidine)



hexahydropyridine
(piperidine)

oxirane
(ethylene oxide)



oxetane

oxolane
(tetrahydrofuran)

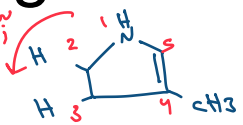
oxane
(tetrahydropyran)

لما يكون المركب مش غير مشبع بالكامل (يعني أنا شلت منه رابطه ثنائية وأضفت هيدروجين) لما أسمي المركب لازم أحدد مكان الإضافة #.

- saturation of the double bonds by designating with numbers the positions on the ring where hydrogen has been added.

عشان أحدد مكان الإضافة → Two Rules ① → نعطي رقم واحد للـ heteroatom

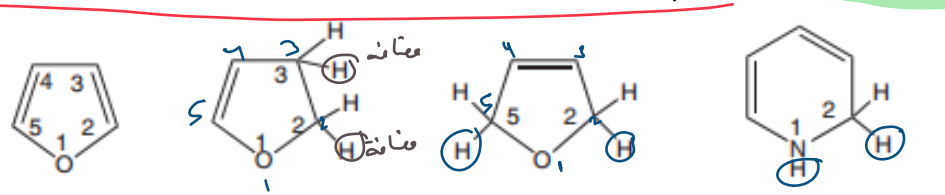
② ↳ بنهيرقم باتجاه الارتباط (اللي باتجاه رابطة ثنائية)



- For this purpose,the heteroatom is designated position 1 on the ring, and the numberingproceeds through the site of hydrogenation.
- If one double bond isremoved, the prefix dihydro- is used;
- with two double bonds removed,it is tetrahydro-.

① اذا شلت رابطة ثنائية و أضفت عليها 2H بسمي المركب dihydro

② اذا شلت رابطتين ثنائيتين و أضفت عليهم 4H بسمي المركب tetrahydro



عشرة رابطة ثنائية و اضفنا 2H

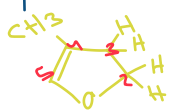
oxa+tal+c

oxalol

2,3-dihydro oxalol

2,3-dihydro furan

example



التمرينات تكتب عشرة

4-methyle-2,3-dihydro furan

③ اذا شلت كل الـ double bonds بسمي Perhydro

Perhydro

6 hexa hydro

وحسب عدد الذرات بسمي ←

Handling the "Extra Hydrogen"

Heterocycles with maximum number of double bonds which can be arranged in more than one way.

Examples

X H

طريقة تسمية

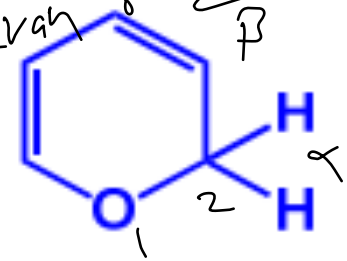
موقع الإضافة بالنسبة لـ heteroatom

Pyrans

سداسي + O

① 1,2-Pyran

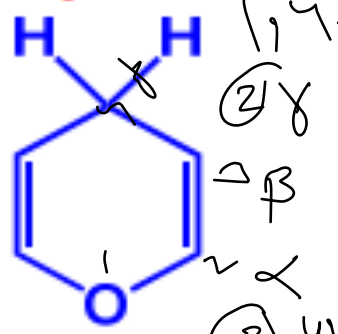
② α-Pyran



Double bonds @ 2 and 4

① 1,4-Pyran

② γ-Pyran



③ 4H-Pyran

Double bonds @ 2 and 5

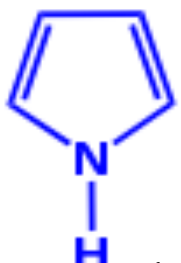
③ 2H-Pyran

ودائماً الشيء أو الـ H من حيث التسمية.

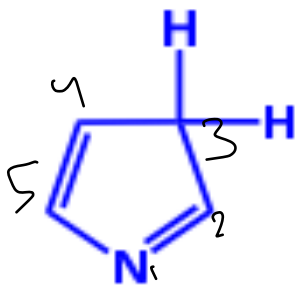
Pyrroles

خماسي + N

Double bonds @ 2 and 4



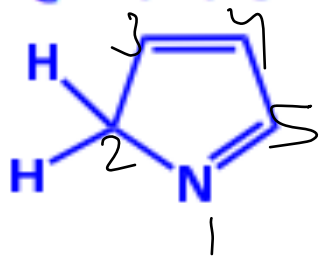
Pyrrole



Double bonds @ 1 and 4

3H-Pyrrole

Double bonds @ 1 and 3



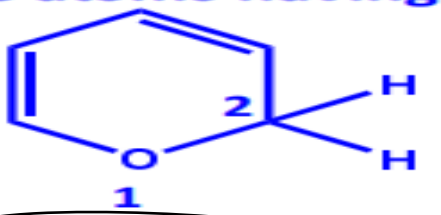
2H-Pyrrole

Therefore, should have different names.

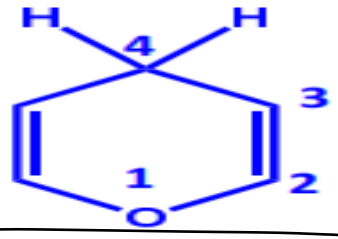
This is a special problem resulting from isomerism in the position of the double bonds which is sometimes referred to as "extra-hydrogen" and this can be addressed by simply adding a prefix that indicates the number of the ring atom that possesses the hydrogen using *italic capital* '*1H*' '*2H*' '*3H*', etc. The numerals indicate the position of these atoms having the extra hydrogen atom.

هذا كله ممكن اه بالتالي

صوره كبير ماكل H



2*H*-Pyran



4*H*-Pyran

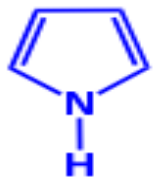
2H - ← عنا هيد روجينه زياده خلا كربونه رقم 2

3H - ← عنا هيد روجين زياده خلا كربونه رقم 3

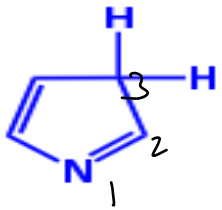
4H - ← عنا هيد روجينه زياده خلا كربونه رقم 4

The saturated position takes priority in numbering.

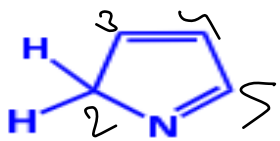
Pyrrole → حلقة خماسية N



1*H*-Pyrrole (Pyrrole)



3*H*-Pyrrole



2*H*-Pyrrole

① رقم واحد لـ heteroatom

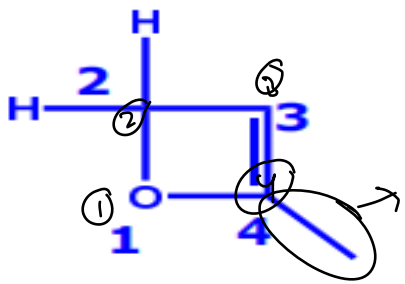
② تشبع بإيجاد saturation (بإيجاد الأقرب للمكان بلي قبله)

③ نزمة التفرع

④ بالتسمية نضع التفرع أولاً

اسم الحلقة - XH - تفرع

فقط تتضمن فإذا كان هنا زيادة H واحده فقط.

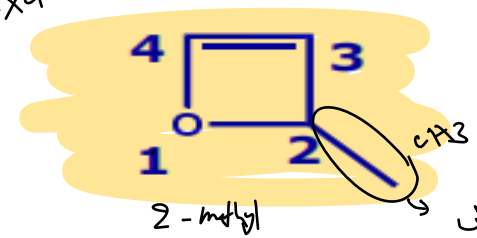


تفرع CH3

4-Methyl-*2H*-oxete

4 - methyl - 2H - oxete

oxa + ete



2 - methyl

هون على كربونة 2 اي مع بعض ← إضافة H

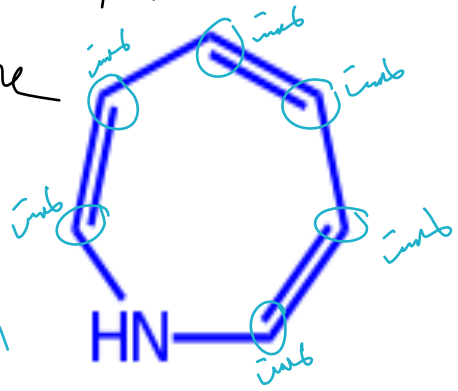
تفرع CH3

2-Methyl-*2H*-oxete

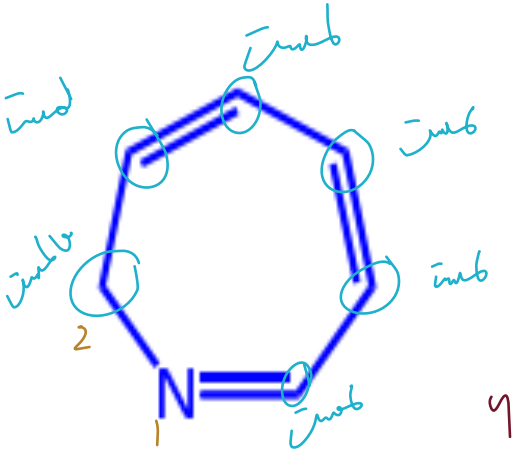
N 7C uns

Azatetpine

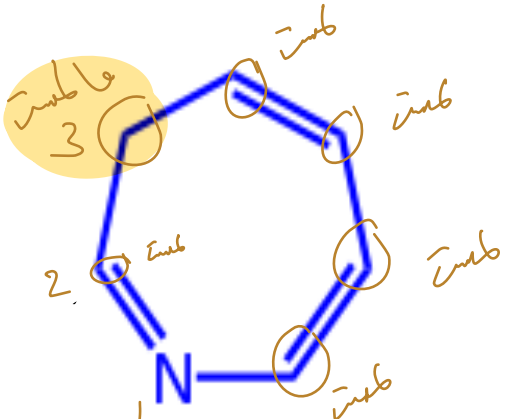
Azepine



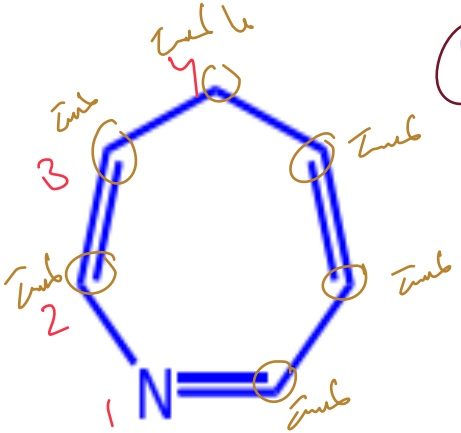
Azepine



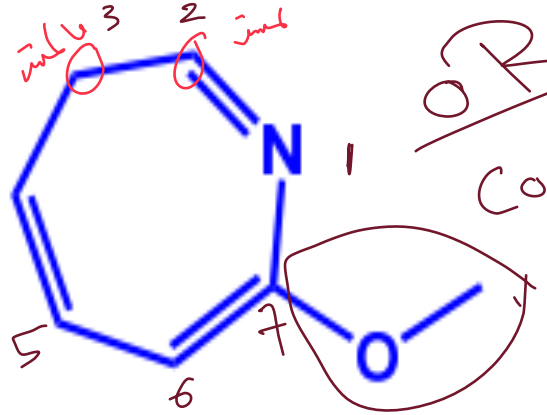
2H-Azepine



3H-Azepine



4H-Azepine



7-Methoxy-3H-azepine

OR

CoCH3

oxy methyl

methoxy

- في حال ما رسم H الإضافة شو أعمل، كيف أعرف مكانهم؟

بشوف الأنواع الكربونية اللي ما حست الرابطة الثنائية هي الكربون اللي أخذتها H.

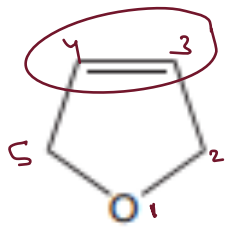
كيف طرا الرابطة الثنائية ← ما أخذ A عليها.

بنمشي لـ كربون اللي ما حست ونمشي فيها بالاتجاه الأقصر. كيف نعطيها أقل رقم ممكن.

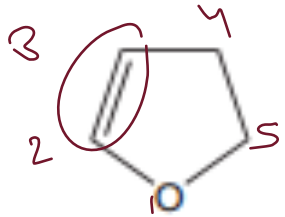
- OR
- OCH3 (methoxy)
- OCH2CH3 (ethoxy)
- ...

There is an alternative system, sometimes useful in complex structures, where the position of the remaining double bond in a partially hydrogenated compound is indicated by a Greek "delta" with a superscript of the ring positions bearing the double bond. Using the dihydro furans as examples, we have the following:

3,4
Δ – dihydrofuran



$\Delta^{3,4}$-dihydrofuran



$\Delta^{2,3}$-dihydrofuran

$\Delta^{2,3}$ – dihydrofuran

furan حلقة فيها
O ٥

alternative system ← يستخدم بـ complex structures ← delta Δ

تعبّر عن مكان وجود الرابطة الثنائية بالمركب

- النظام الأول Δ كان بين X H ← مكان إضافة H
double bond وليس مكان الـ
(قد يكون single)

- النظام الثاني $\Delta^{-,-}$ ← يعبر عن مكان الـ double bond
(قد يكون الـ double)

① $\Delta^{-,-}$

② dihydro / tetrahydro

كم زوج اتي يعبر عن الـ H .

5,6

معناها صناك double bond بين ذرة رقم 5 ورقم 6

??

1,2

معناها صناك double bond بين ذرة رقم 1 ورقم 2 .

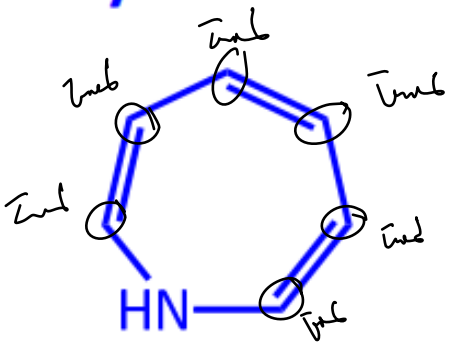
- dihydro / tetrahydro ← تستخدم اذا كان صناك اضافة H مكثر من

2,3-dihydro.... ؟ يعني تم اضافة H على 2 و 3 وكسرا الرابطة الثنائية بين ذرة 2 وذرة 3

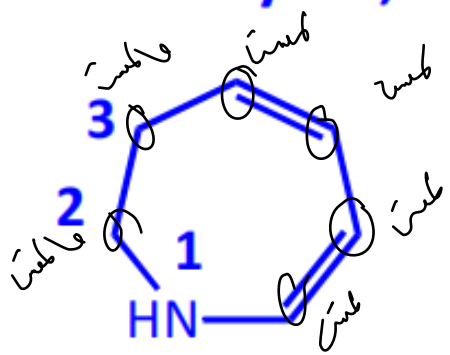
2,3,4,5-tetrahydro ← الذرات 2, 3, 4, 5 تم كسرا الرابطة الثنائية وتم اضافة الهيدروجينات عليهم .

Partial Unsaturation

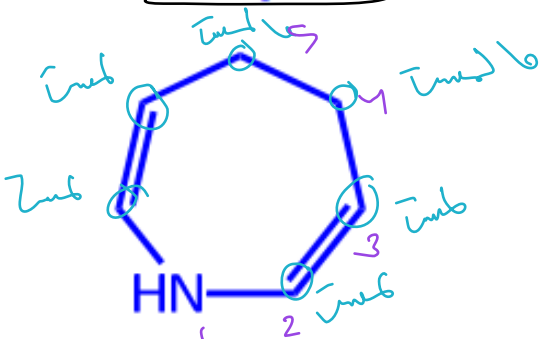
Use fully unsaturated name with dihydro, tetrahydro, etc



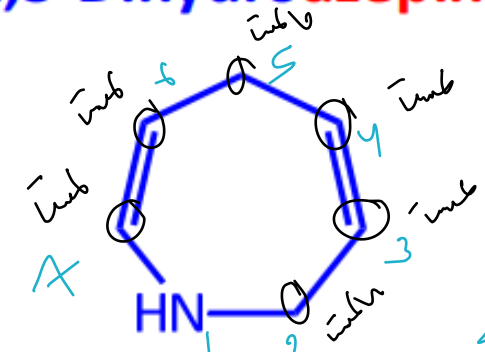
Azepine



2,3-Dihydroazepine

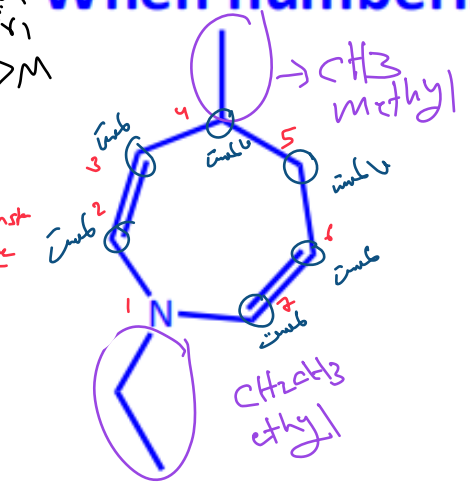


4,5-Dihydroazepine

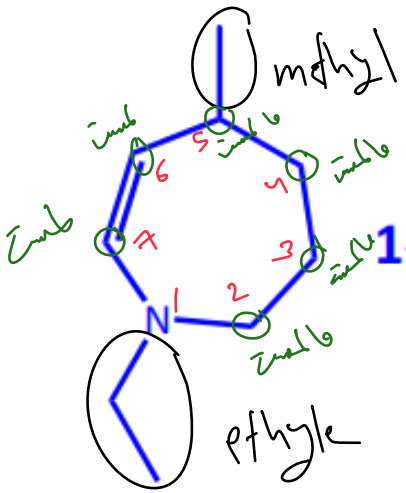


2,5-Dihydroazepine

When numbering give priority to saturated atoms.



1-Ethyl-4-methyl-4,5-dihydroazepine



1-Ethyl-5-methyl-2,3,4,5-tetrahydroazepine

الجدول اللي عندنا

Stems for 3-10 membered heterocycles

Ring Size	Unsaturation	Saturation
Three	irene(a)	irane(b)
Four -	ete	etane(b)
Five-	ole	olane(b)
Six- A	ine	ane
B	ine	inane
C	inine	inane
Seven-	epine	epane
Eight-	ocine	ocane
Nine-	onine	onane
Ten-	ecine	ecane

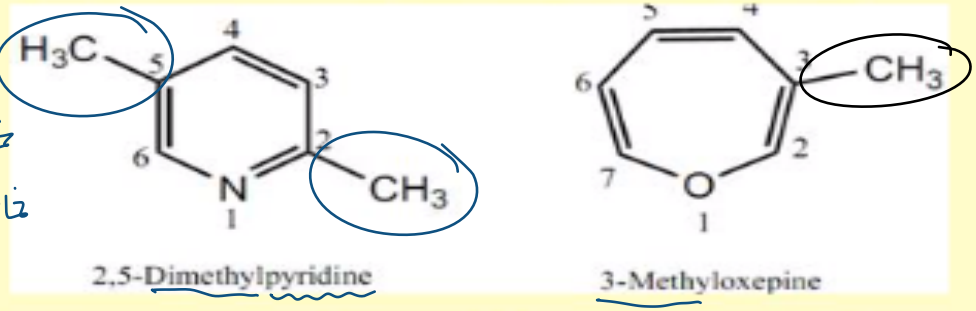
Prefixes for heteroatoms (decreasing order of priority)

Heteroatom	Valence	Prefix
Oxygen O	II	Oxa
Sulfur S	II	Thia
Selenium	II	Selena
Tellurium	II	Tellura
Nitrogen N	III	Aza
Phosphorous P	III	Phospha
Arsenic	III	Arsa
Antimony	III	Stiba
Bismuth	III	Bisma
Silicon	IV	Sila
Germanium	IV	Germa
Tin	IV	Stanna
Lead	IV	Plumba
Boron	III	Bora
Mercury	II	Mercura

Rules

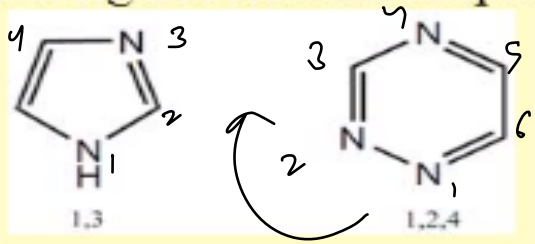
Numbering

With one heteroatom: The numbering starts from the heteroatom giving the position-1 and proceeds in such a way as to give the lowest possible locant to the substituent if present.



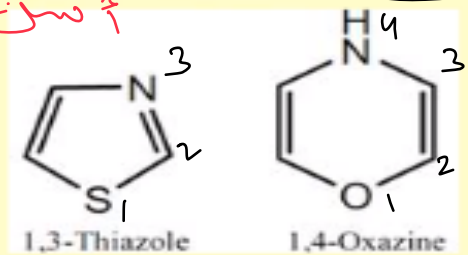
2,5-Dimethylpyridine — 3-Methyloxepine

With two or more identical heteroatoms: The ring is numbered in such a way that the heteroatoms are assigned the lowest possible set of number of locants.



1,3 — 1,2,4

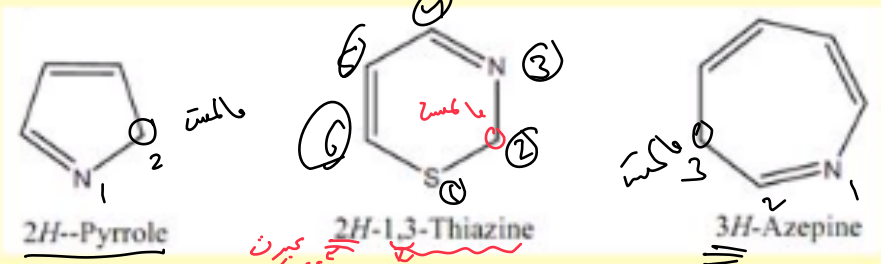
With two or more different heteroatoms: The numbering starts from the heteroatom with the highest preference as in the table (O>S>N…). The remaining heteroatoms are given lowest number locants.



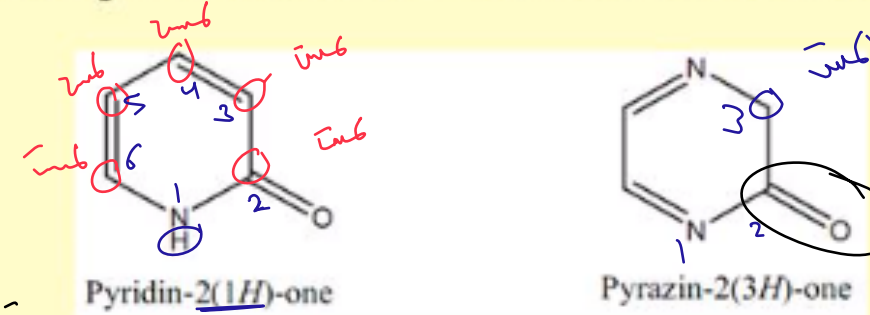
1,3-Thiazole — 1,4-Oxazine

Presence of saturated atom (indicated hydrogen)

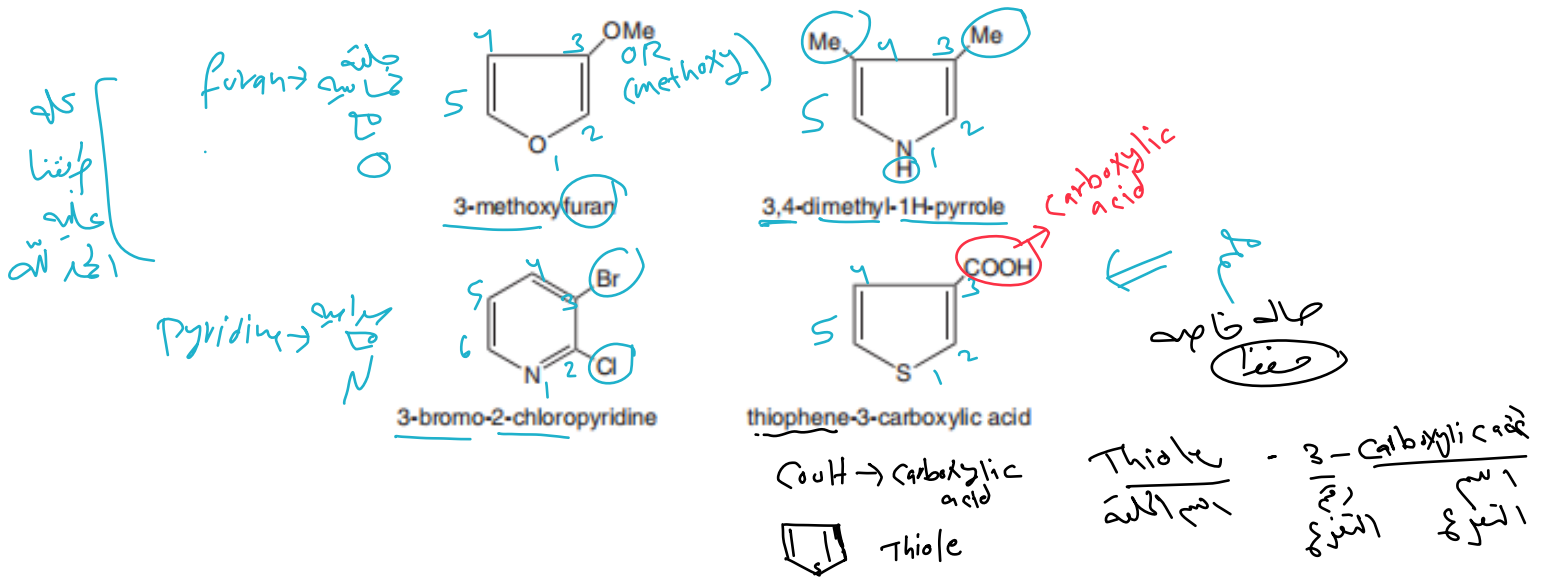
- When heterocyclic ring with maximum number of noncumulative double bonds contains a saturated atom, its position is given the lowest possible locant and is numerically indicated by an italic capital *H* before the name of heterocyclic ring system.



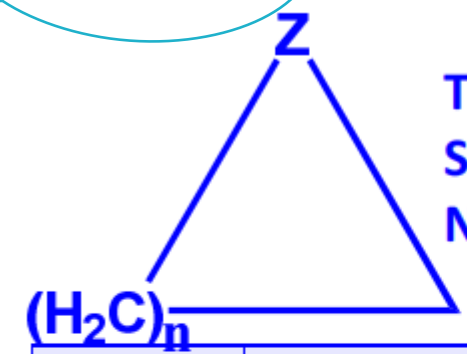
- However, the heterocyclic system in which a carbon atom of the ring is involved in the carbonyl group, the indicated hydrogen is normally cited as an italic capital *H* in parenthesis after the locant of the additional structural features.



- 2.4. SUBSTITUTED MONOCYCLIC COMPOUNDS
- With the rules discussed previously, we can name any parent mono□cyclic heterocycle with a single heteroatom, in any state of unsaturation.
- Compounds in which ring hydrogen is replaced by one or more of thecommon functional groups of organic chemistry also are readily named,by assigning numbers to the ring atom(s) bearing the substituents,
- RINGS WITH MORE THAN ONE HETEROATOM starting with the heteroatom as number 1. The functional groups areplaced alphabetically in the name. Some examples are as follows:



Revision



Type (Z) - Prefix
Size (n) - Suffix
Nature of ring - Ending

Hetreroatom	Prefix
O	Oxa
N	Aza
S	Thia
P	Phospha

Ring size	Saturated	Unsaturated	Saturated (With Nitrogen)
3	-irane	-irine	-iridine
4	-etane	-ete	-etidine
5	-olane	-ole	-olidine
6	-inane	-ine	
7	-epane	-epine	
8	-ocane	-ocine	
9	-onane	-onine	
10	-ecane	-ecine	

ملخص

① زيادة H واحدة فقط بشرط :

اسم — X H

موقع الـ H الزيادة. على الـ vinyl

example

اسم — 4 H

الكربون يلي ما لمست الرابطة الثنائية

هنا H زيادة على ذرة كربون رقم 4.

② زيادة أكثر من H بشرط :

اسم ___ di hydro

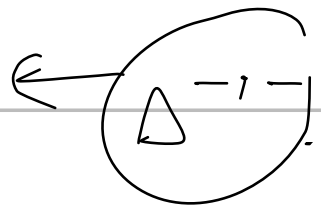
اكربونات يلي ما لمست الرابطة الثنائية

اسم ___ tetra hydro

اكربونات يلي ما لمست الرابطة الثنائية

③ كيف يكون الـ Double Bond :

الرابطة الثنائية هي
الذرة رقم — والذرة رقم —



اسم dihydro

RINGS WITH MORE THAN ONE HETEROATOM

- The usual rules for stems to indicate **ring size and suffixes for degree of saturation are used, as are the**
  - **prefixes for the various heteroatoms**.
- They are listed in the following order of priorities, derived from the main groups of the Periodic System, and then within each group by increasing atomic number:
- Group VI (O > S > Se > Te) > Group V (N > P > As) > Group IV (Si > Ge) > Group III (B).

prefix → heteroatom
suffix → ring size + degree of saturation

O > S > Se > Te > N > P > As > Si > Ge > B

مجموعة سادسة — مجموعة خامسة — مجموعة رابعة — مجموعة ثالثة

داخل كل مجموعة الأولوية لزيادة العدد الذري

(أ) Each heteroatom is then given a number as found in the ring, with that of highest priority given position 1

(ب) A saturated heteroatom with an extra-hydrogen attached is given priority over an unsaturated form of the same atom, as in 1H-1,3-diazole (see the following discussion).

(ج) The numbers are grouped together in front of the heteroatom listings (thus, 1,3-oxazole, not 1-oxa-3-azole).

(د) The heteroatom prefixes follow the numbers in the priorities given previousl

(ه) Punctuation is important; in the examples to follow, a comma separates the numbers and a dash separates the numbers from the heteroatom prefixes.

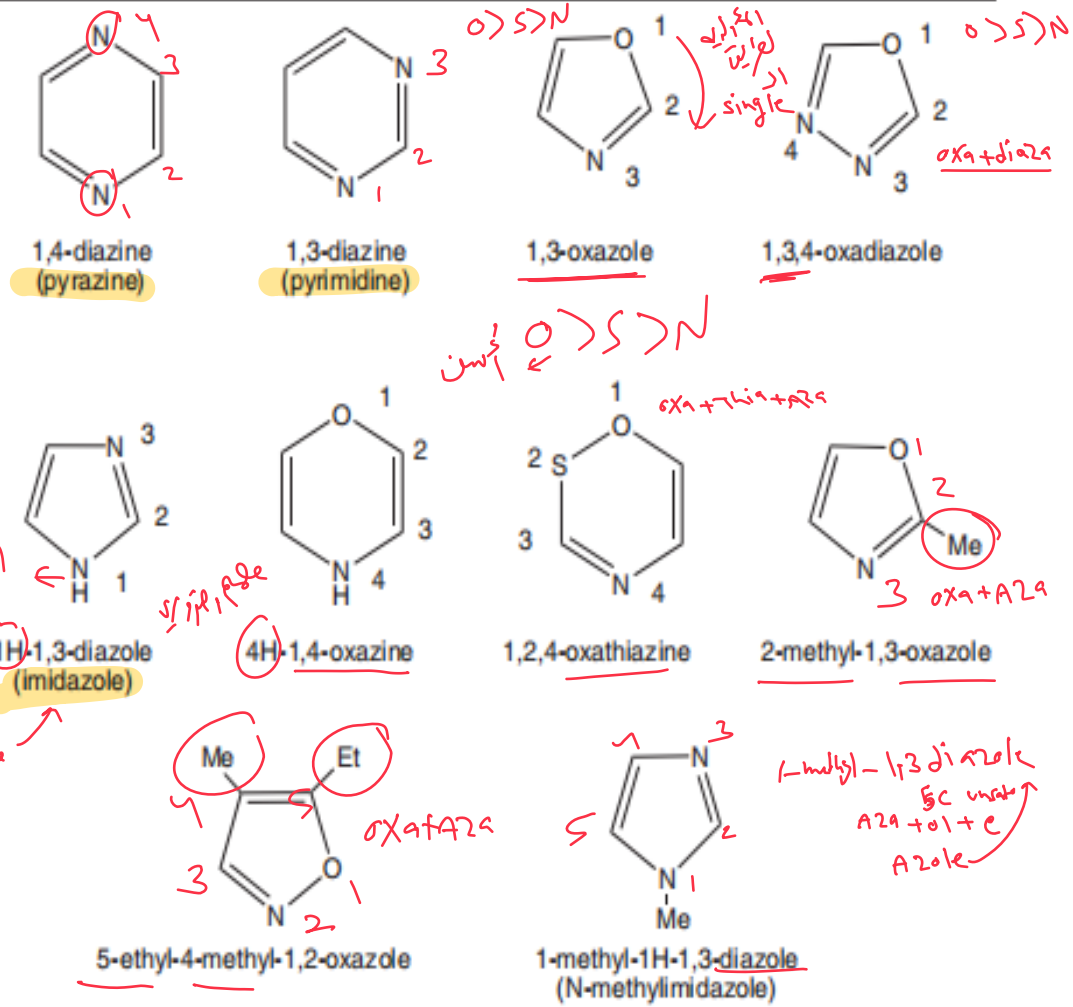
number , number — Name

comma

dash

- A slight modification is used when two vowels adjoin; one is deleted, as in the listing for "oxaaza," which becomes simply "oxaza."
- As for monohetero systems, substituents on the ring are listed alphabetically with a ring atom number for each (not grouped together).

Table 2.3. Some Multiheteroatom Systems



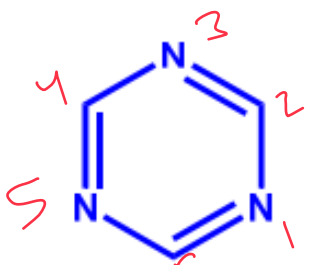
8

Two or more similar atoms contained in a ring are indicated by the prefixes *'di-', 'tri', etc.*

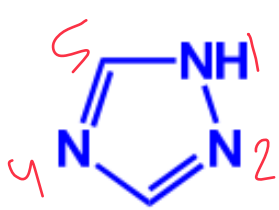
6c unsatu

3 A 2a +in +e

Tri a2ine



1,3,5-Triazine

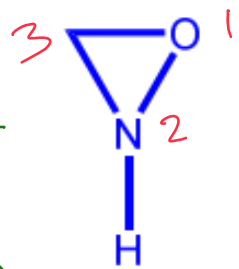


1,2,4 - Triazole

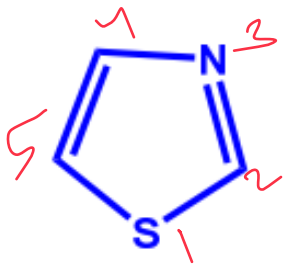
If more than one hetero atom occur in the ring, then the heterocycle is named by combining the appropriate prefixes with the ending in Table I in order of their preference, O > S > N.

More examples

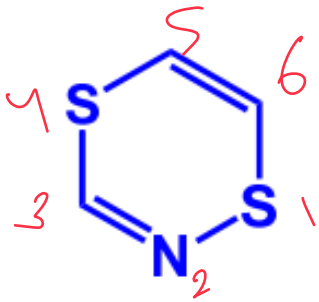
O > S > N



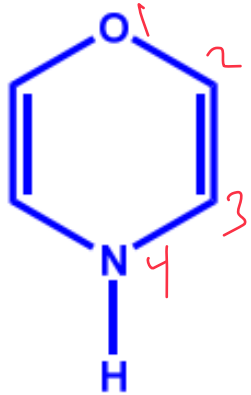
Oxaziridine



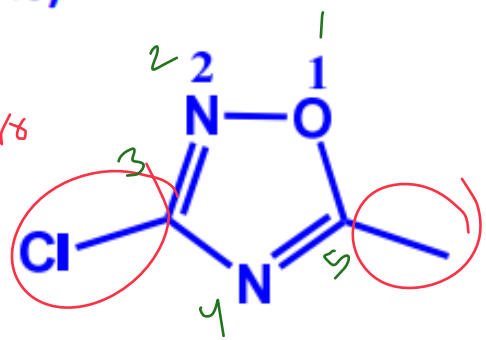
1,3-Thiazole
(Thiazole)



1,4,2 - Dithiazine

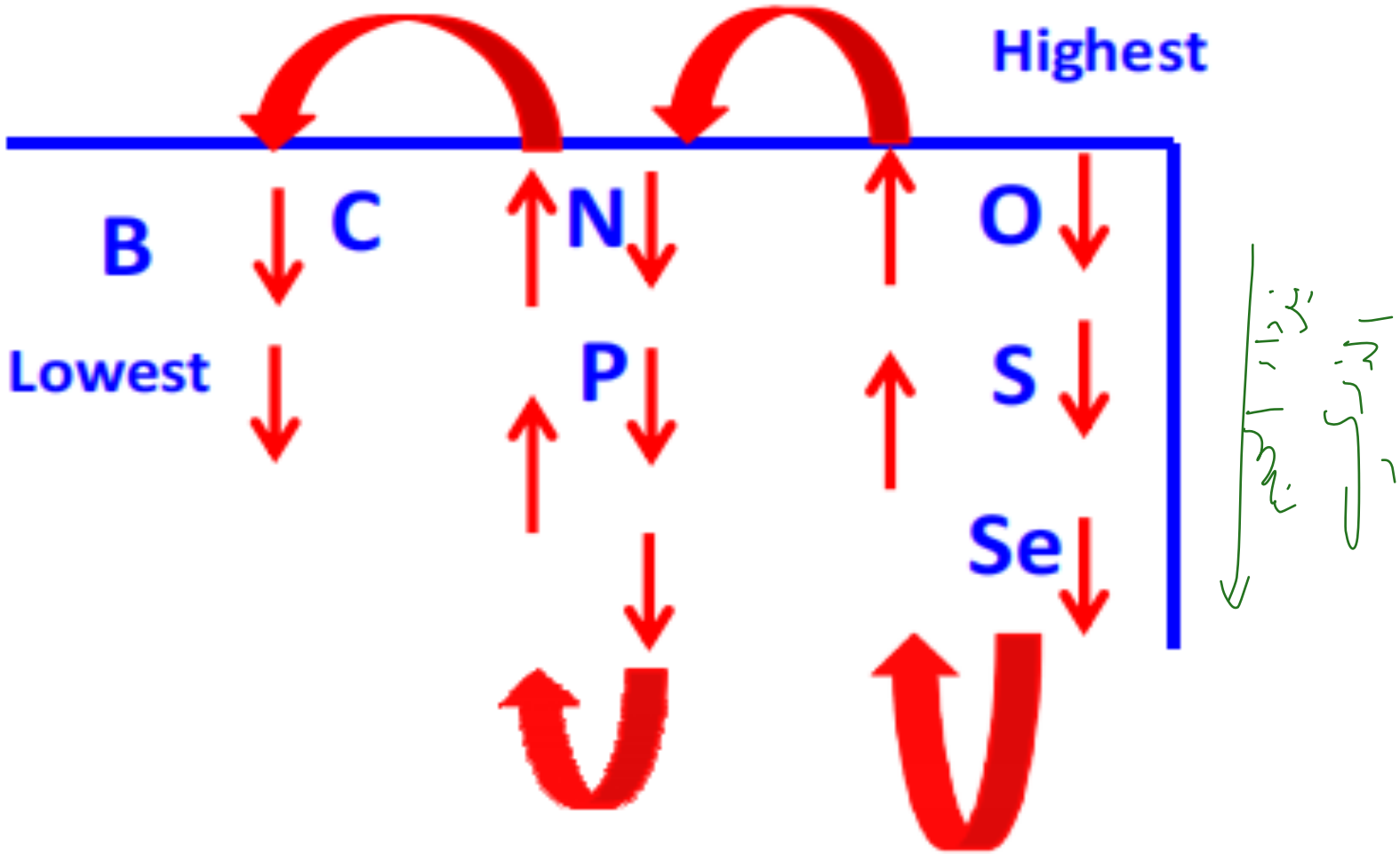


1,4-Oxazine



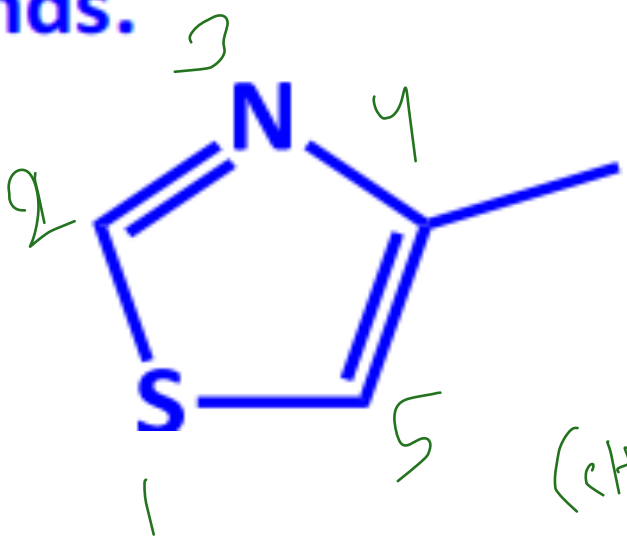
3-chloro-5-methyl-1,2,4-oxadiazole

Priority of heteroatoms for numbering purposes:



9

The ring is numbered from the atom of preference in such a way so as to give the smallest possible number to the other hetero atoms in the ring. As a result the position of the substituent plays no part in determining how the ring is numbered in such compounds.



4-Methyl-1,3-thiazole

ex) ثيازول) أول من التعريف hetero atoms ال