VMC Vidyamandir Classes SINCE 1986

IIT JEE | MEDICAL | FOUNDATION

Introduction to organic chemistry

IOC

Topics included:

(1) Nomenclature

(2) GOC-I (Electronic displacement effects)

(3) GOC- II (Stability of intermediates)

(3) GOC-III (Acidity & Basicity)

(4) Isomerism

Basicity / Basic strength ⟶

$B^{\ominus} \xrightarrow{H^+} BH$

$\ddot{B} \xrightarrow{H^+} BH^+$

Base — Conjugate acid

Basicity $\propto$ Stab. of conjugate acid

$\propto K_b \propto \frac{1}{pK_b}$

$\propto pH \propto \frac{1}{pOH}$

* EDG $(+M, H.C, +I)$ stabilize conj. acid.

$+M > H.C. > +I$

* EWG $(-M, -I)$ destablize conj. acid.

$-M > -I$

* Delocalised lone pair will be less basic
* Localised lone pair will be more basic.

Q. write basicity order ?

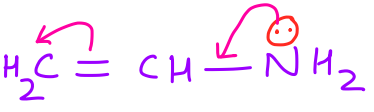
(1) $CH_3-CH_2-\ddot{N}H_2$

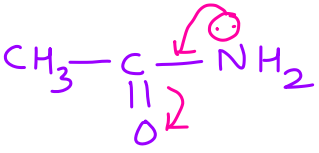
ethanamine

Aniline

Aliphatic amines > Aromatic amines a > b

(2) $CH_3-CH_2-\ddot{N}H_2$





a > b > c

Amine > enamine > amide

(3) $CH_3-\ddot{N}H_2$ (sp^3) $CH_3-CH=\ddot{N}H$ (sp^2) $CH_3-C\equiv\ddot{N}$ (sp)

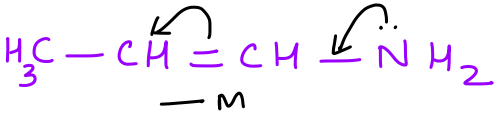
a > b > c Amine > Imine > cyanide

(4) $\ominus\ddot{N}H_2$ $\ominus\ddot{O}H$ $\ominus\ddot{O}R$ (EDG) $R-OH$ NH_3 H_2O

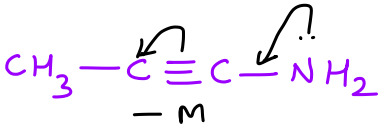
a > c > b > e > d > f

(5) $H_2C=CH-CH_2-\ddot{N}H_2$ (−I)

$HC\equiv C-CH_2-\ddot{N}H_2$ (−I)



(−M)

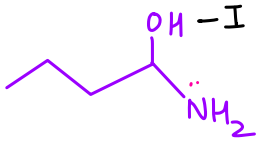
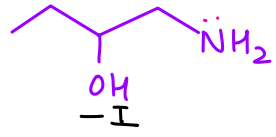
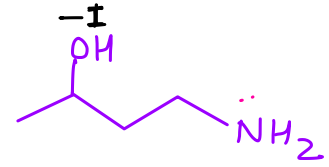


(−M)

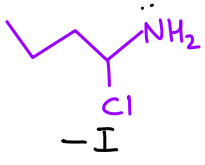
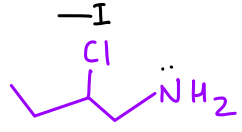
a > b > c > d

(6) NH_3 $\quad$ $\overset{-I}{NH_2-NH_2}$ Hydrazine $\quad$ $\overset{-I}{NH_2-OH}$ Hydroxylamine

a > b > c

(7)   

c > b > a

(8)  

$H_2\overset{..}{N}-Cl$ $\quad$ $-I > -M$ $\quad$ $H_2\overset{..}{N}-OH$ $\quad$ $-I$

b > a > d > c

Imp.

(9) $R-\overset{..}{N}H_2$ $\quad$ $R-\overset{..}{N}H-R$ $\quad$ $R-\overset{..}{\underset{\underset{R}{|}}{N}}-R$ $\quad$ $\overset{..}{N}H_3$

+I $\quad$ +I $\quad$ +I $\quad$ +I

$3^0 > 2^0 > 1^0 > NH_3$ (In gaseous state and non Polar solvent)

$R = CH_3/Bu$ $\quad 2^0 > 1^0 > 3^0 > NH_3$ (In H_2O)

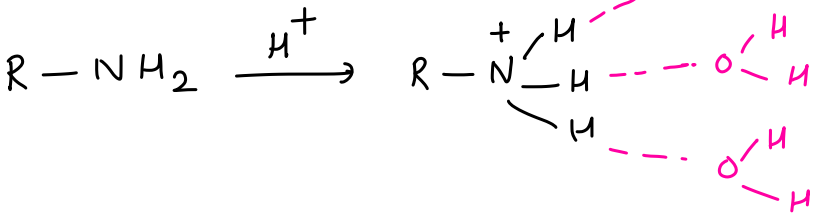
$R = et/pr$ $\quad 2^0 > 3^0 > 1^0 > NH_3$ (In H_2O)

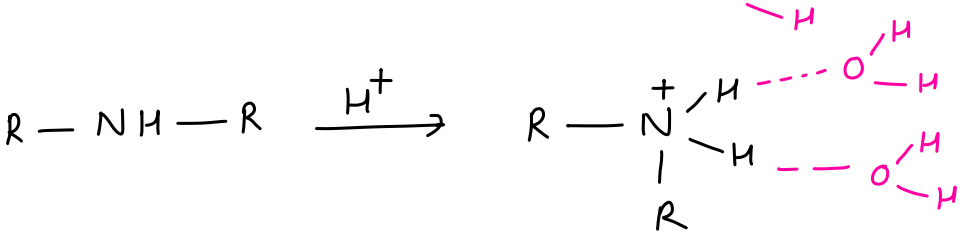
Three Reasons →

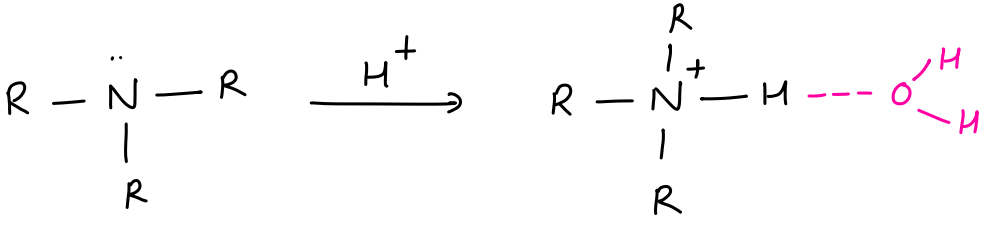
(i) +I effect → $3^0 > 2^0 > 1^0$

(ii) steric crowding → $1^0 > 2^0 > 3^0$

(iii) Solvation →







$1^{\circ} > 2^{\circ} > 3^{\circ}$

(10) $Ph-\ddot{N}H_2$ $Ph-\ddot{N}H-Ph$ $Ph-\ddot{N}(Ph)-Ph$

$Ph-CH_2-\ddot{N}H_2$

benzyl amine

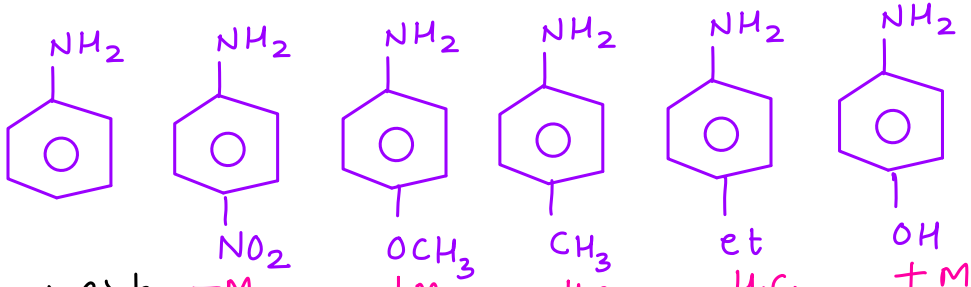
d > a > b > c

(11) $R-\ddot{N}H-R$ $\ddot{N}H_3$  

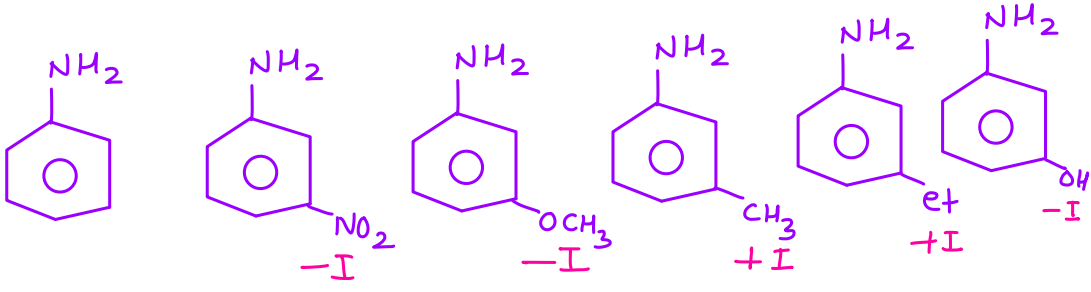
a > b > d > c

(12) $R-CH_2-\ddot{N}H_2$ $CH_3-C(=O)-\ddot{N}H_2$ $Ph-C(=O)-\ddot{N}H_2$

a > c > b

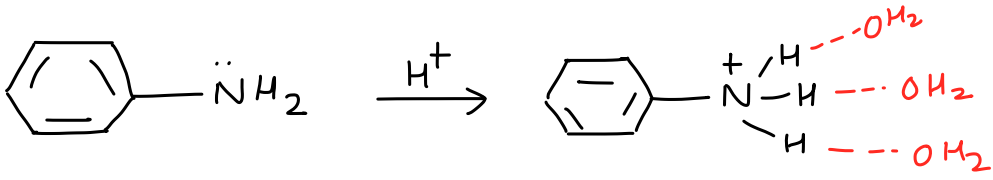
(13) 

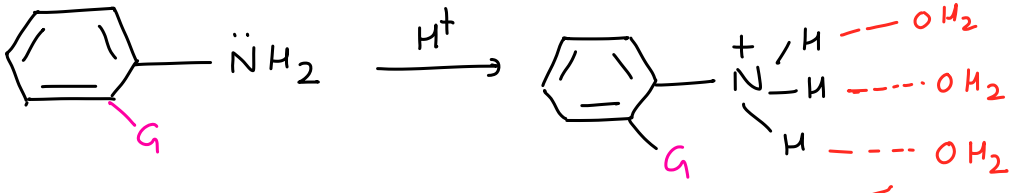
f > c > d > e > a > b

(14) 

e > d > a > f > c > b

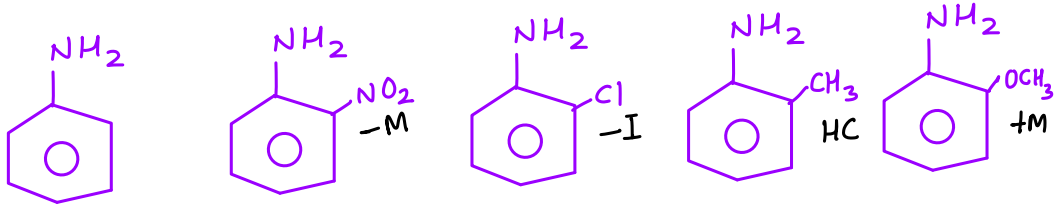
Ortho effect ⟶ Ortho-Substituted aniline is weaker base than aniline irrespective of nature of electronic effect. This is due to the steric inhibition to solvation (SIS).





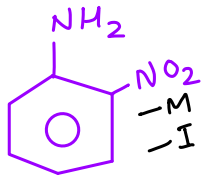
$$\text{basic strength} \propto \frac{1}{SIS}$$

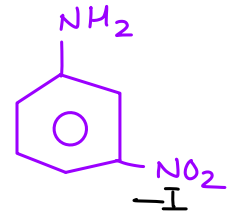
(15)

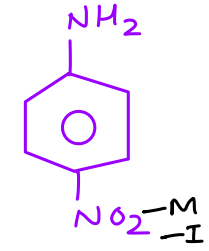


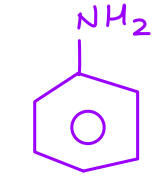
a > e > d > c > b

(16)





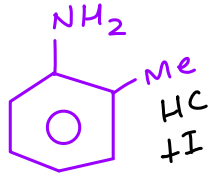


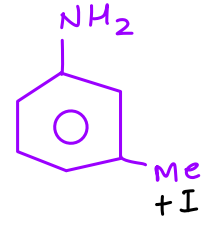


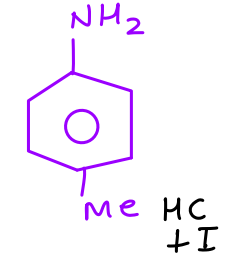
Expected → d > b > c > a

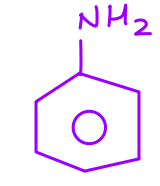
Actual → d > b > c > a

(17)





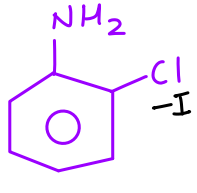


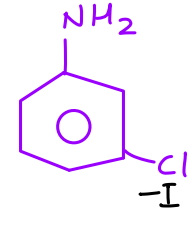


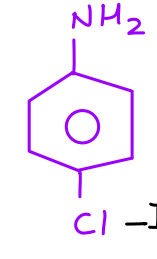
Expected → a > c > b > d

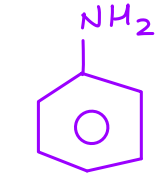
Actual → c > b > d > a

(18)



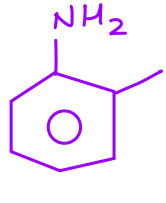


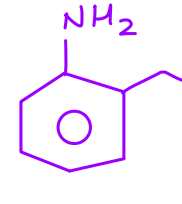


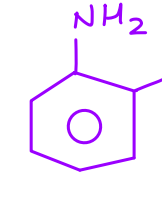


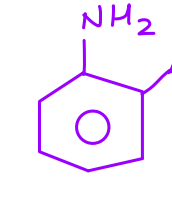
Expected → d > c > b > a (Actual)

(19)





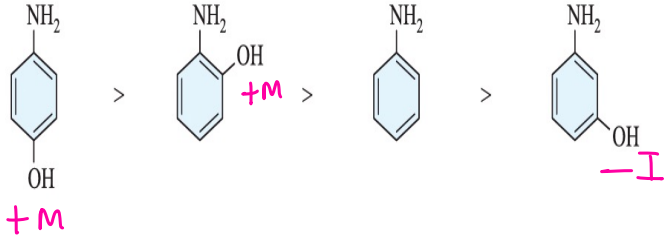




a > b > c > d

Order of Basic Strength :

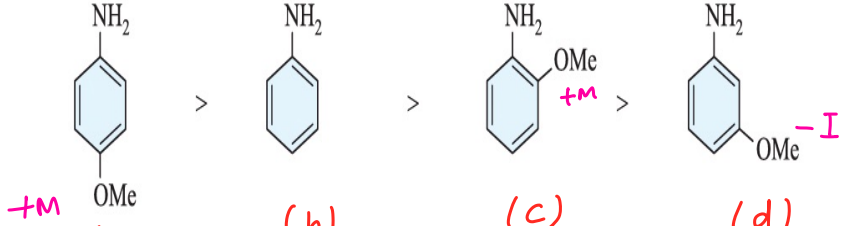
Imp.



Expected → a > b > c > d

Actual → a > b > c > d (−OH ⇒ +M >> SIs)

Order of Basic Strength :

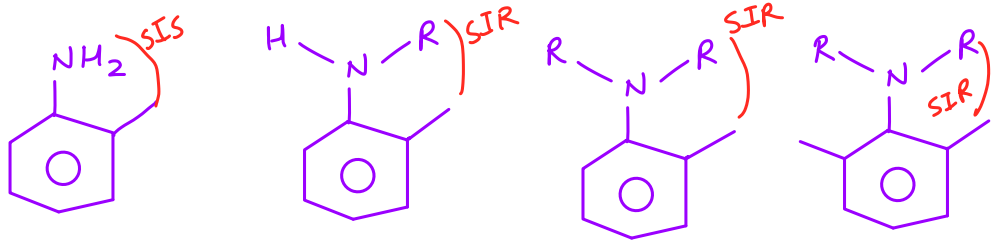


+M (a) (b) (c) (d)

Expected → a > c > b > d

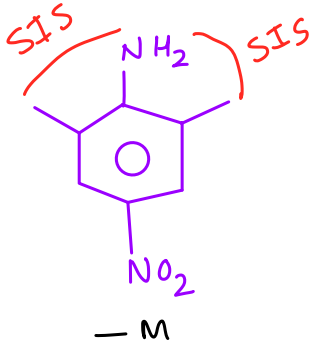
Actual → a > b > c > d

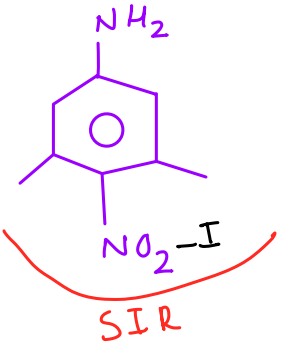
(20)



$d > c > b > a$

(21)

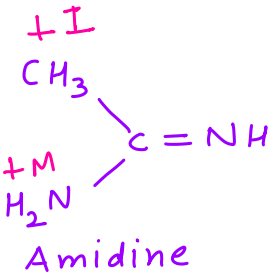


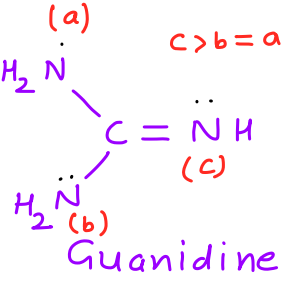


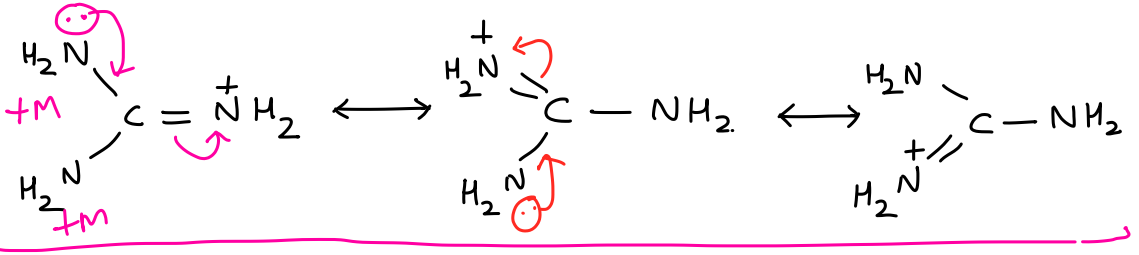
$b > a$

(22) $CH_3-CH_2-NH_2$

$c > b > a$

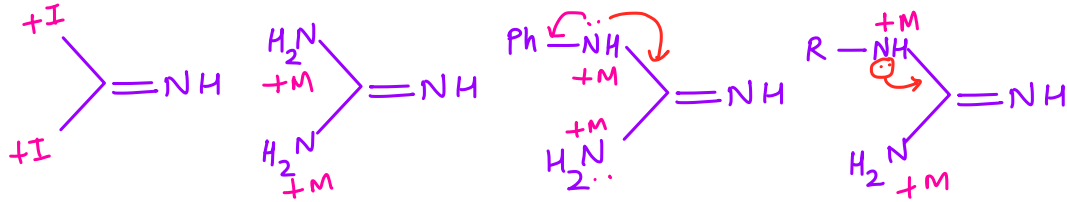






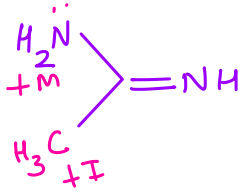
* Guanidine is strongest nitrogeneous organic base.

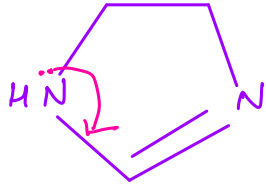
(23)



b > d > c > a

(24)

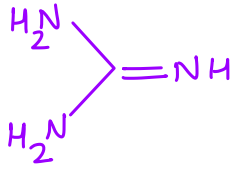


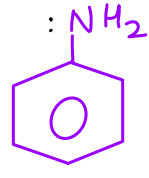


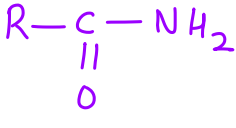
+M ⇒ $-NH_2 > -NHR > -NR_2$

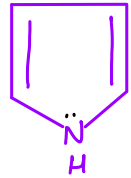
a > b

(25)







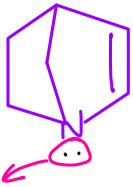


Pyrrole

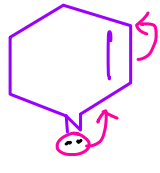
a > b > c > d > e > f

lp is responsible for aromaticity. on protonation, Ar. lost.

(26)

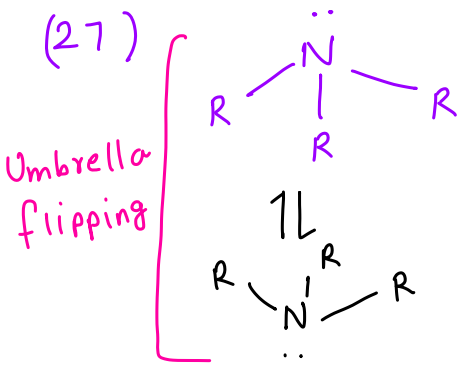


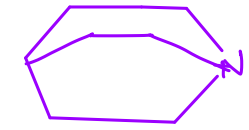
localised



a > b

(27)

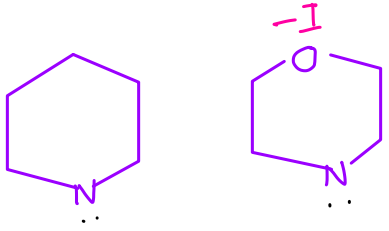




Quinuclidine

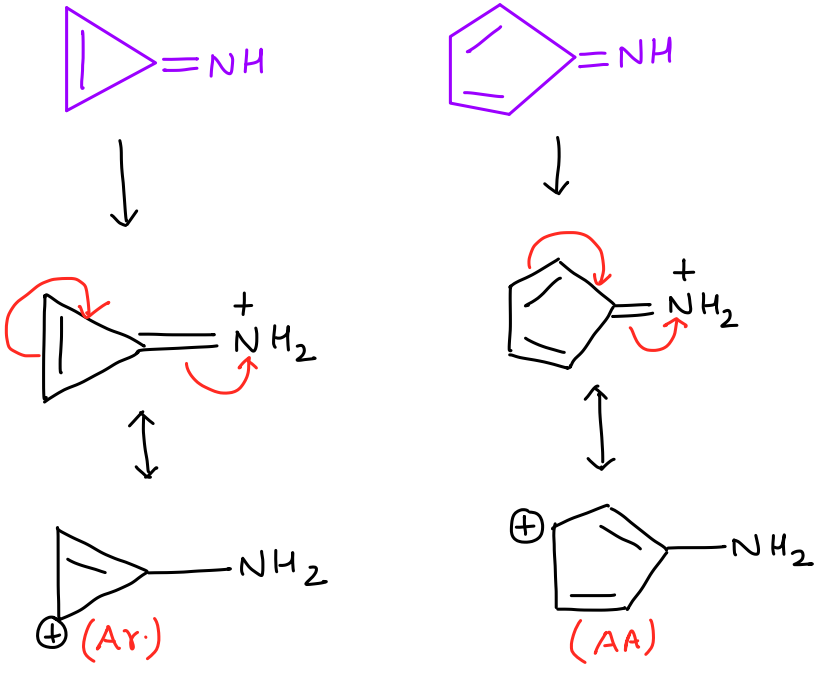
b > a

(28)



a > b

(29)



a > b

Degree of Unsaturation / Double bond equivalent / Hydrogen deficiency index ⟶

It shows no. of multiple bonds or/and no. of rings in a compound.

$$D.U. = (C+1) - \left(\frac{H+X-N}{2}\right)$$

Where C = No. of carbon atoms

H = no. of H-atom

X = No. of halogen atoms

N = No. of nitrogen atoms.

Ex. C_5H_5N $\quad DU = (5+1) - \left(\frac{5-1}{2}\right) = 4$

$C_6H_{12}O_6$ $\quad DU = (6+1) - \left(\frac{12}{2}\right) = 1$

$C_{12}H_{22}O_{11}$ $\quad DU = (12+1) - \frac{22}{2} = 2$

* If DU = 0 ⟹ No double bond
No Triple bond
No Ring
open chain comp. (Like alkane)

* If DU = 1 ⟹ 1 double bond in open chain comp.

or

1 Ring (without double bond)

* If DU = 2 ⇒ 2 double bond in open chain comp.

or

1 Triple bond in open chain comp.

or

2 Ring

or

1 Ring + 1 double bond

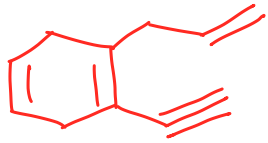
Q. If a comp. has 4 double bonds, 3 triple bonds and 3 rings in its structural formula then find its DU ?

Soln → DU = 4 + 6 + 3 = 13

Q. Calculate DU in the following —

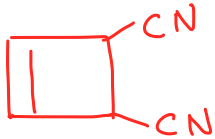
(i) 

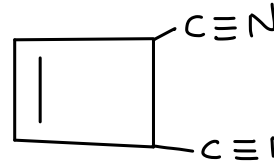
DU = 1 + 3 = 4

(ii) 

DU = 1 + 5 = 6

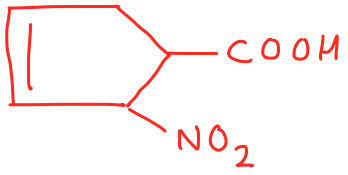
* DU = No. of rings + No. of π-bonds

(iii) 



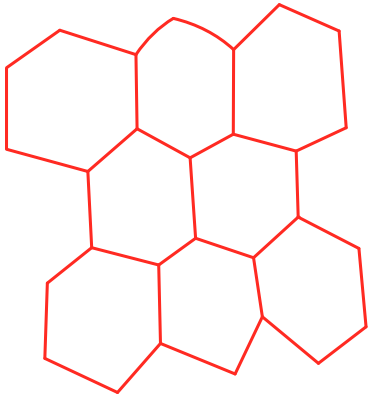
DU = 1 + 5 = 6

(iv)



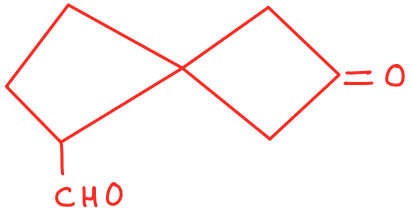
DU = 1 + 3 = 4

(v)



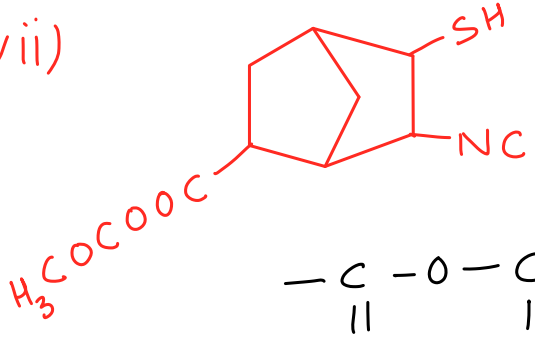
DU = 8

(vi)

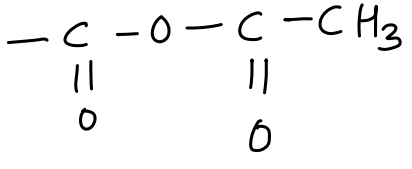


DU = 2 + 2 = 4

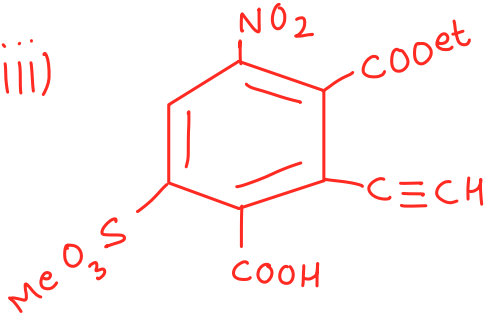
(vii)

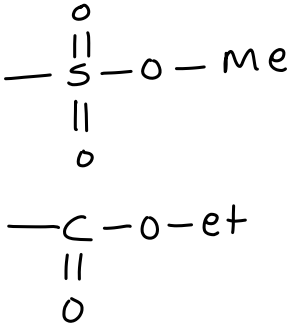


DU = 2 + 4 = 6



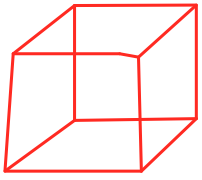
(viii)





DU = 1 + 10 = 11

(ix)



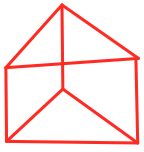
(C_8H_8)

(cubane)

DU = 5

(No. of faces − 1)

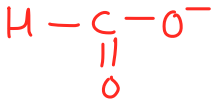
(x)



(Prismane)

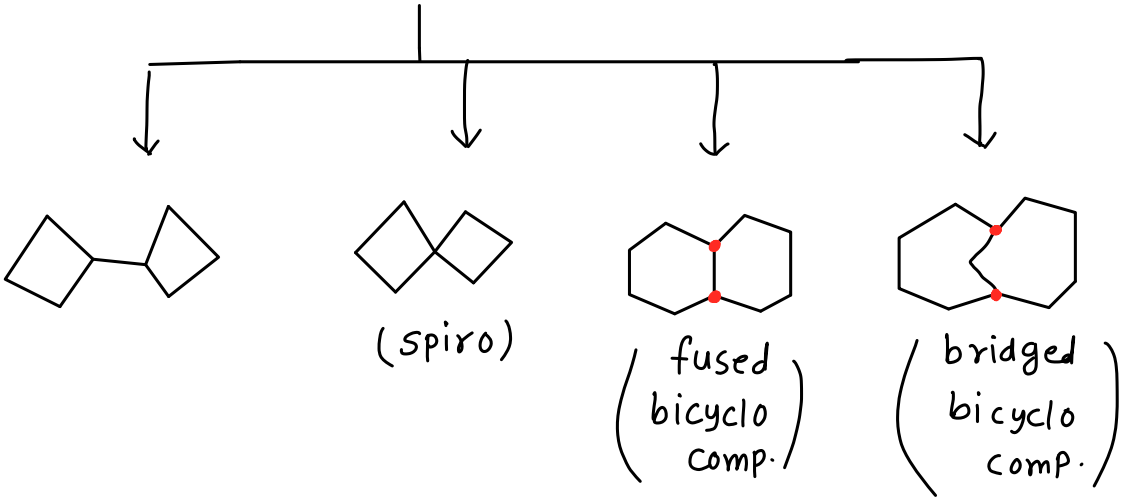
DU = 5 − 1 = 4

(xi)



$DU = (1+1) - \frac{1}{2} = 1.5$

✳ Two Rings in comp.



✳ Two double bonds

Cumulated

$H_2C=C=CH_2$

$H_3C-CH=C=CH_2$

Conjugated

$C=C-C=C$

$C-C=C-C=C$

Isolated

$C=C-C-C=C$

Isomerism → Two or more comp. which have same molecular formula but differ in Physical or/and Chemical properties are Called isomers.

- Isomerism
  - Structural/constitutional
    - Chain
    - Positional
    - Functional
    - Ring chain
    - metamerism
    - Tautomerism
  - Stereo/space/3-D
    - Configurational
      - Geometrical
      - optical
    - Conformational

Structural Iso. → Same M.F. but different structural formula (diff. str.)

Chain Isomers (Skeletal or nuclear Isomers) → Differ in Parent chain/side chain.

Positional Isomers → Same Parent chain and side chain but differ in position of functional group / multiple bond / substituting groups.

Functional Isomers → Different Functional group

* Alcohol and Phenol are considered as diff. F.G.
* $1^\circ, 2^\circ, 3^\circ$ amines —— " ——
* $1^\circ, 2^\circ, 3^\circ$ amides —— " ——
* —CN and —NC —— " ——
* $-NO_2$ and —ONO —— " ——

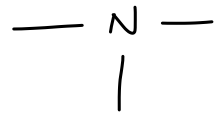
Ring Chain Isomers → One isomer is acyclic but other is cyclic.
They may have diff. functional group.

Metamers → (i) F.G. should be same and It must be Polyvalent.

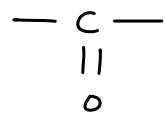
(ii) Different alkyl group on either side of Polyvalent F.G.

Polyvalent F.G. →

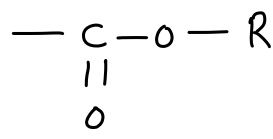
—O—	ether
—S—	thioether
—NH—	2° amine



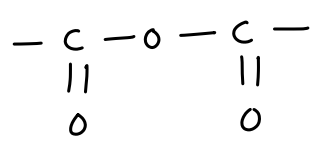
3° amine



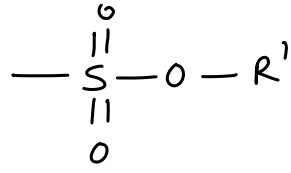
Ketone



ester



Anhydride

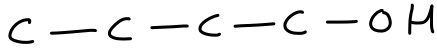


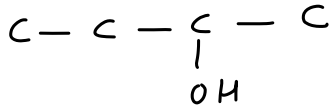
sulphonic ester

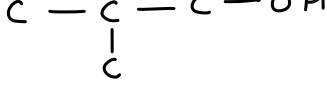
Q Draw the structural Isomers of following

(1) $C_4H_{10}O$ (Alc./ether)

DU = 0

(i) 

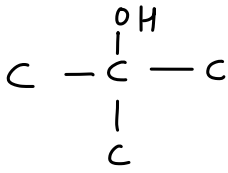
(ii) 

(iii) 

(i), (ii) — P.I.

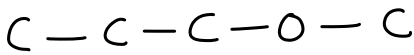
(i), (iii) — C.I.

(ii), (iii) — C.I.

(iv) 

(iii), (iv) — P.I.

(iii), (v) — F.I.

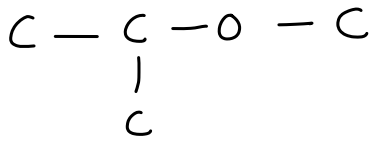
(v) 

(iv), (v) — F.I.

(vi) 

(v), (vi) — meta.

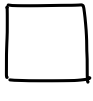
(vi), (vii) — meta.

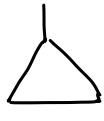
(vii) 

(v), (vii) — meta.
P.I.

(2) C_4H_8

DU = 1

(i) 

(ii) 

(i), (ii) — C.I.

(i), (iii) — R.C.I

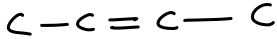
(ii), (iii) — R.C.I.

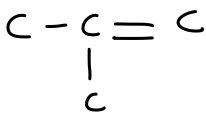
(iii), (iv) — P.I.

(iv), (v) — C.I.

(iii), (v) — C.I.

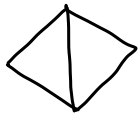
(iii) 

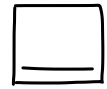
(iv) 

(v) 

(3) C_4H_6

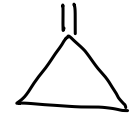
DU = 2

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) $C=C=C-C$

(vii) $C=C-C=C$

(viii) $C-C-C\equiv C$

(ix) $C-C\equiv C-C$

(i), (ii) — R.C.I.

(ii), (iii) — C.I.

(iii), (iv) — P.I.

(iii), (v) — C.I.

(vi), (vii) — P.I.

(iii), (vi) — R.C.I.

(vii), (viii) — F.I.

(viii), (ix) — P.I.

Homework

Bio molecules workbook
DTS-1-11 Q. 86-95
JEE MAIN Q.57,58,62-64,78,79,81,96,98
JEE ADVANCED Q. 32

IOC WORKBOOK
DTS-1-11
Q.16-18,26,27,33,82,87-90,104,106,107,134,135,139