ToppersNotes

THE IIT-JEE SECRET

ORGANIC CHEMISTRY VOL.-I

Sierra Innovations Pvt. Ltd.

Contents

Organic Chemistry

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Study of organic compounds

Organic Compounds :- Hydrocarbon & their derivatives

(Carbon is directly attached to hydrogen)

Hydrocarbon :- Comp^s containing 'C' & 'H' & 'C' is directly attached to 'H'.

$$CH_4 \xrightarrow[+COOH]{-H} CH_3-COOH$$

☆) Carbon is a main element of organic compounds due to following reasons :-

i) Catenation :- self - linking tendency

⇒ 'C' has strong self - linking tendency

$C-C-C-C$ (↓ 80 kcal/mole), $-O-O-$, $N\equiv N-N$, S_8, P_4

ii) Tetravalency of 'C' → proposed by 'Kekule'

iii) Every sp^3 hybridized carbon has tetrahedral shape. Lebell & Vant Kaff

Formulas :-

i) Molecular formula (M.F.) → C_4H_8O , C_6H_6

ii) General formula (Gr.F) → C_nH_{2n}

eg C_4H_6 → C_nH_{2n-2}

C_8H_8 → C_nH_{2n-6}

C_4H_8O → $C_nH_{2n}O$

C_3H_9N → $C_nH_{2n+3}N$

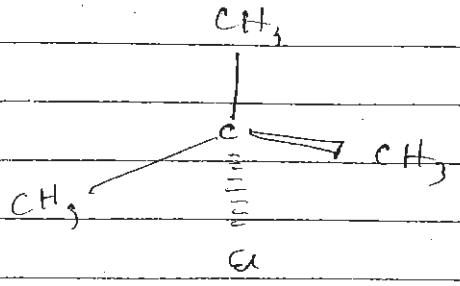
C_7H_7O → $C_nH_{2n-7}O$

(BO-III) Structural formula ⇒ Formula which represents connectivity of atom in the compound.

eg C_4H_{10} → C–C–C–C or $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

iv) Stereo chemical formula ⇒ Formula which tell us about orientation of atom or group of atom present in compound

eg



Types of 'C' & 'H'

a.) 1° or primary 'c' → 'c' which is attached to one 'c' atom

eg CH_3-CH_3

b) 2° or secondary 'c' → 'c' which is attached to two 'c'-atom

eg :- $CH_3-CH_2-CH_3$ (↓ 2° at CH_2)

c) 3° or tertiary 'c' → 'c' which is attached to 3 'c'-atom

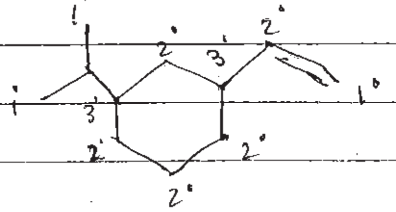
eg $CH_3-CH(CH_3)-CH_2-CH_3$ (3° at CH)

d) 4° or quaternary 'c' → 'c' attached to 4 'c'-atom.

eg $CH_3-C(CH_3)_2-CH_3$

eg $\overset{1^\circ}{C}H_3-\overset{3^\circ}{C}(\overset{1^\circ}{C}H_3)=\overset{2^\circ}{C}H-\overset{2^\circ}{C}H-\overset{1^\circ}{C}H_3$

eg



Types of 'H' :-

i.) 1° or primary 'H' → 'H' attached to 1° 'C'

ii.) 2° or sec. 'H' → 'H' attached to 2° 'C'

iii.) 3° or tert. 'H' → 'H' attached to 3° 'C'

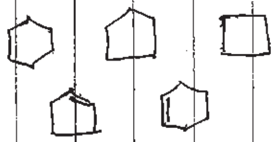
Classification of Organic Compounds

a.) open chain comp. or acyclic or aliphatic

saturated
→ there is only single bond b/w C-atom
like → alkanes (Paraffins) → least reactive

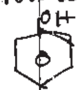
Unsaturated
→ there is π-bond b/w C-atom
C=C alkenes
C≡C alkynes

Alicyclic → (Hydrocarbons)
→ cyclic comp. which have aliphatic properties
cycloalkane or cycloalkenes



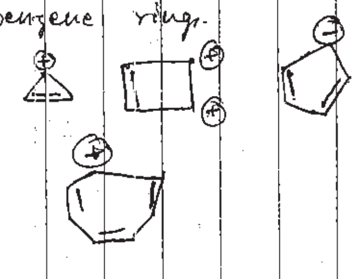
Aromatic

Benzenoid
→ Benzene containing aromatic compounds

eg:-  → Phenol

eg:-  → Toluene

Non-Benzenoid
→ those aromatic comps which do not have benzene ring.



b.) closed chain compounds or cyclic compounds.

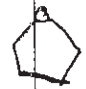
Homocyclic or Isocyclic or Carbocyclic
→ all atoms are same in cycle

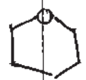
Heterocycl
→ one or more atom are from C atom in a

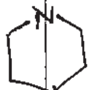
Heterocyclic alicyclic

eg  oxirane

 Oxetane

 Tetrahydrofurane

 Pyrane

 Piperidine

Heterocc aro

 Pyridine

 furane,

 Pyrol

 thio

Degree of Unsaturation (DU) or Double bond equ of Organic compound

→ D.U tell us about idea of presence of ring or π-bond in the compound.

☆) if D.U = 1, then compound will have one π-bond or 1 ring

☆) if D.U = 2, then comp. will have 2 π-bond, or 2 ring or 1 π-bond + 1 ring

☆) if D.U = 3, then comp. will have 3π, 3 ring (2π + 1 ring), (2 ring + 1π)

☆) if DU ≥ 4, then most probably comp. will have benzene ring:

Calculation of D.U, for hydrocarbon

$C_nH_{2n} \xrightarrow{+1H_2} C_nH_{2n+2}$

∴ DU = 1

$C_2H_2 \xrightarrow{+2H_2} C_2H_6$

∴ DU = 2

C_3H_4 → D.U = 2

C_4H_4 → DU = 3

C_6H_6 → DU = 4

$C_{10}H_{10}$ → DU = 6

C_8H_8 → DU = 5

$C_3H_3^{\oplus}$, $C_3H_3^{\ominus}$, $C_4H_4^{2+}$, $C_5H_5^{\ominus}$, $C_5H_5^{\oplus}$

D.U → 2 , 2 , 2 , 3 , 3

$C_8H_8^{2+}$, $C_8H_8^{2-}$, $C_9H_9^{\ominus}$

D.U → 4 , 4 , 5

or

Calculation of D.U. for organic compound

Organic comp ⟶ Hydrocarbon $\xrightarrow{n\,H_2}$ alkane

↳ D.U

N O X (Halo)

add 'H'-atom, equal to no. of X, ignoring

↓

no adding or subtraction of 'H'-atom

H - fluctuate as per no. of N ignoring

eg :- $C_3H_4O_2 \longrightarrow C_3H_4 \xrightarrow{+2H_2} C_3H_8$

∴ D.U = 2

eg :- $C_3H_4H_2 \longrightarrow C_3H_6 \longrightarrow C_3H_8$

D.U = 1

$C_3H_7N_3 \longrightarrow C_3H_4 \longrightarrow C_3H_8$

D.U = 2

eg $C_{12}H_{10}O_5N_2Br_4 \longrightarrow C_{12}H_{12} \xrightarrow[DU=7]{+7H_2} C_{12}H_{26}$

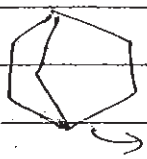
$C_6H_2Cl_4 \longrightarrow C_6H_6 \xrightarrow{+4H_2} C_6H_{14}$

$DU = 4$

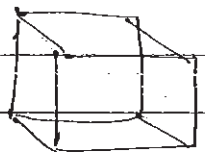
$C_6Br_6 \rightarrow C_6H_{12} \xrightarrow[DU=2]{+H_2} C_6H_{14}$

$C_9N_6 \rightarrow C_9H_{-6} \xrightarrow{+13H_2} C_9H_{20}$

$\therefore DU = 13$

eg  $\rightarrow$ D.U = 2

$\hookrightarrow C_7H_{12}$

eg  $\rightarrow C_8H_8 \xrightarrow{+5H_2} C_8H_{18}$

$DU = 5$

If in form

$C_nH_n \rightarrow n\pi e^-$

$C_nH_n^{+n} \rightarrow (n-n)\pi e^-$

$C_nH_n^{-y} \rightarrow (n+y)\pi e^-$

If no. of $\pi e^- \rightarrow 4n+2$ (2, 6, 10, ---)

$n = 0, 1, 2, 3, ---$

$\therefore$ aromatic

If no of $\pi e^- \rightarrow 4n$ (4, 8, 12, 16, 20 ---)

$n = 1, 2, 3, 4, ---$

$\therefore$ anti-aromatic