FREE NOTES · NCERT + JEE/NEET LEVEL

Organic Chemistry: Some Basic Principles

Tetravalency and hybridisation, structural representations, classification, IUPAC nomenclature, isomerism, bond fission and reactive intermediates, electronic effects, types of reactions, purification methods and qualitative and quantitative analysis.

01 Carbon & structural representations
02 Classification & functional groups
03 IUPAC naming steps
04 Isomerism
05 Bond fission & reactive intermediates
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01 Carbon & structural representations

- Carbon is **tetravalent** and shows catenation. sp^3 (single bonds, 109.5°), sp^2 (one double bond, 120°), sp (triple or two doubles, 180°).
- More s character ⇒ more electronegative carbon: $sp > sp^2 > sp^3$.
- Representations: complete (all bonds), condensed (CH_3CH_2OH), bond-line (zig-zag, ends and corners are C).
- 3D: wedge (towards you), dash (away).

02 Classification & functional groups

- **Acyclic** (open chain) vs **cyclic**: alicyclic (cyclohexane), aromatic: benzenoid (benzene) and non-benzenoid (tropolone), heterocyclic (furan, pyridine).
- **Homologous series:** successive members differ by $-CH_2-$ (14 u); same general formula and functional group.

Group	Suffix / prefix	Group	Suffix / prefix
−COOH	-oic acid	−CHO	-al
$-SO_3H$	-sulphonic acid	>C=O	-one
−COOR	-oate	−OH	-ol
−COCl	-oyl chloride	$-NH_2$	-amine
$-CONH_2$	-amide	−X, $-NO_2$, −OR	prefix only
−CN	-nitrile	C=C / C≡C	-ene / -yne

Priority (high → low): acid > sulphonic acid > anhydride > ester > acid halide > amide > nitrile > aldehyde > ketone > alcohol > amine > alkene > alkyne. Halo, nitro, alkoxy are always prefixes.

03 IUPAC naming steps

1. Pick the longest chain that contains the principal functional group (and most multiple bonds).
2. Number to give the lowest locant to the principal group, then multiple bonds, then substituents (lowest set rule).
3. Prefixes in alphabetical order (ignore di, tri; but "iso" counts).
4. Name = prefixes + root (meth, eth, prop, but, pent…) + primary suffix (-ane/-ene/-yne) + secondary suffix.

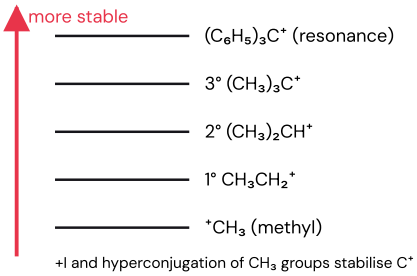
Structure	IUPAC name
$CH_3CH(CH_3)CH_2CH_3$	2-Methylbutane
$CH_2{=}CH{-}CH_2{-}OH$	Prop-2-en-1-ol
$CH_3COCH_2CH_2CHO$	4-Oxopentanal
$CH_3CH(Cl)CH(CH_3)_2$	2-Chloro-3-methylbutane
$HOOC{-}CH_2{-}COOH$	Propanedioic acid

04 Isomerism

Type	Example
Chain	Pentane vs 2-methylbutane
Position	Propan-1-ol vs propan-2-ol
Functional group	Ethanol vs methoxymethane; propanal vs propanone
Metamerism	Diethyl ether vs methyl propyl ether
Stereo: geometrical	cis/trans-but-2-ene (restricted rotation)
Stereo: optical	Lactic acid, 2-butanol (chiral carbon)

05 Bond fission & reactive intermediates

- **Homolytic** (each atom takes one electron) ⇒ **free radicals**; needs light/heat/peroxide.
- **Heterolytic** (one atom takes both) ⇒ **carbocation** (C^+, sp^2, planar) or **carbanion** (C^-, sp^3, pyramidal).
- Stability: carbocations and free radicals: 3° > 2° > 1° > CH_3. Carbanions: CH_3 > 1° > 2° > 3°.
- **Electrophiles** (electron-loving, E^+): H^+, NO_2^+, Cl^+, carbocations, BF_3, $AlCl_3$. **Nucleophiles** (nucleus-loving, Nu^-): OH^-, CN^-, NH_3, H_2O, ROH.



+I and hyperconjugation of CH_3 groups stabilise C^+

Order of carbocation stability

06 Electronic effects

Effect	What it is	Examples
Inductive (I)	Permanent shift of σ electrons along a chain; fades after ~3 carbons	−I: NO_2 > CN > COOH > F > Cl > Br > I > OH. +I: alkyl groups, $(CH_3)_3C-$ > $(CH_3)_2CH-$ > CH_3CH_2- > CH_3-
Resonance / mesomeric (R/M)	Delocalisation of π or lone-pair electrons in conjugated systems	+R: −OH, −OR, $-NH_2$, −X. -R: $-NO_2$, −CHO, −COOH, −CN
Electromeric (E)	Temporary complete shift of π electrons when a reagent attacks; disappears when reagent removed	Addition to C=C, C=O
Hyperconjugation	Delocalisation of σ C–H electrons into an adjacent empty p orbital or π bond ("no-bond resonance")	Explains stability of 3° carbocations and of more substituted alkenes

Resonance rules: only electrons move; more covalent bonds, complete octets and negative charge on more electronegative atoms ⇒ more stable contributor.

07 Types of organic reactions

- **Substitution** (nucleophilic, electrophilic, free radical): $CH_4 + Cl_2 \rightarrow CH_3Cl$.
- **Addition**: across C=C or C=O.
- **Elimination**: alkyl halide + alc. KOH → alkene.
- **Rearrangement**: atoms reorganise within a molecule.

08 Purification & analysis

Method	Used for
Sublimation	Camphor, naphthalene, iodine, benzoic acid
Crystallisation	Solids with different solubility (sugar)
Simple distillation	Liquids with very different b.p. (chloroform 334 K + aniline 457 K)
Fractional distillation	Close b.p. (crude oil, acetone + methanol)
Distillation under reduced pressure	Liquids that decompose below b.p. (glycerol from spent lye)
Steam distillation	Steam-volatile, water-immiscible (aniline, essential oils)
Differential extraction	Using a separating funnel and an immiscible solvent
Chromatography	Mixtures; R_f = distance by substance / distance by solvent

DETECTION & ESTIMATION

- **Lassaigne's test** (fuse with Na): N ⇒ Prussian blue ($Fe_4[Fe(CN)_6]_3$); S ⇒ violet with sodium nitroprusside; N + S ⇒ blood red ($Fe(SCN)^{2+}$); halogens ⇒ AgX ppt (white Cl, pale yellow Br, yellow I).
- C and H: CuO heating ⇒ CO_2 (lime water milky) and H_2O (white $CuSO_4$ turns blue).
- **Estimation:** Liebig (C, H), **Dumas** (N as N_2 gas), **Kjeldahl** (N as NH_3; not for nitro, azo, ring N), Carius (halogens, S), P as $Mg_2P_2O_7$.
- Kjeldahl: %N = 1.4 × N × V / m (N = normality of acid used up, V in mL, m in g).

09 JEE Extra + Tricks

JEE LEVEL

- Stability of carbocations: 3° > 2° > 1° > methyl; benzyl and allyl stabilised by resonance; tropylium (aromatic) very stable. Carbanions: reverse order.
- Inductive effect: -I order NO_2 > CN > COOH > F > Cl > Br > I > OH; +I: alkyl groups (t-butyl highest).
- Hyperconjugation: number of α-H ⇒ more stable carbocation/alkene (explains stability of more substituted alkenes).
- Acidity trick: anything that stabilises the conjugate base increases acidity (-I, -M groups); phenol > water > ethanol.
- Aromaticity (Hückel): cyclic, planar, conjugated, $(4n + 2)$ π electrons. $4n$ π electrons planar ⇒ antiaromatic.
- Lassaigne's test: N ⇒ Prussian blue; S ⇒ violet with sodium nitroprusside; halogens ⇒ AgX precipitate.

10 Solved questions

Q1. Name: $CH_3–CH=CH–CH_2–COOH$.

Pent-3-enoic acid.

Q2. Which is more stable: $(CH_3)_3C^+$ or $CH_3CH_2^+$? Why?

$(CH_3)_3C^+$: 3 methyl groups give +I and 9 hyperconjugating C–H bonds.

Q3. Hybridisation of each C in $CH_2=C=CH_2$.

sp^2, sp, sp^2.

Q4. 0.25 g of an organic compound in Kjeldahl's method gives NH_3 that needs 30 mL of 0.1 M H_2SO_4. %N?

Moles $NH_3 = 2 \times 0.1 \times 0.030 = 0.006$ ⇒ N = 0.084 g ⇒ %N = 0.084/0.25 × 100 = **33.6%**.

11 Mistakes & practice

- Numbering from the wrong end (always lowest locant to the principal group).
- Calling a carbanion planar (it is pyramidal, sp^3).
- Saying -I groups donate electrons.
- Using Kjeldahl's method for nitrobenzene.

1. Electrophile or nucleophile: NH_3, BF_3, CN^-, NO_2^+?
2. Best method to purify aniline?
3. Which effect is temporary?
4. Blood red colour in Lassaigne's test means?

ANSWERS

1) Nu, E, Nu, E · 2) Steam distillation · 3) Electromeric · 4) Both N and S present

12 Quick revision: 5 minutes before the exam

NAMING

- Longest chain with principal group.
- Lowest locants; alphabetical prefixes.
- COOH highest priority.

INTERMEDIATES

- C^+: 3° > 2° > 1° (sp^2, planar).
- C^-: reverse order (sp^3).
- Radicals from homolysis.

EFFECTS

- I: permanent, σ.
- R/M: π delocalisation.
- E: temporary. Hyperconjugation: σ C–H.

LAB

- Steam distillation: aniline.
- Lassaigne: Prussian blue = N.
- Dumas (all N), Kjeldahl (limited).

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.