FREE NOTES · NCERT + JEE/NEET LEVEL

Hydrocarbons

Alkanes (banana, properties, conformations), alkenes (isomerism, banana, Markovnikov aur peroxide effect, ozonolysis), alkynes (acidity, reactions), aromatic hydrocarbons (benzene, aromaticity, electrophilic substitution, directive influence) aur carcinogenicity.

01 Classification
02 Alkanes: banana
03 Alkanes: properties & conformations
04 Alkenes: structure & banana
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01 Classification

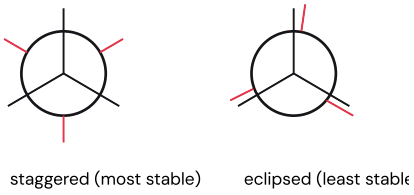
Type	Formula	Bond	Example
Alkane (saturated)	C_nH_{2n+2}	C–C (sp^3)	Methane
Alkene	C_nH_{2n}	C=C (sp^2)	Ethene
Alkyne	C_nH_{2n-2}	C≡C (sp)	Ethyne
Aromatic (arenes)	—	Delocalised ring	Benzene

02 Alkanes: banana

- Alkenes/alkynes ka **hydrogenation**: H_2 + Pt/Pd/Ni.
- **Alkyl halides se:** Zn + HCl se reduction; **Wurtz**: 2RX + 2Na (dry ether) → R–R (even-carbon alkanes; methane nahi banta).
- **Decarboxylation:** RCOONa + NaOH/CaO (soda lime) → R–H + Na_2CO_3 (ek C kam).
- **Kolbe's electrolysis:** 2RCOONa (aq) → R–R + $2CO_2$ (anode pe).

03 Alkanes: properties & conformations

- Non-polar; size badhe to b.p. badhta, branching se ghatta (n-pentane 309 K > isopentane 301 K > neopentane 282.5 K).
- **Halogenation** (free radical, light): $CH_4 + Cl_2 \rightarrow CH_3Cl \rightarrow \ldots \rightarrow CCl_4$. Reactivity $F_2 > Cl_2 > Br_2 > I_2$; H hatne ka order: 3° > 2° > 1°.
- **Combustion**: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, ΔH bahut negative (fuel).
- Controlled oxidation, isomerisation ($AlCl_3$/HCl), aromatisation (hexane → benzene, Cr_2O_3/V_2O_5), pyrolysis/cracking.



Ethane ke Newman projections

Ethane ke conformations: C–C pe ghumane se staggered (H door door, sabse kam torsional strain) aur eclipsed forms; energy ka fark sirf ~12.5 kJ/mol, isliye room temperature pe badalte rehte aur alag nahi kar sakte. Dikhane ke tareeke: sawhorse aur Newman.

04 Alkenes: structure & banana

- C=C = 1σ + 1π (π electrons dheele ⇒ reactive). Bond length 134 pm.
- **Geometrical isomerism**: cis (ek taraf) aur trans (ulti taraf). cis-but-2-ene polar, b.p. zyada; trans non-polar, m.p. zyada.
- **Alkynes se**: Lindlar's catalyst (Pd/C + quinoline) ⇒ cis-alkene; Na/liquid NH_3 ⇒ trans-alkene.
- **Dehydrohalogenation**: R–X + alc. KOH ⇒ alkene (Saytzeff).
- Vicinal dihalides ka Zn se **dehalogenation**.
- Alcohols ka **acidic dehydration**: conc. H_2SO_4, garam.

05 Alkenes: reactions

Reagent	Product / rule
H_2 / Ni	Alkane
CCl_4 me Br_2	Vicinal dibromide; **laal-bhoora rang gayab** (unsaturation ka test)
HX (unsymmetrical alkene)	**Markovnikov:** H us C pe jisme pehle se zyada H (zyada stable carbocation ke through). Propene + HBr → 2-bromopropane
HBr + peroxide	**Anti-Markovnikov** (Kharash, free radical): 1-bromopropane. Sirf HBr me.
Thanda dil. $KMnO_4$ (Baeyer's reagent)	Glycol; **gulabi rang gayab** (test)
Garam acidic $KMnO_4$	Ketones/acids (C=C tootta)
O_3 phir Zn/H_2O (ozonolysis)	Aldehydes/ketones; double bond ki jagah batata
H_2SO_4 phir H_2O	Alcohol (Markovnikov)
Polymerisation	n CH_2=CH_2 → polythene

06 Alkynes

- C≡C = 1σ + 2π, linear, 120 pm. **CaC_2 se ethyne**: $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$. Vicinal dihalides + alc. KOH, phir $NaNH_2$ se bhi.
- **Acidic H:** terminal ≡C–H acidic (sp C me 50% s character). HC≡CH + Na → HC≡C^-Na^+ + ½H_2. Acidity: HC≡CH > CH_2=CH_2 > CH_3–CH_3. Terminal alkynes ammoniacal $AgNO_3$ se safed ppt dete (internal se pehchaan).
- H_2, X_2, HX (Markovnikov, do baar), paani (Hg^{2+}/H_2SO_4 ⇒ ethyne se ethanal; baaki se ketones) ka addition.
- **Cyclic polymerisation:** 3 HC≡CH, laal-garam Fe tube 873 K ⇒ benzene.

07 Benzene & aromaticity

- C_6H_6, planar, saare C sp^2, saare C–C bonds barabar (139 pm, single aur double ke beech) resonance (Kekulé structures) ki wajah se. Bahut stable, addition ki jagah substitution pasand.
- **Hückel's rule**: planar, cyclic, poora conjugated, **(4n + 2) π electrons** ⇒ aromatic. Benzene (6), naphthalene (10), cyclopentadienyl anion (6), tropylium cation (6).
- **Banana:** ethyne ka cyclic polymerisation; sodium benzoate ka decarboxylation (soda lime); phenol + Zn dust.

08 Electrophilic substitution & directive influence

Reaction	Reagent	Electrophile
Nitration	conc. HNO_3 + conc. H_2SO_4	NO_2^+
Halogenation	Cl_2 + $FeCl_3$ (andhere me)	Cl^+
Sulphonation	fuming H_2SO_4	SO_3
Friedel-Crafts alkylation	RCl + anhyd. $AlCl_3$	R^+
Friedel-Crafts acylation	RCOCl + anhyd. $AlCl_3$	RCO^+

Mechanism: E^+ banta → ring pe attack, σ-complex (arenium ion, aromaticity gayi) → H^+ chhod ke ring wapas. UV light me benzene + Cl_2 addition deta: BHC (gammaxene, $C_6H_6Cl_6$).

SUBSTITUENTS KA DIRECTIVE INFLUENCE

Ortho/para directing, activating: –OH, $–NH_2$, $–OCH_3$, $–CH_3$. **Ortho/para directing, deactivating:** halogens. **Meta directing, deactivating:** $–NO_2$, –CN, –CHO, –COOH, $–SO_3H$.

Carcinogenicity: 4+ judi rings wale polynuclear hydrocarbons (tambaakoo, koyla, petrol ke adhoore jalne se) cancer karte, jaise 1,2-benzanthracene, 3-methylcholanthrene.

09 JEE Extra + Tricks

JEE LEVEL

- Markovnikov: H us carbon pe jisme zyada H. **Anti-Markovnikov** (Kharasch, peroxide effect) sirf HBr ke saath.
- Ozonolysis se double bond ki jagah: har C=C do C=O banta.
- Terminal alkynes ki acidity: sp C–H acidic; Na, ammoniacal $AgNO_3$ (safed ppt), Cu_2Cl_2 (laal ppt). Acidity: $HC{\equiv}CH > CH_2{=}CH_2 > CH_3{-}CH_3$.
- Electrophilic aromatic substitution: -OH, $-NH_2$, $-CH_3$, halogens ⇒ o/p; $-NO_2$, -CHO, -COOH, -CN ⇒ m. Halogens deactivating par o/p directing.
- Conformations: ethane ka staggered eclipsed se stable (torsional strain ~12.5 kJ/mol); Newman projections.
- Wurtz reaction se even C wala alkane (R–R); Kolbe electrolysis bhi R–R.

10 Solved questions

Q1. Propene + HBr ka product, peroxide ke saath aur bina.

Bina: 2-bromopropane (Markovnikov). Peroxide ke saath: 1-bromopropane.

Q2. Ek alkene ozonolysis pe sirf propanone deta. Kaun sa?

$(CH_3)_2C{=}C(CH_3)_2$, 2,3-dimethylbut-2-ene.

Q3. Kya cyclooctatetraene (8 π e^-, non-planar) aromatic hai?

Nahi: 8, 4n + 2 nahi hai aur ring tub jaisi hai.

Q4. But-1-yne aur but-2-yne me fark kaise?

But-1-yne (terminal) ammoniacal $AgNO_3$ se safed ppt deta; but-2-yne nahi.

11 Mistakes & practice

- HCl ya HI pe peroxide effect lagana.
- Wurtz se methane ya odd-carbon alkanes banana.
- Halogens ko meta directing kehna.
- Bhoolna ki Lindlar cis deta, Na/NH_3 trans.

1. Unsaturation ka test reagent?
2. Benzene me carbons ka hybridisation?
3. Sabse acidic: ethane, ethene, ethyne?
4. CH_3COONa + soda lime ka product?
5. Nitration me electrophile?

ANSWERS

1) Br_2 water / Baeyer's reagent · 2) sp^2 · 3) Ethyne · 4) CH_4 · 5) NO_2^+

12 Quick revision: exam se 5 minute pehle

ALKANES

- Wurtz, soda lime, Kolbe.
- Free radical halogenation.
- Staggered zyada stable.

ALKENES

- Markovnikov; HBr + peroxide anti.
- Baeyer's: gulabi rang gayab.
- Ozonolysis se C=C ki jagah.

ALKYNES

- Terminal H acidic.
- Lindlar cis, Na/NH_3 trans.
- 3 C_2H_2 → benzene.

BENZENE

- $(4n + 2)\ \pi\ e^-$.
- EAS: NO_2^+, Cl^+, SO_3, R^+, RCO^+.
- $-NO_2$ meta; $-OH$, $-X$ o/p.

Koi doubt? padhaiadda.netlify.app pe AI Doubt Solver se poocho, ya is chapter ka mock test do.