

carbon and hydrogen only, and the bond type decides everything else

The three families

Alkanes

C_nH_{2n+2} , only single bonds, saturated: mostly unreactive except toward free radicals

Alkenes / Alkynes

C_nH_{2n} and C_nH_{2n-2} : one or more $C=C$ or $C\equiv C$ bonds, the pi bond reacts

Arenes

benzene's ring, C_nH_{2n-6} for one ring: a stabilised delocalised system, not simple unsaturation

Degree of unsaturation

for $C_nH_mN_pX_q$ (O/S don't count)

$$DoU = \frac{2n+2+p-m-q}{2}$$

each ring OR each pi bond counts as one degree; the formula alone can't tell you which, only how many

Q. Find the degree of unsaturation of C_6H_8 , and suggest one structure that fits.

- ① use $DoU = (2n+2+p-m-q)/2$ with $n=6$, $m=8$, no N or halogens ($p=q=0$)
- ② $DoU = (2 \times 6 + 2 - 8)/2 = (12 + 2 - 8)/2 = 6/2$
- ③ $DoU = 3$

Answer

$DoU = 3$, e.g. 1,3-cyclohexadiene: one ring plus two $C=C$ bonds

three pi bonds in an open chain (hexatriene) fits the same number: the formula only counts, it never tells you the shape

Naming and preparing alkanes

- Wurtz reaction: $2 R-X + 2 Na \rightarrow R-R + 2 NaX$, joins two alkyl halides
- works best for making a symmetrical alkane
- decarboxylation: sodium carboxylate heated with soda lime ($NaOH + CaO$) gives an alkane
- one fewer carbon: $R-COONa + NaOH \rightarrow R-H + Na_2CO_3$
- catalytic hydrogenation ($Ni/Pt/Pd$) adds H_2 across the pi bond(s), giving the alkane

Alkanes: the one reaction that matters

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- free-radical halogenation: $X_2 + UV$ light or heat replaces one C-H hydrogen at a time
- initiation: X_2 splits into two X radicals under light
- propagation: a radical abstracts H; the carbon radical grabs X from another X_2
- termination: two radicals combine and the chain stops
- a tertiary C-H is abstracted fastest: its radical is most stable ($3^\circ > 2^\circ > 1^\circ$)
- so a mix of monohalogenated products forms, not just one

Free-radical chlorination of methane, one propagation cycle

