



ARMSTRONG

Aromatic Compounds



Benzene and compounds resembling
benzene in chemical behavior.

Structure of Benzene

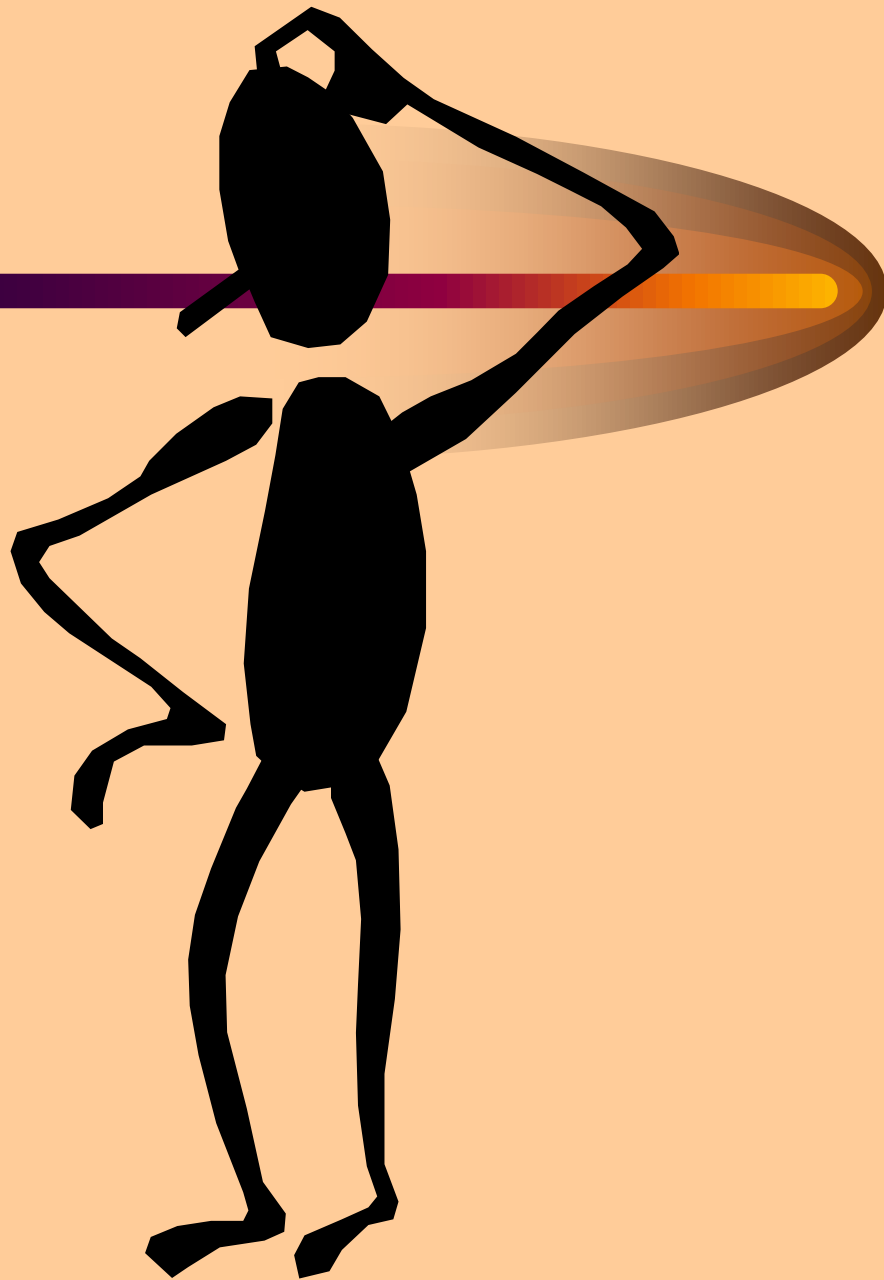


- C_6H_6
- 1858 - Friedrich August Kekule' proposed that carbon atoms joint to form chains
- 1865 - Carbon chains sometimes close to form rings
- Benzene yields only one monosubstitution product - C_6H_5Y
- Benzene yields three disubstitution products

Stability of Benzene



- Undergoes substitution rather than addition
- Heats of hydrogenation and combustion are lower than expected
- All C-C bonds are equal and are intermediate in length between single and double bonds



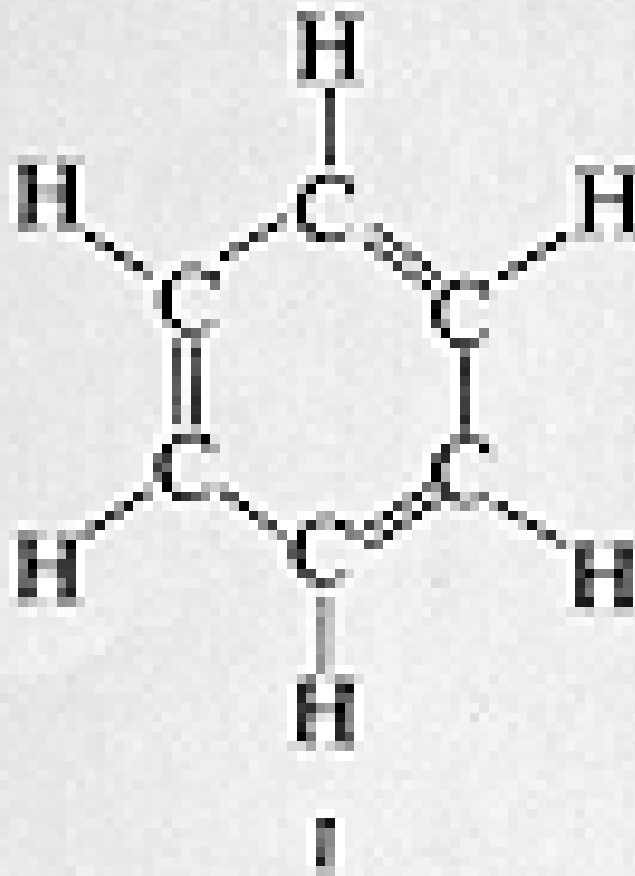
A Flat!



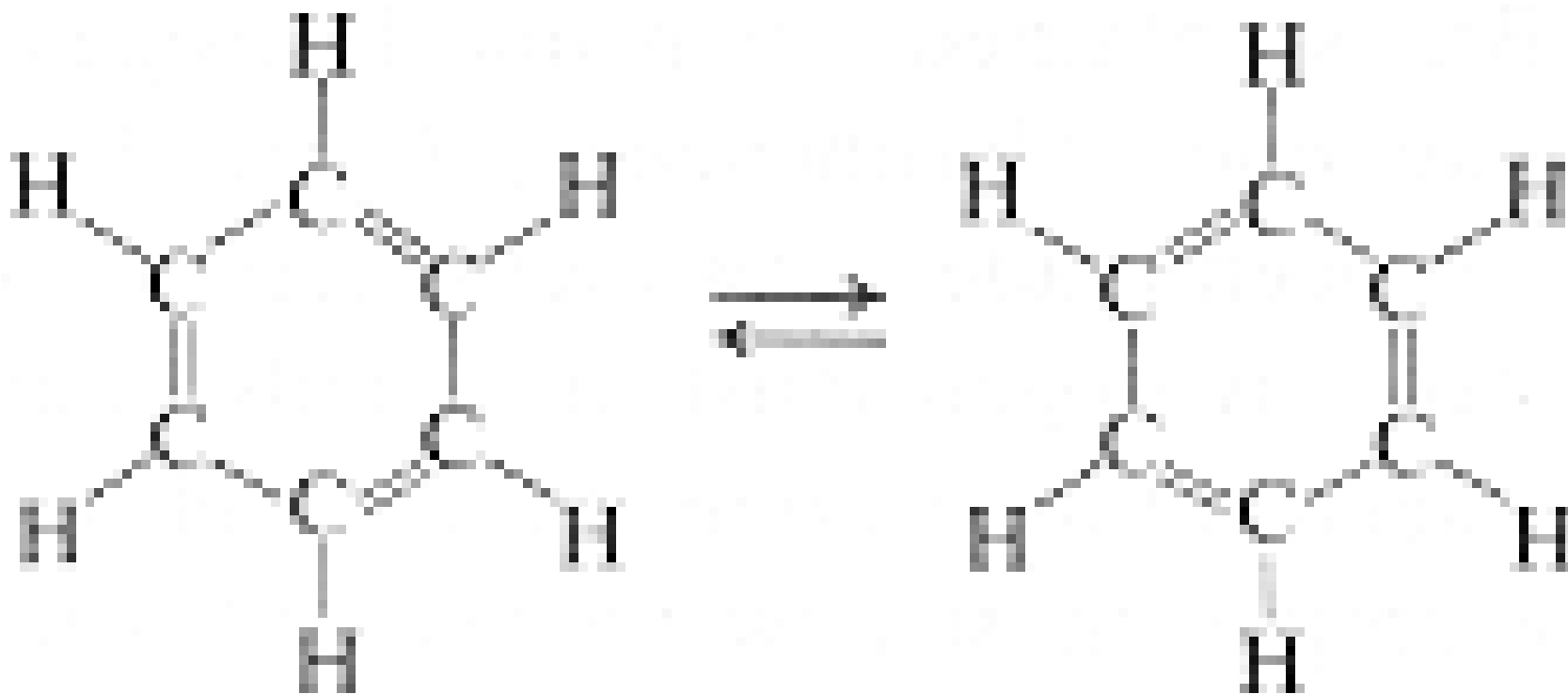
Molecule



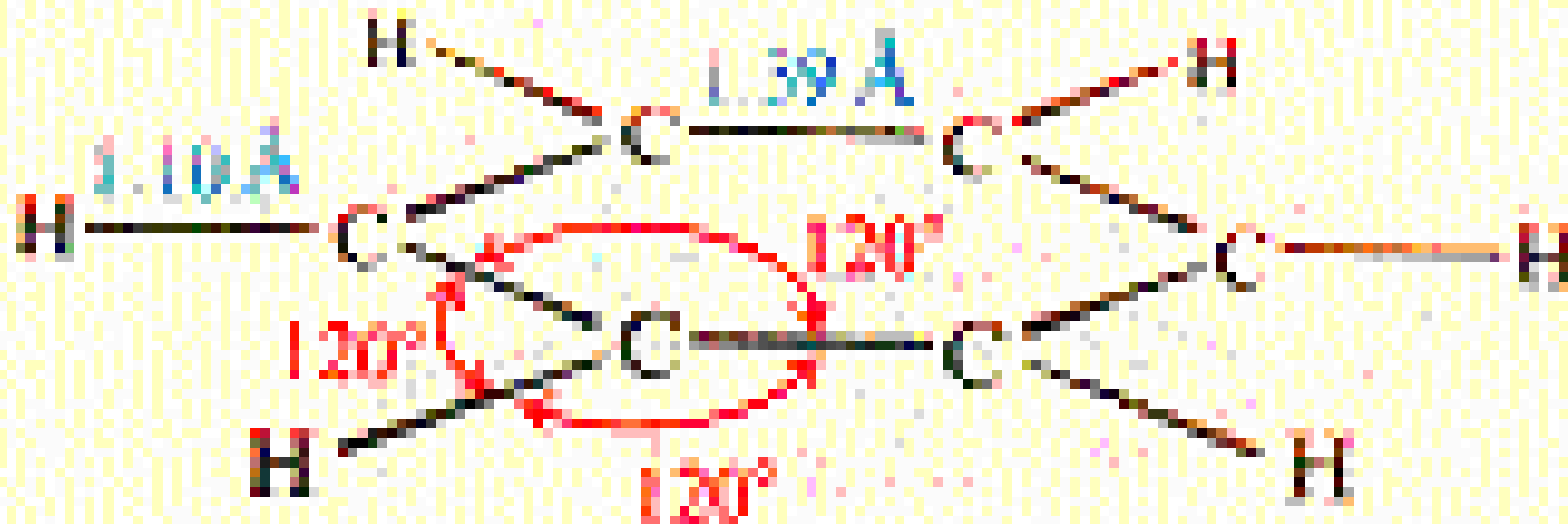
Benzene

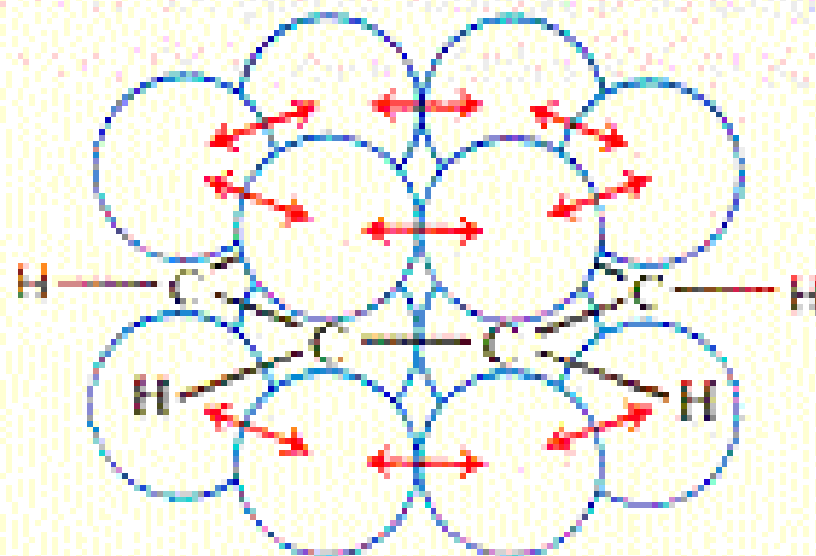
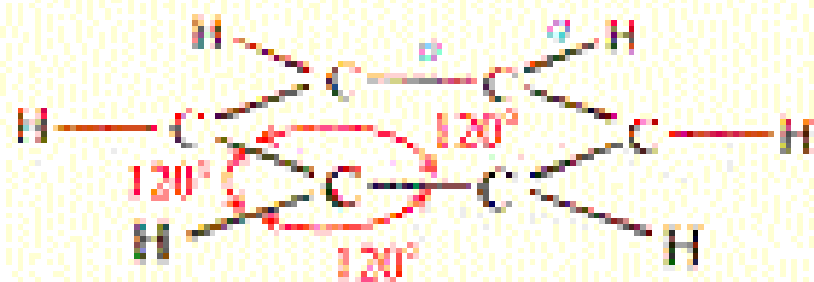


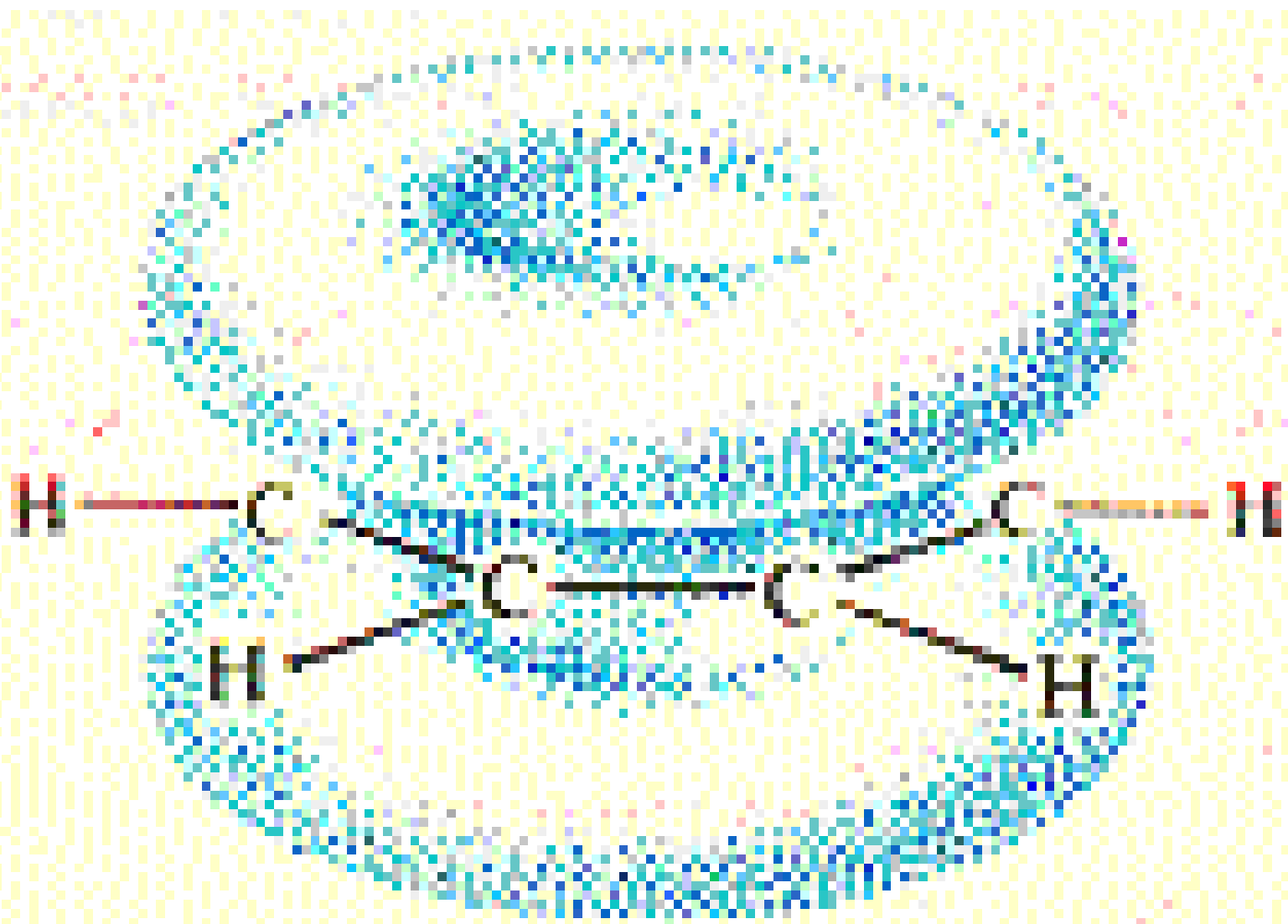
Kekulé formula



A Resonance Hybrid





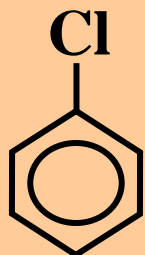


Aromatic Character

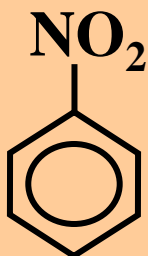


- Hückel $4n+2$ rule: Aromatic compounds must contain cyclic clouds of delocalized π electrons above & below the plane of the molecules and the π clouds must contain a total of $(4n+2)$ π electrons

Nomenclature



Chlorobenzene

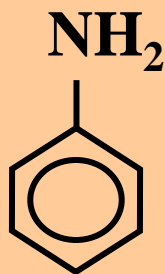


Nitrobenzene

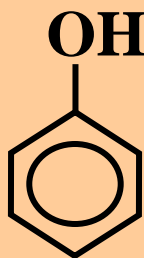


Toluene

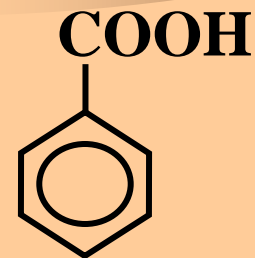
Nomenclature



Aniline



Phenol



Benzoic Acid

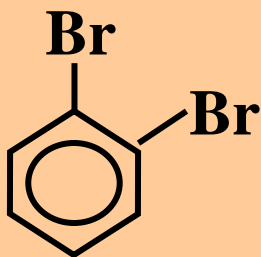


With two
groups.....

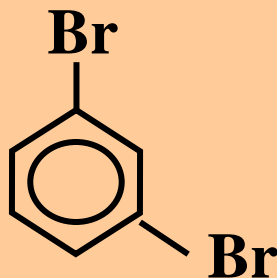


Use
ortho, meta,
& para

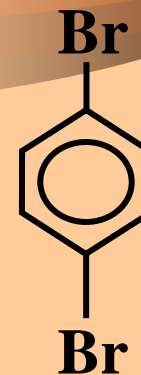
Nomenclature




o -Dibromobenzene



m -Dibromobenzene



p -Dibromobenzene



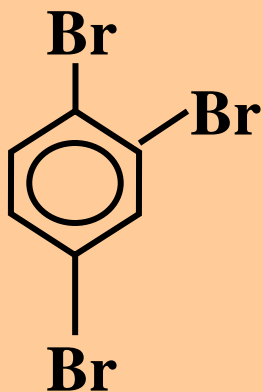
With
three or more
groups.....



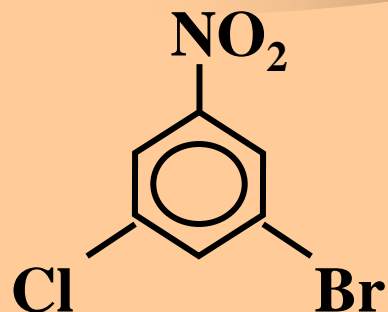


Use numbers


Nomenclature



1,2,4-tribromobenzene



3-bromo-5-chloronitrobenzene



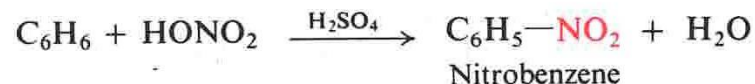
Benzene
only undergoes
substitution
reactions

CYCLOHEXENE vs. BENZENE

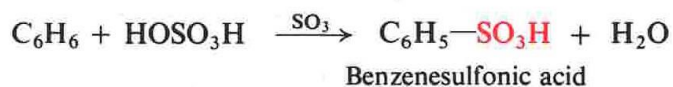
Reagent	Cyclohexene gives	Benzene gives
KMnO_4 (cold, dilute, aqueous)	Rapid oxidation	No reaction
Br_2/CCl_4 (in the dark)	Rapid addition	No reaction
HI	Rapid addition	No reaction
$\text{H}_2 + \text{Ni}$	Rapid hydrogenation @ 25°C, 20 lb/in ²	Slow hydrogenation @ 100-200°C, 1500 lb/in ²

REACTIONS OF BENZENE

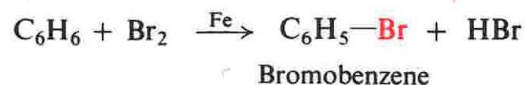
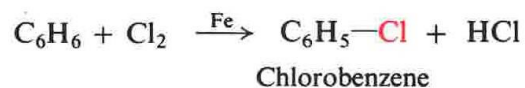
1. **Nitration.** Discussed in Sec. 15.8.



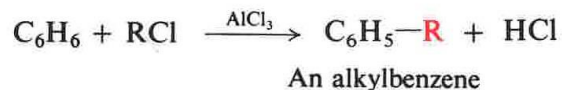
2. **Sulfonation.** Discussed in Sec. 15.9.



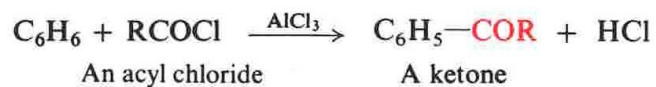
3. **Halogenation.** Discussed in Sec. 15.11.

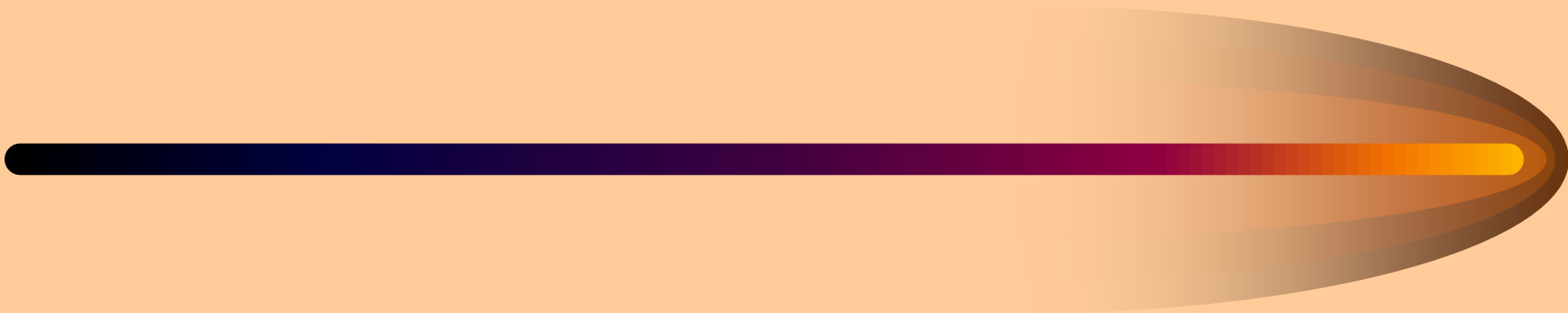


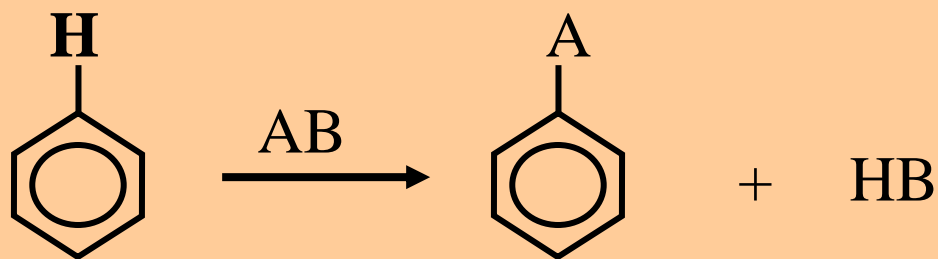
4. **Friedel-Crafts alkylation.** Discussed in Secs. 15.10 and 16.7.



5. **Friedel-Crafts acylation.** Discussed in Sec. 18.5.





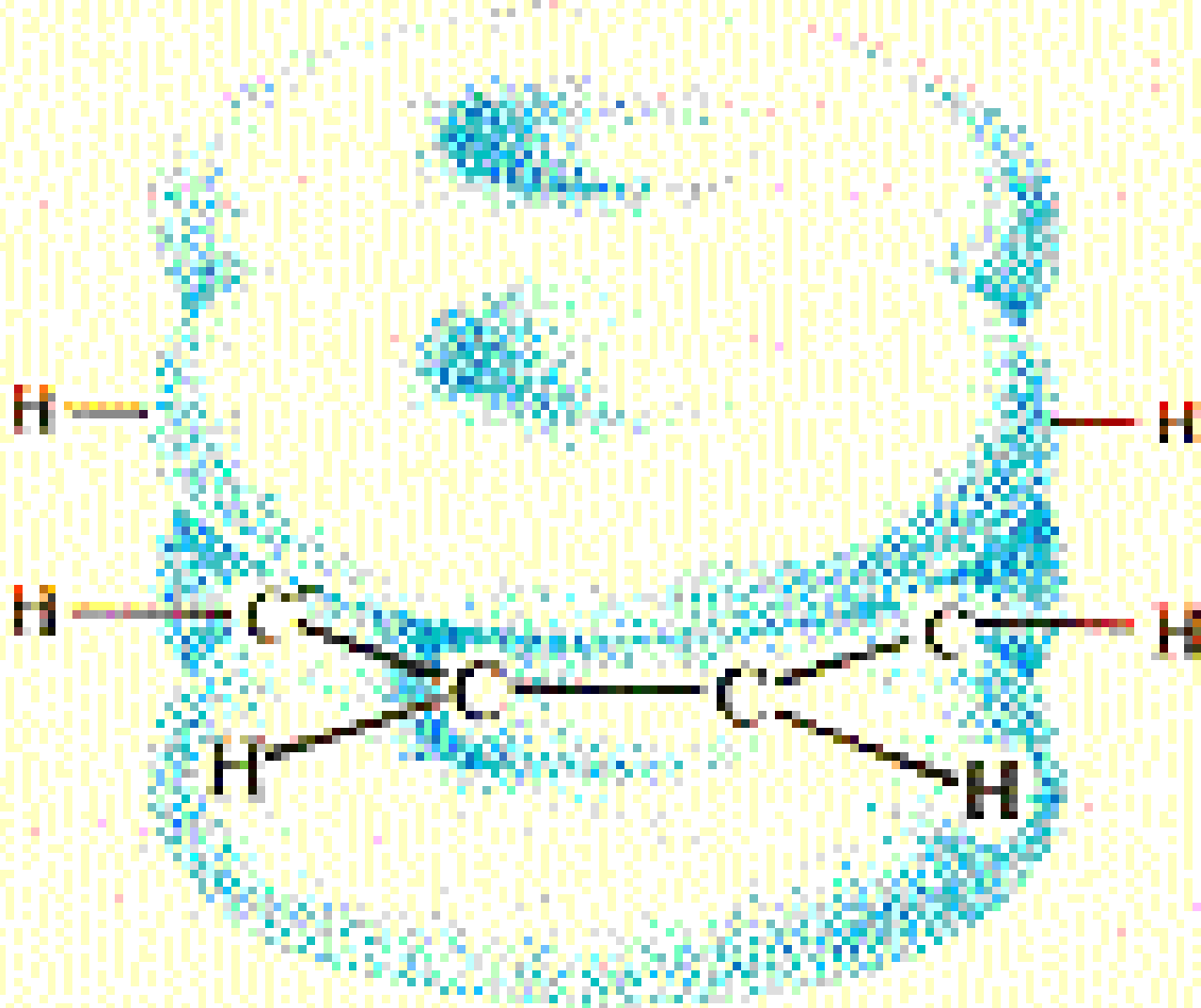


AB: HONO_2 or HOSO_3H or Cl_2 or RCl or RCOCl

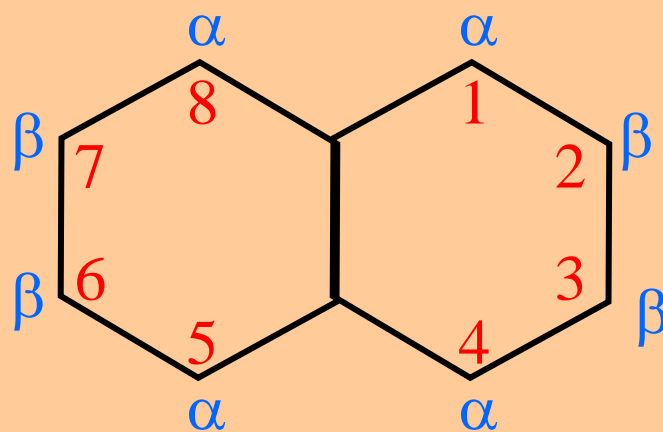
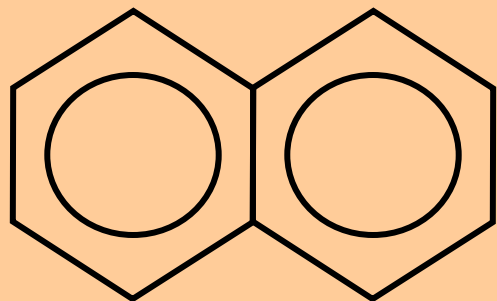
*Polynuclear Aromatic
Hydrocarbons*

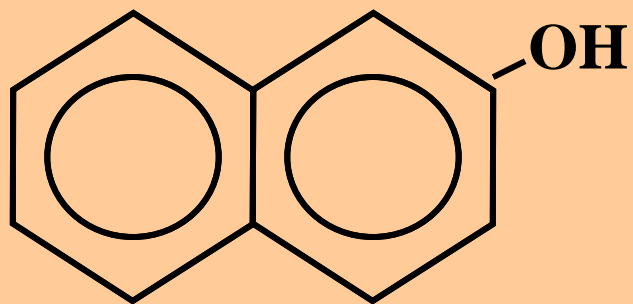


Naphthalene

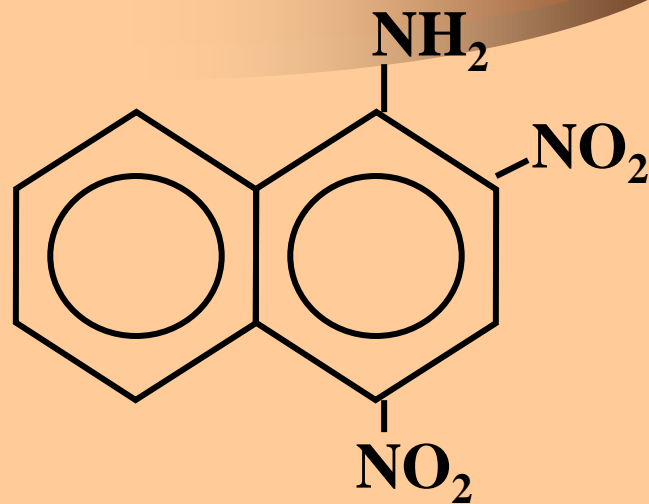


Naphthalene



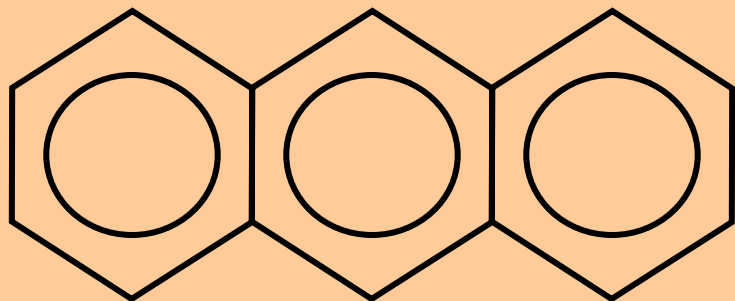


2-Naphthol
or
 β -Naphthol

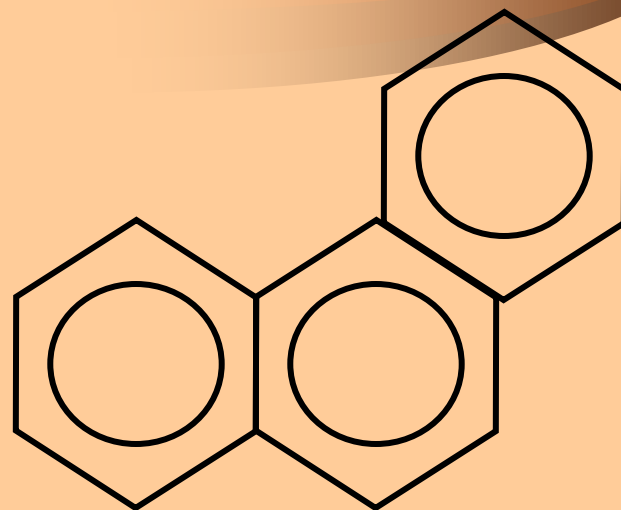


2,4-Dinitro-1-naphthylamine

Other Fused-ring Hydrocarbons



Anthracene



Phenanthrene

