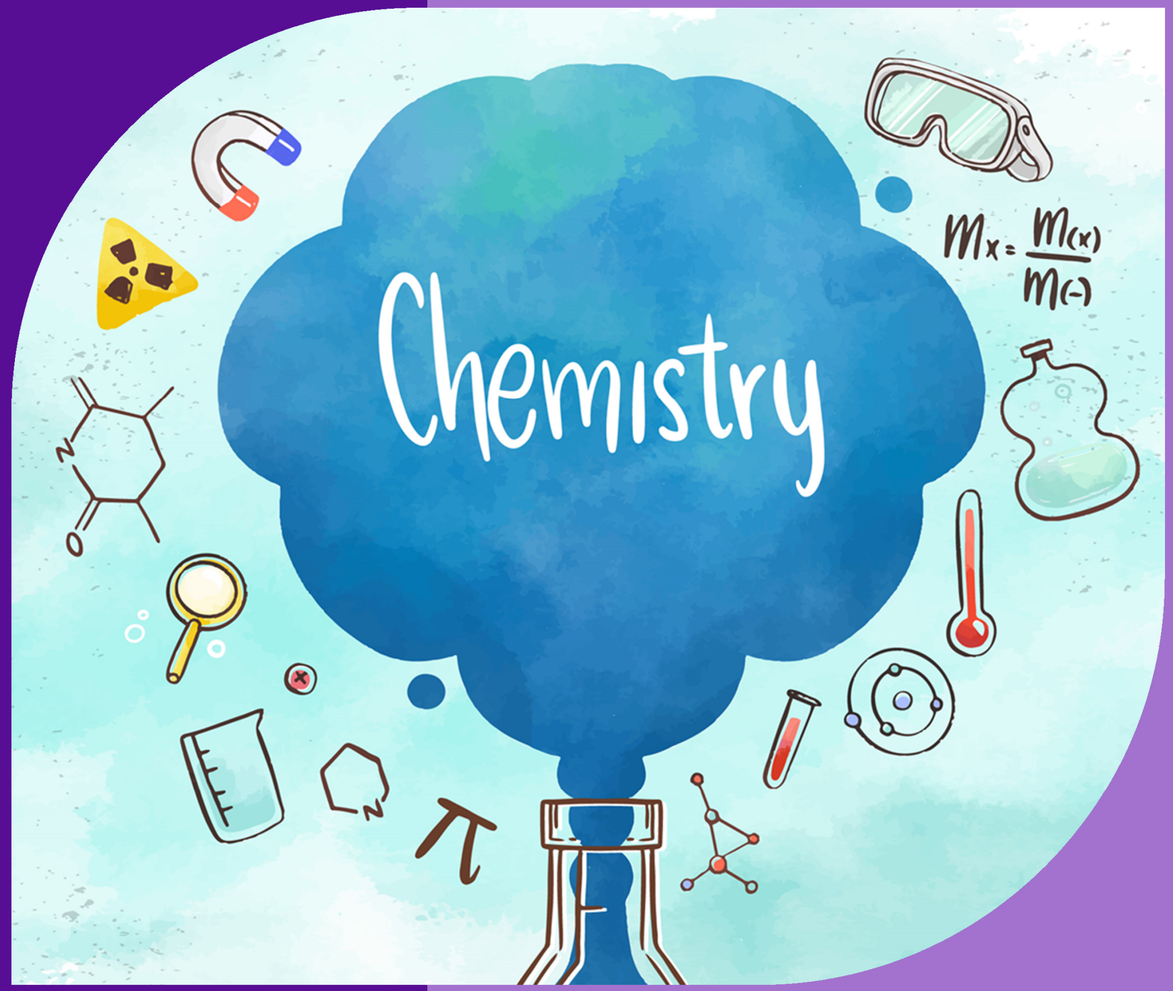
CLASS XII ACADEMIC PROGRAM 2020

CHEMISTRY 2ND PAPER

LECTURE : C 10

CHAPTER 2 : ORGANIC CHEMISTRY (Aromatic)

SADAT AHMED DIPRO



Aromatic Compouns

Benzene and compounds having same type of structure as benzene are known as Aromatic Compounds.

Aroma → সুগন্ধ

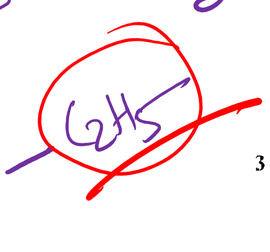
Aromatic

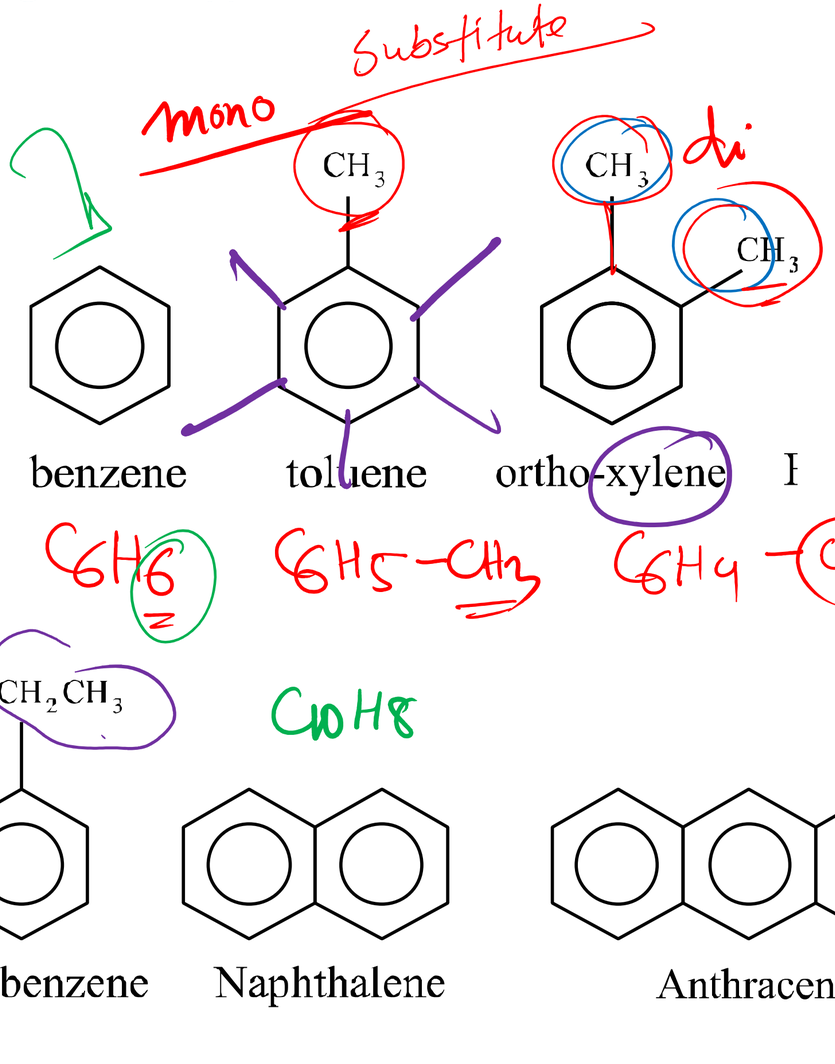
Δ → Arom.

B → সুগন্ধ Aromatic✗

Isomer

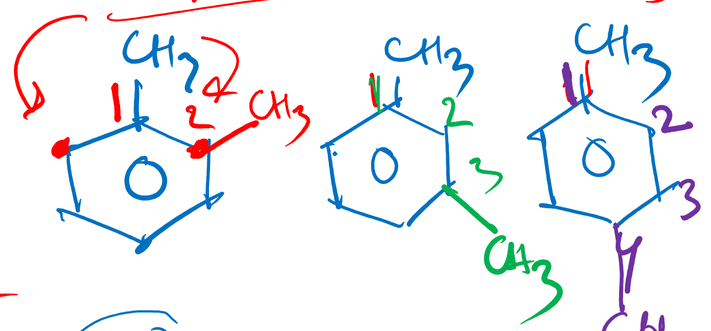
$C_6H_5-CH_3$ → isomer ২টি





Chemical
- Structure
- Reaction

pos. isomers (ৎ-07)

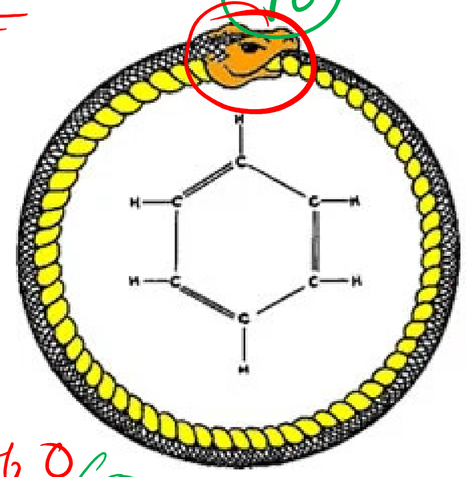


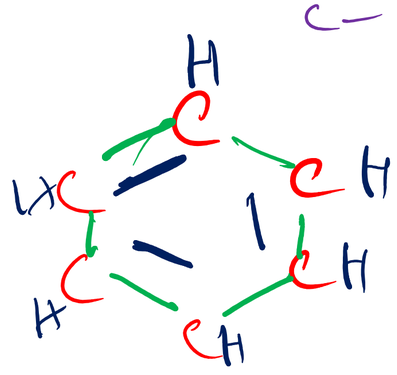
physical property

Benzene's Kekulé Structure

1. Michael Faraday -1825 (1st Isolated Benzen)
2. Eilhard Mitscherlich-1833 (from benzoin)
3. Charles Manifield -1845 (from coal tars)
   Friedrich August Kekulé – 1865

- Catenation
- Ring Structure





ouroboros or **uroboros**

Mono substituted compounds of Benzene have only one Isomer

$C_6H_6 + Y \rightarrow C_6H_5-Y$

$C_6H_5-CH_3$

C_6H_5-Cl

only 1 isomer

(experimental)

Possible structures envisioned for C_6H_6 : Benzene

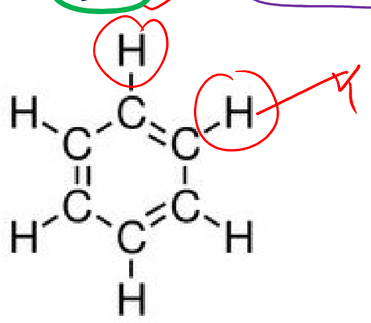
C_6H_5-Y

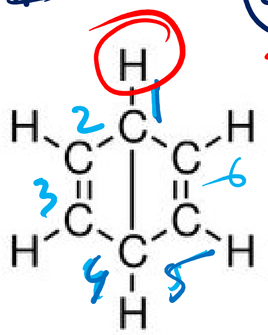
1

Single isomer ✓

I **Isomer Theory** II

2



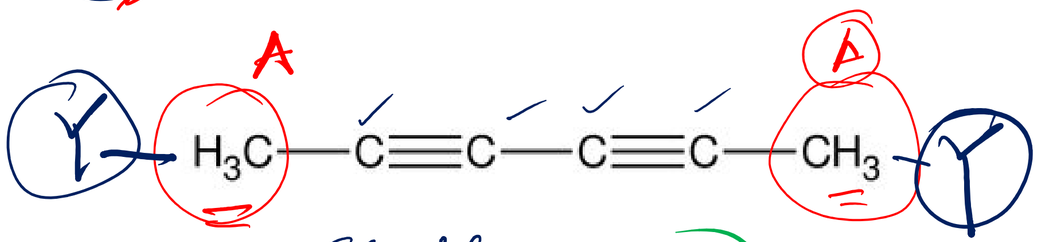


C_6H_6

8/10

1

(possible) **Original Kekule structure**



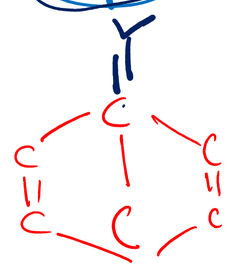
same

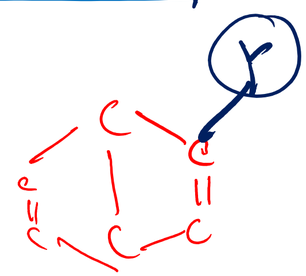
III

X

1, 4

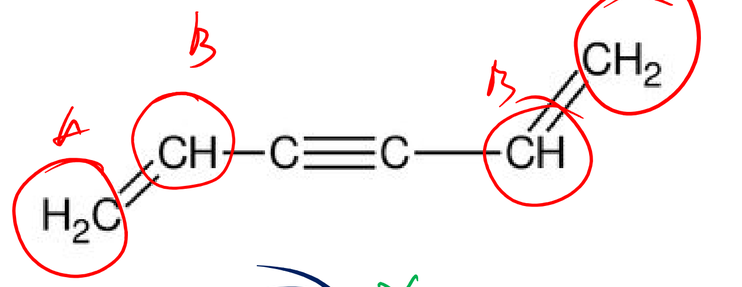
2, 3, 5, 6





A

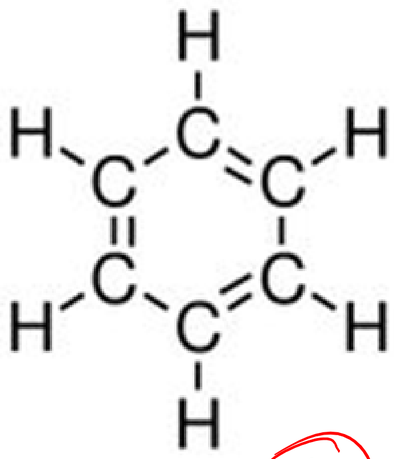
Dewar structure (possible)

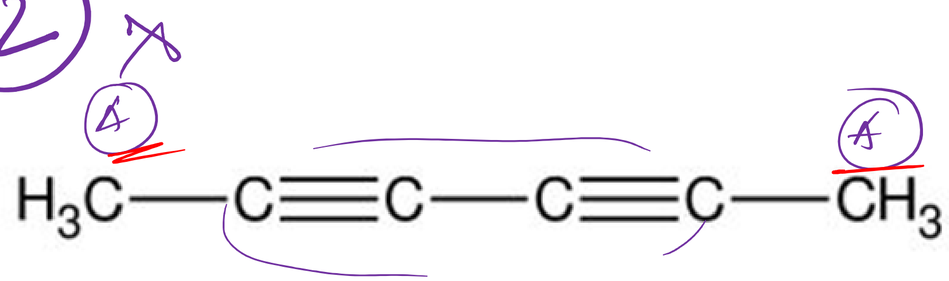


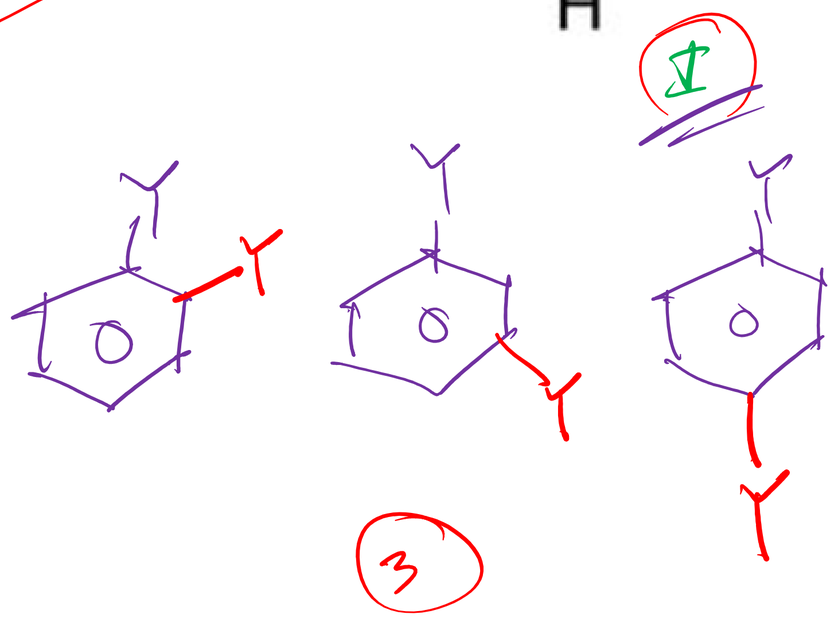
2

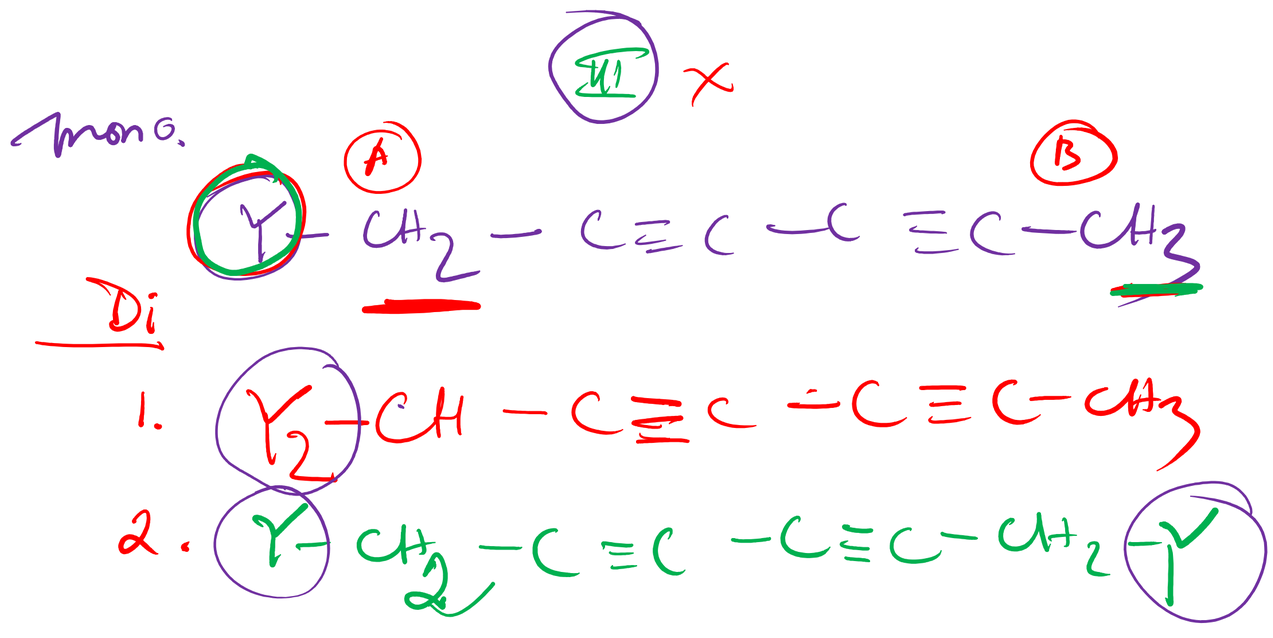
IV X

Disubstituted compounds of Benzene have three Isomers (experimental) 3







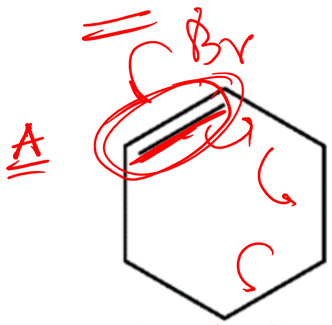


Comparison between Benzene & Alkene

Practical

Reagent

	Alkene	Benzene
$KMnO_4$ (dil)	pink → cone	No Reaction
Br_2 (CCl_4)	Red →	NR
HI	fast addition	NR



cyclohexene

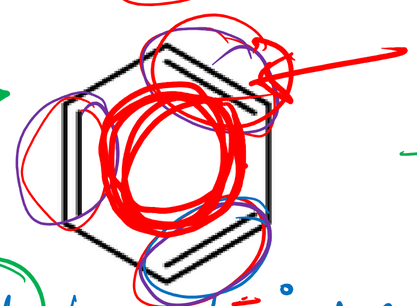
fast oxidation

fast addition

fast addition

Cycloalkene

Theory



Benzene

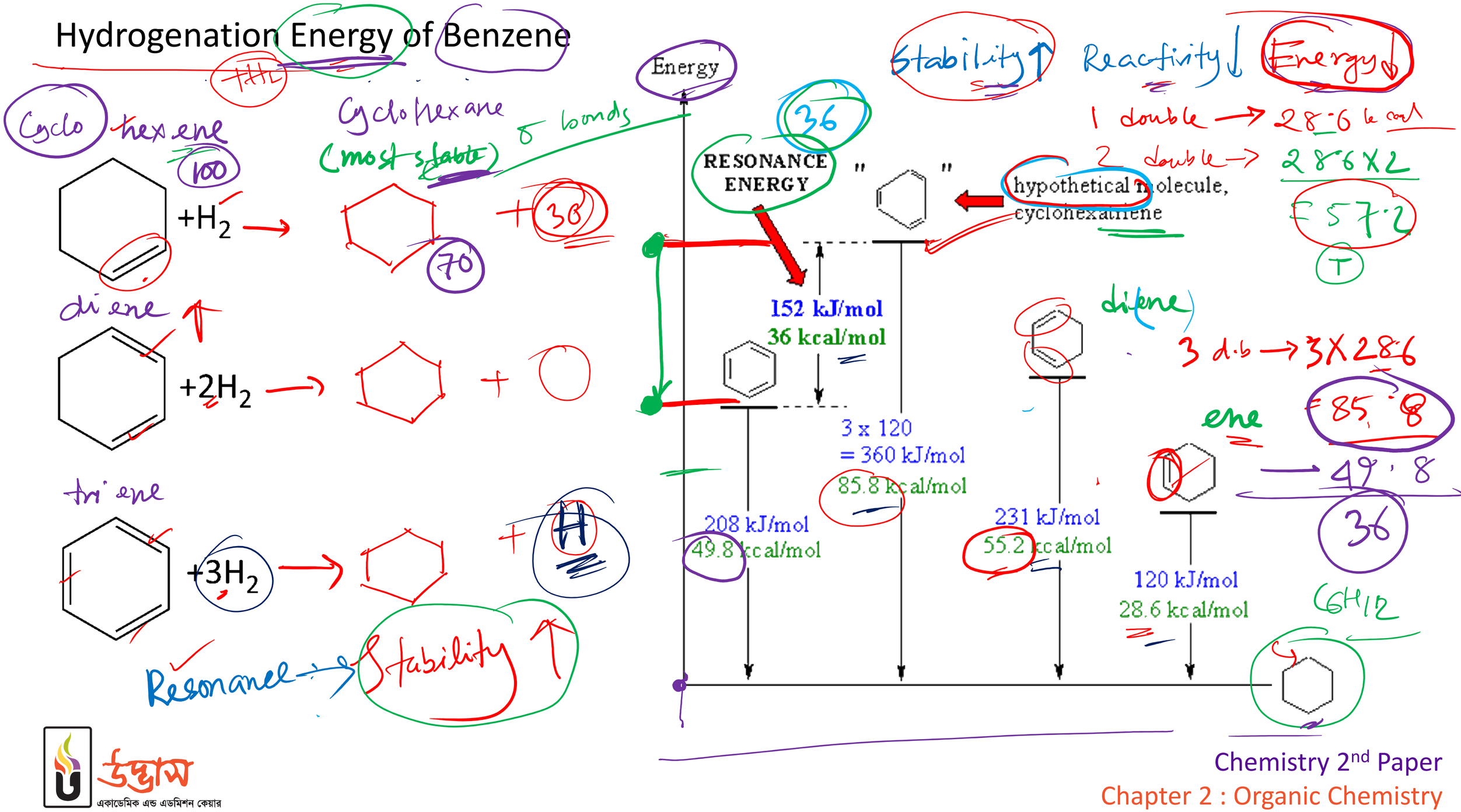
Ep

cyclo hexatriene

Stability ↑

Special kind of Unsaturation

Hydrogenation Energy of Benzene

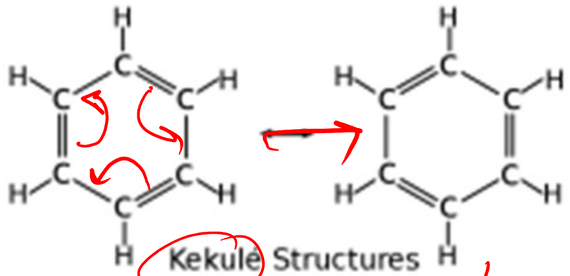


Resonance Theory for Benzene (Special Kind of Unsaturation)

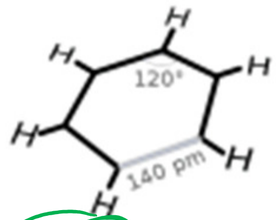
delocalised

shifting of e⁻

C = C — sp²



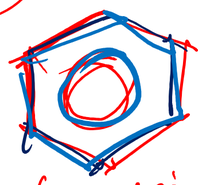
50% 50%



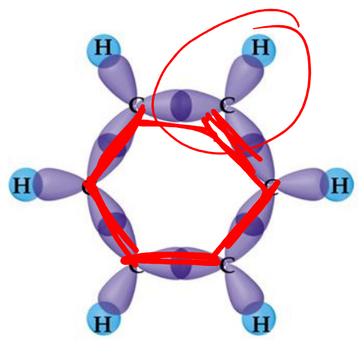
100%

0·140 nm

IR Spectroscopy

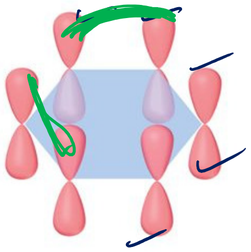


(more stable)



(a) σ bonds

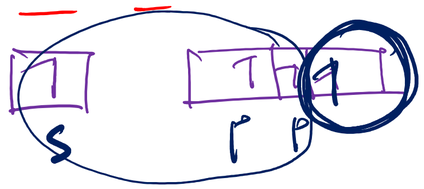
sp^2



(b) 2p atomic orbitals

(c) Delocalized π bonds

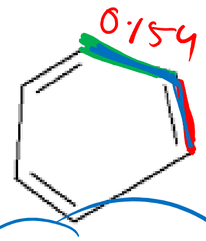
C(6) → $1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$



Co-planar
(triangular

C-C

Ethane C– C bond distance = 0.154 nm
Ethylene C– C bond distance = 0.134 nm
Benzene C– C bond distance = 0.134 nm



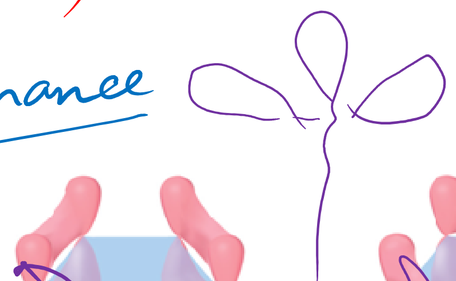
0·154

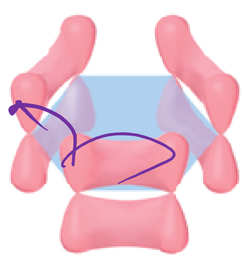
0·134

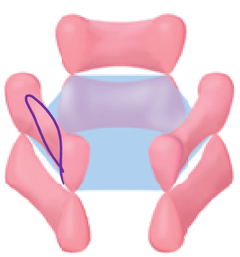
0·139 nm

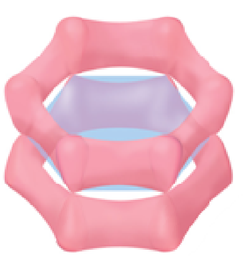
'Cyclohexatriene'

Resonance









Alkane Benzene Alkene

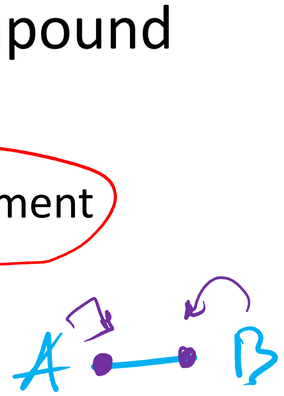
0·154 > 0·139 > 0·134

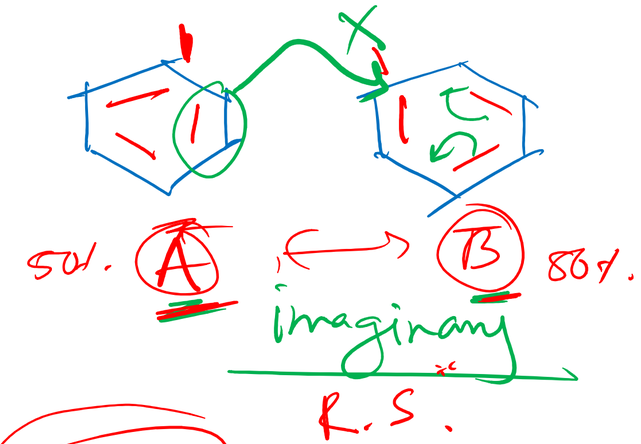
1·54 1·39 1·34

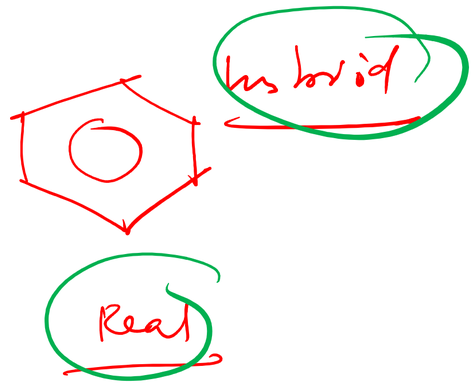
Å $= 10^{-8}$

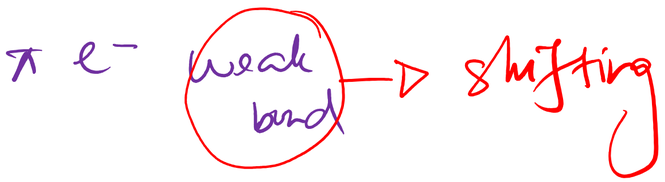
Resonating Structures Of Compound

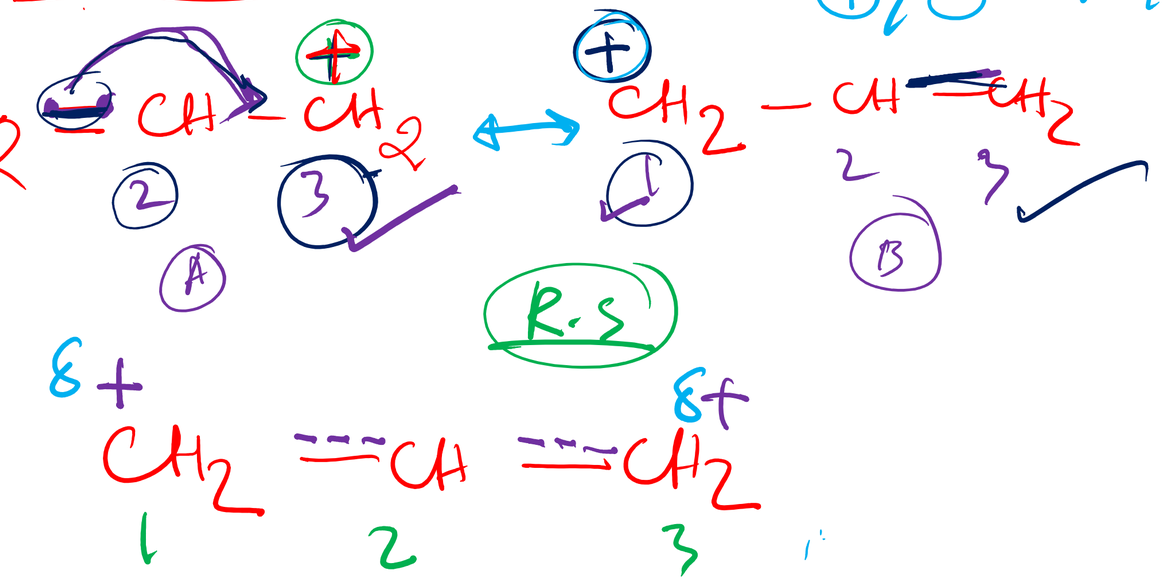
- Multiple Structural Formulas having difference only in electronic arrangement
- Shifting of electrons
- Intramolecular
- Hypothetical/ Imaginary
- Real : hybrid of all resonating structures

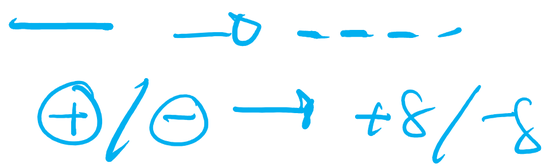












উদ্ভাস
একাডেমিক এন্ড এডমিশন কেয়ার

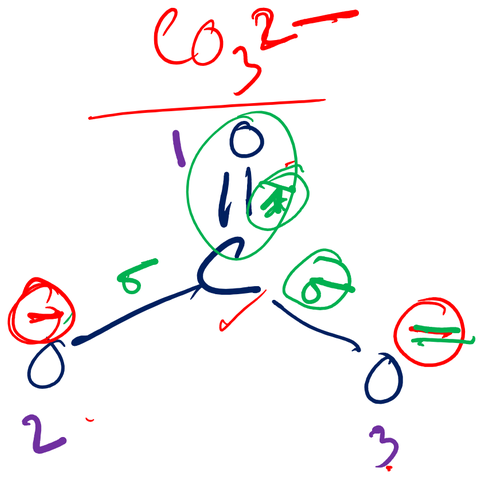
Resonating Structures Of Compound (Conjugation)

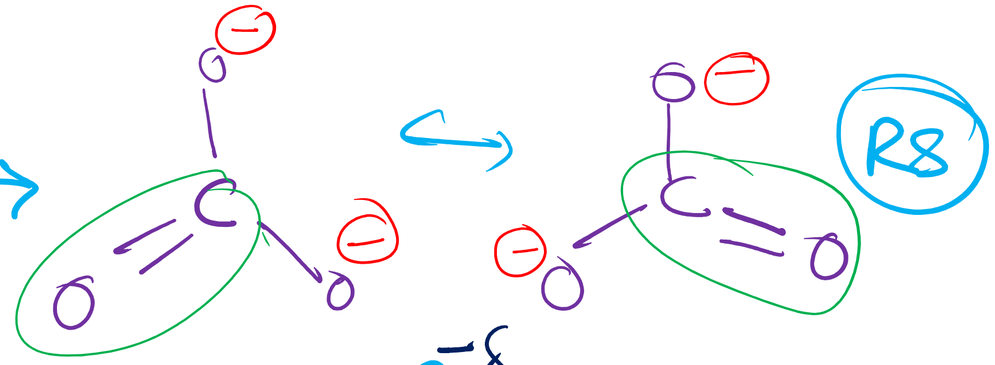
1. π σ+ (vacant p orbital)

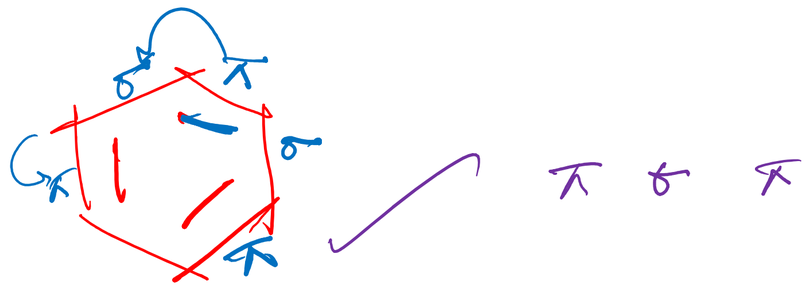
2. π σ lone pair/

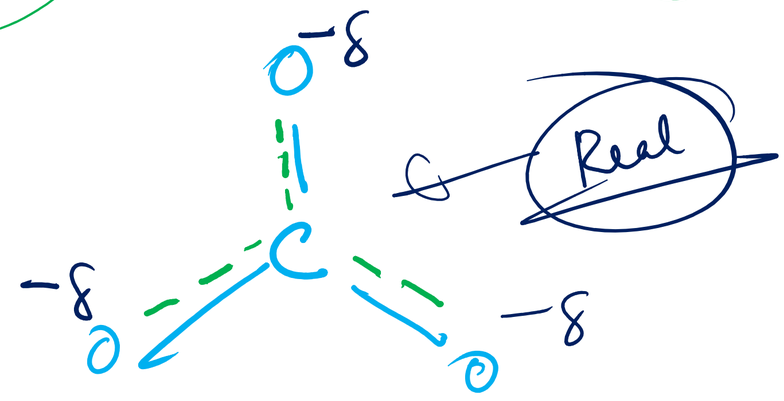
3. π σ free radical

4. π σ π

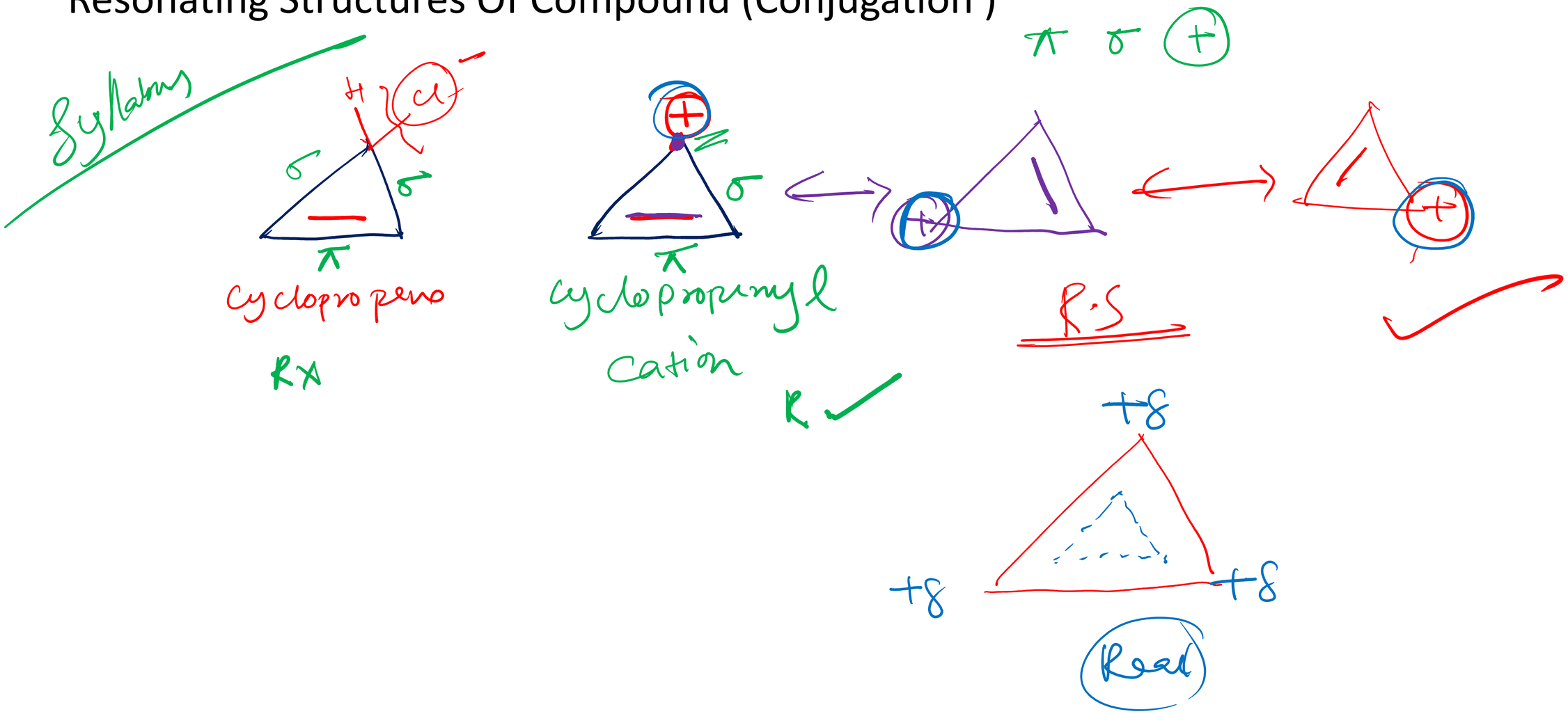








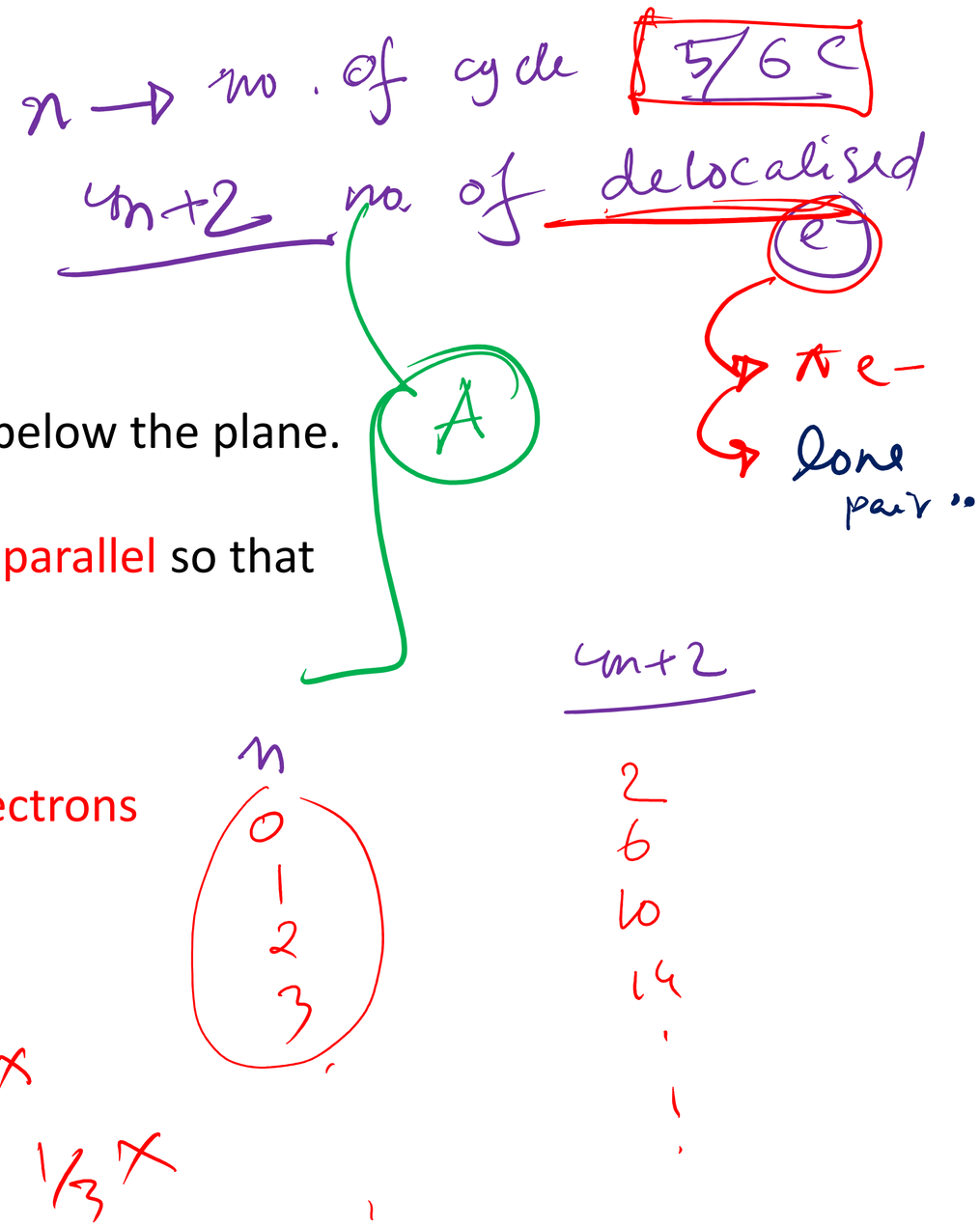
Resonating Structures Of Compound (Conjugation)



Aromaticity & Huckle's Rule

Conditions:

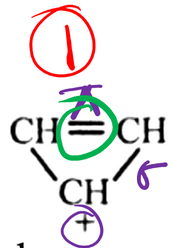
- Compound has to be flat and cyclic.
- There has to be delocalized π electron cloud above and below the plane.
- Each atomic P orbitals in the cyclic structure should stay parallel so that overlapping is possible.
- In the overlapping of P orbitals, $(4n+2)$ number of π electrons participate where $n=0, 1, 2, 3$ etc



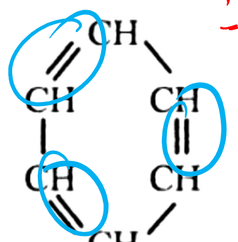
Huckle's Rule

(i) Special type of unsaturation
(ii) Resonance
(iii) Delocalized π electrons

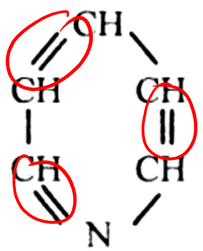
Cyclic
Conjugated
Planar
4n + 2



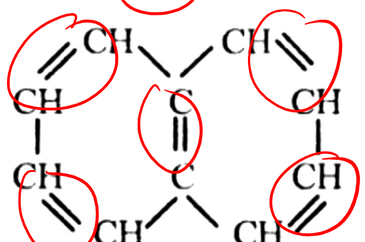
cyclopropene ion



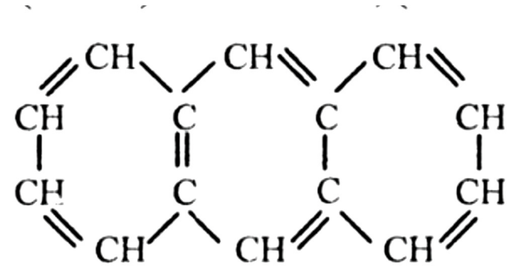
Benzene



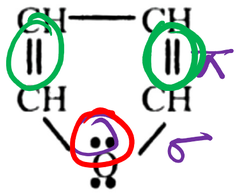
Pyridine



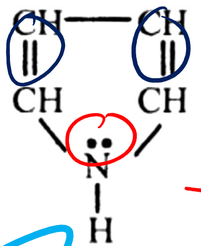
Naphthalene



anthracene

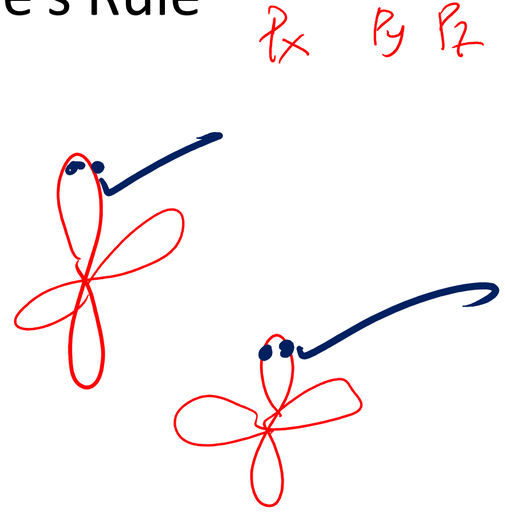


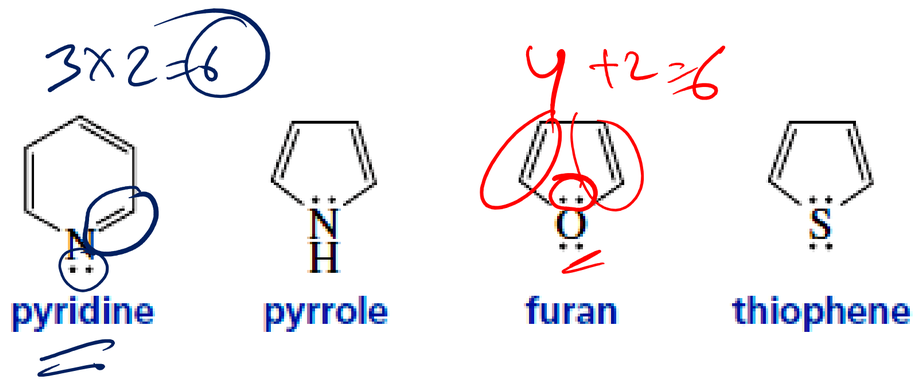
Furan



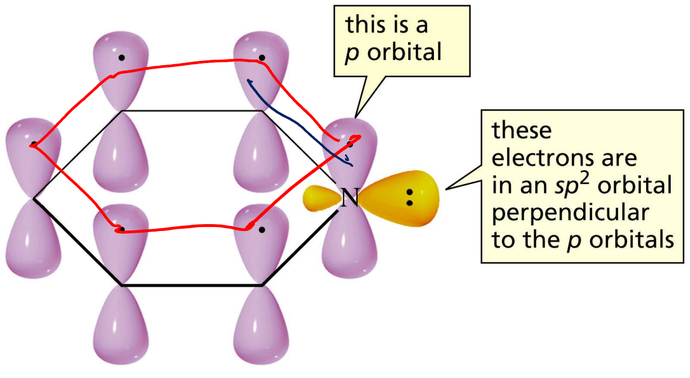
Pyrrole

Huckle's Rule

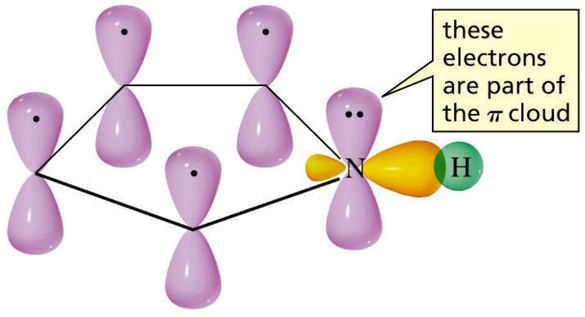




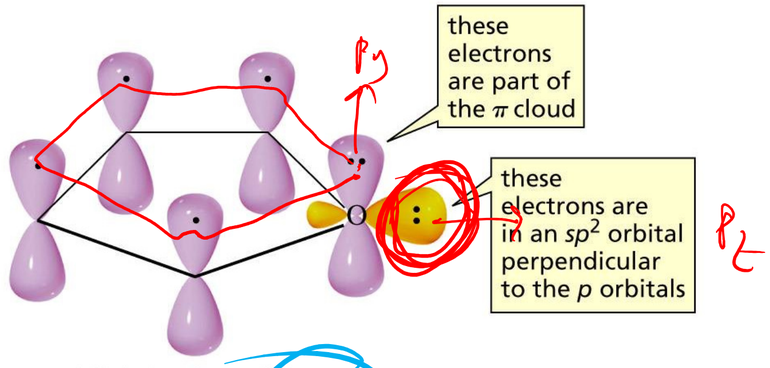
Cyclic
Conjugated
Planar
4n + 2



orbital structure of pyridine



orbital structure of pyrrole

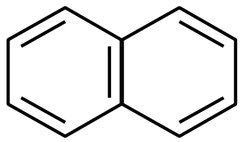


orbital structure of furan

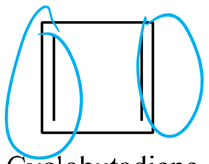
Huckle's Rule

2, 6, 10, 14

Benzene



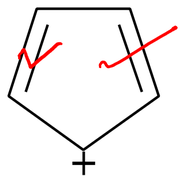
Naphthalene



Cyclobutadiene

4 π e⁻

Aromatic



cyclopentadinyl cation

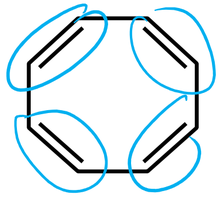
2×2 = 4

Arom ✗

cyclopentadinyl anion

4+2 = 6

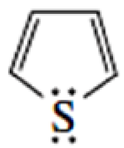
Arom ✓



Cyclooctatetraene

4×2 = 8

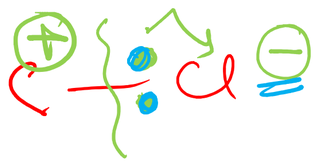
Arom ✗



thiophene

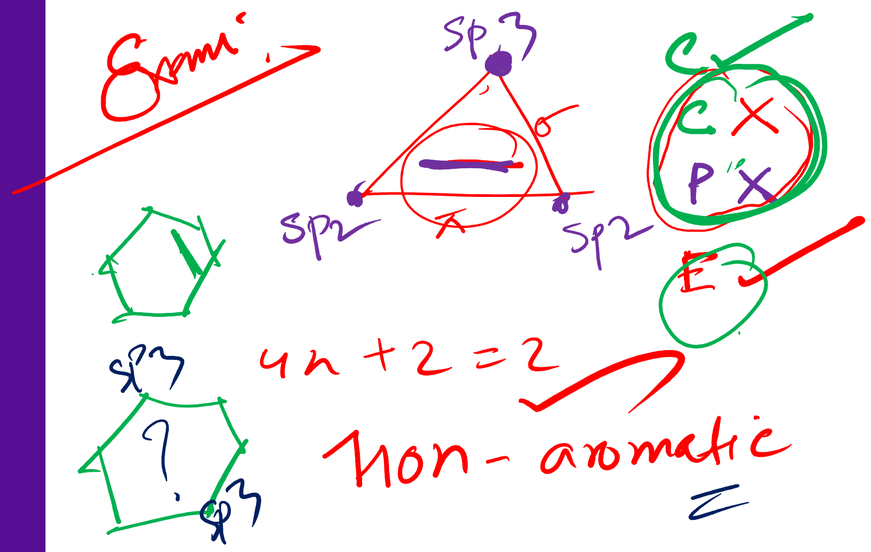
Cyclic
Conjugated
Planar

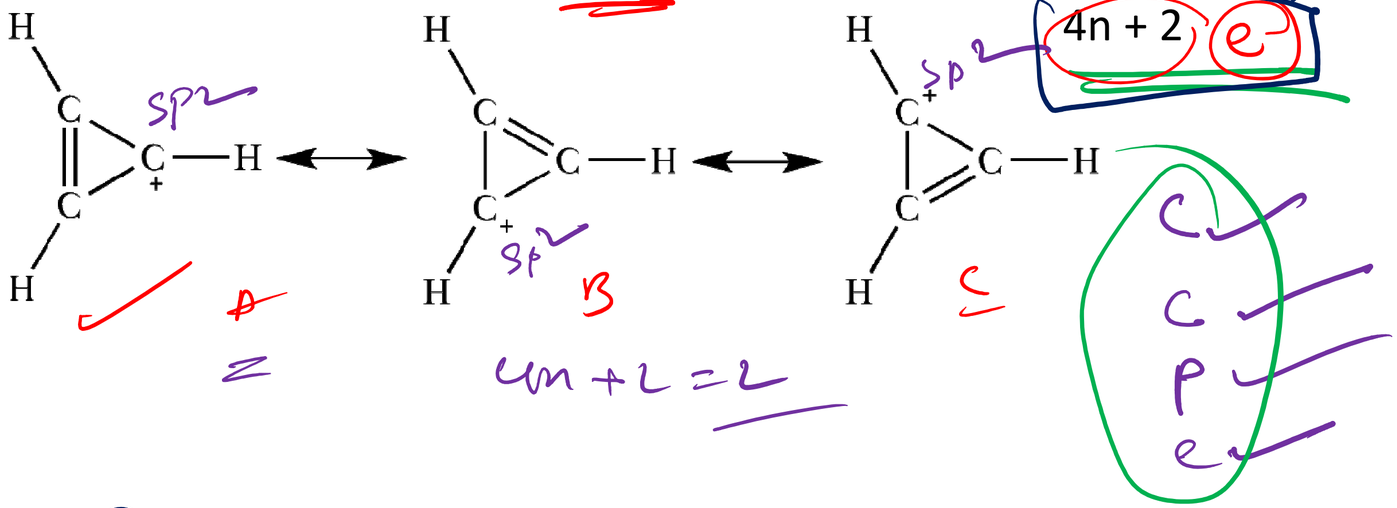
4n + 2

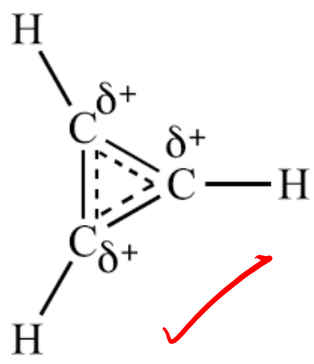


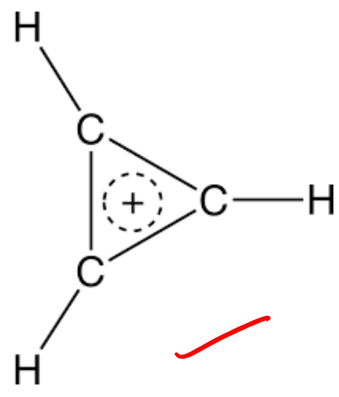
উদ্ভাস
একাডেমিক এন্ড এডমিশন কেয়ার

Aromatic , Anti aromatic & Non aromatic



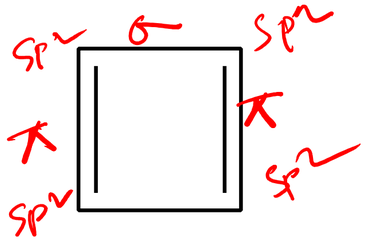






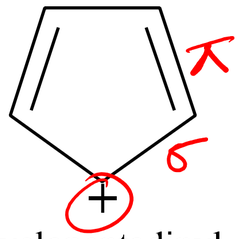
Aromatic, Anti aromatic & Non aromatic

4n+2 4n

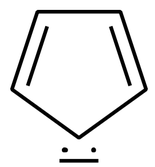


Cyclobutadiene

4π e⁻



cyclopentadinyl cation



cyclopentadinyl anion

Practical

Cyclic
Conjugated
Planar
4n + 2

Solve:

C ✓
C ✓
P ✓

4n+2 X

So, Anti Aromatic

but, 4n = 4
∴ n = 1

C ✓
C ✓
P ✓

4n+2 X

4n = 4

Anti

C ✓
C ✓
P ✓

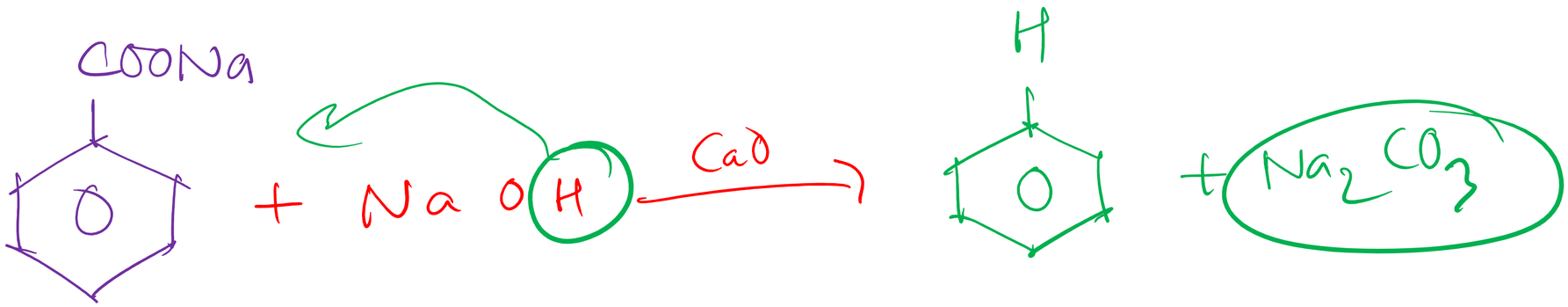
4n+2 = 6 ✓

Aromatic

Preparation of Benzene

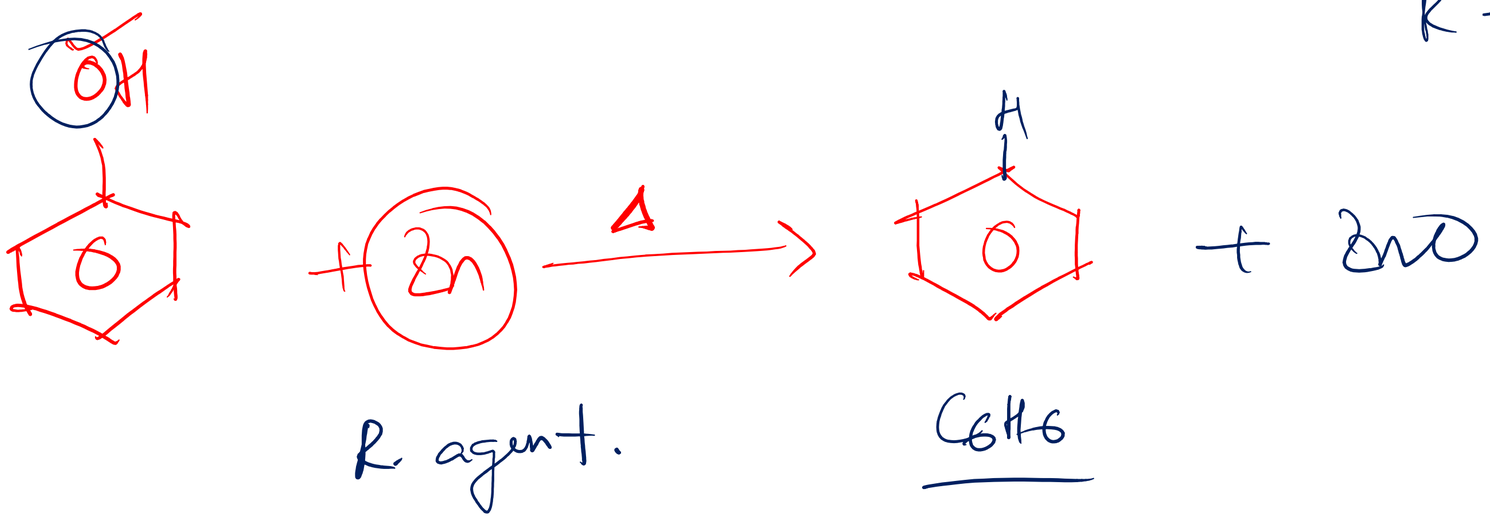
Decarboxylation

C-08 → Prep. of Alkane



Preparation of Benzene

From Phenol

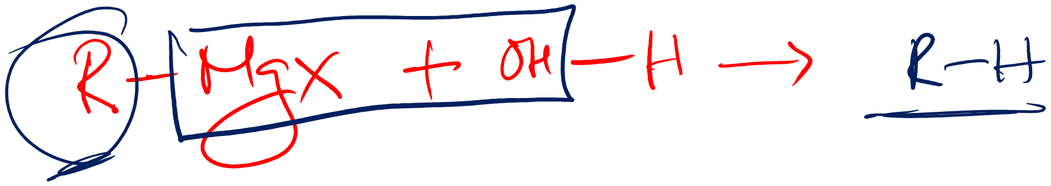


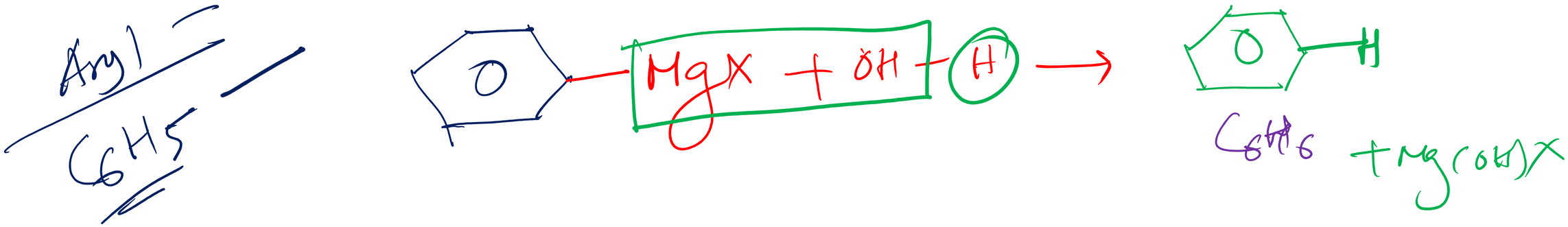
R → O out
H in

Preparation of Benzene

By Hydrolysis of Grignard Reagents

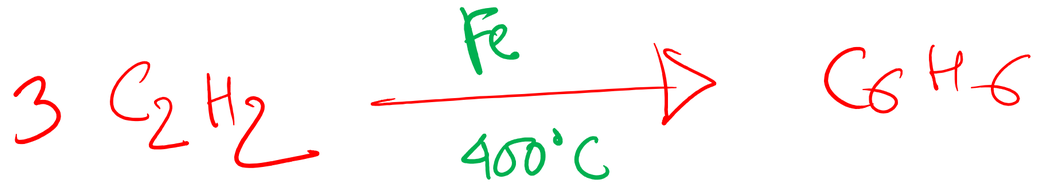
(C-08)





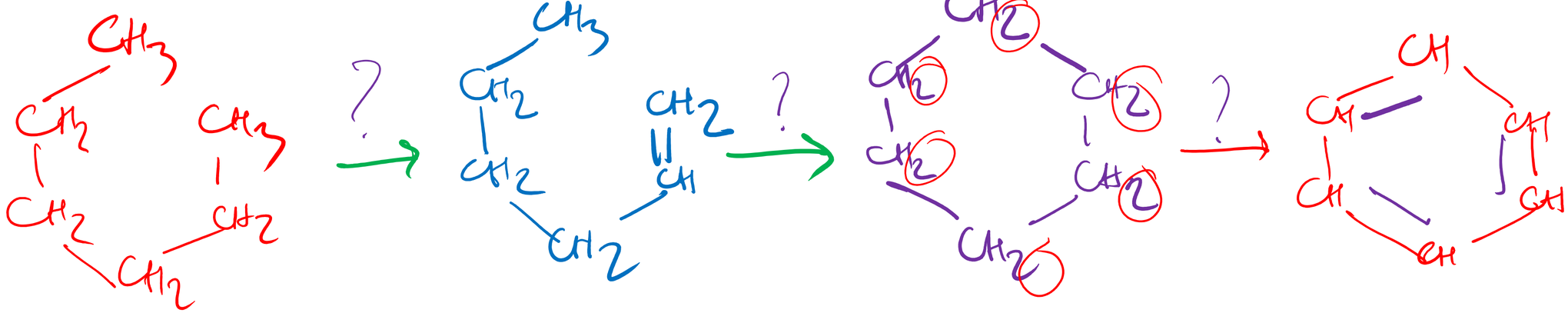
Preparation of Benzene

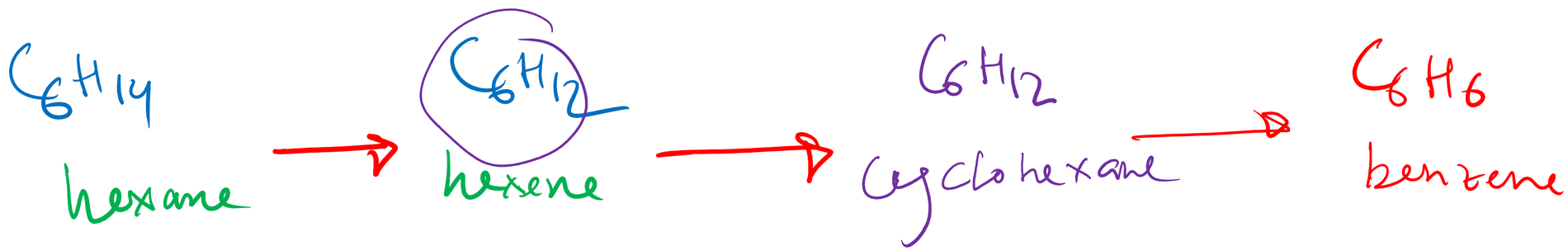
Polymerization of Alkyne



Preparation of Benzene

Aromatization of Hexane





লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।