CONCEPT MAP

CLASS XI

HYDROCARBONS

Get well-prepared for exams with quick revision of important concepts of organic chemistry.

Alkanes (C_nH_{2n+2})

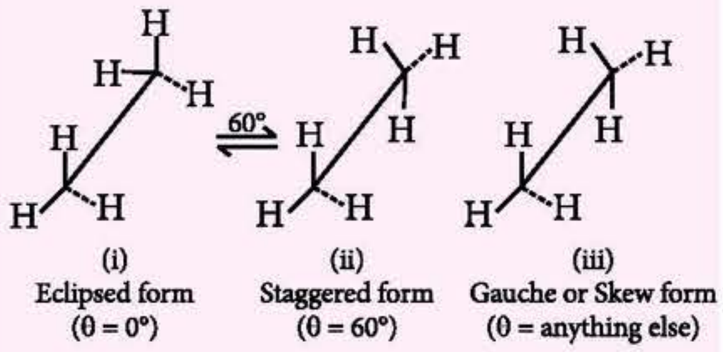
- **Boiling points and melting points :**
- B.pt. and m.pt. $\propto \frac{1}{\text{Branching}}$
- B.pt. $\propto$ molecular mass
- M.pt. $\propto$ symmetrical and close packing
- Alkanes with even no. of carbon atoms are more closely packed and thus show higher m.pt. as compared to next alkane with odd no. of carbon atoms.

Chemical Properties :

- Least reactive because of strong C—C and C—H σ bonds.
- Undergo only substitution reactions.
- Sulphonation and halogenation occur by free radical mechanism.

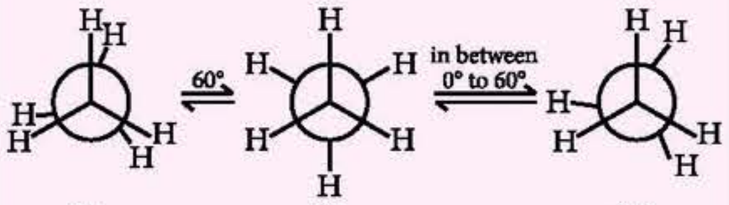
Conformations of Ethane

- **Sawhorse projection :**



(i) Eclipsed form (θ = 0°) (ii) Staggered form (θ = 60°) (iii) Gauche or Skew form (θ = anything else)

- **Newmann projection :**



(i) Eclipsed form (ii) Staggered form (iii) Gauche or Skew form

Order of Stability

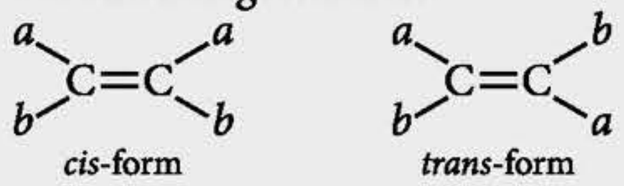
- Staggered (*anti*) > gauche > partially eclipsed > fully eclipsed
- For cyclohexane; chair > half-chair > boat
- **Baeyer's strain theory :**
  Amount of deviation (d) = 1/2(109°28′ – valency angle)

Alkenes (C_nH_{2n})

- **Boiling points :** *cis*-isomer > *trans*-isomer
- Most substituted alkenes are more stable.
  $R_2C = CR_2 > R_2C = CHR > RCH = CHR$ (*trans*)
  $R_2C = CH_2 > RCH = CHR$ (*cis*) $> RCH = CH_2 > CH_2 = CH_2$
- Undergo electrophilic addition reactions.
- **Test for unsaturation :** Gives bromine water and Baeyer's tests.
- Addition of unsymmetrical reagents (HX, H_2O, HOX, etc.) takes place according to Markovnikov's rule.

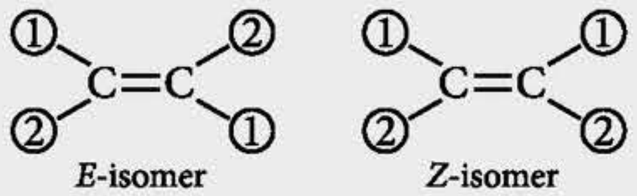
Isomerism

- **Geometrical (*cis-trans*) :** Molecules have identical atomic arrangement but different geometries.



cis-form *trans*-form

- ***E* and *Z* system :**



E-isomer *Z*-isomer

- **Calculation of geometrical isomers in polyenes :**
  (a) When the ends of polyene are different, then the number of geometrical isomers = 2^n
  where, n is the number of double bonds.
  (b) When the ends of polyene are same,
  (i) When n is an even number, then the number of geometrical isomers $= 2^{(n-1)} + 2^{(n/2-1)}$
  (ii) When n is an odd number, then the number of geometrical isomers $= 2^{(n-1)} + 2^{\left(\frac{n-1}{2}\right)}$

Alkynes (C_nH_{2n-2})

- **Melting points and boiling points :** Alkynes > Alkenes > Alkanes.
- **Acidity :** Alkynes > Alkenes > Alkanes (as *s*-character $\propto$ acidity).
- **Degree of unsaturation** or index of hydrogen deficiency $= (2n_1 + 2 - n_2)/2$,
  where, n_1 = number of carbon atoms, n_2 = number of hydrogen atoms.
- **Test for unsaturation :** Gives bromine water and Baeyer's test.
- Undergo electrophilic and nucleophilic addition.

Aromatic Compounds

- A compound is said to be aromatic when it is cyclic and planar.
- It has complete delocalisation of π-electrons.
- It follows Huckel's rule, *i.e.*, $(4n + 2)\pi$ electrons. Where, n is a positive integer (0, 1, 2, 3, ...).
- A compound is said to be anti-aromatic when it is cyclic, planar, conjugated and have $4n\pi$ electrons.

Directive influence of Substituents

- ***o-*, *p*-directing groups :** –*R*(alkyl), –OH, –SH, $-NH_2$, $-O^-$, –*OR*, –*NHR*, $-NR_2$, –*NHCOR*, –Cl, –Br, –I, $-CH_2Cl$, $-CH_2OH$, $-CH_2NH_2$, $-CH_2CN$, $-CH_2COOH$, $-CH=CH_2$, $-CH=CHCOOH$, $-C_6H_5$, –N=N, –NC, etc.
- ***m*-directing groups :** $-SO_3H$, $-NO_2$, –CHO, –COOH, –CN, SO_2Cl, –COCl, –*COOR*, –*COR*, $-CONH_2$, $-CCl_3$, $-CF_3$, $-\overset{+}{N}H_3$, $-\overset{+}{N}H_2R$, $-\overset{+}{N}HR_2$, $-\overset{+}{N}R_3$, etc.

- Addition of symmetrical reagents over symmetrical alkenes can be generalised as :
  - *cis*-alkene + *syn*-addition → *meso*-product
  - *cis*-alkene + *anti*-addition → *racemic*-product
  - *trans*-alkene + *syn*-addition → *racemic*-product
  - *trans*-alkene + *anti*-addition → *meso*-product