CHEMISTRY 1 CHEM10003 REVISION NOTES

Section A – Organic Chemistry

LECTURE 1 – CARBON

- **Sp3 hybridisation**: 1s + 3p orbitals => 4 sp3 hybrid orbitals
- Sp3 orbitals point to vertices of **tetrahedral**
- C-H: 109.5°, 109pm, 439 kJ/mol
- C-C: 111.2°, 154pm, 377kJ/mol
- Ethane: sp3 hybrid orbital end-on-end overlap => **σ-bond**

LECTURE 2 – ALKANES, CONFORMATIONAL ISOMERS

- General formula: CnH2n+2
- **Conformational isomers**: due to free rotation about bond
- **Torsional strain** – due to bonding electrons, **steric strain** – due to atomic space filling
- Ethane conformations:
    - **Staggered** – **dihedral angle** = 60°
    - **Eclipsed** – dihedral angle = 0°, +12 kJ/mol
- Butane conformations:
    - Anti-periplanar – CH3 as far apart as possible
    - Synclinal (Gauche) - steric strain from CH3 near each other, +3.8 kJ/mol
    - Anticlinal – CH3 over H, steric + torsional, + 16 kJ/mol
    - Syn-periplanar – CH3 over CH3, +19 kJ/mol

LECTURE 3 – CHIRALITY

- **Chiral**: has non-superimposable mirror image
- Asymmetric C atom if has 4 different substituents = chiral molecule
- **Enantiomer**: stereoisomer with identical physical/chemical properties except for behaviour towards plane polarised light (rotates it) and reactivity in a chiral environment

- Cahn-Ingold rules: assign 1-4 priority of decreasing atomic number (H = 4), look down C-4 bond and:
    - Clockwise (right) => R
    - Anticlockwise (left) => S
- **Diastereoisomer**: stereoisomer that is not an enatiomer
- Number of stereosiomers = 2^n (n = no. of asymmetric centres)
- **Meso compound**: stereoisomer with 2 or more asymmetric centres and is achiral

LECTURE 4 – CYCLOHEXANE

- **Ring strain**: increase in energy due to closeness of bonds (deviated from 109.5^o)
- Cyclohexane exists as chair or boat configurations (chair is preferred due to less ring strain)
- **Ring flip**: reverse chair positions, ~43 kJ/mol
- Point up or down = **axial**, point out = **equatorial**
- Boat = chair + 29 kJ/mol, half chair = chair + 43 kJ/mol
- **1,3-diaxial steric interaction**: bigger group attaches to cyclohexane (prefer to be in equatorial)

LECTURE 5 – CIS/TRANS ISOMERISM

- C-C bonds in cyclohexane cannot rotate freely
- **Cis**: groups on same face of ring, **trans**: groups on opposite faces of ring
- Eq,eq preferred in 1,2-trans, 1,3-cis, 1,4-trans

LECTURE 6 – DOUBLE BONDS

- **Sp2 hybridisation** to form **trigonal planar** shape (p-orbital orthogonal to trigonal plane)
- Also have side-on p-orbital overlap (weaker) => **π-bond**
- P-orbitals on both sides of plane, but electrons only found in one at any given time
- No rotation about π-bond