Organic Chemistry

Large number of compounds due to:

- 4 valence pairs
- single / double / triple bonds
- cyclic (ring) structures

Properties of hydrocarbons

- *Saturated* - all C-C bonds are single
- Insoluble in water
- Almost non-polar (similar electronegativities)
- Only dispersion forces (valence e-)
- Dispersion forces increase with length
- Branched molecules have lower density

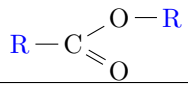
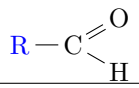
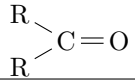
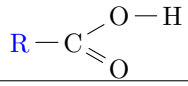
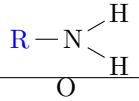
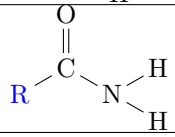
Linear (aliphatic)

Alkanes: $C_n H_{2n+2}$
Alkenes: $C_n H_{2n}$
Alkynes: $C_n H_{2n-2}$

Naming hydrocarbons

- Branches end with *-yl*
- Indicate number of branches with di-, tri- etc.
- Longest unbranched carbon chain includes function group

Functional groups

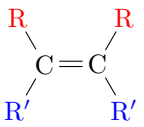
Alcohols	–OH	
Esters	–OCO–	
Aldehydes	–CHO	
Ketones	–CO–	
Carboxylic acids	–COOH	
Ethers	–O–	
Amines	$-NH_2$	
Amides	$-CONH_2$	

Isomers

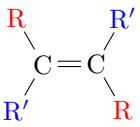
- **Structural isomers** - same molecular formula, different arrangement

- **Stereoisomers** - same structural configuration, different orientation
  - **Opotical isomers** - chiral centre, 4 groups bonded to C, non-superimposable mirror image
  - **Geometric isomers** - C=C double bond, 2 groups bonded to carbon atoms
    - **Cis** - same horizontal plane
    - **Trans** - diagonal

cis



trans



Reactions

Cracking - split moluecules with heat/pressure/catalyst

Alkanes

- Relatively inert
- Non-polar solvent
- Non-soluble in H_2O
- Combusts in O_2 (forms $CO_2 + H_2O$)
- Reacts with halogens (**substitution** of H)

Alkenes

- More reactive than alkanes
- **Addition reactions**: C=C bond is broken (energy released)
- **Addition polymerisation**

Alcohols

- Can be formed from haloalkane substitution reaction
- **Oxidation** (combustion)
- Oxidation state $\propto$ no. of atoms connected to C
- **Substitution** of functional group, e.g. $ROH + NH_3 \longrightarrow RNH_2 + H_2O$
- Primary alcohols oxidise to aldehydes then carboxylic acids
- Secondary alcohols oxidise to ketones

Carboxylic acids

- Weak acids
- **Hydrolysis**: $RCOOH + H_2O \rightleftharpoons RCOO^- + H_2O^+$
- Rxn with amines - carboxylic acid + amine $\rightarrow$ ammonium salt $\rightarrow$ amide + water

Esterification

- **Condensation reactions** (esterification): $RCOOH + R'OH \longrightarrow RCOOR' + H_2O$
- This is reversed by **hydrolysis**: ester + water $\rightarrow$ carboxylic acid + alcohol
- Polyesters