Grade 12 Physical Sciences: Organic Chemistry Study Guide

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1. Organic Compounds Overview

Organic chemistry deals with carbon-based compounds. Key functional groups in Grade 12:

- Alkanes: CnH(2n+2) - single bonds only - saturated - suffix: -ane
- Alkenes: CnH(2n) - one double bond - unsaturated - suffix: -ene
- Alkynes: CnH(2n-2) - one triple bond - suffix: -yne
- Haloalkanes: -X (F, Cl, Br, I) substituent - suffix: -chloro/-bromo etc.
- Alcohols: -OH group - suffix: -ol (primary, secondary, tertiary)
- Carboxylic acids: -COOH group - suffix: -anoic acid
- Esters: -COO- group - suffix: -anoate
- Aldehydes: -CHO group - suffix: -anal
- Ketones: -CO- (internal) - suffix: -anone
- Amines: -NH2 group - suffix: -amine

2. IUPAC Nomenclature Rules

1. Find the longest carbon chain -> gives the parent name
2. Number the chain to give lowest locants to substituents or functional groups
3. Name substituents as prefixes (methyl-, ethyl-, chloro-, bromo-)
4. Alphabetical order for multiple substituents
5. Use di-, tri-, tetra- for multiple identical substituents

3. Types of Reactions

Addition Reactions (alkenes)

A small molecule adds across the C=C double bond.
- Hydrogenation: + H2 (catalyst Pt or Ni)
- Halogenation: + Br2 (decolourises brown/orange)
- Hydrohalogenation: + HBr (Markovnikov: H adds to C with more H)
- Hydration: + H2O (acid catalyst) -> alcohol

Substitution Reactions (alkanes/haloalkanes)

One atom replaces another.
- Halogenation of alkanes: UV light, Cl2 replaces H
- Nucleophilic substitution of haloalkanes: OH- replaces halogen -> alcohol

Elimination Reactions

Remove atoms to form a double bond.
- Dehydrohalogenation: haloalkane + KOH/ethanol -> alkene + HX
- Dehydration: alcohol + H2SO4 (180 degC) -> alkene + H2O

Esterification

Carboxylic acid + alcohol -> ester + water (concentrated H2SO4 catalyst, reversible).
ester name: alkyl group from alcohol + -anoate from acid

4. Physical Properties

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Boiling point increases with chain length (stronger London dispersion forces)

- Branching DECREASES boiling point (less surface area, weaker LDF)
- Alcohols have HIGHER BP than alkanes of similar mass (hydrogen bonding)
- Carboxylic acids have HIGHEST BP (strong H-bonding, dimerisation)
- Solubility: "like dissolves like" - polar dissolves polar, non-polar dissolves non-polar

TIP Bromide water test: alkene present -> brown $Br_2(aq)$ decolourises. $KMnO_4$ test: alkene present -> purple decolourises. Sodium carbonate test: carboxylic acid -> fizzing (CO_2).