

Alkanes

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Definition and Classification

- Alkanes, also known as paraffins, are the simplest class of hydrocarbons, consisting only of carbon (C) and hydrogen (H) atoms with single covalent bonds.
- The general formula for alkanes is C_nH_{2n+2} .

Types of Alkanes

- **Straight-chain (Normal) Alkanes:** Carbon atoms connected in a linear sequence without branches. Denoted as "n-" (e.g., n-pentane).
- **Branched chain (Iso) Alkanes:** Carbon atoms form a main chain with one or more branches. Denoted as "iso-" (e.g., isopentane).

Nomenclature of Alkanes

- The naming follows the IUPAC system:
 - Identify the longest chain to determine the base name.
 - Assign a prefix based on the number of carbons in the main chain (meth-, eth-, prop-, etc.).
 - Add the suffix "-ane" to indicate an alkane.
 - Identify and name any branches or substituents (methyl-, ethyl-, etc.).
 - Number the carbon atoms in the main chain from the end nearest a substituent.
 - Assign a number to each substituent and list them alphabetically before the base name.

Physical Properties

- Molecular Size and Mass:** Increase with more carbon atoms.
- Boiling and Melting Points:** Increase with size; branched alkanes have lower boiling points than their straight-chain counterparts.
- Density:** Increases with molecular mass but remains below 1 g/cm^3 .
- Solubility:** Insoluble in water, soluble in nonpolar solvents (hexane, benzene, chloroform).

Chemical Properties

- Reactivity:** Generally low due to stable C-C and C-H bonds.
- Combustion:** Burn in oxygen to produce CO_2 , H_2O , and energy.
- Halogenation:** Undergo substitution reactions with halogens in UV light or heat.
- Cracking:** Broken down into smaller alkanes and alkenes with heat, pressure, or catalysts.
- Isomerization:** Can transform into different structural isomers.

6. **Reforming (Aromatization):** Converted into aromatic hydrocarbons and H₂ gas with a catalyst (e.g., Pt).

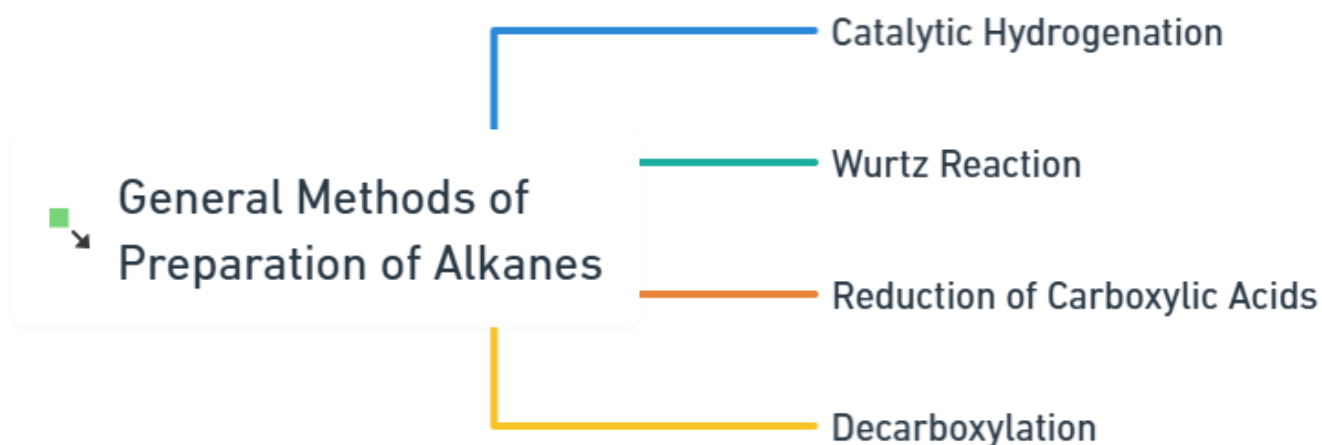
Uses of Paraffins (Alkanes)

- Paraffins (alkanes) are widely used across industries due to their stability and non-reactivity:
 - Fuels:** Key components in gasoline, diesel, and kerosene for transportation, heating, and aviation.
 - Lubricants:** High molecular weight paraffins serve as lubricants for engines and machinery, reducing wear.
 - Wax Production:** Used in candles, wax paper, cosmetics, and protective coatings for perishables.
 - Chemical Industry:** Feedstocks for producing solvents, detergents, and plastics like polyethylene and polypropylene.
 - Pharmaceuticals:** Used as carriers or excipients in drugs to enhance delivery and effectiveness.

Alkanes: Preparation, Reactions and Applications

- Alkanes, the simplest and most fundamental class of hydrocarbons, are characterized by their single covalent bonds between carbon atoms.
- This section delves into the methods of preparation, key chemical reactions, and the diverse applications of alkanes.

General Methods of Preparation

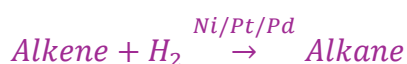


1. Catalytic Hydrogenation:

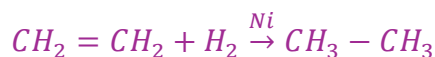
Process

- Alkenes or alkynes are converted into alkanes by the addition of hydrogen (H₂) in the presence of a metal catalyst such as **Pt, Pd, or Ni**.

General Reaction



Example



- Ethene → Ethane

2. Wurtz Reaction:

Process

- Alkyl halides react with sodium metal in the presence of **dry ether** to produce higher alkanes.

General Reaction



Example



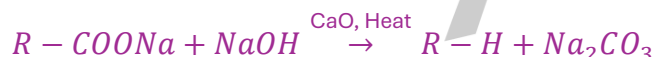
- Ethyl bromide → Butane

3. Reduction of Carboxylic Acids:

Process

- Sodium salt of a carboxylic acid is heated with soda lime to produce an alkane with **one carbon less** than the original acid.

General Reaction



Example



- Sodium ethanoate → Methane

4. Decarboxylation:

- Carboxylic acids on reduction with **LiAlH₄** or **BH₃** give **primary alcohols**, not alkanes. To convert carboxylic acids to alkanes, stronger methods like **reduction to alcohol followed by further reduction**, or special reagents (e.g., HI/red phosphorus), are required.

Reaction (LiAlH₄ Reduction)



Example



- Ethanoic acid → Ethanol



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