

AQA GCSE Chemistry: Topic 7

"Grade 7" Examiner Cheat Sheet — Organic Chemistry

Section 1: Crude Oil Fundamentals

Definition: Crude oil is a **finite** resource found in rocks. **Origin:** Remains of ancient biomass consisting mainly of **plankton** that was buried in **mud**.

The Alkanes: Most of the compounds in crude oil are hydrocarbons called alkanes.

- **General Formula:** C_nH_{2n+2}
- **Saturated:** They only contain **single carbon-carbon bonds**.
- **Mnemonic:** Monkeys Eat Peeled Bananas (Methane, Ethane, Propane, Butane).

Section 2: Fractional Distillation Algorithm

The Goal: To separate crude oil into fractions with similar numbers of carbon atoms.

1. The oil is **vaporised** (heated until it turns into a gas).
2. The gases enter a **fractionating column**.
3. There is a **temperature gradient**: hot at the bottom, cool at the top.
4. The gases rise, cool, and **condense** at their specific boiling points.
5. **Heavier** fractions (long chains) condense at the **bottom**; **lighter** fractions (short chains) condense at the **top**.

Section 3: The Property Trends Masterlist

As the Carbon chain length **INCREASES**:

Property	Change	Reason
Boiling Point	Increases	Stronger intermolecular forces.
Viscosity	Increases (Thicker)	Longer chains get tangled.
Flammability	Decreases	Harder to vaporise/ignite.

Combustion Rule: Hydrocarbon + Oxygen → Carbon Dioxide + Water (Energy released).

Section 4: The Cracking Algorithm

Purpose: To break down long-chain hydrocarbons (low demand) into smaller, more useful ones (high demand). **Type of reaction: Thermal Decomposition.**

The Two Methods:

1. **Catalytic Cracking:** Vaporise and pass over a **hot powdered aluminium oxide catalyst**.
2. **Steam Cracking:** Vaporise, mix with **steam**, and heat to a **very high temperature**.

Products: Always produces a shorter Alkane + an **Alkene**.

Section 5: Alkenes & Unsaturation

Definition: Alkenes are hydrocarbons with a **double carbon-carbon bond** ($C = C$).

- **General Formula:** C_nH_{2n}
- **Unsaturated:** They contain two fewer hydrogen atoms than an alkane of the same length.
- **Functional Group:** The $C = C$ bond is the part that reacts.

The Chemical Test for Unsaturation:

1. Add **Bromine Water** (Orange solution).
2. **Alkane Result:** Stays Orange (no reaction).
3. **Alkene Result:** Turns **Colourless** (Bromine reacts across the double bond).

Section 6: Addition Reactions (Chemistry Only)

Alkenes react by the double bond "opening up" to pick up new atoms.

- **Hydrogenation:** Alkene + Hydrogen \rightarrow **Alkane** (needs catalyst).
- **Hydration:** Alkene + Steam \rightarrow **Alcohol** (needs catalyst/high temp).
- **Halogenation:** Alkene + Halogen \rightarrow **Dihaloalkane** (e.g. dibromoethane).

Section 7: Alcohols (Chemistry Only)

Functional Group: $-OH$. **First 4:** Methanol, Ethanol, Propanol, Butanol.

Key Reactions:

- **Combustion:** Burn in air to produce CO_2 and H_2O .
- **Sodium:** React with sodium to produce **Hydrogen** gas.
- **Oxidation:** React with oxidising agents to form **Carboxylic Acids**.
- **Solubility:** Dissolve in water to form **neutral** solutions.

Production of Ethanol: 1. **Fermentation:** Sugar $\xrightarrow{\text{yeast}}$ Ethanol + CO_2 . (Conditions: $37^\circ C$, anaerobic).
2. **Hydration of Ethene:** Fast and pure, but uses non-renewable oil.

Section 8: Carboxylic Acids (Chemistry Only)

Functional Group: $-COOH$. **First 4:** Methanoic, Ethanoic, Propanoic, Butanoic acid.

Properties of Weak Acids (HT):

- They **partially ionise** in water.
- They have a **higher pH** (less acidic) than strong acids of the same concentration.

Reactions:

- + **Carbonates:** \rightarrow Salt + Water + **Carbon Dioxide** (Fizzes).
- + **Alcohols:** \rightarrow **Ester** + Water (needs acid catalyst).

Section 9: Esters (Chemistry Only)

Example: Ethyl Ethanoate (The only one you must name).

- **Properties:** Distinctive **fruity smells** and very volatile.
- **Uses:** Perfumes and food flavourings.
- **Structure:** Functional group is $-COO-$.

Section 10: Addition Polymerisation

Mechanism: Millions of small **alkene** molecules (monomers) join to form very large molecules (polymers).

- **Requirement:** The monomer must have a $C = C$ double bond.
- **The Catch:** The polymer is the **only product**.
- **Drawing Repeat Units:** Change $C = C$ to $C - C$, add brackets, and extending bonds. Don't forget the 'n'!

Section 11: Condensation Polymerisation (Chemistry HT)

Mechanism: Involves monomers with **two functional groups**.

- **The Difference:** For every bond formed, a **small molecule** (usually **water**) is lost.
- **Polyesters:** Formed from a *diol* (2 alcohol groups) and a *dicarboxylic acid* (2 acid groups).

Section 12: Natural Polymers (Chemistry Only)

1. Amino Acids: Have two different functional groups (**Amine** group and **Carboxylic acid** group).

- They react by condensation polymerisation to form **polypeptides**.
- Different amino acids in a chain form **Proteins**.

2. DNA: Encodes genetic instructions.

- Structure: **Two polymer chains** made from four different monomers called **nucleotides**, in the form of a **double helix**.

3. Carbohydrates: Starch and Cellulose are polymers made from **glucose** monomers.

"Organic Chemistry is the study of Carbon. Bonding types determine life and fuel."