

Hydroxy compounds

A-Level Chemistry 9701 · Topic 16 revision notes

Everything from the 2 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Reactions of alcohols

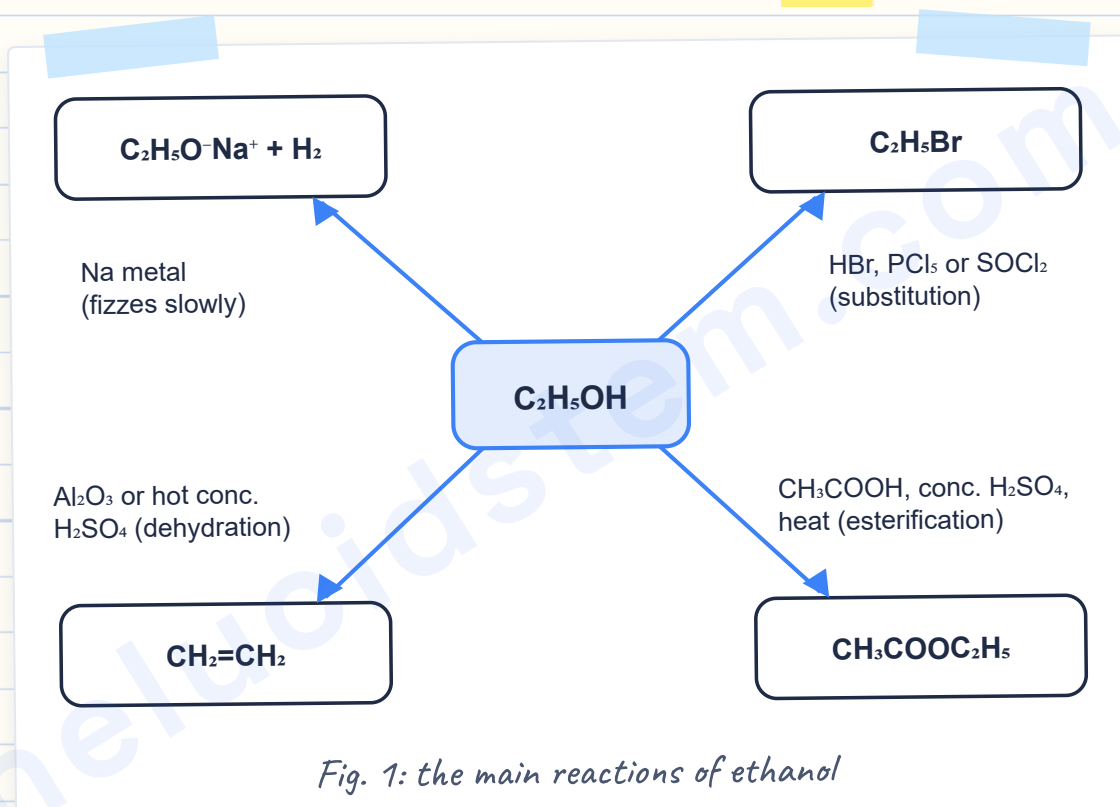
2. Oxidation of alcohols

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1 Reactions of alcohols

Syllabus 16.1

Alcohols contain the $-OH$ group. **Hydrogen bonding** between molecules gives them much higher boiling points than alkanes of similar M_r , and lets short-chain alcohols mix with water. They are made by hydrating alkenes, hydrolysing halogenoalkanes, reducing carbonyl compounds or hydrolysing esters. They react with **sodium** to give an alkoxide and hydrogen (more slowly than water, as alcohols are weaker acids); with **HX , PCl_5 or $SOCl_2$** to give halogenoalkanes; with hot concentrated acid or Al_2O_3 by **dehydration** to alkenes; and with carboxylic acids, using a concentrated H_2SO_4 catalyst, to form **esters**.



Na, halogenation, dehydration, esterification.

- ✓ **Hydrogen bonding:** high b.p., soluble in water.
- ✓ **Na:** alkoxide + H_2 .
- ✓ **PCl_5 :** steamy HCl fumes.
- ✓ **Esterification:** acid + alcohol, conc. H_2SO_4 , reversible.

Watch out!

Alcohols react with sodium **more slowly** than water does, because they are weaker acids: the ethyl group pushes electron density towards O, making O-H harder to break. In esterification, the concentrated H_2SO_4 is a catalyst and the reaction is **reversible**, so yields are well below 100%.

2 Oxidation of alcohols

Syllabus 16.1

Acidified potassium dichromate(VI) is a mild oxidising agent; when it oxidises an alcohol, orange $\text{Cr}_2\text{O}_7^{2-}$ is reduced to green Cr^{3+} . A **primary** alcohol is oxidised to an **aldehyde**, which must be **distilled off** as it forms; with excess oxidant **heated under reflux** it goes on to a **carboxylic acid**. A **secondary** alcohol gives a **ketone**. A **tertiary** alcohol is **not oxidised**, because the C-OH carbon has no hydrogen. The **tri-iodomethane test** (alkaline iodine, warm) gives a pale yellow precipitate of CHI_3 with alcohols containing $\text{CH}_3\text{CH}(\text{OH})-$.

acidified $\text{K}_2\text{Cr}_2\text{O}_7$: orange $\rightarrow$ green when oxidation happens

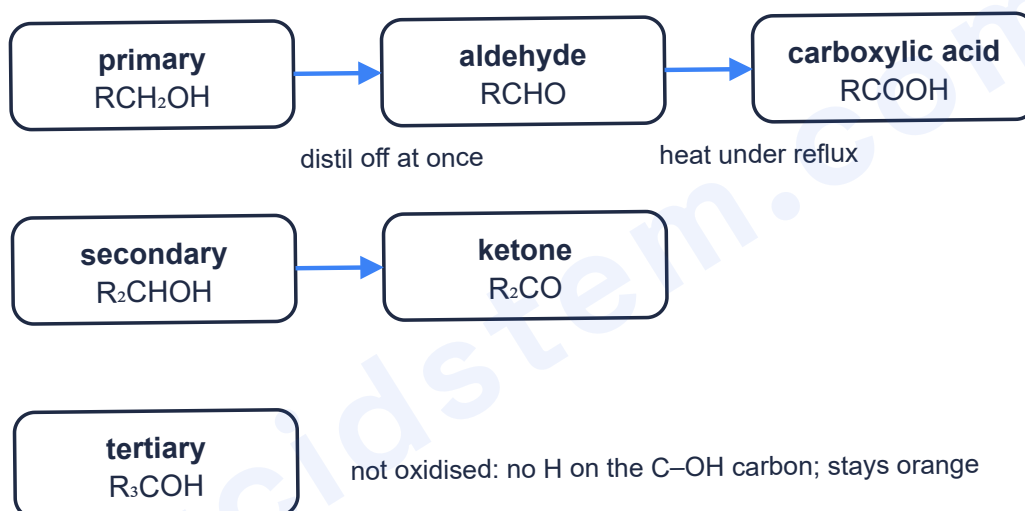


Fig. 1: what each class of alcohol gives with acidified dichromate(VI)

**Primary to aldehyde to acid;
secondary to ketone.**

- ✓ $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$: orange to green.
- ✓ **Distil** for aldehyde; **reflux** for acid.
- ✓ **Tertiary**: no reaction.
- ✓ CHI_3 (yellow) for $\text{CH}_3\text{CH}(\text{OH})-$ and $\text{CH}_3\text{CO}-$.

Watch out!

Distillation gives the **aldehyde**; reflux gives the **carboxylic acid**. The colour change is orange to **green**. Tertiary alcohols are not oxidised because there is **no hydrogen on the carbon bearing the OH**. The tri-iodomethane test needs a CH_3 group next to the $\text{CH}(\text{OH})$, so propan-1-ol is negative.