A-LEVEL CHEMISTRY • EXERCISE SHEET

16.1 Alcohols

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

KEY WORDS alcohol 醇 • primary 伯 • secondary 仲 • tertiary 叔 • acidity 酸性

Objective

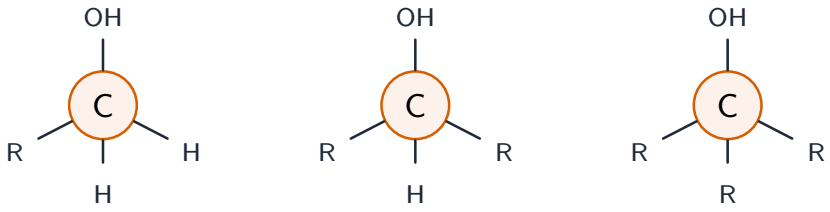
Build the skills to answer exam questions on **alcohols** 醇 — their reactions, **oxidation** 氧化 by class, the **iodoform test** 碘仿反应, and their acidity.

You must be able to:

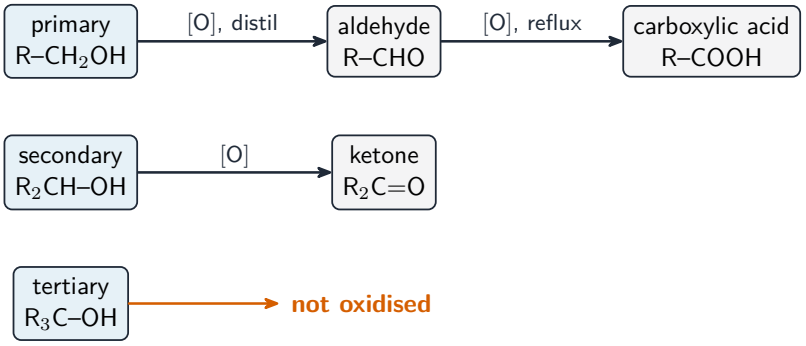
- describe the reactions of alcohols (combustion, substitution, Na, oxidation, dehydration, ester)
- classify alcohols and explain how oxidation distinguishes the classes
- describe the iodoform test and explain the acidity of alcohols

1 Worked examples

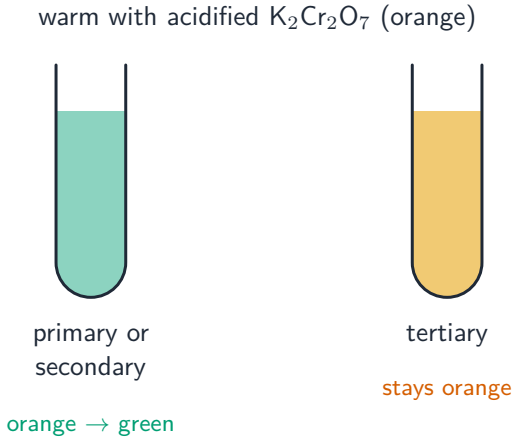
■ Classes and oxidation



The class is set by the carbon holding the –OH



Oxidation (acidified $K_2Cr_2O_7$): primary → aldehyde (distil) → acid (reflux); secondary → ketone; tertiary not oxidised



Acidified dichromate goes orange → green with primary/secondary; stays orange with tertiary

Distillation removes the aldehyde as it forms; **reflux** fully oxidises to the acid.

Other reactions and acidity

Alcohols also: burn; react with Na (→ H_2 + alkoxide); dehydrate to alkenes (hot Al_2O_3 or conc. acid); form esters with carboxylic acids (conc. H_2SO_4). The **iodoform test** (warm with alkaline I_2) gives a yellow CHI_3 precipitate for a $CH_3CH(OH)-$ group. Alcohols are **less acidic** than water (the alkyl group destabilises RO^-).

2 Practice

2.1 State the oxidation product of (a) a primary alcohol (refluxed) and (b) a secondary alcohol. [2]

2.2 State the colour change when acidified $K_2Cr_2O_7$ oxidises a primary alcohol. [1]

3 Exam-style questions

3.1 Which alcohol is **not** oxidised by acidified $K_2Cr_2O_7$? [1]

- **A** primary
- **B** secondary
- **C** tertiary
- **D** all are oxidised

3.2 To oxidise a primary alcohol only as far as the aldehyde, you should: [1]

- **A** reflux with excess oxidising agent
- **B** distil off the aldehyde as it forms
- **C** add sodium metal
- **D** add concentrated sulfuric acid

3.3 (a) Describe a chemical test to distinguish a secondary alcohol from a tertiary alcohol. [3]

(b) State the reagents and conditions to dehydrate ethanol to ethene. [2]

3.4 Explain why ethanol is a weaker acid than water. [2]

Solutions

2.1 (a) a carboxylic acid; (b) a ketone.

2.2 orange to green.

3.1 C. Tertiary alcohols are not oxidised.

3.2 B. Distil off the aldehyde before it is further oxidised.

3.3 (a) add acidified potassium dichromate(VI) and warm; the secondary alcohol turns it from orange to green (oxidised to a ketone); the tertiary alcohol leaves it orange (not oxidised).
(b) pass the ethanol vapour over hot Al_2O_3 (or heat with concentrated sulfuric/phosphoric acid).

3.4 the alkyl group pushes electron density onto the oxygen, making the ethoxide ion (RO^-) less stable than OH^-, so ethanol holds its H^+ more tightly — weaker acid.