

Exercise walk-through

Alcohols ■ 16.1

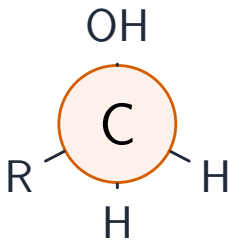
eXercise

You must be able to

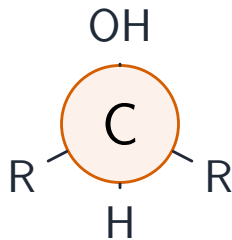
- describe the reactions of alcohols (combustion, substitution, Na, oxidation, dehydration, ester)
- classify alcohols and explain how oxidation distinguishes the classes
- describe the iodoform test and explain the acidity of alcohols

Method — Classes and oxidation

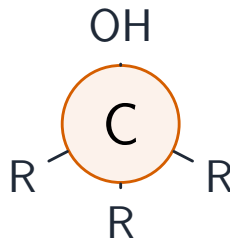
Distillation removes the aldehyde as it forms; **reflux** fully oxidises to the acid.



primary (1 R)



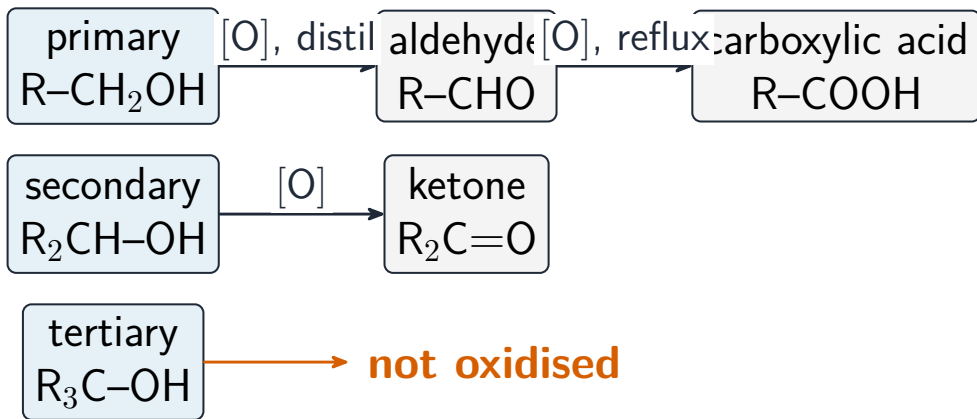
secondary (2 R)



tertiary (3 R)

Primary (1 R group), secondary (2), tertiary (3) on the carbon holding the -OH

Method — Classes and oxidation



Primary $\rightarrow$ aldehyde $\rightarrow$ carboxylic acid; secondary $\rightarrow$ ketone; tertiary not oxidised

Method — Classes and oxidation

warm with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ (orange)



primary or
secondary
orange → green



tertiary
stays orange

Method — Other reactions and acidity

Alcohols also: burn; react with Na ($\rightarrow$ H + alkoxide); dehydrate to alkenes (hot Al O or conc. acid); form esters with carboxylic acids (conc. H SO). The **iodoform test** (warm with alkaline I) gives a yellow CHI precipitate for a CH₃CH(OH)– group. Alcohols are **less acidic** than water (the alkyl group destabilises RO).

Practice 2.1 ■ 2 marks

State the oxidation product of (a) a primary alcohol (refluxed) and (b) a secondary alcohol.

Solution 2.1

Method: Classes and oxidation

Worked steps

(a) a carboxylic acid; (b) a ketone **B1** *each*.

Practice 2.2 ■ 1 mark

State the colour change when acidified K Cr O_7 oxidises a primary alcohol.

Solution 2.2

Method: Classes and oxidation

Worked steps

orange to green **B1**.

Exam-style 3.1 ■ 1 mark

Which alcohol is **not** oxidised by acidified K Cr O ?

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

Solution 3.1

Method: Classes and oxidation

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

Worked steps

C. Tertiary alcohols are not oxidised.

Exam-style 3.2 ■ 1 mark

To oxidise a primary alcohol only as far as the aldehyde, you should:

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

Solution 3.2

Method: Classes and oxidation

A reflux with excess oxidising agent

B distil off the aldehyde as it forms



C add sodium metal

D add concentrated sulfuric acid

Worked steps

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

Exam-style 3.3 ■ 3 marks

- (a) Describe a chemical test to distinguish a secondary alcohol from a tertiary alcohol.
- (b) State the reagents and conditions to dehydrate ethanol to ethene.

Solution 3.3

Method: Classes and oxidation

Worked steps

- (a) add acidified potassium dichromate(VI) and warm **M1**; the secondary alcohol turns it from orange to green (oxidised to a ketone) **M1**; the tertiary alcohol leaves it orange (not oxidised) **A1**.
- (b) pass the ethanol vapour over hot Al_2O_3 (or heat with concentrated sulfuric/phosphoric acid) **B1** **B1**.

Exam-style 3.4 ■ 2 marks

Explain why ethanol is a weaker acid than water.

Solution 3.4

Method: Other reactions and acidity

Worked steps

the alkyl group pushes electron density onto the oxygen **M1**, making the ethoxide ion (RO^-) less stable than OH^- , so ethanol holds its H^+ more tightly — weaker acid **A1**.