

Exercise walk-through

16.1

Alcohols

A-Level Chemistry

Alcohols and three classes

Count how many carbons are attached to the C that carries the OH.

primary

one C – ethanol,
oxidises to aldehyde then acid

secondary

two C – propan-2-ol,
oxidises to a ketone

tertiary

three C – 2-methylpropan-2-ol,
does *not* oxidise

Four ways to make an alcohol

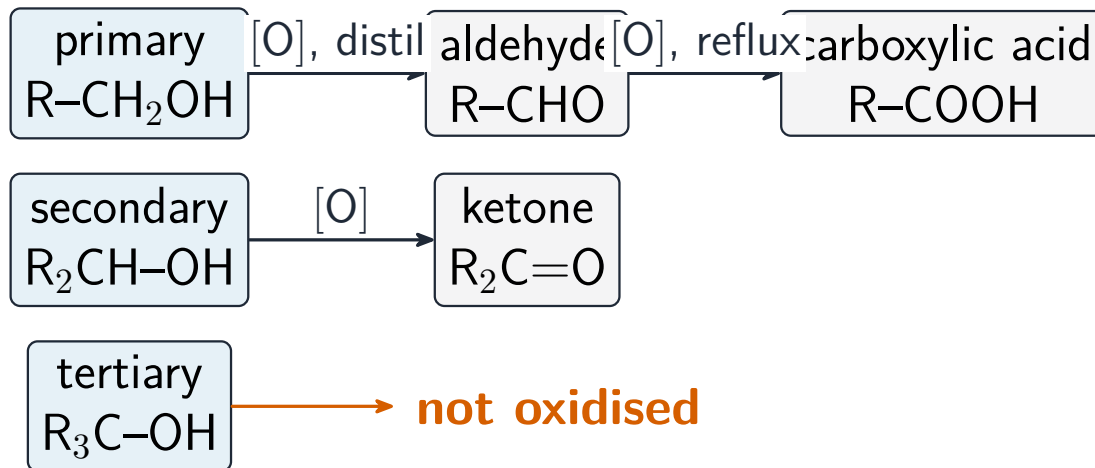
Method	Reagents and conditions
hydration of an alkene	steam, H_3PO_4 (electrophilic addition)
reduction of an aldehyde or ketone	NaBH_4 or LiAlH_4
an alkene with cold dilute KMnO_4	gives a diol – two $-\text{OH}$ groups
substitution of a halogenoalkane	NaOH(aq) , heat under reflux
hydrolysis of an ester	dilute acid or alkali, heat

NaOH in **water** substitutes to the alcohol; NaOH in **ethanol** eliminates to the alkene. Same reagent, different solvent, different product.

Oxidation by class

With acidified $\text{K}_2\text{Cr}_2\text{O}_7$:

- primary → **aldehyde** → **carboxylic acid**
- secondary → a **ketone**
- tertiary → **not oxidised**



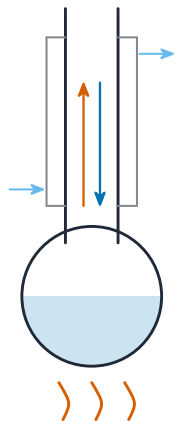
The dichromate test

Acidified **dichromate** turns orange to green with a primary or secondary alcohol, but stays orange with a tertiary one.

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

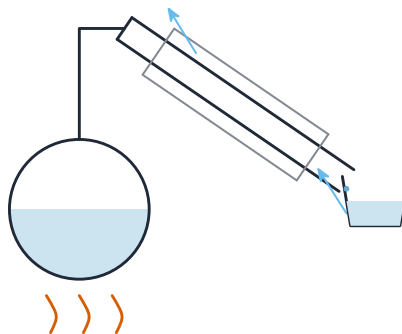


Distillation vs reflux



reflux

vapour returns: fully oxidised to the acid



distillation

product distils off as it forms (the aldehyde)

- **distillation** removes the aldehyde as it forms – stops at the aldehyde
- **reflux** keeps boiling & returning the vapour – fully oxidises to the acid

Exercises 2.1·2.2

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 $\text{K}_2\text{Cr}_2\text{O}_7$ oxidises a primary alcohol. [1]

Exercises 2.1·2.2

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

2.1

(a)

- a carboxylic acid

(b)

- a ketone

2.2 State the colour change when acidified $\text{K}_2\text{Cr}_2\text{O}_7$ oxidises a primary alcohol. [1]

2.2

- orange to green

Exercises 3.1·3.2

3.1 Which alcohol is **not** oxidised by acidified $\text{K}_2\text{Cr}_2\text{O}_7$?

[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

Exercises 3.1-3.2

3.1 Which alcohol is **not** oxidised by acidified $\text{K}_2\text{Cr}_2\text{O}_7$?

[1]

☐

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

3.1 C

- Tertiary alcohols are not 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

3.2 B

- Distil off the aldehyde before it is further oxidised

Exercise 3.3

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]

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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)

Exercise 3.4

3.4 Explain why ethanol is a weaker acid than water.

[2]

Exercise 3.4

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[2]

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