

Week 28

A-Level Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

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A-Level Chemistry

Name: _____ Score: _____

1. The functional group of an alcohol is:
 - ☐ the -OH (hydroxyl) group
 - ☐ the $\text{C}=\text{C}$ double bond
 - ☐ the C-X bond
 - ☐ the -COOH group
2. A primary alcohol can be oxidised to:
 - ☐ an aldehyde, then a carboxylic acid
 - ☐ a ketone
 - ☐ an alkene
 - ☐ nothing
3. Which reaction makes an alcohol?
 - ☐ a halogenoalkane warmed with aqueous NaOH
 - ☐ dehydration of an alcohol
 - ☐ combustion of an alkane
 - ☐ free-radical substitution
4. With acidified dichromate, a tertiary alcohol:
 - ☐ stays orange (it is not oxidised)
 - ☐ turns green
 - ☐ turns purple
 - ☐ turns colourless
5. An alcohol reacting with sodium metal produces:
 - ☐ hydrogen gas (and a sodium alkoxide)
 - ☐ oxygen
 - ☐ an alkene
 - ☐ a carboxylic acid
6. Alcohols contain the _____ functional group.

7. To stop the oxidation of a primary alcohol at the aldehyde you distil the product off as it forms; refluxing instead gives the carboxylic acid.
- ☐ True ☐ False
8. To stop oxidation of a primary alcohol at the aldehyde, you use:
- ☐ distillation (removing the aldehyde as it forms)
- ☐ reflux
- ☐ no heating
- ☐ a tertiary alcohol
9. Dehydrating an alcohol (hot Al_2O_3 or conc. acid) gives:
- ☐ an alkene
- ☐ a halogenoalkane
- ☐ a ketone
- ☐ an ester
10. Compared with water, alcohols are:
- ☐ less acidic (the alkyl group destabilises the RO^- ion)
- ☐ more acidic
- ☐ equally acidic
- ☐ strongly basic

A-Level Chemistry

1. the -OH (hydroxyl) group

Alcohols are defined by the hydroxyl (-OH) group.

2. an aldehyde, then a carboxylic acid

Primary $\rightarrow$ aldehyde (by distillation) $\rightarrow$ carboxylic acid (by reflux); secondary $\rightarrow$ ketone; tertiary $\rightarrow$ not oxidised.

3. a halogenoalkane warmed with aqueous NaOH

NaOH(aq) substitutes the halogen for -OH ; adding steam to an alkene or reducing a carbonyl also work.

4. stays orange (it is not oxidised)

Tertiary alcohols are not oxidised, so the dichromate stays orange; primary/secondary turn it green.

5. hydrogen gas (and a sodium alkoxide)

Like water, alcohols react with sodium to give hydrogen — but more slowly.

6. hydroxyl

Written -OH .

7. True

Distilling removes the volatile aldehyde before it can be oxidised again; reflux keeps it in the mixture for full oxidation.

8. distillation (removing the aldehyde as it forms)

Distillation removes the aldehyde before it oxidises further; reflux instead gives the carboxylic acid.

9. an alkene

Dehydration removes water from the alcohol to form an alkene (the reverse of steam addition).

10. less acidic (the alkyl group destabilises the RO^- ion)

The electron-pushing alkyl group makes RO^- less stable, so alcohols hold their H^+ more tightly than water.

16.1 Alcohols

Name: _____ Class: _____ Date: _____

Total: 12 marks

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

Objective

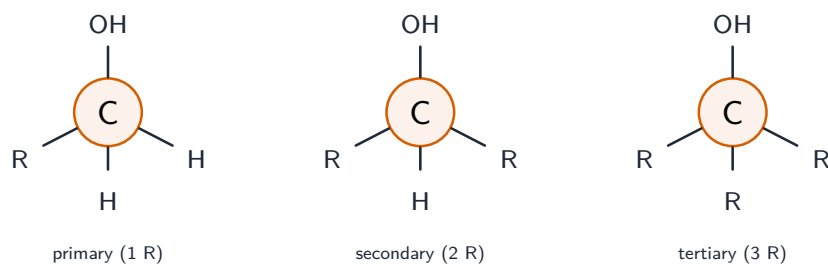
Build the skills to answer exam questions on **alcohols** 醇 — their reactions, **oxidation** 氧化 by class, the **iodoform test** 碘仿反应, and their acidity.

You must be able to:

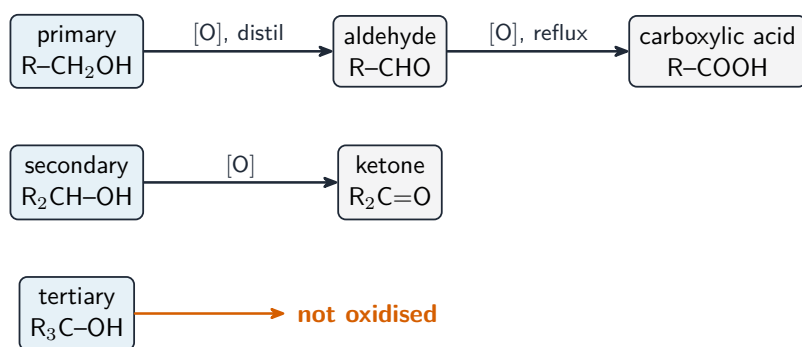
- describe the reactions of alcohols (combustion, substitution, Na, oxidation, dehydration, ester)
- classify alcohols and explain how oxidation distinguishes the classes
- describe the iodoform test and explain the acidity of alcohols

1 Worked examples

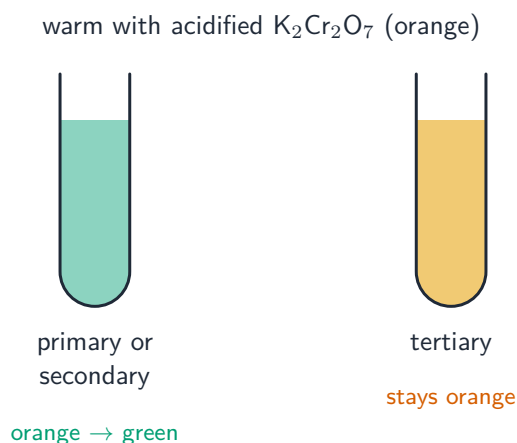
■ Classes and oxidation



The class is set by the carbon holding the $-OH$



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



Acidified dichromate goes orange $\rightarrow$ 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 ($\rightarrow$ 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 $\text{K}_2\text{Cr}_2\text{O}_7$ oxidises a primary alcohol. [1]

3 Exam-style questions

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
-

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.

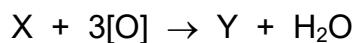
3.2 B. Distil off the aldehyde before it is further oxidised.

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).

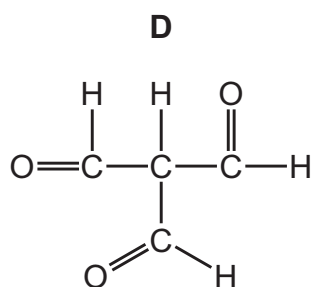
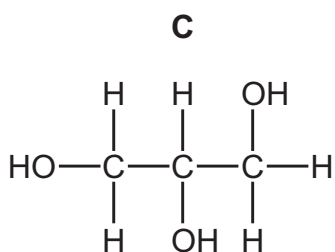
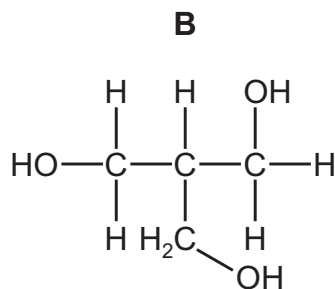
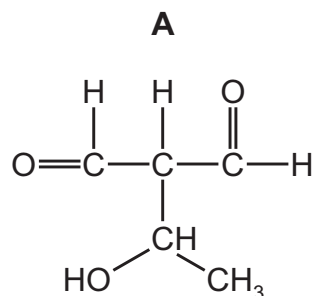
3.4 the alkyl group pushes electron density onto the oxygen, making the ethoxide ion (RO^-) less stable than OH^- , so ethanol holds its H^+ more tightly — weaker acid.

33 The balanced equation for the reaction of X with an excess of acidified $\text{K}_2\text{Cr}_2\text{O}_7$ is shown.



Compound Y is the only organic product of the reaction.

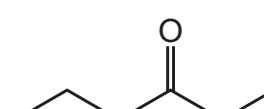
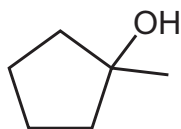
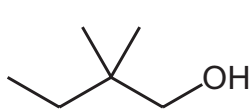
Which compound is X?



39 Some properties of compound X are listed.

- 1.0 mol X reacts with exactly 8.5 mol oxygen when completely combusted.
- X does **not** react when heated with acidified KMnO_4 .

What are the possible identities of X?



A 1 and 3

B 2 and 4

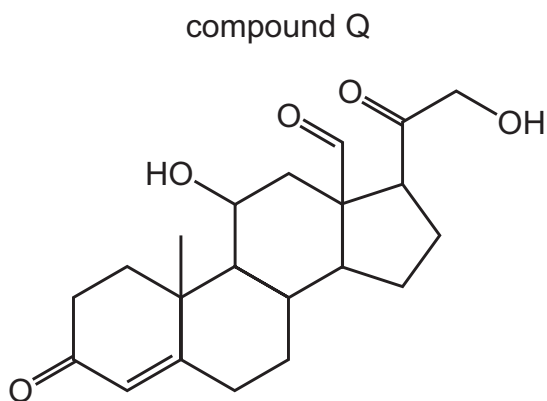
C 3 only

D 4 only

32 Which reaction mixture produces a primary alcohol as the major product?

- A** propanone with NaBH_4
- B** propene with steam in the presence of H_3PO_4
- C** butanoic acid with LiAlH_4
- D** ethene with hot concentrated acidified KMnO_4

35 The structure of a naturally occurring compound, Q, is shown.



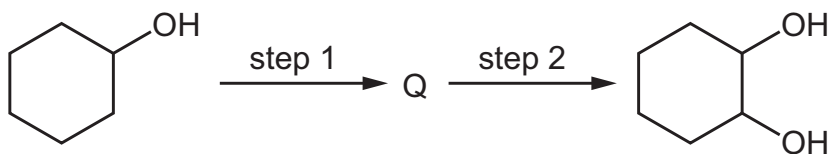
Compound Q is heated under reflux with an excess of acidified KMnO_4 .

Organic product R is formed.

Which row is correct?

	results of tests with compound Q	results of tests with organic product R
A	orange precipitate with 2,4-DNPH and no reaction with alkaline $\text{I}_2(\text{aq})$	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and no reaction with Fehling's reagent
B	red precipitate with Fehling's reagent and no reaction with alkaline $\text{I}_2(\text{aq})$	orange precipitate with 2,4-DNPH and no reaction with alkaline $\text{I}_2(\text{aq})$
C	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and orange precipitate with 2,4-DNPH	no reaction with alkaline $\text{I}_2(\text{aq})$ and no reaction with Fehling's reagent
D	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and red precipitate with Fehling's reagent	yellow precipitate with alkaline $\text{I}_2(\text{aq})$ and orange precipitate with 2,4-DNPH

33 Cyclohexanol is converted to cyclohexane-1,2-diol via a two-step synthesis that proceeds via intermediate Q.

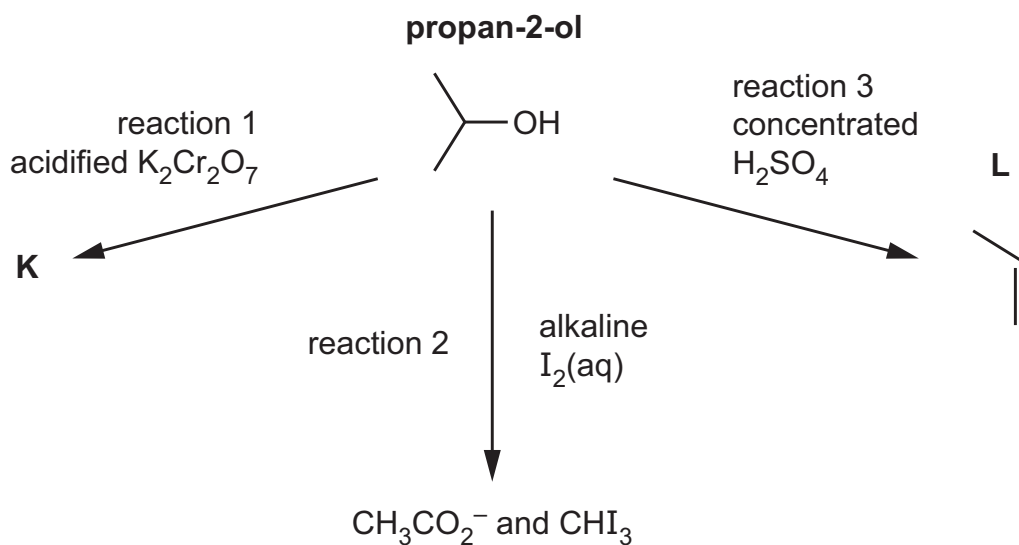


Which row identifies the type of reaction in step 1 and in step 2?

	step 1	step 2
A	dehydration	oxidation
B	dehydration	nucleophilic substitution
C	reduction	oxidation
D	reduction	nucleophilic substitution

- 3 Propan-2-ol, $(\text{CH}_3)_2\text{CHOH}$, is sometimes added to fuel to help it burn.

Fig. 3.1 shows some reactions of propan-2-ol.



- (a) (i) Draw the structure of organic compound **K**.

[1]

- (ii) State an observation you would make in reaction 2.

..... [1]

- (iii) State the type of reaction that is shown in reaction 3.

..... [1]

- (iv) Complete Fig. 3.2 to show the pi (π) bond in **L** that is formed from orbital overlap.

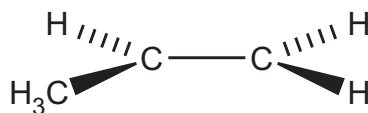


Fig. 3.2

[1]

(b) Propan-2-ol reacts with sodium to produce $(\text{CH}_3)_2\text{CH-O}^-$ anions.

These anions react with 2-bromopropane to form compound **N**, as shown in Fig. 3.3.

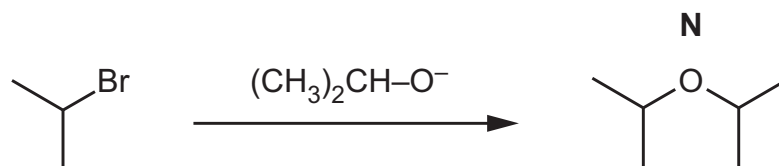


Fig. 3.3

(i) Write an equation for the reaction of propan-2-ol with sodium.

..... [1]

(ii) The reaction of 2-bromopropane with $(\text{CH}_3)_2\text{CH-O}^-$ anions follows an $\text{S}_{\text{N}}1$ mechanism.

Complete Fig. 3.4 to show this mechanism. Include charges, dipoles, lone pairs of electrons and curly arrows, as appropriate.



Fig. 3.4

[3]

(iii) Suggest how the rate of the $\text{S}_{\text{N}}1$ reaction would change, if at all, if 2-chloropropane were used instead of 2-bromopropane.

Explain your answer.

.....
.....
..... [2]

(iv) **N** is also added to petrol to make it burn more smoothly.

Construct an equation for the complete combustion of **N**, $\text{C}_6\text{H}_{14}\text{O}$.

$\text{C}_6\text{H}_{14}\text{O}$ [1]

[Total: 11]