Week 25

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 C=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

16. Hydroxy compounds

Answers · 答案

A-Level Chemistry

1. **the –OH (hydroxyl) group**

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

2. **an aldehyde, then a carboxylic acid**

   Primary → aldehyde (by distillation) → carboxylic acid (by reflux); secondary → ketone; tertiary → 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.

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

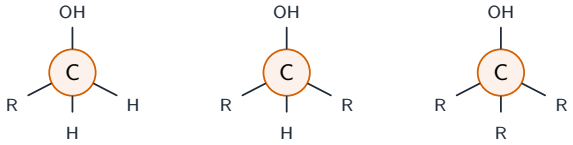
Build the skills to answer exam questions on **alcohols** 醇 — their reactions, **oxidation** 氧化 by class, the **iodoform test** 碘仿反应, and their acidity.

You must be able to:

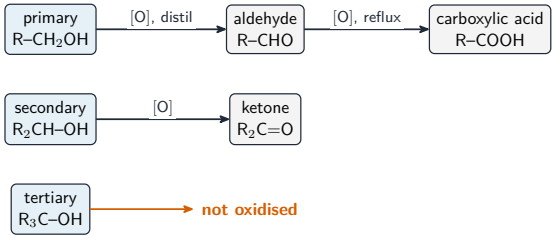
- describe the reactions of alcohols (combustion, substitution, Na, oxidation, dehydration, ester)
- classify alcohols and explain how oxidation distinguishes the classes
- describe the iodoform test and explain the acidity of alcohols

1 Worked examples

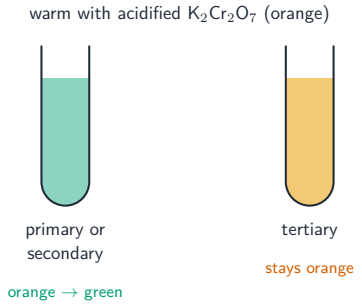
Classes and oxidation



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.

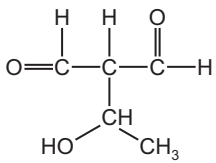
33 The balanced equation for the reaction of X with an excess of acidified $K_2Cr_2O_7$ is shown.

$$X + 3[O] \rightarrow Y + H_2O$$

Compound Y is the only organic product of the reaction.

Which compound is X?

A



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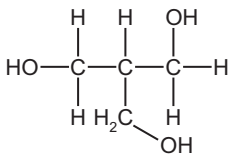

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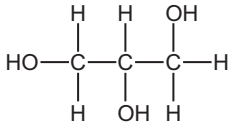

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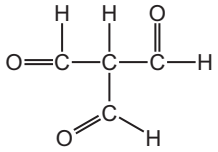
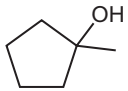


39 Some properties of compound X are listed.

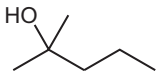
- 1.0 mol X reacts with exactly 8.5 mol oxygen when completely combusted.
- X does **not** react when heated with acidified $KMnO_4$.

What are the possible identities of X?

1



2



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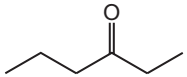


4

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 $NaBH_4$

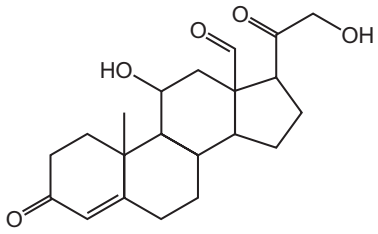
B propene with steam in the presence of H_3PO_4

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



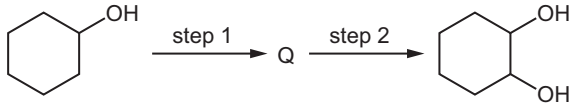
Compound Q is heated under reflux with an excess of acidified $KMnO_4$.

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 I_2(aq)	yellow precipitate with alkaline I_2(aq) and no reaction with Fehling's reagent
B	red precipitate with Fehling's reagent and no reaction with alkaline I_2(aq)	orange precipitate with 2,4-DNPH and no reaction with alkaline I_2(aq)
C	yellow precipitate with alkaline I_2(aq) and orange precipitate with 2,4-DNPH	no reaction with alkaline I_2(aq) and no reaction with Fehling's reagent
D	yellow precipitate with alkaline I_2(aq) and red precipitate with Fehling's reagent	yellow precipitate with alkaline I_2(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, $(CH_3)_2CHOH$, is sometimes added to fuel to help it burn.

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

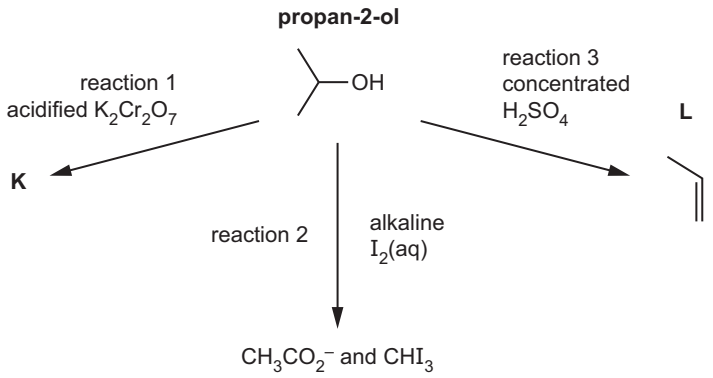


Fig. 3.1

(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.

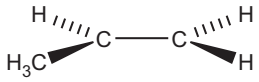


Fig. 3.2

[1]

(b) Propan-2-ol reacts with sodium to produce $(CH_3)_2CH–O^-$ anions.

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

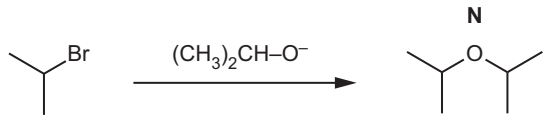


Fig. 3.3

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

..... [1]

(ii) The reaction of 2-bromopropane with $(CH_3)_2CH–O^-$ anions follows an S_N1 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 S_N1 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**, $C_6H_{14}O$.

$C_6H_{14}O$ ..... [1]

[Total: 11]