

Exercise walk-through

2.5.2

Alcohol pathways, purification and spectra

Pearson Edexcel · International A-Level · Chemistry

Controls distinguish chemical evidence from contamination

- 1 Set up** Match measured amounts, particle size, apparatus and heating rate; compare sample temperature at a consistent decomposition criterion.
- 2 Reason** CO_2 : milky limewater; O_2 : glowing splint relights; NO_2 : brown and acidic.
- 3 Conclude** Clean flame-test wire and keep the flame region/loading consistent. Na yellow, K lilac, Ca brick-red, Sr crimson-red; sodium carry-over can mask another colour.

Supplied IR data: heteroatom environments

Bond / environment	Supplied region / cm^{-1}
Alcohol O–H	3200–3600, broad
Acid O–H	2500–3300, very broad
C–Cl	500–800
Amine N–H	3300–3500

Independent identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has a carbonyl IR absorption and gives a positive Fehling's test. Which structure fits all evidence?

- A. CH_3COCH_3
- B. $\text{CH}_3\text{CH}_2\text{CHO}$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D. CH_3COOH

Exercises 2.1·2.3

2.1 Name the products of controlled oxidation of propan-1-ol by immediate distillation, propan-1-ol by reflux with excess oxidant, and propan-2-ol. [3]

2.2 Write the equation using [O] for propan-2-ol oxidation and state the oxidant colour change. [3]

2.3 State the reagent/condition for ethanol dehydration and the organic product. Classify the reaction. [3]

3 Exam-style questions

Exercises 2.1·2.3

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2.1 Propanal; propanoic acid; propanone. Acidified potassium dichromate(VI) is the stated oxidant.

2.2 Write the equation using [O] for propan-2-ol oxidation and state the oxidant colour change. [3]

2.2 $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3 + [\text{O}] \rightarrow \text{CH}_3\text{COCH}_3 + \text{H}_2\text{O}$. Orange to green.

2.3 State the reagent/condition for ethanol dehydration and the organic product. Classify the reaction. [3]

3 Exam-style questions

2.3 Concentrated phosphoric acid with heat, ethene, elimination.

Exercises 3.1·3.2

3.1 An unknown has molecular-ion m/z 60, a $C=O$ absorption and very broad acid $O-H$ absorption. It releases CO_2 with Na_2CO_3 . Given $C = 12$, $H = 1$, $O = 16$, assess CH_3COOH and $CH_3CH_2CH_2OH$ as proposals. Explain why one strong IR peak alone is insufficient. [5]

3.2 Explain why reflux is appropriate when making propanoic acid but distillation is useful when making propanal. State two distinct purification actions after a liquid-organic preparation. [4]

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3.1 Ethanoic acid has M_r 60, contains both carbonyl and acid OH , and reacts with carbonate. Propan-1-ol also has M_r 60 but lacks carbonyl and does not give the acid carbonate test. A carbonyl alone also fits aldehydes/ketones, so combine independent evidence.

3.2 Explain why reflux is appropriate when making propanoic acid but distillation is useful when making propanal. State two distinct purification actions after a liquid-organic preparation. [4]

3.2 Reflux returns vapour and allows further oxidation to acid; distillation removes aldehyde before further oxidation. Any two explained actions: solvent extraction/separation, drying removes residual water, final distillation separates volatile product from less volatile impurities.

Exercise 3.3

3.3 State the reagents used to convert an alcohol to a chloroalkane, bromoalkane and iodoalkane. For 2-methylpropan-2-ol with concentrated HCl, name the organic product and explain why layer identification and drying are separate steps. [5]

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3.3 PCl_5 gives a chloroalkane; KBr with 50% concentrated sulfuric acid supplies HBr for a bromoalkane; red phosphorus and iodine provide reagent for an iodoalkane. The tertiary alcohol gives 2-chloro-2-methylpropane. Layer identification separates bulk aqueous/organic phases; drying removes water remaining in the organic layer.