

Oxidising alcohols and testing carbonyl compounds

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Lab

Name: _____ Date: _____ Class: _____

Can a few test-tube reactions identify five clear, colourless liquids? You will oxidise alcohols with dichromate, then test the carbonyl products with 2,4-DNPH and Tollens' reagent. The pattern of results shows which liquids are primary, secondary or tertiary alcohols and which are aldehydes or ketones.

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Aim

To identify five unlabelled liquids (propan-1-ol, propan-2-ol, 2-methylpropan-2-ol, propanal and propanone) using acidified dichromate, 2,4-DNPH and Tollens' reagent, and to test the products of oxidation.

Equipment

- five liquids labelled A to E (1 cm³ each)
- acidified potassium dichromate(VI), 0.1 mol/dm³
- 2,4-DNPH solution; freshly prepared Tollens' reagent
- test tubes and rack, beaker for a hot-water bath at 60 °C, dropping pipettes, thermometer
- small distillation set-up for 5 cm³ (teacher-assisted)

Safety

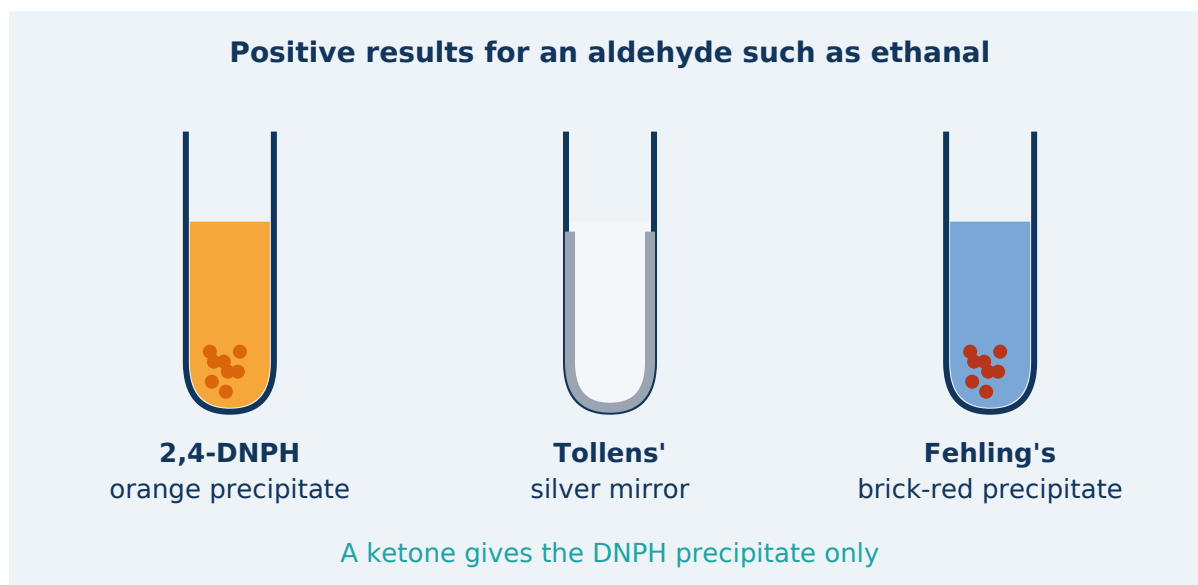
Safety

Wear goggles and gloves. Dichromate is toxic and a suspected carcinogen; keep it off the skin. 2,4-DNPH is irritant and flammable when dry. Make Tollens' reagent fresh and wash it away with dilute nitric acid immediately, because stored mixtures can become explosive. Propanone and alcohols are flammable: use a hot-water bath, never a naked flame.

Method

1. Place 1 cm³ of dichromate in five tubes, add 5 drops of a liquid to each and warm in the 60 °C bath for 3 minutes. Note the colour.

- Add 3 drops of each liquid to 2 cm³ of 2,4-DNPH in a clean tube and record any precipitate.
- Add 3 drops of each liquid to fresh Tollens' reagent and warm for 5 minutes; record any mirror.
- For each alcohol that turned the dichromate green, repeat the oxidation on 5 cm³ and distil off a few drops of product.
- Test each distillate with 2,4-DNPH and with Tollens' reagent.



Carbonyl tests: DNPH detects any C=O; Tollens' and Fehling's detect aldehydes only.

Results

Sample observations:

Liquid	Dichromate (warm)	2,4-DNPH	Tollens'	Distillate: DNPH / Tollens'
A	green	no precipitate	no mirror	precipitate / mirror
B	green	no precipitate	no mirror	precipitate / no mirror
C	stays orange	no precipitate	no mirror	not tested
D	green	orange precipitate	silver mirror	not tested
E	stays orange	orange precipitate	no mirror	not tested

Analysis questions

Question 1 Identify the liquids

Use the table to identify A to E.

Question 2 Separating A and B

Explain how the distillate tests separate A from B.

Question 3 Why C stays orange

Explain the result for C.

Question 4 D and E with dichromate

Explain why D turns the dichromate green but E does not.

Question 5 Equation

Write an equation using [O] for the reaction of A, then name the final acid if refluxed.

Question 6 Silver from propanal

A student reacts 0.58 g of propanal ($M = 58.0 \text{ g/mol}$) with excess Tollens' reagent. Calculate the mass of silver formed (2 Ag per molecule, $\text{Ag} = 107.9 \text{ g/mol}$).

Question 7 Safety and improvement

Explain why Tollens' reagent is never stored and suggest one improvement to the procedure.