

14–16 years

The properties of alcohols

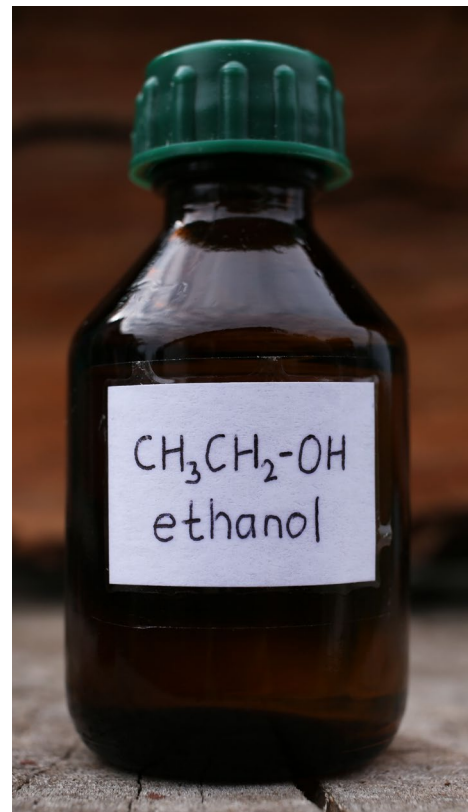




In this lesson ...

Ethanol and propan-1-ol are tested for:

- pH
- reaction with sodium
- combustion
- oxidation with acidified dichromate(VI) solution.



Learning objectives

- Make and record experimental observations.
- Use your results to explain the properties of the alcohols.
- Understand that members of the same homologous series behave in a similar way.

Equipment

- Test tubes x 2
- Boiling tubes x 2
- Test tube/boiling tube rack
- Beakers (100 cm³) x 2
- Can lid
- Wooden splints, matches or gas lighter
- Heat-resistant mat
- Bunsen burner
- Boiling tube holder
- Dropping pipette (for water)
- Universal indicator paper (full range, pH 1–14)

- Forceps for sodium
- Filter paper for sodium
- White tile
- Spotting tile
- Spill tray (optional)

Safety equipment

- Eye protection: splash-proof goggles
- Container filled with tap water (e.g. washing-up bowl) to place the spotting tiles after use.

Chemicals

- Ethanol or Industrial denatured alcohol, IDA, 15 cm³



DANGER: Highly flammable./DANGER: Highly flammable. Harmful by ingestion.

- Propan-1-ol, 15 cm³



DANGER: Highly flammable liquid and vapour. Causes serious eye damage. May cause drowsiness or dizziness.

- Acidified potassium dichromate(VI) solution, 0.1 mol/dm³
in 1.4 mol/dm³ sulfuric acid, 3 cm³



DANGER: Corrosive (skin, eyes). Harmful (ingestion). Irritant (respiratory). Sensitiser (skin, respiratory). Serious Health Hazard (RE). Serious Health Hazard (CMR).

- Sodium, 2 small pieces in oil (about 2 x 2 x 2 mm)



DANGER: Reacts violently with water. In contact with water releases flammable gases which may ignite spontaneously. Causes severe skin burns and eye damage.

- Access to distilled water bottles

Method

Carry out each of these tests firstly with ethanol and then propan-1-ol:

1. Place a few drops of the alcohol in a test-tube and add an equal number of drops of water. Do the liquids mix fully?
2. Place a drop of the alcohol on a piece of full-range indicator paper. Note the pH.
3. Place a few drops of alcohol on a can lid on a heat-resistant mat. Make sure that all the bottles of alcohols are closed and kept far away from the can lid. Ignite the alcohol with a lit splint and observe the flame.

Continued on next slide...

Method (continued)

4. Using forceps, take two small pieces of sodium and place them on a piece of filter paper. Dab the pieces of sodium with the filter paper to remove any excess oil.
5. Place about 0.5 cm depth of each of the alcohols in a separate, dry, 100 cm³ beaker. To each, add a small piece of sodium (using forceps) and observe the reaction.
6. Place 3 drops of acidified potassium dichromate(VI) solution into two wells of the spotting tile and add 2 drops of ethanol to the first well and 2 drops of propna-1-ol to the second well. Observe the colour change(s) in each well over 5–10 minutes. Do you notice a change of smell that could come from a new compound?

Results table

Test	Observations	
	Ethanol	Propan-1 -ol
Water		
pH		
Sodium		
Combustion		
Acidified potassium(VI) solution		

Results

Test	Observations	
	Ethanol	Propan-1-ol
Water	Miscible, mixes with water	Miscible, mixes with water
pH	green	green
Sodium	Fizzing/bubbles/effervescence, traces of white solid	Fizzing/bubbles/effervescence, traces of white solid
Combustion	Burns with blue flame	Burns with blue flame
Acidified potassium(VI) solution	Orange to green	Orange to green

Test 1

1 3–4 drops alcohol ☐ ☐

2 3–4 drops water ☐ ☐

3 Fully mixed? ☐ ☐

Repeat all once for
ethanol and once
for propan-1-ol

RSC Nuffield practical
collection

The properties of alcohols
<https://rsc.li/3Ualnmi>



Test 2

4 1 drop alcohol ☐ ☐

5 pH? ☐ ☐

UI

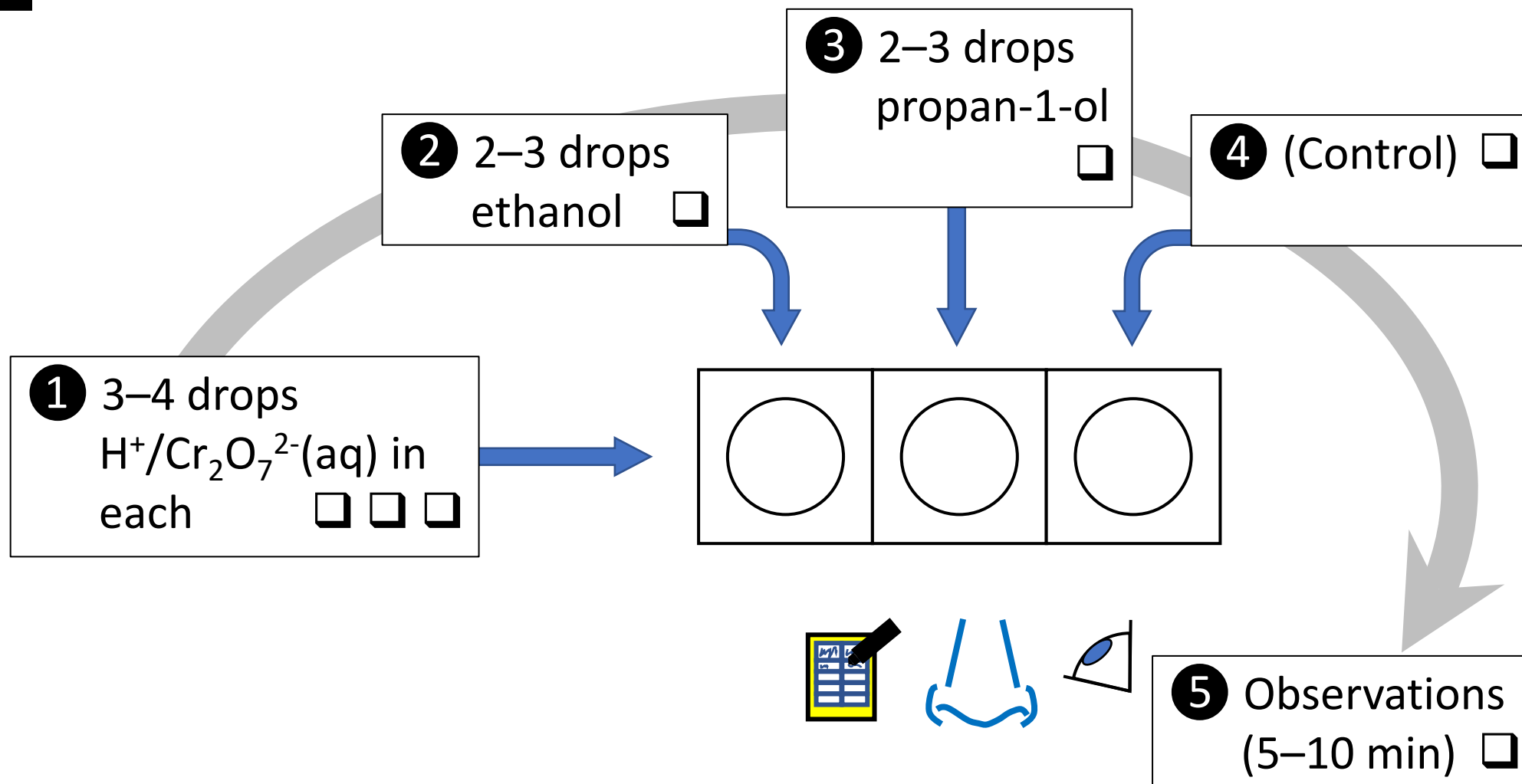
Test 3

7 Light ☐ ☐

8 Observe
flame ☐ ☐

6 3–4 drops
alcohol ☐ ☐
Close bottle and put
away

Test 4



Follow-up questions

1. Look at your results table and compare your observations for each alcohol.
2. Write down the chemical formula for (a) ethanol (b) propanol and highlight the functional group.
3. Circle the correct word in bold for each sentence:
(a) Ethanol is **immiscible/miscible** in water.
(b) Propanol is **acidic/neutral/basic**.
(c) Ethanol + oxygen → **carbon/carbon dioxide/carbon monoxide** + water.
4. Predict what you will observe when a piece of sodium metal is added to butanol. Suggest a reason for your answer.
5. When ethanol is oxidised by acidified potassium dichromate, an aldehyde named ethanal is produced.
Name the aldehyde produced when:
(a) Propan-1-ol is oxidised.
(b) Butan-1-ol is oxidised.

Challenge question

6. Write a balanced symbol equation for:
- (a) complete combustion of ethanol.
 - (b) the reaction of propanol and sodium.

Answers

1. All observations for each alcohol are similar/the same.
2. (a) $\text{C}_2\text{H}_5\text{OH}$ (b) $\text{C}_3\text{H}_7\text{OH}$
3. (a) Ethanol is **miscible** in water. (b) Propanol is **neutral**. (c) Ethanol + oxygen $\rightarrow$ **carbon dioxide**.
4. Fizzing and traces of a white solid. Butanol belongs to the same homologous series (or is an alcohol) so behaves in the same way as ethanol and propanol as it has the same functional group
5. (a) Propanal (b) Butanal

Challenge question

6. (a) $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ (b) $2\text{C}_3\text{H}_7\text{OH} + 2\text{Na} \rightarrow 2\text{C}_3\text{H}_7\text{ONa} + \text{H}_2$