

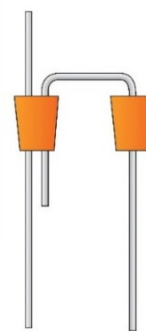
The 'breathalyser' reaction

This resource accompanies the article **Crime-busting chemical analysis** in *Education in Chemistry* which you can view at: rsc.li/3T27kfh.

See the teacher notes, available from rsc.li/3Utqblt, for the procedure.

Equipment (per demonstration)

- Measuring cylinder, 25 cm³, x 2
- Boiling tube
- Boiling tube with side arm
- Filter pump attached to the side arm of the boiling tube
- Access to a water tap
- Clamp stand, boss and clamp x 2
- Rubber bungs x 2, one with two holes, to fit boiling tubes
- Glass tubing x 2, one straight and one with a double bend (u shape)
- Safety equipment: splashproof goggles and chemical-resistant nitrile gloves







Chemicals, preparation, safety and hazards

Read our standard health and safety guidance, available from rsc.li/49bHIZG, and carry out a risk assessment before running any live practical.

Refer to SSERC/CLEAPSS Hazcards and recipe sheets. Hazard classification may vary depending on supplier.

Wear splashproof goggles and chemical-resistant nitrile gloves.

Chemicals supplied for the practical	Preparation and hazards
Ethanol or IDA (industrial denatured alcohol), 95%, C ₂ H ₆ O(l)  DANGER	Highly flammable liquid and vapour. Harmful if swallowed. May cause damage to organs. See CLEAPSS Hazcard HC040a (bit.ly/42uO520).
Potassium dichromate(VI) solution in 1.4 mol dm ⁻³ sulfuric acid, 0.1 mol dm ⁻³ , K ₂ Cr ₂ O ₇ (l)  DANGER	Corrosive to skin and eyes. Harmful if swallowed. Respiratory irritant. Skin and respiratory sensitiser. Serious health hazard (RE). Serious health hazard (CMR). See CLEAPSS Hazcards HC098a (bit.ly/3Oz7Q2M) and HC078c (bit.ly/42GygWh). See CLEAPSS recipe sheets RB098 (bit.ly/3OyW9t1) and RB070 (bit.ly/3SO9RdX). To prepare the solution, wear splashproof goggles and chemical-resistant gloves. Measure

	<p>out the mass of solid potassium dichromate(VI) in a fume cupboard that is not switched on but with the sash down. Dissolve the solid in about two thirds of the final volume of sulfuric acid. Add to a measuring cylinder and top up to the final volume using sulfuric acid.</p>
<p>Potassium dichromate(VI) solid, $K_2Cr_2O_7(s)$ (Needed to prepare the 0.1 mol dm^{-3} potassium dichromate(VI) solution)</p>  <p>DANGER</p>	<p>May intensify fire; oxidiser. Toxic if swallowed. Harmful in contact with skin. Causes severe skin burns and eye damage. May cause allergic skin reaction. Fatal if inhaled. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause cancer or genetic defects. May damage fertility or the unborn child. Causes damage to organs through prolonged or repeated exposure. Very toxic to aquatic life with long-lasting effects.</p> <p>See CLEAPSS Hazcard HC078c (bit.ly/42GygWh) and recipe sheet RB070 (bit.ly/3SO9RdX).</p>
<p>Sulfuric acid solution, 1.4 mol dm^{-3}, $H_2SO_4(aq)$ (Needed to prepare the 0.1 mol dm^{-3} potassium dichromate(VI) solution)</p>  <p>WARNING</p>	<p>Causes severe skin burns and eye damage. See CLEAPSS Hazcard HC098a (bit.ly/3Oz7Q2M) and recipe sheet RB098 (bit.ly/3OyW9t1).</p> <p>You can prepare this solution by diluting a sulfuric acid solution of higher concentration, eg 2.0 mol dm^{-3}</p>

Products

- Ethanal (acetaldehyde), $CH_3CHO(l)$: extremely flammable, harmful – see CLEAPSS Hazcard HC034 at bit.ly/3HMQnAq.
- Ethanoic acid solution (acetic acid), $CH_3COOH(aq)$: irritant – see CLEAPSS Hazcard HC038a at bit.ly/3SyRB6W.

Disposal

- Reuse the ethanol left in the boiling tube, eg as a solvent to remove permanent marker pen from glassware.
- Add the green potassium dichromate solution in sulfuric acid containing ethanal and ethanoic acid to water and pour down a foul-water drain with further dilution. If the solution has not turned green due to the formation of Cr^{3+} ions, then add solid sodium metabisulfite in small portions with stirring until you obtain a colour change. Mix thoroughly, add some water and pour the solution down a foul-water drain with further dilution.
- Rinse all glassware and wipe up any potassium dichromate solution that might have spilled on surfaces. Do not allow the solution to dry out.