Solubility curves • staff

Teacher / technician preparation and teaching notes

YEAR 10 / LESSON 3 / SINGLE CHEMISTRY ONLY

Teacher / technician guidance. This document does not certify a completed classroom trial or replace the school risk assessment. Keep this edition separate from student copies.

One method, one solute

Potassium nitrate in water; first-crystal temperatures on cooling. Groups investigate one assigned composition twice, then pool at least four compositions. Allow approximately 50–60 minutes for setup and observations; the graph and analysis may need a follow-up lesson.

Requisition • one group of up to three

- Splash-resistant eye protection
- One clean, dry heat-resistant test tube (approximately 150 × 16 mm), rack and label
- Balance reading to 0.01 g, weighing boat and clean spatula
- Distilled-water wash bottle or dropper for weighing water into the tube
- 0–110 °C non-mercury thermometer or suitable probe, readable to 1 °C or better
- Smooth glass stirring rod; do not use the thermometer as a stirrer
- Clamp stand and clamp; heat-resistant tube holder; heatproof mat
- Teacher-managed electric water bath at about 70 °C (maximum 75 °C); tube held upright, not touching the heater or bath base
- White card behind the tube to help you see small crystals
- Labelled container for cooled potassium nitrate solutions; cool-water bath only if directed

Chemical allocation • planning quantities

Groups / assignment	KNO_3 total	Distilled water
Each group	2, 3, 4 or 5 g	5.00 g
Class of 30: 10 groups; 3×2 g, 3×3 g, 2×4 g, 2×5 g	33 g total	50 g total

Provide a small separately labelled reserve for remaking a spilled sample, plus bath/rinse water. Reheating the same sample uses no extra solute. These are allocation totals, not measured class results.

Preparation and safe delivery

Electric water bath • no direct flame • no dry nitrate residues

YEAR 10 / LESSON 3 / SINGLE CHEMISTRY ONLY

Before the class

• Check the supplier label and current SDS for the actual potassium nitrate stock. The solid is an oxidiser; keep it separate from combustible materials and reducing agents, avoid dust and use clean dedicated equipment.

• Use an electric thermostatic bath near 70 °C, with a local maximum of 75 °C. Confirm that the issued tubes, clamp and probe fit safely; bath water must remain below the open tube mouth. Plan access so students do not carry unprotected hot tubes.

• Check that 5.00 g water covers the probe sensing region in the actual tube while leaving room for gentle stirring. If it does not, select a suitable tube/probe before teaching; do not add unrecorded water.

• Trial the assigned compositions with the actual apparatus before class. Confirm complete dissolution within the temperature limit and visible crystals on cooling. The bath setting and mass choices are local design choices, not a claim of a completed physical trial.

• Warm rooms may prevent the lowest-concentration mixture reaching its first-crystal point in air. Provide a teacher-managed cool-water bath around 15–20 °C if needed, with slow cooling and continuous observation; no ice quench.

• Explain balance taring and independent water/salt masses. Use a stable tube support. Demonstrate the first persistent crystal endpoint and distinguish it from dried deposits on the rim.

During and after

• Heat briefly only until clear. Do not boil, evaporate to dryness or seal the tube. Use the electric water bath throughout; no direct flame.

• Record both temperatures. The 2 °C flag is a classroom consistency check; it does not demonstrate equilibrium or define instrument uncertainty. Do not repeat heating indefinitely to force agreement.

• Spillage, substantial evaporation, added unmeasured water or loss of solid invalidates the known composition. Record the problem and remake a measured sample if time allows.

• Collect cooled solutions in a labelled compatible container for potassium nitrate aqueous residues. Follow the school’s approved chemical-waste route; do not assume drain disposal. Keep residues separate from combustible/organic waste. Follow school first-aid procedures for exposure.

Teaching, answers and sources

Estimates of saturation • no model data in student results

YEAR 10 / LESSON 3 / SINGLE CHEMISTRY ONLY

What this measures

A known solute-to-solvent mass ratio is paired with a first-crystal temperature. Delayed nucleation can make that temperature lower than the equilibrium saturation temperature. A class curve is therefore an experimental estimate. Solubility is not dissolution speed, and a two-run repeatability check does not remove systematic error.

Answer guidance • keep out of the student edition

• Q1: S = 100 × m(salt) / m(water), with g salt per 100 g water. Dividing by solution mass gives a different concentration measure. Target ratios 2/5, 3/5, 4/5 and 5/5 correspond to 40, 60, 80 and 100; use actual masses.

• Q2–3: infer the trend from recorded data; potassium nitrate normally becomes more soluble as temperature rises. An interpolated value needs its temperature and units. Do not manufacture a full curve from one composition.

• Q4: (80 − 40) × 10.0 / 100 = 4.0 g crystallised. These are invented arithmetic values, not a reference potassium nitrate dataset.

• Q5: supercooling shifts an observed point to a lower temperature for the same calculated ratio. If water is lost but its original mass is used, the calculated ratio is too low for the actual mixture. These effects can distort the curve in different ways.

• Q6: accept an improvement tied to an observed limitation: brief warming to reduce water loss, an appropriate probe and gentle stirring, duplicate independent mixtures, clearer endpoint lighting or controlled slow cooling. A smooth curve alone is not proof of accuracy.

Sources and editorial choices

Pearson 4CH1: 1.5C, 1.6C and 1.7C are Chemistry-only. The historical Pearson GCE practical supports the first-crystal approach; it is not this class's specification. This version uses an electric bath and measured mass ratios in place of direct Bunsen heating and a water-volume series.

Course specification — Pearson 4CH1

Method background — Pearson GCE guide, printed pages 44–45

Supplier hazard reference — potassium nitrate SDS

Reviewed 21 November 2026. Consult current school safety guidance and the supplied-product SDS before use. The mixed-method requisition and 10° unit typo are removed. Completed lessons remain untouched.