Hydrates and solution calculations

Teacher / technician

YEAR 10 / LESSON 52 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Desk-based original hydrate data. Shared core plus explicitly labelled Chemistry-only concentration extension; no heating method.

Coverage and delivery

Shared core: 1.31–1.33 hydrate/formula data. Chemistry-only extension: 1.34C, questions 5–6 and step 5. No hydrate heating or solution preparation is carried out.

Allow about 60 minutes. Follow the student sequence and use the answers to check reasoning.

Requisition • class of 30, working in 15 pairs

Item	Per pair / setup	Class total
Booklet / writing tools	1 per learner	30 sets
Calculator / periodic table	1 calculator each; table per pair	30 calculators; 15 tables

Immediate safety

Desk activity only; no chemicals or equipment for heating are issued.

Preparation and delivery

Read alongside the student method

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1. Provide 30 booklets/calculators and 15 periodic tables. No copper sulfate, flame, crucible or liquid handling is required.

2. Shared-core learners complete steps 1–4 and questions 1–4. Clearly separate the concentration extension for Chemistry-only learners; the whole lesson stays shared in the curriculum.

3. Explain the idealised mass-loss assumptions before calculation. Discuss cooling, repeated mass readings and possible decomposition conceptually; this is not a practical heating recipe.

4. Use M($CuSO_4$)=160 and M(hydrate)=250 consistently; all data are original invented exercises. Solution volume is final volume, not starting water volume.

5. Allow 10 minutes model, 20 hydrate calculations, 20 evaluation/extension and 10 checking. Correct formula units versus molecules and include the dot in $CuSO_4 \cdot 5H_2O$.

Close of lesson

- Keep calculations and corrections; return shared materials.

Check before teaching

Check the cards, reference data and quantities against this requisition. Keep the staff answer guide separate until the checking stage. Supplied numerical practice datasets are labelled examples; they are not class measurements.

Answers and teaching notes

Expected explanations • do not give as experimental observations

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• Hydrate mass=2.50 g; residue=1.60 g; water loss=0.90 g.

• $n(CuSO_4)=1.60/160=0.0100$ mol; $n(H_2O)=0.90/18=0.0500$ mol; x=5; $CuSO_4 \cdot 5H_2O$.

• Some water remains, so the apparent water loss is smaller and apparent anhydrous mass too large; both effects reduce x under this calculation.

• Water molecules form a defined part of the crystal structure in a fixed ratio to salt formula units. $CuSO_4$ is ionic; the dot specifies associated crystal water, not a separate liquid coating.

• Chemistry only: 2.50/250=0.0100 mol hydrate and hence $CuSO_4$ units; V=0.100 dm^3; concentration=0.100 mol dm^{-3}. Using 160 would treat the water mass as additional $CuSO_4$.

• Chemistry only: acid amount=0.100×0.0200=0.00200 mol; NaOH=0.00400 mol; concentration=0.00400/0.0250=0.160 mol dm^{-3}.

References and provenance

Pearson Chemistry specification

Prepared 22 November 2026. Original wording, tables and questions. Sources inform the concepts and technique; the lesson scope and classroom quantities are explicitly described here. No laboratory trial or final school risk approval is claimed.