Thermal decomposition: copper carbonate evidence

Student activity • practical and reasoning

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The question

What evidence shows that heating produces a new gas and solid?

Heat a small school-issued copper carbonate sample under supervision and test the gas using limewater. Explain the observations without treating a single test as a thermal-stability ranking.

Equipment

- Eye protection; heat-resistant boiling tube, clamp/stand, vented delivery-tube assembly and heatproof mat
- Bunsen burner, spark lighter, small spatula and receiver test tube
- Staff-issued copper carbonate sample and 3 cm^3 limewater; no other carbonates

Wear eye protection; avoid copper-compound dust and contact. Keep the gas path open. Remove delivery outlet from limewater before stopping heat; leave hot glass clamped to cool.

Course coverage: Shared core: 2.12. Copper carbonate decomposition and carbon dioxide identification; the simplified syllabus equation is distinguished from basic copper carbonate stock.

Plan, model or apparatus sketch

Draw and label the model or apparatus that explains the central idea of this lesson.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. Check the apparatus with the teacher: secure the boiling tube, point its opening away from people and ensure the gas path is unobstructed.

2. Use the staff-issued small sample in the dry boiling tube. Arrange the delivery outlet just below the surface of 3 cm^3 limewater; never seal the receiving vessel.

3. Record the initial solid and limewater appearances. Gently warm the tube, then heat the sample as demonstrated. Keep faces and hands clear of hot glass.

4. Observe the solid and limewater. Record actual changes; do not assume a time measurement ranks different carbonates fairly.

5. While the tube remains hot, lift the delivery outlet clear of limewater BEFORE stopping heating. Then turn off the burner. This prevents liquid being drawn into hot glass as the gas cools.

6. Leave the apparatus to cool on the stand. Explain gas identity, the solid change and the simplified decomposition equation; label any water droplets separately.

Cleanup

• Staff collect cooled copper-containing solids and receiver liquid under the local waste plan. Do not put copper waste down the sink. Wash hands after cleanup.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Simplified syllabus model: $CuCO_3 \rightarrow CuO + CO_2$. Many school bottles actually contain basic copper carbonate, $Cu_2(OH)_2CO_3$, which decomposes to $2CuO + CO_2 + H_2O$. Check the supplied label before interpreting water or doing a mass calculation. Limewater test: $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$. No expected reading is an actual class result.

Stage	Solid / receiver observation	Interpretation
Before heating		
During heating		
After cooling		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Describe your actual changes in the solid and limewater.

2. Write the simplified syllabus equation and name the black product.

3. Explain why limewater becomes cloudy.

4. Explain the correct shutdown sequence and the hazard it prevents.

5. Why might water droplets occur with school copper carbonate stock?

6. Why is time to cloudiness alone a weak way to compare thermal stability?