The Missing Label

Use three properties to identify a pure substance

8.1 "Plan and carry out investigations to support the claim that pure substances can be described and defined by their properties, including solubility, electrical conductivity, and density."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each test the technician performs, circle each result for the unlabeled cube, and number the known-sample properties that you use to identify it.

A Mystery at the Museum Workshop

1 At a museum workshop, four labels fall off sample trays. The trays hold pure aluminum, copper, sulfur, and sodium chloride. A technician has one small cube from an unlabeled tray. To identify it, she will compare its properties with those of known samples, not just its color. She wears goggles and tests tiny pieces so the main cube stays intact. For a fair solubility test, she puts equal masses of each substance into equal amounts of water at the same temperature and stirs each for the same time.

2 Known samples give distinct clues. Aluminum and copper do not dissolve in water, and both conduct electricity as solids. Sulfur does not dissolve in water, but it does not conduct electricity as a solid. Sodium chloride dissolves in water; its solid crystals do not conduct, although a solution of it can conduct. Density adds another clue: for each cubic centimeter, aluminum has a mass of about 2.7 grams, copper 8.9 grams, sulfur 2.1 grams, and sodium chloride 2.2 grams. These values apply to solid material, not loose piles of grains.

3 The technician measures the unlabeled cube: its mass is 2.7 grams and its volume is 1.0 cubic centimeter. She tests a tiny shaving in water, and it does not dissolve. A simple battery-and-bulb circuit lights when the dry cube completes the circuit. She records the conditions because changing them can change the results. For example, wet crystals of sodium chloride might let current pass through the water around them, even though dry crystals do not conduct. She will compare all three test results with the known samples before replacing the label.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which known substance can the technician rule out because the shaving does not dissolve in water? Explain.

2. Which remaining substance can the technician rule out because the dry cube lights the bulb? Explain.

3. Calculate the cube's density. Which of the two remaining substances matches it?

4. Why does the technician test a dry cube in the circuit instead of relying on a test of wet crystals?

3 YOUR TURN

Your own words

You receive a small cube of a pure solid that is not named in the passage. Write a plan to test its solubility in water, electrical conductivity as a dry solid, and density, then explain how you would use known samples to support an identification.

ANSWER KEY

The Missing Label

GRADE 8 · 8.1

PART 1 · READ AND MARK

Underline each test the technician performs, circle each result for the unlabeled cube, and number the known-sample properties that you use to identify it. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which known substance can the technician rule out because the shaving does not dissolve in water? Explain.	**Sodium chloride, because it dissolves in water and the shaving did not.**
2	Which remaining substance can the technician rule out because the dry cube lights the bulb? Explain.	**Sulfur, because solid sulfur does not conduct electricity.**
3	Calculate the cube's density. Which of the two remaining substances matches it?	**2.7 grams per cubic centimeter (2.7 grams ÷ 1.0 cubic centimeter). It matches aluminum, not copper.**
4	Why does the technician test a dry cube in the circuit instead of relying on a test of wet crystals?	**Water around wet sodium chloride crystals might carry current, even though dry sodium chloride crystals do not conduct. Testing dry solids makes the results comparable.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would measure the cube's mass and side lengths, calculate its volume, and divide mass by volume to find density. I would put a small shaving in a measured amount of water and note whether it dissolves. I would place the dry cube in a battery-and-bulb circuit to test conductivity. I would repeat those tests on known samples under the same conditions and look for a match across all three properties.

Accept plans that measure mass and solid volume before the water test, test conductivity on a dry solid, and compare results with known samples under consistent conditions. A single matching property is not enough to support an identification.