



**From**

Executive Office  
The Kroger® Building  
Cincinnati, OH 45202

**To**

Laboratory Technicians  
Kroger® Laboratories  
Food Services Division  
Quality-Control Sector

**Assignment:** We have received several complaints concerning the quality of Kroger® Baking Soda. Please test several samples to verify the contents and the package label. Attached to this memo is a suggested procedure. Please modify if necessary.

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**Material Under Testing**

Kroger® Baking Soda

**Important Information**

Baking soda is the common household name for sodium bicarbonate,  $\text{NaHCO}_3$ . When heated, sodium bicarbonate will decompose into solid sodium carbonate, carbon dioxide gas, and water vapor. Sodium carbonate is a white, powdery solid that is very similar in appearance to sodium bicarbonate. Carbon dioxide gas is odorless and colorless, but it can be detected by using a burning splint of wood. Oxygen gas will make the wood splint burn brightly: on the other hand, carbon dioxide gas will extinguish the flame. Water vapor is easily observable on glass, just like in the bathroom after you take a shower. It is your job to observe this reaction, identify the products, and verify that the material under testing, Kroger® Baking Soda, is in fact baking soda.

**Equipment at Kroger® Laboratories**

triple-beam balance: 0.01 gram sensitivity  
test tube  
test tube holder  
ring stand  
Bunsen burner

utility clamp  
metal scoop  
wood splint

### Suggested Procedure:

1. Find the mass of an empty test tube and test tube holder to the nearest hundredth of a gram. Record this in a data table.
2. Add two scoops ( each approximately a tablespoon) of powdered Kroger® Baking Soda to the test tube using the metal scoop. To insure all of the soda gets into the test tube, insert the metal scoop into the test tube before dumping its contents. Find and record the mass of the test tube, test tube holder, and its contents in a data table.
3. Attach the utility clamp to the ring stand. Connect the Bunsen burner to a gas outlet. Turn on the gas and light the burner with a match.
4. Gently tap down all of the Kroger® Baking Soda so that it is in the bottom of the test tube. Then shake the test tube horizontally to spread out the Kroger® Baking Soda as evenly as possible on the inside wall of the tube. Insert the test tube with the soda into the utility clamp so that the tube is close to being horizontal and the label is facing up. Take off the test tube holder. Screw down the clamp just enough to hold the test tube at the very top near the opening. You should be able to jiggle the tube just a little bit.
5. Light the wood splint in the flame of the Bunsen burner. Move the burner underneath the test tube and start heating. The test tube should be about 3 inches above the burner. Heat the closed end of the tube first. Hold the lit splint directly in front of the test tube opening as you start to heat the tube. Be sure to heat every part of the test tube. Total heating time: 8 minutes. OBSERVE THE CONTENTS OF THE TEST TUBE.
6. Let the test tube cool for 8 minutes.
7. Remove the test tube from the utility clamp by attaching the test tube holder to the tube and unscrewing the clamp. Find the mass of the test tube holder, test tube, and contents. Record in a data table.

### Example Data and Results Table

mass of test tube and test tube holder	_____	g
mass of test tube, test tube holder, and baking soda	_____	g
mass of baking soda	_____	g
mass of test tube, test tube holder, and product (after heating)	_____	g
mass of product (after heating)	_____	g

mass of product

theoretical mass of product

% error

Group 1	_____ g	_____ g	_____ %
Group 2	_____ g	_____ g	_____ %
Group 3	_____ g	_____ g	_____ %
Group 4	_____ g	_____ g	_____ %
Group 5	_____ g	_____ g	_____ %
Group 6	_____ g	_____ g	_____ %

### Calculations

mass of baking soda = {mass of test tube, test tube holder, and baking soda} - {mass of test tube and test tube holder}

mass of product = {mass of test tube, test tube holder, and product after heating} - {mass of test tube and test tube holder}

% error = [(mass of product) - {theoretical mass of product}] ÷ [{theoretical mass of product}] x 100%

theoretical mass of product = three-stepper using the factor-label method and the road map.

### Answers The Boss Will Want to See

1. Write the skeleton equation for the reaction you observed. Be sure to include symbols that describe the reactants and products (solid, liquid, gas, aqueous solution).
2. Write the balanced equation for the reaction you observed.

### What did you observe as you heated the Kroger® Baking Soda?

3. Did anything collect near the top of the test tube? What was it?
4. What happened to the burning splint held at the opening of the test tube? Why?
5. If this is indeed real baking soda, what was the product left in the test tube after heating?
6. Show your calculations for the theoretical mass of product left in the test tube after heating. Start with the mass of the baking soda, then follow the road map and convert to moles of reactant, to moles of product, and finally to mass of product.
7. Did you correctly predict the mass of the product left in the test tube after heating? (is your % error very low?)
8. Do these observations confirm or deny that Kroger® Baking Soda is indeed the real thing? How?
9. How much of sodium bicarbonate is sodium? Find the percentage composition of sodium in baking soda.

10. Show your work that proves that the information about the amount of sodium per serving on the side of the box (pictured on back) is accurate. Note: one serving size = 1.1 grams.
11. Do you think the procedure you followed to test Kroger® Baking Soda is a good one taking into consideration the factors of time, cost, accuracy, and equipment? If you were in charge of the Food Services Division, Quality-Control Sector, what would you change?

### **Cleaning Up**

After your test tube has cooled and has been massed, please dump its contents into the waste beaker, a 600 mL beaker with paper towels inside sitting in the middle of the lab. Rinse your test tube with tap water. Remove as much as you can of the product. Then, using a very small amount of soap, scrub the inside of your test tube with a test tube brush. Rinse with tap water until all of the soap is gone, then finally rinse once with distilled water. Replace your test tube in the test tube rack. Put all equipment back into their proper places.

### **Grading**

Questions: #1 = 10 points; #2 - #5 = 5 points each; #6 = 10; #7 = 5; #8 = 10; #9 = 5; #10 = 10; #11 = 10. Data and Results Table: 20 points.

Total = 100 points.