Lab 7: What is That White Powder?

Goals:

The goal of this lab is to identify all five of the unknown white powders you are given. Each of these powders can be superficially described as a "dry white powder", but they have different chemical and physical properties.

You will need to develop your own procedure for this lab by reading the material given in this hand out. You will show your procedure to an instructor and it must be accepted before you can begin the lab. The possibilities of the unknown solids are given in the table below.

FORMULA	NAME	USE
NaCl	sodium chloride	Table salt
$NaHCO_3$	sodium bicarbonate	Baking soda
$C_{12}H_{22}O_{11}$	sucrose	Table sugar
$C_6H_{12}O_6$	glucose/dextrose	Sweetener
$CaSO_4$	calcium sulfate	Plaster of Paris
$(C_6H_{12}O_6)_n$	cornstarch	Thickener
$MgSO_4 \cdot 7H_2O$	magnesium sulfate (hydrated)	Epsom Salts
$Na_2B_4O_7$	sodium tetraborate	Borax
$KHC_4H_4O_6$	potassium bitartrate	Cream of Tartar
$CaCO_3$	calcium carbonate	Chalks, antacids
NaOH	sodium hydroxide	Lye, drain cleaner
Na_2CO_3	sodium carbonate	Washing soda

Procedure:

You will need to develop your own procedure for this lab by reading the material given in this hand out. You will show your procedure to an instructor and it must be accepted before you can begin the lab. **NOTE: You do not have to carry out each test on each powder.**

Tests You Can Perform:

I. Solubility

A. Water Solubility

Eight of the twelve possible powders are soluble in water (dissolve in water). The four that are insoluble are calcium sulfate, calcium carbonate, cornstarch, and potassium bitartrate. To test water solubility, add a pea-sized sample to a test tube, and about 5 mL of water, stopper and shake the test tube. Even if the solid does not completely dissolve, decide if it is soluble or insoluble.

B. Solubility in hydrochloric acid (HCl)

Calcium sulfate and cornstarch are not soluble in 10% HCl. The rest of the powders are soluble. Test solubility similarly to how you tested water solubility. Bicarbonates and carbonates react with acid to form carbon dioxide bubbles.

C. Solubility in Vinegar (dilute acetic acid)

Bicarbonates and carbonates react with acetic acid to form carbon dioxide bubbles.

II. pH Test

We will use universal indicator to test the pH of the solutions. Add a few drops of indicator to the test tubes in which the samples proved to be water-soluble. Add the drops directly to the test tubes that you used for the water solubility test. Again, only do the pH test for those powders that are *water-soluble*. Record any color.

Sodium bicarbonate should appear light blue or blue-green, sodium carbonate should be violet, sodium hydroxide should be aqua or blue (but may appear violet at first), magnesium sulfate should be blue-green or yellow, sodium tetraborate should be blue-violet or violet, sodium chloride should be yellow, sucrose should be orange-yellow or yellow, and glucose should be yellow-green or yellow.

III. Iodine (I_2) Test

Recall from the vitamin C titration that starch reacts with I_2 to form a blue complex. Put a pea-sized amount of powder that you suspect to be cornstarch in a test tube. Add two drops of tincture of iodine (a solution of iodine dissolved in alcohol) to the test tube, add a few drops of water, and mix the contents. Record your observations.

IV. Reaction with Sodium Hydroxide (NaOH)

Recall the precipitation reactions from the qualitative analysis lab. Magnesium sulfate reacts with sodium hydroxide (NaOH) to form insoluble magnesium hydroxide (a solid). Add a pea-sized amount of powder you suspect to be magnesium sulfate to a test tube, add about 5 mL of water, stopper and shake the test tube (to dissolve the magnesium sulfate). Add about 20 drops of 0.2 *M* NaOH to the solution, and record your observations.

V. Copper(II) Reduction

Glucose will react with a basic solution of copper(II) sulfate (called Benedict's Reagent) to form the insoluble copper(I) oxide, which is red (although it may appear yellow at first).

Place a pea-sized amount of powder you suspect to be glucose into a test tube and add about 5 mL of water. Add a few drops of Benedict's Reagent and place the test tube in a boiling water bath for about 5 minutes. Record your observations.

VI. Conductivity Test

Compounds that form ions in aqueous (water) solution will conduct electricity. Sucrose and glucose are water soluble, but do not form ions in water. Dissolve a pea-sized amount of powder that you wish to test in about 20 mL of *deionized* water in a 50 mL beaker. Use the conductivity apparatus provided to test the solutions. Record your observations.

Report:

You are working in a crime lab and have been given five different white powders from the scene of a crime. Write a report explaining what tests you performed, your observations, and the identity of each of the powders. These powders are numbered when given to you. As part of your report, construct a table as shown below. Be sure to include the unknown number given to you in the lab for each of the five white solids. As with the pre-lab table, write NA in the box if the test was not performed.

Keep in mind the overall goal: correctly identify the unknown using the minimal number of tests possible.

Test	Unknown #	Unknown #	Unknown #	Unknown #	Unknown #
Water Solubility					
10% HCl					
Vinegar					
pH Test					
Iodine Test					
NaOH					
Copper(II) Reduction					
Conductivity Test					