

Identification of Unknown Solutions

INTRODUCTION

In this experiment, the student will determine if a chemical reaction has taken place when two solutions are combined, describe the chemical reaction, and use this information and logic to determine the identity of ten unknown solutions.

DISCUSSION

In the daily work of a scientist, he or she often encounters situations in which an unknown substance must be identified. Many physical and chemical tests are performed on the unknown. The results of the testing coupled with logic and deductive reasoning are used to narrow the possible identities of the unknown until the substance is unambiguously identified.

In this experiment, you are provided with a set of ten solutions of a known composition and the same ten solutions in a set of unidentified numbered bottles. Your goal is to produce experimental data that will allow you to correctly identify the ten solutions in the numbered bottles.

ADDITIONAL INFORMATION

When a chemical reaction occurs in solution, one of the following observations is usually made:

1. *A precipitate forms.* A precipitate is an insoluble solid which remains suspended in the solution or sinks to the bottom. The word precipitate means literally to "fall out". When a precipitate forms as a result of a reaction, the reaction mixture appears cloudy. A precipitate may be colored.
2. *A gas is evolved.* The gas appears as bubbles that effervesce from the solution. The gases may have a noticeable odor. The correct procedure for smelling a chemical is to waft the fumes towards your nose by waving your hand over the substance. Sniffing at close range may cause undesirable results.
3. *Heat is evolved or absorbed.* This will be indicated by a change in temperature of the reaction mixture. The change is often enough to be detected by touching alone. Other changes may be detected by using a thermometer.
4. *There is a change in color.*

PROCEDURE

SAFETY GLASSES MUST BE WORN DURING THE ENTIRE EXPERIMENT. DO NOT SPILL SILVER NITRATE ON YOUR SKIN OR CLOTHING AS IT REACTS WITH LIGHT PRODUCING STAINS THAT ARE VERY DIFFICULT TO REMOVE.

1. Locate solutions of the following compounds in the laboratory: calcium chloride (CaCl_2), hydrochloric acid (HCl), lead(II) nitrate ($\text{Pb}(\text{NO}_3)_2$), magnesium sulfate (MgSO_4), potassium iodide (KI), silver nitrate (AgNO_3), sodium carbonate (Na_2CO_3), sodium sulfate (Na_2SO_4), strontium nitrate ($\text{Sr}(\text{NO}_3)_2$), and zinc nitrate ($\text{Zn}(\text{NO}_3)_2$). Locate the ten solutions identified with letters and numbers. These are your unknown solutions.

2. Combine equal amounts (2 or 3 drops) of any combination of known or unknown solutions together into the plastic wells provided. Record whether a chemical reaction takes place.
 - If a precipitate is formed, note its color and any other obvious characteristics — is it a fine precipitate or is it chunky? The letters “ppt” are used to abbreviate the word precipitate.
 - You must watch closely to observe the formation of gas bubbles. When gas bubbles are formed, they often disappear immediately. Watch for bubbles at the instant solutions come in contact with each other.
 - If no reaction occurs, write “NR”. Magnifying glasses are available for you to examine your combinations more closely.

Hint: Be careful that you record which combinations of chemicals are in each of the wells. A systematic, organized approach to this experiment will yield much more meaningful results than a random combination of all 20 bottles of chemicals two at a time!

3. Using the data (experimental observations) you have generated, correctly identify the ten unknown solutions. You may find that you cannot identify all the solutions and it may be necessary to repeat a combination of solutions to review the results or to try some new combinations.
4. Clean up your lab area and dispose of waste as directed by your instructor

LABORATORY REPORT

Include the following components in your laboratory report, due at the beginning of the laboratory period next week. *At your instructor's discretion, individual or pair reports may be required.*

1. Title (including name, partner's name, etc.)
2. Experimental Procedure. Because this lab gave you the freedom to design the experiment yourself, you will have to provide the complete description of what you did in a paragraph or two.
3. Experimental results from your combinations of solutions. This is usually easiest to present as a table showing the results of the various combinations of solutions that you completed. You may use more than one table if you combined solutions together in different ways.
4. Discussion and Conclusion. Identify what your unknown solutions were (claims) and describe the evidence you used to support these claims. You should also use this section to talk about how any questions that you had the beginning of the lab were answered, any errors or difficulties that occurred, and anything that you would do differently (especially in the procedure).
5. References, properly cited, to any sources you may have used to perform, complete, or analyze the results of the lab.

6. **Follow your instructor's directions for submission of the lab report.** You may have the option of submitting this lab by email, through the D2L dropbox, or on paper. If you submit the file electronically, please use the filename convention of *Lastname Firstname Unknown Solutions*. If you email your report, please use the subject line of "Chem 1061: Unknown Solutions."