

CH 221 Fall 2025:

“Identification of an Unknown Compound”

Lab Instructions

Step One:

Get a printed copy of this lab! You will need a printed (hard copy) version of pages I-5-2 through I-5-6 to complete this lab. If you do not turn in a printed copy of the lab, there will be a 2-point deduction.

Step Two:

Watch the video introduction for this lab **here:** <http://mhchem.org/w/5.htm>

The video introduction will help prepare you for the lab and assist you in completing the work before turning it in to the instructor.

There are no PreLab questions for this lab.

Step Three:

Bring the printed copy of the lab with you on Monday, October 20 (section L1), Tuesday, October 21 (section L2), Wednesday, October 22 (section L3) or Friday, October 24 (section L4). During lab, you will use these sheets (with the valuable instructions!) to gather data, all of which will be recorded in the printed pages below.

Step Four:

Complete the lab work and calculations on your own, then **turn it in** (pages I-5-5 through I-5-6 *only* to avoid a point penalty) **at the beginning of recitation to the instructor on Monday, October 27 (section L1), Tuesday, October 28 (section L2), Wednesday, October 29 (section L3) or Friday, October 31 (section L4)** The graded lab will be returned to you the following week during recitation.

If you have any questions regarding this assignment, please email (mike.russell@mhcc.edu) the instructor! Good luck on this assignment!

Identification of an Unknown Compound

An Introduction to Scientific Investigations

Problem solving is not restricted to scientific investigations but is a life-long process that involves every aspect of human endeavor. Although every investigator, being human, approaches each problem with some preconceived ideas, facts are gathered by accurately observing the behavior of a system of interest. Conclusions are based solely on the observed data.

The approach used by scientists is referred to as the **Scientific Method**. *First*, the behavior of matter is observed. *Second*, the results or data are arranged in an orderly fashion. *Third*, the observed data is correlated to form a hypothesis. *Finally*, new experiments are designed to test the hypothesis.

Creativity is an intrinsic part of the scientific investigation; it allows new concepts and technologies to develop.

In this experiment you will determine the identity of an unknown compound by comparing its characteristic reaction with the reactions of four known substances. A chemical reaction can be observed by one of the following changes:

1. The formation or disappearance of a **precipitate**, a solid product formed from the mixture of two aqueous solutions. A precipitate often gives a cloudy appearance due to very small solid particles evenly distributed throughout the solution. A color change may also occur.
2. The formation of a **gas**, indicated by *bubbles*, a process known as **effervescence**. A change in the odor of the solution also indicates that a gas has been produced.
3. Change in **temperature**.

"No change" is also an observation that must be noted.

By carefully observing any changes that occur it should be possible for you to obtain enough data to determine the identity of your unknown solution. Make sure you write down your unknown letter in your lab report.... you will need to include it in your lab report.

All waste should be placed in the waste bottle before the end of lab.... do not place these chemicals in the drain!

PROCEDURE: *Work in groups of 2 or 3 while performing labs. Safety glasses should be worn while performing this lab.*

Part A: Testing for Gas Evolution

1. Clean five test tubes and label as: NaCl, Na₂CO₃, Na₂HPO₄, Na₂SO₄, and U (unknown – **do not use “U”**, use the actual unknown letter on the bottle). Use a clean spatula to place a pea-sized sample of each of the above **solids** in its corresponding test tube. (There is no need to dry test tubes). **Record** your unknown letter.
2. Add 5 drops of HNO₃ solution to **each** test tube. **Record** your observation. Wash the test tubes and rinse with water. (There is no need to dry the test tubes)

Part B: Testing with Barium Nitrate (Ba(NO₃)₂)

1. Place 20 drops of each of the following solutions in their corresponding test tubes: NaCl, Na₂CO₃, Na₂HPO₄, Na₂SO₄, and Unknown. Use the same unknown letter as in part A.
2. Add 3 drops of NH₃ (note that NH₃ is often displayed as "NH₄OH" when in water) to the first test tube. Mix the solution with a clean, dry stirring rod. Place a drop of the solution adhering to the stirring rod to a piece of red litmus paper. If the paper does not turn blue, add three more drops of NH₃ and re-test the solution with litmus. Continue to add NH₃ until the litmus turns blue (it can take more than 20 drops depending on the solution). Repeat with each sample.
3. Add 5 drops of Ba(NO₃)₂ to each test tube. Flick the test tube to mix, being careful not to spill the mixture. **Record** if a precipitate (i.e. cloudiness) forms and the color of the precipitate.
4. NOTE: This step only applies to those test tubes that contain precipitates. Add 10 drops of HNO₃ to each test tube that contains a precipitate. **Record** if the precipitate dissolves.
5. Discard the solutions into the waste bottle. Wash and rinse the test tubes.

Part C: Testing with Silver Nitrate (AgNO₃)

1. Place 20 drops of each solution into the corresponding cleaned test tube as in part B. Add 5 drops of AgNO₃ solution to each test tube. **Record** your observations.
2. NOTE: This step only applies to those test tubes that contain precipitates. Add 10 drops of HNO₃ to each test tube that contains a precipitate. **Record** if the precipitate dissolves.
3. Discard the solutions in the test tubes into the waste bottle. Wash and rinse the test tubes.

Part D: Determination of Unknown Identity

Your unknown is one of the four tested solutions (NaCl; Na₂CO₃, Na₂HPO₄, or Na₂SO₄). Compare your observations to those of the four known experiments to determine the identity of your unknown compound. If there are any discrepancies, you may need to repeat one of the above experiments.

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Identification of an Unknown Compound

NAME:

Lab Partner(s):

Include *all first and last names!*

Complete the table of data.

Sample	Part A: +HNO ₃	Part B3: +Ba(NO ₃) ₂	Part B4: +Ba(NO ₃) ₂ and HNO ₃	Part C2: +AgNO ₃	Part C3: +AgNO ₃ and HNO ₃
NaCl					
Na ₂ CO ₃					
Na ₂ HPO ₄					
Na ₂ SO ₄					
Unknown Letter: _____					

Conclusion: Your unknown compound is most likely which sodium salt? Explain briefly.

POST LAB QUESTION:

1. You are given an unknown that contains **two of the four compounds** you tested in this laboratory session. You made the following observations:
 - a. No gas evolves when the solid is treated with HNO_3 .
 - b. A white precipitate forms after the addition of NH_3 and $\text{Ba}(\text{NO}_3)_2$ to a solution of the unknown. The precipitate does not dissolve after the addition of a solution of HNO_3 .
 - c. A white precipitate forms after the addition of a solution of AgNO_3 to a solution of the unknown. The precipitate does not dissolve after the addition of a solution of HNO_3 .

Use your observations from the lab to **determine the identity of the two compounds** in this hypothetical unknown. *Explain* your answer.