



## Mystery Test Tube Lab

**Introduction:** Chemists, like detectives, attempt to identify unknowns through a process of careful and creative analysis. This usually involves observing the colours, odours, and reactions of the unknown substances and comparing them with those of known substances.

**Purpose:** In this experiment, you will try to identify twelve different chemical compounds in solution by reacting them with each other, observing the results, and comparing the results with the known characteristics of some common chemicals.

The twelve chemicals are (in no particular order):

- potassium chromate ( $K_2CrO_4$ )
- aluminum chloride ( $AlCl_3$ )
- sodium carbonate ( $Na_2CO_3$ )
- sodium acetate ( $NaCH_3COO$ )
- hydrochloric acid ( $HCl$ )
- sodium hydroxide ( $NaOH$ )
- ammonium hydroxide ( $NH_4OH$ )
- iron (III) nitrate ( $Fe(NO_3)_3$ )
- silver nitrate ( $AgNO_3$ )
- copper (II) sulfate ( $CuSO_4$ )
- nickel (II) chloride ( $NiCl_2$ )
- lead (II) nitrate ( $Pb(NO_3)_2$ ).

### Materials:

Each group will be given:

- solutions in test tube x12
- test tube rack x1
- disposable pipettes x12 (do not cross-contaminate your pipettes)
- spot plate x1
- wooden splints x18 (for flame tests)
- Bunsen burner x1
- striker x1
- pH paper x1
- distilled water (200 mL)
- periodic table x2
- solubility chart
- colour chart for solutions containing certain ions (note: this is different from the colour for flame test)
- lab data sheet (rough copy) x1
- solutions identification table

### Required Time:

Two days of lab time

**Final Lab Report Due:** \_\_\_\_\_

### Safety Precautions:

- Safety goggles must be worn at all times during the lab, remove goggles only when instructed by teacher.
- All solutions must be treated as if they were poisonous and corrosive. If a solution makes contact with skin / clothes, rinse immediately under running water for 5 minutes, and notify teacher.
- Avoid inhaling any fumes.
- To smell, hold test tube away from face and carefully waft towards you.
- Tie back long hair and roll/pull up long sleeves.
- Shut off Bunsen burner when not using it.
- Shut off gas valve if flame on Bunsen burner goes out.
- Shut off gas valve if you're unable to light Bunsen burner after 5 seconds.
- Keep your area neat and tidy.
- Listen carefully to all instructions from the teacher.

**Method:** Each group must correctly complete the pre-lab table before they will be allowed to actually begin the lab.

Once the teacher verifies the pre-lab table to be correct, it is up to each group to decide how they will use the given materials to determine the identity of each solution.

There are 3 sources of information that each group should be drawing upon:

1. Information given in this lab handout.
2. Information learned in previous classes.
3. Researching characteristics observed during the lab, which include:
  - any distinguishing odours (carefully waft the smell to your nose)
  - flame test colours (not all solutions will produce a colour)
  - colours of any precipitates that may be created

<b>Marks:</b>	Pre-lab table	4 marks
	Lab data table	12 marks
	Solution identification table	12 marks
	Explanation/rationale of identification	24 marks
	Summary Questions	8 marks
	Neatness, spelling, formatting of lab report	4 marks
	<b>Total</b>	<b>64 marks</b>

Though group members might perform different duties/tasks within the group, all group members are expected to equally contribute in this lab with respect to effort and time. If this is observed not to be the case, marks will be deducted on a per-group basis depending on the circumstances (there will be no warnings or second chances).

### Pre-Lab Question

Using your solubility chart, fill in the pre-lab table that represents all possible solution combinations.

- If no precipitate is formed between the 2 solutions, write in "N.P." (no reaction).
- If a precipitate is formed between the 2 solutions, write in formula of ppt.

Every person in the group needs to complete a pre-lab table. Take care of this table since it will be included in the group lab report.

**Lab Data Sheet:** Each group must record all their data / observations on the lab data sheet that is given. This sheet will be the group's rough copy.

- if rough copy of lab data sheet is not handed in by the end of the second lab day, a mark of zero will result for this section

The lab report will include a word-processed lab data table that is based on the rough copy of your lab data sheet. Marks for the lab data table will be based on the lab report.

- Any discrepancies between the rough copy and lab report copy will result in marks deducted.
- Each solution that has the correct data reported will earn 1 mark, for a total of 12 marks for this section.

There will be no ½ marks for any solution (i.e. all data for each solution has to be correct)

**Solutions Identification Table:** Each group will be required to hand in the solutions identification table to the teacher by the end of the second day.

- if solution identification table is not handed in by the end of the second lab day, a mark of zero will result for this section
- on the second day of the lab, each group will be allowed to ask the teacher, two times, how many solutions they correctly identified in their table (hopefully the answer is 12)

Marks for this section will be determined by the answers given to the teacher at the end of the second day. Each correctly identified solution will earn 1 mark, for a total of 12 marks for this section.

**Special note about Lab Data Sheet (rough copy) and Solutions Identification Tables:** Both must be kept stapled together and handed in to the teacher by the end of the first day of the lab, they will then be returned to the groups at beginning of the second day.

Both will be allowed outside the classroom (e.g. home) once the teacher has made a photocopy of them immediately after the second day of the lab.

**Explanation/rationale of identification:** The final lab report will include a clear, concise, logical explanation/rational for how each solution was identified. Please include 3 supporting piece of evidence as well as the net ionic equation.

- You cannot **ONLY** rely on just the colour of the solution/colour chart for the identification of a solution; each group must provide other data to support their explanation/rational. (You may include pictures of your precipitate, flame, etc to enhance your explanation)

Each correct explanation/rational will earn 2 marks, for a total of 24 marks.

### Summary Questions:

1. State four methods to determine that a chemical reaction has taken place.
2. Which unknowns were the easiest to identify and why?
3. Which aqueous solutions contained ions that were coloured? Which ions were responsible for the color?
4. Explain, on the molecular level, why reactions occurred very quickly in aqueous solutions compared to the reaction of two solids.
5. Your ID refers to a famous chemist. Please write (in your own words) their "claim to fame" in chemistry in 3-4 sentences. Include a picture and reference(s).

### Lab Report:

One lab report must be handed in for each group.

The lab report must include these 7 sections:

- A title page (which will include lab title, group ID of your test tubes group)
- member names, date, course, and teacher name)
- Table of Contents
- Pre-lab data tables (the one that was done in class)
- Lab data table (based on the rough copy produced in the lab)
- Explanation/rationale of identification of solutions
- Solution identification table (based on the rough copy produced in the lab)
- Rough copies of the data table and identification chart

Each group's lab report will have these sections in this order.  
All sections, except the Pre-lab data table, have to be word-processed.

### Advice for Success

**Each group member should read the lab instructions completely.**

**As a group, plan your lab first:**

- what needs to be done for the 2 days and in what order
- then decide what each person's responsibilities are (delegate tasks and avoid people doing nothing or "just watching")
- time is limited – use it wisely – be efficient without rushing

**Be alert in your observations then accurately and carefully record those observations.**

- Observe each reaction for at least 2 minutes before disposing the products, some reactions occur very fast, while others take longer.

**Be careful with the solutions and supplies given to you, you do not get any replacements.**

**Keep your work area clean and organized – helps to avoid accidents and mistakes.**

**Be prepared to meet your group members outside of class to discuss or work together.**

**Understand that this lab is trying to promote some higher-level thinking that includes:**

- applying knowledge
- analyzing, evaluating and creating lab methods and results.

GOOD LUCK! 😊