

B. Reactions of Unknown Solutions

1. Clean the test tubes from Part I.
2. Place the clean test tubes in a pattern following the unshaded boxes of Table 2.
3. Mix the appropriate unknown solutions together and write the results in Table 2.
- 4. Dispose of the waste in the sink, rinse the test tubes and return them to the box.**
5. Compare the reactions of the known solutions with the reactions of the unknowns. Use the comparison to identify the unlabeled bottles.

| Solubility Rules (adapted from OpenStax) | |
|--|---|
| Compounds that are generally soluble | Exceptions (when paired with) |
| Group 1 metal cations, NH_4^+ | none |
| NO_3^- , $\text{C}_2\text{H}_3\text{O}_2^-$, HCO_3^- , ClO_3^- | none |
| Cl^- , Br^- , I^- | Ag^+ , Hg_2^{2+} , Pb^{2+} |
| F^- | Group 2 metal cations, Pb^{2+} , Fe^{3+} |
| SO_4^{2-} | Ag^+ , Ba^{2+} , Ca^{2+} , Pb^{2+} , Sr^{2+} |
| Compounds that are generally insoluble | Exceptions (when paired with) |
| CO_3^{2-} , CrO_4^{2-} , PO_4^{3-} | Group 1 metal cations, NH_4^+ |
| OH^- | Group 1 metal cations, NH_4^+ , Ba^{2+} |

CHM111 Lab – The Case of the Unlabeled Bottles – Grading Rubric

| Criteria | Points |
|---|--------|
| Lab work performed correctly. Proper safety procedures followed and waste disposed of correctly. Work space and glassware cleaned up. Participated actively in performing the experiment. | 2 |
| All observations recorded clearly | 2 |
| Q1. Unknowns identified | 1 |
| Q2 4 sets of molecular, complete ionic, and net ionic equations are legibly written, all are balanced with correct charges and phases written | 12 |
| Q3 molecular, complete ionic, and net ionic equations are legibly written, all are balanced with correct charges and phases written | 3 |
| Total | 20 |

Subject to other additional penalties as per the instructor

Unlabeled Bottles

Name _____

Team Name: _____

Part A: Known Solutions (Fill in the table with the results from your experimental observations: ppt, gas, heat etc.)

| | CaCl ₂ | Na ₂ CO ₃ | NaCl | NaOH | H ₂ SO ₄ |
|---------------------------------|-------------------|---------------------------------|------|------|--------------------------------|
| CaCl ₂ | | | | | |
| Na ₂ CO ₃ | | | | | |
| NaCl | | | | | |
| NaOH | | | | | |
| H ₂ SO ₄ | | | | | |

Part B: Unknowns: (Fill in the table with the results from your experimental observations: ppt, gas, heat etc.)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

Q1. Unknown 1 is _____

Unknown 2 is _____

Unknown 3 is _____

Unknown 4 is _____

Unknown 5 is _____

Q2. For the three precipitate reactions and the acid-base reaction (even if not observed) Write the a) **Molecular** equation b) the **Complete ionic** equation and c) the **Net ionic** equation.

Ask yourself the following

- Are the product ionic formulas the simplest ratio where charges equal to zero? If you are not thinking about charges when you write the product formulas you are not doing it right.
- Are all lines of each equation balanced?
- Does every separated ion have the correct charge written?
- Does every species have a phase written?

Q3. A student combines a solution of aqueous rubidium sulfate with a solution of aqueous strontium chloride. Write the balanced molecular equation, the complete ionic equation and the net ionic equation.