**Lab: The Eight Solution Problem**

**Objectives:**

* Examine the results of combining aqueous solutions in potential double replacement reactions
* Verify if a double replacement reaction has occurred.
* For reactions that did occur, translate into complete and net ionic equations while identifying spectator ions.
* Used recorded observations to identify your unknown solution.

**Materials per group:**

* piece of transparency acetate (1 per student)
* White paper—to add labels & look for precipitate
* Known solutions
* Unknown, coded solutions

**Solutions:**

Mercury (I) nitrate Sodium iodide

Lead (II) nitrate Sodium hydroxide

Barium nitrate Copper (II) chloride

 Sodium sulfate Iron (III) nitrate

Your unknowns are guaranteed to be within this group of solutions.

**Safety:**

Sodium hydroxide is corrosive. You will not know which solution is your unknown so assume EVERYTHING is corrosive and toxic.

**Contamination is your enemy! Keep everything VERY clean and do not mix up pipettes.**

**Procedure:**

**PART 1**

1. Inspect your transparency piece. If it appears cloudy, clean it. You will be using the smooth side of the transparency
2. The labels on your Observation Tables show the solutions to be mixed in each well. **Place an X or shade in the appropriate squares of your Knowns Observation Table to show where you do not need to mix solutions**.
3. Place the transparency smooth side up over the grid provided in the lab handout. **This is a very important step which will save you a lot of frustration.**
4. Place **ONE** drop of each solution onto the transparency according to the grid. There will be **TWO** drops total in each section.

NOTE: Be aware of time constraints. These materials will be used by the following class so your work cannot be saved. Make all the mixtures and THEN take observations. **Sometimes precipitates only form if they are left standing for a few minutes. It may not happen right away – be patient.**

1. It is very important you make excellent, detailed observations in your data table.
	1. If a reaction occurs, note with a “+” sign. **If a reaction does occur, provide further detail.** **Your level of detail is very important**. Was there a color change? If so, from what to what color? Was a solid formed? If so, what color is the solid? Is the color bright or pale? Does the solid appear dense or flocculent (clumped) or flaky? Does the solid sink or float or is it hanging suspended in solution? **Do NOT use similes like “looks like milk” or “foggy” or “cloudy” – that is not a good observation!**
	2. If **n**o **v**isible **r**eaction occurs, note with the abbreviation “NVR”. Underneath, include a general description of the mixture—color, clarity, etc…

**PART 2**

1. Three unknowns will be assigned to the group. When you are ready please ask for the unknowns. You will need to share well plates. Each unknown is one of the 8 solutions, but you will have to test to determine which solution. Obviously your observations and testing methods must be meticulous.
	1. Record your observations for your unknowns in the provided Unknown Data Table.
	2. Write your conclusion in Claim-Evidence-Reasoning format. Identify your unknown, then provide written clarification as to why you believe the unknown to be a particular solution based on how the unknown reacted (or didn’t react) with the test solutions.

For example, “I believe unknown Z is hydrochloric acid because it reacted with nitric acid to produce a white solid, reacted with silver nitrate to produce a black solution, and did not react with the other substances. Unknown Z produced identical observations to hydrochloric acid from the Knowns table, therefore unknown Z is hydrochloric acid.”

* 1. Bring remaining unknown back to your teacher. Dispose of the mixtures by wiping the transparency with paper towel. Rinse if necessary and thoroughly dry.

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**Knowns Observation Table (8 pts = complete/accurate observations, 2 pts = quality and detail of observations)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Hg2(NO3)2 | NaI | Ba(NO3)2 | Fe(NO3)3 | Na2SO4 | Pb(NO3)2 | CuCl2 | NaOH |
| Hg2(NO3)2 |  |  |  |  |  |  |  |  |
| NaI |  |  |  |  |  |  |  |  |
| Ba(NO3)2 |  |  |  |  |  |  |  |  |
| Fe(NO3)3 |  |  |  |  |  |  |  |  |
| Na2SO4 |  |  |  |  |  |  |  |  |
| Pb(NO3)2 |  |  |  |  |  |  |  |  |
| CuCl2 |  |  |  |  |  |  |  |  |
| NaOH |  |  |  |  |  |  |  |  |

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**Unknown Data Table**

**(5 pts = unknown is correctly ID’ed, 3 pts = complete/accurate observations, 2 pts = quality and detail of observations)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | HgNO3 | NaI | Ba(NO3)2 | Fe(NO3)3 | Na2SO4 | Pb(NO3)2 | CuCl2 | NaOH |
| Unknown\_\_\_\_\_\_ |  |  |  |  |  |  |  |  |
| Unknown\_\_\_\_\_\_ |  |  |  |  |  |  |  |  |
| Unknown\_\_\_\_\_\_ |  |  |  |  |  |  |  |  |

**Conclusion Questions: Write in complete sentences.**

1. Write a conclusion for the identity of the unknowns in Claim-Evidence-Reasoning format. See the example in Part 2

 of the procedure. Mention both the unknown code number and the identity of the unknown. Quality and detail are

 very important. **(5 pts)**

|  |
| --- |
| **Claim**  |
| **Evidence** | **Reasoning** |

2. Write the balanced molecular equation, the balanced total ionic equation, and the balanced net ionic equation for

 your unknown solution with any of the original known solutions, if it makes precipitate. Include all states for each

 reactant and product. Don’t forget all ions must have charges. **(5 pts)**

 Balanced molecular equation:

 Balanced total ionic equation:

 Balanced net ionic equation: