**Finding Unknowns Using Reactivity and Spectroscopy**

You have been provided with a solution of a chemical compound. Your task: Figure out the identity of this compound using both precipitation reactions and by application of the flame test.

Your write-up should be written in the usual format.

Good luck!

**Teacher Instructions: Finding Unknowns Using Reactivity and Spectroscopy**

**Purpose of this lab:**

The goal in this lab is to have the students identify the contents of a bottle containing an unknown ionic compound. They can do this using two different tools:

* **Precipitation reactions:** By comparing the precipitation reactions of the unknown to double displacement reactions they perform on their own, student can get more information about the identity of the compound.
* **Flame test:** By comparing the color given off by the unknown when heated over a Bunsen burner to that of reference elements, the cation in the compound can be determined (or at least narrowed down somewhat).

As you can see, this lab contains no wholly novel elements. What makes it interesting is that it links the concepts of reactivity and spectroscopy in students' minds, helping them to learn that all of the topics they're learning are related to one another.

**Safety warnings:**

Because this lab is the combination of two other labs, the safety precautions for both labs must be taken into account. The features you should keep in mind include (but are not limited to):

* **Goggles!** Always wear goggles, no matter what lab is performed!
* **Bunsen burner safety**: Make sure that students understand how to use Bunsen burners and understand how to handle hot objects. Additionally, no students should be given rubber gloves, as they can melt to the skin.
* **Compound toxicity issues**: If you use compounds that are too toxic to wash down the sink (and you probably will), make sure that your students place them into marked disposal containers and that they wipe down their lab area after the lab is complete. It's also important that the students wash their hands after the lab – there has been a growing trend for students to use hand sanitizer instead, and this is clearly not a good substitute for chemical contamination.
* **Compound flammability issues**: As always, keep flammable compounds away from the Bunsen burners. Nitrates are particularly hazardous in this lab, as they'll be used in all aspects of the lab. However, don't go overboard with the worry – if nitrates are used in the flame test lab, there shouldn't be any problems. It's only if large quantities of nitrates are heated that this becomes an issue.
* **Other unforeseen issues**: As you already know, one can never tell what might present a problem in the class. Keep a close eye on the kids, and remember that *you* are the person responsible for their safety. I know these labs have worked *for me*, but can't guarantee that you'll have the same experience.

**Suggestions for the teacher:**

* If you soak toothpicks into solutions of each cation, they can be held over the Bunsen burner directly to perform the flame test. Of course, the traditional metal loop also works.
* Limit the number of compounds you work with. Give yourself six cations and six anions to work with and you should be fine.
* Keep in mind that more than one compound may give the same result. For example, sodium nitrate will give the same result as sodium acetate when performing these tests. For this reason, either limit the ions you work with so this doesn't happen, or check everybody's work to make sure that they haven't inadvertently come up with a valid alternate answer.
* Limit the quantities of reagent used. If you allow the students to use 10 mL of each solution per test, they will.