Name: _____ Date: _____ Period: _____

Flame Test Lab

Background:

The flame test is a simple form of spectroscopy, which is used to identify unknown substances based on the interaction between matter and electromagnetic energy, more specifically visible light. The flame test can be used to identify elements based upon the different colors emitted, even though the sensitivity of the equipment used is different from other spectroscopic methods.

The normal electron configuration of atoms or ions of an element is known as the ***ground state***. In this most stable energy state, all electrons are in the lowest energy levels available. When atoms or ions in the *ground state* are heated to high temperatures, some electrons may absorb enough energy to allow them to "jump" to higher energy levels. The element is then said to be in the ***excited state***. This excited configuration is unstable, and the electrons "fall" back to their normal positions of lower energy (ground state). As the electrons return to their normal levels, the energy that was absorbed is emitted in the form of electromagnetic energy. Some of this energy may be in the form of visible light. The color of light given off corresponds to the difference in energy between the ground state and excited state of the element. Because each element has a unique energy difference between these two states, each element emits a unique color when heated. Therefore, the color of this light can be used as a means of identifying the elements involved. Such analysis is known as a flame test.

To do a flame test on a metallic element, the metal is first dissolved in a solution and the solution is then held in the hot, blue flame of a Bunsen burner. This test works well for metal ions, and was perfected by Robert Bunsen (1811–1899). Many metallic ions exhibit characteristic colors when vaporized in the burner flame.

Purpose:

The purpose of the Flame Test Lab is to observe the characteristic colors produced by certain metallic ions when vaporized in a flame and then to identify an unknown metallic ion by means of its flame test.

Hypothesis:

If there is a relationship between _____
dependent variable

and _____, then the identity of the unknown
independent variable

metal can be determined by _____

_____.

Materials:

Set of known and unknown metal chloride solutions
Bunsen Burner and matches
8 – 10 Q-tips

Safety:

Be sure to wear safety goggles, apron, and closed-toe shoes at all times; avoid wearing loose clothing and jewelry. Place personal possessions in seat or on desk when moving to lab stations. Use caution when moving around the classroom and when using an open flame. Some metallic ions form toxic solutions; wash hands after any spills and at the end of the lab.

Procedure:

1. Light the Bunsen burner with a match. Once ignited, lower the gas level until a small blue cone of flame appears. Discard used matches in the metal waste container provided at each lab station.
2. Dip the cotton end of a clean Q-tip into the known solution until it is saturated.
3. Hold the Q-tip in the hottest part of the flame, without catching the Q-tip on fire. Observe the color of the flame. Discard Q-tip in the metal waste container provided at each lab station.
4. Record detailed observations in the Data Table.
5. Repeat Steps 2 through 4 for all known solutions, using a clean Q-tip each time.
6. When known solutions have been tested and data regarding color emitted have been recorded in detail, test an unknown solution, using a clean Q-tip. Record detailed observations in the data table. Return the unknown solution to the teacher workstation.
7. Repeat Step 6 for each unknown solution. Test one unknown solution at a time, returning it to the teacher workstation before taking another unknown.
8. Clean up lab stations.
    a. Be sure gas is turned off and Bunsen burners have no flame.
    b. Empty waste containers into trash cans available at each lab station.
    c. Be sure tops are secured on all solution containers.
    d. Wash all lab table surfaces and clean out sinks.
    e. Wash hands.
    f. **1st through 5th Periods**: Fold aprons neatly, and leave aprons and goggles at lab station. **7th Period**: Return aprons to hooks in back corner of class room and safety goggles to the goggle cabinet. Empty small trash cans at each lab station into the trash can near the front door of the classroom.

Data Table:

Compound in Solution	Color of Flame Produced
Sodium chloride, NaCl	
Calcium chloride, $CaCl_2$	
Lithium chloride, LiCl	
Strontium chloride, $SrCl_2$	
Copper(II) chloride, $CuCl_2$	
Potassium chloride, KCl	
Unknown compound #1	
Unknown compound #2	
Unknown compound #3	

Results:

Based on your observations, identify the unknown solutions you examined.

Unknown compound #1 is _____.

Unknown compound #2 is _____.

Unknown compound #3 is _____.

Post-Lab Questions: *Use complete sentences to answer.*

1. Compounds are formed by chemically combining two or more elements. The metallic ion in each of the tested solutions is different. Which element is the same in each solution?

2. Which element in each of the tested compounds is responsible for the production of colored light?

3. Why do elements have to be heated in the flame first before the colored light is emitted?

4. Why do different elements emit different colors of light?

5. What elements in the unknown solutions are responsible for the production of colored light? What evidence supports this conclusion?

6. Was the hypothesis for this lab supported by lab data or not?

Conclusion: *Write conclusion on the lined page.*

In a well-developed paragraph, explain how the colors observed in the flame tests are produced and how these observations can be used to identify the unknown elements. Be sure to explain why the colors produced by different elements correspond to different parts of the visible light spectrum.