Name: _____ Period: _____

Flame Tests

Pre-Lab Discussion

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. 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 this light can be used as a means of identifying the elements involved. Such crude analyses are known as flame tests.

Only metals, with their loosely held electrons, are excited in the flame of a laboratory burner. Thus, flame tests are useful in the identification of metallic ions. Many metallic ions exhibit characteristic colors when vaporized in the burner flame. In this experiment, characteristic colors of several different metallic ions will be observed, and an unidentified ion will be identified by means of its flame test.

Purpose

Part 1. Observe the characteristic colors emitted by certain metal ions when vaporized in a flame.
Part 2. Identify unknown metal ions by observing the bright line spectrum they emit when vaporized in a flame.

Equipment:	Materials:
Striker	Solids of NaCl, KCl, $CaCl_2$,
Laboratory burner	$SrCl_2$, $BaCl_2$, $CuCl_2$, LiCl
7 small beakers	
Cotton swabs with wood splints	Tap Water
Spectrum glasses	Seven Unknowns

Procedure:

1. Obtain 7 small beakers. Label each beaker for one of the known ions to be tested. Obtain 2 or 3 cotton swabs for each of the known to be tested. Fill a beaker half full of tap water. This will be used to extinguish used cotton swabs.
2. Ignite your Bunsen burner and obtain one pair of spectrum glasses for your team.
3. When everyone has reached this point, the room will be darkened. At this point you will begin to test your seven known metals. Using tongs, hold a wet cotton swab in the flame of your burner. One member of the team views the flame with the spectrum glasses. Record both the naked eye color and the spectrum lines for each sample tested. When you are finished with the cotton swab, place it in the beaker of water. Repeat this for the seven known samples.
4. When you finish the knowns, clean out your beakers and obtain six unknowns labeled A-F. Repeat the above procedure with the unknowns.

Data:

Metallic Ion	Color in flame with naked eye	Bright lines with spectrum glasses
Na^+		
K^+		
Li^+		
Ca^{2+}		
Sr^{2+}		
Ba^{2+}		
Cu^{2+}		
Unknown A		
Unknown B		
Unknown C		
Unknown D		
Unknown E		
Unknown F		

Analysis Questions

1. Identify the independent and dependent variables in this lab:
   a. Independent variable:_____
   b. Dependent variable:_____

2. What possible sources of error exist in this experiment? Be very specific in your answer!

3. What is the difference between an electron in the ground state and one in the excited state?

4. Explain, on the atomic level, how the colors observed in this lab were produced.

5. Write out the electron configuration of each element tested in the lab:

a. Na _____ valence e$^-$s _____

b. K _____ valence e$^-$s _____

c. Ca _____ valence e$^-$s _____

d. Sr _____ valence e$^-$s _____

e. Ba _____ valence e$^-$s _____

f. Cu _____ valence e$^-$s _____

g. Li _____ valence e$^-$s _____

6. Which pair(s) of ions tested in this experiment had similar colors to the naked eye? How did you tell these similar ions apart from one another?

7. Why did the seven ions tested in this experiment produce unique line-emission spectra?

8. Write a conclusion that identifies each of your unknowns. Use information from your known data to justify your conclusions (i.e. what are your unknowns and how did you come to these conclusions?).

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