

Name: _____ Block: _____

The Flame Test

Background

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 – note that there are no "in between" states. The element is then said to be in the **excited state**. This excited configuration is unstable, and the electrons quickly 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 unidentified ions will be identified by means of its flame test. Keep in mind that the colors you see are mixtures of colors and that each element actually gives off specific lines, or a signature of colors. We will discuss this phenomenon in more detail during class.

Purpose - Observe the characteristic colors produced by certain metallic ions when vaporized in a flame. Identify an unknown metallic ion by means of its flame test.

Procedure - Groups will be assigned a couple of unknowns (of three possible). Identification of these will count for 2 points of the lab grade. DO NOT CROSSCONTAMINATE THE SOLUTIONS! **WARNING:** the lights will be off during the lab, please be mindful of clothing and hair around the burners.

1. I will demonstrate the technique you will use to view each excited ion. Please take notes while this demonstration takes place.
2. Rotate to a new station and test each solution in the same manner. Record all your observations in the data list.
3. Obtain the letter of 2 unknown solutions from me. Perform a flame test and identify the metallic ion present by the color of the flame.

Data (colors should be red, yellow, green, violet – look carefully)

Known solution	Color of flame
NaCl	
Ba(NO ₃) ₂	
Ca(NO ₃) ₂	
LiCl	
Cu(NO ₃) ₂	
CuCl ₂	
KBr	
NaBr	
KNO ₃	
CuSO ₄	
KCl	
SrCl ₂	

What is the flame test color of the unknown solutions?

Unknown A:

Unknown B:

Please identify the unknowns based on the data you collected from above.

Post-Lab Questions

1. What inaccuracies may be involved in using flame tests for identification purpose?
2. Which pair of ions produce similar colors in the flame tests?
3. Explain (briefly) how the colors observed in the flame tests are produced.
4. In the lab, scientists use a few different instruments to analyze metal ions; one is called ICP-OES. What does this acronym stand for, and also please visit the PerkinElmer website and tell me which one of their instruments you think would be best for a new lab (ICP-OES)? While your there, take a few minutes to look around.