Name _____ period _____ Date_____

Flame Test Lab
Atomic Emission and Electron Energy Levels

Purpose

The purpose of this experiment is to observe the characteristic flame test colors of different metal compounds and to use the information to identify an unknown metal ion.

Pre-Lab Question

Fill-in the blanks:

When an atom absorbs energy, the electrons move from their _____ state to an _____ state. When an atom emits energy, the electrons move from an _____ state to their _____ state and give off _____.

Materials

Calcium Chloride Solution, $CaCl_2$
Copper (II) Chloride Solution, $CuCl_2$
Lithium Chloride Solution, LiCl
Potassium Chloride Solution, KCl
Sodium Chloride Solution, NaCl
Strontium Chloride Solution, $SrCl_2$
Unknown chemical Solution
Goggles and apron
Water
Beaker (for extinguishing splints)
Bunsen burner
Strikers
Wooden Splints
Spectroscopic glasses
Test tubes (7)
Test tube rack
pipettes

Safety Precautions:

Copper (II) chloride is highly toxic by ingestion; avoid contact with eyes, skin and mucous membranes. Lithium chloride is moderately toxic by ingestion and is a body tissue irritant. Wear chemical splash goggles and apron. Fully extinguish the wooden splints before discarding in the trash. Wash hands thoroughly with soap and water after handling chemicals.

Procedure:

1. Label each of the test tubes with the name of the chemicals.
2. Place a pipette full of each chloride solution into the corresponding test tubes.
3. Place two of the wooden splints soaking in each of the solutions into the test tube labeled with the appropriate chemical.
4. Light the Bunsen burner. (Make sure you have the correct blue flame)
5. Place a wooden splint from one of the solutions into the flame. Observe the color of the flame and record on your data sheet. Allow the splint to burn until the color fades
6. Immerse the splint into the "waste beaker" containing water.
7. Repeat the test with the same compound (using the 2nd splint), look through the defraction glasses and draw the best line spectrum you can on the data sheet. Extinguish the splint in the waste beaker.
8. Choose another compound and repeat steps 5-7 with that color. Continue this process until all six metal chlorides have been tested.
9. Place the wooden splint from the unknown compound into the flame and record its color.
10. Throw out all used wooden splints. Clean out all test tubes and waste beakers and return to the lab table. Disassemble the Bunsen burner set-op.
11. Wipe down your lab station and wash your hands before leaving the lab.

Data Table:

Metal Ion	Color Observed	Line Spectrum
Calcium		
Copper		
Lithium		
Potassium		
Sodium		
Strontium		
Unknown **Letter _____**		

Results Table:

Use equation 1 from the *Background* section to calculate the average energy (ΔE) corresponding to the observed flame color for each metal. Show one sample calculation in the space below and record all values in Joules in the Results Table.

Metal	**Representative wavelength, λ (nm)**	**Wavelength, λ in meters**	**Energy (J)**

Conclusions:

1. What metal is present in the unknown sample? How do you know?

2. Is a flame test a qualitative or quantitative test for the identity of an unknown? Explain.

3. Which color has the highest frequency in the visible spectrum, a photon of red or a photon of violet light? Which of these two has the longer wavelength?

4. What relationship (equation) did Planck find relating energy and frequency of light? Why does green light have a higher energy of radiation than orange light?

5. A glass rod was heated in a burner flame and gave off a bright yellow flame. What metal ion predominates in the glass rod?

6. The alkali metals cesium (Cs) and rubidium (Rb) were discovered based on their characteristic colors. Cesium is named after the sky and rubidium is named after the gem color. What colors of light do you think these metals give off when heated in a flame?

7. If the unknown substance contained a mixture of two compounds, could each metal be identified? Why or why not?

8. Explain how the colors are created by atoms when they are heated.

9. What are some practical uses of spectroscopy (flame tests) used by scientists?