

Flame Tests of Metal Ions (Based on NSTA Flame Test Lab)

Objective:

To observe the colors emitted by heating a variety of metal ions and to identify the ion(s) present in unknown solutions.

Materials:

- 250 mL beaker of water
- laboratory burner
- drawing pencils in a variety of colors
- spot plates
- chemical splash goggles, aprons, and gloves
- spectroscope
- spectrum tubes (neon, helium, or hydrogen)
- spectrum tube power source
- cotton swabs or wooden splints soaked separately in each of the metal ion solutions:

Solutions

- copper (II) nitrate
- lithium nitrate
- sodium nitrate
- potassium nitrate
- strontium nitrate
- barium nitrate
- calcium nitrate
- sample of unknown solution 1
- sample of unknown solution 2



SAFETY

Wear approved chemical splash goggles and chemical-resistant gloves and aprons. The burned cotton swabs or splints may be safely disposed of in the trash can; however, this disposal should be handled by the teacher to avoid the possibility of a fire.

Procedure:

- 1. Wear chemical splash goggles, aprons, and gloves. Fill a 250 mL beaker with water and place it at your lab station. This will be used for soaking the cotton swabs with water as well as extinguishing burned swabs or splints.**
- 2. Obtain a cotton swab or splint from one of the metal ion solutions.**
- 3. Carefully light the lab burner and slowly pass the cotton swab or splint back and forth through the flame. After carefully observing the flame, immerse the swab or splint in water to make sure it is fully extinguished. At the end of the experiments, return all extinguished swabs or splints to the teacher for disposal.**
- 4. Record your observations, especially about the COLORS you see.**
- 5. Repeat steps 1-4 with another metal ion solution until all seven ions have been tested.**
- 6. Repeat steps 1-4 with both unknown ion solutions 1 and 2. One of the solutions is a single ion, while the other is a mixture of two ions. Determine which ion(s) are present in the unknown solutions by comparing them to the colors of known ion flame tests.**
- 7. Use a spectroscope to view the colors produced by several ion flame tests, especially the light produced by the heated copper ion. Also, observe the spectrums of a few spectrum tubes set up by your teacher. We recommend helium, neon, or hydrogen. You should see a distinct pattern of brightly colored lines with at least one of these elements. Draw the color pattern that you see.**

Data Table for Flame Test Observation

SOLUTION	Metal Ion Present	Color Seen	Description of Colors
$\text{Cu}(\text{NO}_3)_2$			
LiNO_3			
NaNO_3			
KNO_3			
$\text{Sr}(\text{NO}_3)_2$			
$\text{Ba}(\text{NO}_3)_2$			
$\text{Ca}(\text{NO}_3)_2$			
Unknown 1			
Unknown 2			

Conclusions:

1. Explain how you identified the two unknown solutions using flame test data.
2. Discuss some limitations of using flame tests to identify ions present in solutions.
3. How might using a spectroscope improve the accuracy of results in this laboratory experiment?
4. In the space below, please draw a picture of the pattern of color lines seen when you observed a metal ion with the spectroscope. Make sure to label the drawing with the name of the metal ion.