

Flame Test

Background:

When atoms or ions are heated, they gain kinetic energy; some electrons may absorb enough energy (photon) to “jump” to higher energy levels (excited state). Excited electrons don’t last long in the higher energy levels (unstable state); the electrons will “fall” back to their ground state and release the extra energy (equal to the difference between ground state and excited state). When the energy released in the visible light spectrum, a certain color can be seen. The color of the light depends on the energy change that took place (wavelength and frequency). Many metallic ions exhibit characteristic colors when heated; therefore, the color of the light can be used to identify certain elements, that’s why these colors are called fingerprint of elements.

Materials:

Nichrome wire loop
Bunsen burner
50 mL beaker
10 mL graduated cylinder

Chemicals:

Nitrate solutions of the following ions:
 Na^+ , K^+ , Li^+ , Ca^{2+} , Sr^{2+} , Ba^{2+} , Cu^{2+}
concentrated hydrochloric acid HCl

Safety:

Safety goggles, gloves, and aprons have to be worn all the time during the lab.

Procedure:

1. Read the entire laboratory, and then develop a data table to collect all data and observations required for this experiment.
2. Put about 10 mL of concentrated hydrochloric acid into a clean, dry 50 mL beaker.
3. Clean the wire loop. To do this, dip the loop in the acid and then heat the loop in the outer edge of the burner flame. Continue to clean the loop until no color is observed in the flame.
4. Dip the clean wire into one of the solutions. Place the loop in the outer edge of the burner flame and move the loop up and down. Note the color in the flame. Watch closely, looking for the first hint of color observed. Record your observations in a data table.
5. Clean the wire loop and repeat step 3 with a different solution. Test each solution, cleaning the loop thoroughly between each test. Record all observations in a data table.
6. Obtain samples of unknown solutions (at least five different solutions). Note the identification of the unknown and the color of the flame in your data table. Identify the metallic ion present by the color of the flame.

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Data: Use the following tables to record your data

Ion	Na	K	Li	Ca	Sr	Ba	Cu
Color							

Unknowns:

	Unknown 1	Unknown 2	Unknown 3	Unknown 4	Unknown 5
Color					
Metal					

Analysis:

1. Which pair of ions produces similar colors in the flame tests? Why do you think this happens?
2. In your own words, explain how the colors observed in the flame tests are produced and why different ions will produce different colors in a flame test.
3. Is the light produced in a flame test from a physical or chemical change? Explain your answer.

Error Analysis:

- 1- What inaccuracies may be involved in using flame tests for identification purposes?
- 2- Explain what errors may be present in this experiment.
- 3- How can you improve this lab to avoid any inaccuracies?

Conclusions:

1. In your own words, explain how the colors observed in the flame tests are produced and why different ions will produce different colors in a flame test.
2. All of the substances we tested contained the nitrate ion (NO_3^-) combined with the positively charged metal ion. Why it is important that all of the compounds tested contained this negatively charged ion and not different negatively charged ions?

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Real World Chemistry:

Astronomy is a very interesting field of science either the ancient or the modern one
In your own words explain how spectrum of lights could be used to study stars.

Teacher notes:

Barium, calcium, copper, strontium, potassium and sodium give readily identifiable colors. The flame test wires should be cleaned between each test by dipping in hydrochloric acid and heating, but it works best if each solution has its own labeled flame test wire. Sodium in particular is difficult to remove, and students will end up thinking everything contains sodium or makes an orange flame! The expected colors are shown below

Ion	Na	K	Li	Ca	Sr	Ba	Cu
Color	Bright orange	Lilac	Red	Brick red	Red/ Purple	Light green	Blue/green