

Flame Tests



Compounds of the Group I and II metals impart characteristic colors to a Bunsen flame. These flame tests are often used as confirmatory tests in identifying an unknown metal. In this experiment you will observe and record the flame colors of several metals of Group I and II. Review Chapter 4, Sections 4.1 to 4.3, and Chapter 24, Sections 24.2 and 24.12 in your textbook, for additional information.

OBJECTIVE

After completing this experiment you should be able to identify certain metal compounds (salts) by the color they give to a flame.

APPARATUS

burner and tubing
sparker
2 cobalt glass plates
test tubes (10)
forceps

5-cm length of No. 24 platinum wire, sealed at the opening of a glass tube 10 cm long. If platinum wire is not available, nichrome wire (not as satisfactory as platinum) may be used. Nichrome wire should be held with forceps.

MATERIALS

hydrochloric acid, 6 *M*
unknown solutions

0.5-*M* solutions in distilled water of the A. R. grade of sodium chloride and 0.5-*M* solutions of the nitrates of barium, calcium, lithium, potassium, sodium, strontium

SAFETY

Begin this experiment by taking the necessary safety precautions. Wear safety goggles, apron, and gloves. Read all safety cautions in your procedures and discuss them with your teacher. Conduct this experiment by using good safety techniques. See pages 112 and 103.



Recording Your Results

Record the colors of all flame tests in the data table at the end of the procedures.

PROCEDURES

1. In order to obtain good results in this experiment, your test tubes must be exceptionally clean to avoid contamination. To clean the ten test tubes, a 6 *M* HCl solution can be used.



CAUTION

Hydrochloric acid is caustic and corrosive. Avoid contact with skin and eyes. Make certain that you wear gloves, safety goggles, and an apron when working with acids. If any should spill on you, immediately flush the area with water and then notify your teacher.

Place a few mL of 6 M HCl into each test tube and use a test tube brush to thoroughly clean the ten test tubes. Rinse the test tubes with tapwater and then distilled water.



CAUTION

Before you use the burner in the next four procedures, check to see that long hair and loose clothing have been confined.

2. Clean a platinum wire by dipping it first into some 6 M hydrochloric acid in a test tube and then holding it in the colorless flame of your burner. Repeat until the wire imparts no color to the flame. Pour 4 mL of sodium nitrate solution into a clean test tube, dip the tip of the clean platinum wire into the solution, and then hold it in the flame. Observe the color of the flame just above the wire. Heat only the tip of the wire. If you heat the glass tube into which the wire is sealed, you will break the glass.

Clean the wire as before and then test a solution of sodium chloride in the same manner. Repeat the test, dipping the wire into a little dry sodium chloride. Describe what you observed.

3. Repeat Step 2, using in turn 4 mL of the solutions of the nitrates of lithium, strontium, calcium, barium, and potassium. Clean the wire thoroughly after each test. In the cases of lithium and strontium, observe which flame is more persistent and takes longer to burn off the wire. Also note the difference in the shades of color produced. When you have tested the calcium flame and then dipped the wire into hydrochloric acid and back into the flame when cleaning it, you often get an excellent flame of calcium momentarily. Record the color of the flame for each metal compound.
4. If two metals are present in the same solution, the color of one flame may obscure that of the other. If cobalt glass plates are used, it is sometimes possible to absorb one color and not the other. Examine the sodium nitrate flame through at least two thicknesses of cobalt glass. Repeat, using the potassium nitrate flame with the cobalt glasses. Record the colors of the flames in the data table.

Flame-test a mixture of the solutions of the nitrates of sodium and potassium with a clean wire. Observe the color the mixture imparts to the flame when viewed without the cobalt glasses. Repeat the test, but observe the flame as seen through the cobalt glasses. Record the colors of the flames in the data table.

5. Secure an unknown solution from your instructor. Test it in the flame as in this experiment in order to identify the metallic ion present. Place your answer in the data table.
6. Clean all apparatus at the end of this experiment. Ask your teacher how to dispose of all waste materials. Check to see that the gas valve is completely shut off and wash your hands before leaving the laboratory.

Ionic Compound Formula	Cation Formed	Color of Flame	Group #	
			short hand e ⁻ configurations (neutral atom)	neutral atom # valence e ⁻ 's
sodium NaNO_3				
lithium LiNO_3			-)	
strontium $\text{Sr}(\text{NO}_3)_2$				
calcium $\text{Ca}(\text{NO}_3)_2$				
barium $\text{Ba}(\text{NO}_3)_2$				
potassium KNO_3				
sodium (cobalt glass) _____				
potassium (cobalt glass) _____				
sodium and potassium _____				
sodium and potassium (cobalt glass) _____				
unknown metal _____				

QUESTIONS

- Is the flame coloration a test for the metal or for the nitrate ion?

- Why do dry sodium chloride and the solutions of sodium nitrate and sodium chloride all impart the same color to the flame?

- Describe the test for sodium and potassium when both are present.

- How would you characterize the flame test with respect to its sensitivity?

QUESTIONS (continued)

5. What difficulties may be encountered in the use of the flame test for identification?

CORRELATING YOUR FACTS

Review Chapter 24, Sections 24.11 and 24.12, and correlate what you have read with what you have learned by performing this experiment.

Describe the activity of electrons when a substance is vaporized in a flame. What is viewed through a spectroscope and how does this instrument serve in identifying substances?
