Flame Test Lab 18

PRE-LAB DISCUSSION

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. The element is then said to be in the "excited state." T

This excited configuration is unstable, and the electrons "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 an unidentified ion will be identified by means of its flame test.

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.

EQUIPMENT

graduated cylinder, 10-mL
platinum
glass-marking pencil
test tube rack
wire loop
laboratory burner
test tubes

MATERIALS

HCl(con.)
Unidentified solutions 0.5 M solutions of nitrates of: Na^+ K^+, Li^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Cu^{2+}

PROCEDURE

1. Measure 5 mL of tap water in a graduated cylinder and pour the water into a 13 x 100 test tube. Using a marking pencil, mark the outside of the tube to indicate the level of the water. Discard the water. Using the marked tube as a guide, mark seven clean test tubes at approximately the same level. Place the clean tubes in a test tube rack. Set the other test tube aside.
2. Into each of the clean test tubes, pour 5 mL of a different nitrate solution. Mark each test tube to indicate the metallic ion it contains.
3. Pour about 10 mL of concentrated hydrochloric acid into a 50-mL beaker. CAUTION: Use extreme care in handling this acid. To clean the wire loop, dip the loop in the acid and then heat the loop in the outer edge of the burner flame. Continue to clean the loop in this manner until no color is observed in the flame.
4. Dip the clean wire loop into one of the nitrate solutions. Place the loop in the outer edge of the burner flame and move the loop up and down as in figure aside. (figure 1). Note the color in the flame. Record your observations in the data list provided.

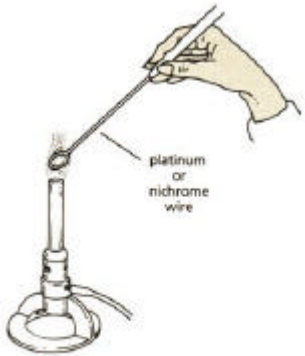

figure 1

5. Clean the wire loop as described in step 3. Repeat step 4 using a different nitrate solution.
6. Test each nitrate solution in the same manner, cleaning the loop thoroughly between tests. Record all your observations in the data list.
7. Obtain a sample of an unknown solution. Perform a flame test and identify the metallic ion present by the color of the flame.

OBSERVATIONS AND DATA

Metallic Ion	Color in Flame		
Na^+	_____	Sr^{2+}	_____
K^+	_____	Ba^{2+}	_____
Li^+	_____	Cu^{2+}	_____
Ca^{2+}	_____	Unknown ___	_____

CONCLUSION AND QUESTIONS

1. What inaccuracies may be involved in using flame tests for identification purpose?

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2. Which pair of ions produce similar colors in the flame tests?

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3. Explain how the colors observed in the flame tests are produced.

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4. Define these terms:

a. quanta
b. ground state
c. excited state

_____

5. What is a spectroscope? What is observed if the flame tests are viewed through a spectroscope?

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