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CHEMISTRY

LAB: FLAME TESTS

Introduction

According to the Bohr theory of the atom, electrons may occupy only specific energy levels. When an atom absorbs sufficient energy, an electron can "jump" to a higher energy level. Higher energy levels tend to be less stable, however, and if a lower energy level is available, the electron will "fall" back, giving off energy in the process. The difference in energies between the two levels is emitted in the form of a photon of electromagnetic radiation. The energy of each photon is described by the equation $E=hv$, where h is plank's constant and v is the frequency of the radiation. If the wavelength of the released photon is between 400 and 700 nm, the energy is emitted as visible light. The color of the light depends on the specific energy change that is taking place.

White light is a continuous spectrum in which all wavelengths of visible light are present. An excited atom, however, produces one or more specific lines in its spectrum, corresponding to the specific changes in energy levels of its electrons. Because each element has a distinct electron configuration, each has a unique line spectrum.

Flame tests are a quick method of producing the characteristic colors of metallic ions. The loosely held electrons of a metal are easily excited in the flame of a lab burner. The emission of energy in the visible portion of the spectrum as those electrons return to lower energy levels produces a colored flame. The color is combination of the wavelengths of each transition, and may be used to determine the identity of the ion.

In this investigation you will perform flame test on seven metallic ions, then use your results to determine the identity of several unknowns.

Target

In this lab you perform flame tests on seven different metal ions. You will use your observations to identify two or more unknown solutions.

Materials

Equipment: goggles, well plate, marking pen, Bunsen burner,

Chemicals: distilled water, HCl, 0.5M solutions of barium nitrate, calcium nitrate, copper (II) nitrate, lithium nitrate, potassium nitrate, sodium chloride, and 3 unknowns.

Safety

Wear your goggles at all times during the investigation. Handle the unknown liquid with care. It may be toxic, flammable or it may give off hazardous vapors. Avoid spills and contact with your skin or clothing. Do not inhale the vapors.

Procedure

1. Put on your goggles. Obtain a beaker with about 10 mL of 6.0 M HCl and a nichrome wire loop. Light the Bunsen burner, and adjust the flame to low. ***Caution****: Hydrochloric acid is corrosive to the skin and eyes.*
2. For each test, be sure that the nichrome wire is clean, so as not to contaminate the solutions. To clean the wire, first rinse it with distilled water, using the water bottle. Then dip it in the 6.0 M HCl solution. Place it in the burner flame for a few moments, as shown in Figure 10-1. **Determine the color of the**

clean nichrome wire in the flame. This is the color you should see after every trial.

3. Sodium has a very strong color, which may affect your other tests. So test the sodium solution last. Dip the clean nichrome wire in one solution. Place the wire in the burner flame and observe. Record your observations on your Data Table. Clean the wire and repeat this step with the next known solution until you have tested all seven solutions. ***Caution****: Do not let these substances come in contact with your skin. If a solution should splash on your skin, wash the affected area with large amounts of water and notify your teacher.*
4. Obtain the unknowns from your teacher. Repeat Step 4 for each unknown. Record your observations on Data Table 2.
5. Turn off the burner. Clean up your work area and was your hands before leaving the laboratory.

Analysis

1. What does a flame test indicate about the energy changes taking place among the electrons in a metallic ion?

2. Explain why a metallic ion produces a characteristic color in a flame test, regardless of the compound used as the source of the ion.

3. What wavelengths correspond to the visible spectrum? Which color has the shortest wavelength? The longest?

4. Summarize the process that produces the colors seen in the flame tests.

5. What are the relationship of the color you saw and the lines of the electromagnetic spectrum produced by the metals?

6. When a glass rod is heated, a yellow flame is observed around the point of heating. What does this yellow flame indicate? Why is it observed when glass is heated?

7. What other equipment could you use in this investigation if burners were not available?

8. How do you think metallic salts are used in fireworks?