FLAME TEST

Introduction

When an atom or ion is at its lowest energy level, it is in its most stable state. This state is known as the **ground state**. When heating them to higher temperatures, the electrons are promoted to higher-energy shells. This is known as the **excited state**. Electrons do not last long in the excited state, and lose the energy in order to return to their ground state. This loss of energy can be seen in the form of photons. The colour of the light released is used to identify the element, known as the flame test.

Metal atoms produce different colours, which is how firework manufactures can create explosions of different colours. Seeing as **salts** are compounds that include a metal and non-metal, they are the compound most often used. To properly perform a flame test, the metallic element (salt) is first dissolved in a solution and said solution is heated using a hot flame. As the element changes state the flame produces the characteristic colour attributed with it.

The following Chart provides the colours associated with each element:

Adapted from ChemEurope
https://bit.ly/2JlsIGf

Purpose

The purpose of this is will be for students to visualise the photon colour of metal ions as they release energy as well as to identify unknown ions via the flame test.

Materials

- Bunsen burner + flint striker
- 9 x Wooden Splits
- Distilled water
- 9 x 250mL Beakers
- 1 x 500mL Beaker
- Cobalt Blue glass
- Barium Nitrate solution, 1M
- Calcium Nitrate solution, 1M
- Copper (II) Nitrate solution, 1M
- Potassium Nitrate solution, 1M
- Sodium Nitrate solution, 1M
- Strontium Nitrate solution, 1M
- Lithium Nitrate solution, 1M
- Unknowns A and B

Notes on materials

Wooden splits should be soaked in distilled water for 24 hours prior to the experiment and stay soaked throughout the experiment. Cotton swabs can be used instead of a splints. Test tubes can be used instead of beakers.

The experiment can be changed where the salts are in their mineral form instead of a solution. Students will dip the swab in distilled water, dip the swab into the salt and put the swab in the flame.

Different salts can be used depending on what is available. Chlorides of metal give the best visuals, but sulfates are also good. However, avoid lead salts and copper chloride due to extra risks involved (dangers to environment, production of toxic fumes). The unknowns will be left up to teachers to decide.

Safety

Be sure that you wear safety goggles and lab apron/lab coat throughout the whole experiment. Make sure hair is tied back and you do not have loose sleeves. Do not touch any of the chemicals with your bare skin, and wash the area of your skin with water immediately if there is contact. Use caution when around fire. Every wooden splint is to be put in the WASTE BEAKER.

Hypothesis

What is your hypothesis concerning the salts used?

_____

_____

Procedure

Part 1: Visualization of photons

1. Label five of the 250mL beakers: barium nitrate, calcium nitrate, copper (II) nitrate, strontium nitrate, lithium nitrate.

2. Label the 500mL beaker waste beaker.

3. Fill waste beaker with 250mL of distilled water.

4. Fill each beaker with 100mL of each solution from the stock solution.

5. Carefully light Bunsen burner.

6. Dip one wooden splint into the first solution.

7. Place soaked end of the wooden splint into the flame.

8. Record your observations.

9. Immerse used splint into the waste beaker.

10. Repeat steps 6 through 9 for the remaining solutions.

11. Label the remaining two 250mL beakers: potassium nitrate, sodium nitrate.

12. Fill each beaker with 100mL of each solution from the stock solution.

13. Dip one wooden splint into the potassium nitrate solution.

14. Place soaked end of wooden splint into the flame.

15. Record observations of naked eye. Use cobalt glass as a screen and record observations.

16. Repeat steps 12 through 14 for sodium nitrate.

Part 2: Determining unknowns

1. Label two 250mL beakers: unknown A and unknown B

2. Fill each beaker with 100mL of the unknown solution.

3. Dip one wooden splint into unknown solution A.

4. Place soaked end of the wooden splint into the flame.

5. Record observation with naked eye. Use cobalt glass as a screen and record observations.

6. Repeat steps 3 through 5 with unknown B.

Data

Part 1- Data Tables for known samples

Sample	Flame Colour

Sample	Flame Colour	Flame Colour with cobalt glass

Part 2- Data tables for unknowns

Sample	Flame Colour	Flame Colour with cobalt glass

Results

1. Identify the two unknowns based on your experimental data:

Unknown A is _____

Unknown B is _____

2. Why was cobalt glass used?

_____

_____

3. Did any of the solutions produce similar colours? If so, list them and explain why.

_____

_____

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