Background

Chemists use a range of techniques for qualitative analysis. For example, the colour of an aqueous solution can help to identify one of the ions that it contains. Another qualitative analysis technique is a flame test. The ionic compound is placed in a flame and the colour of the flame is noted. However, the flame test is only useful for identifying metallic ions. But why do the elements give out different colours when placed in a flame?

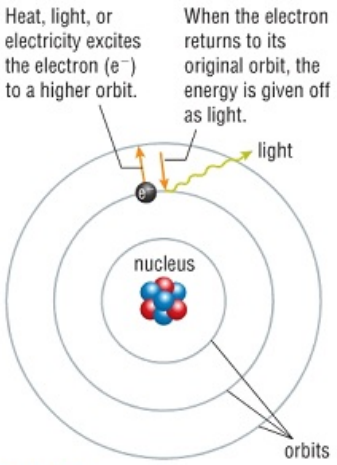

Figure 11 The Bohr–Rutherford model of the atom

According to the Bohr model of the atom, when the atoms in an element are provided with energy, some of the electrons may "jump" up to higher levels. This energy can be in the form of heat, light, or electricity. The electrons are said to be in an excited state because they are in higher energy orbits than normal. The electrons then tend to fall back down to their normal, lower energy level or ground state. When this happens, the atoms give out energy in the form of light. Since different elements have slightly different energy levels, different energies or colours of light are given out. These colours are like the "fingerprints" of elements, especially metals, even when they are combined with other elements in chemical compounds.

{1} **Question**

What can be observed when various compounds are heated in a flame?

{3} **Hypothesis** (You will need to develop a hypothesis. See the background info above to help complete the statement!)

If a metal sample is placed in a flame then the flame will change colour because ...

{1} **Materials**

- safety goggles
- Bunsen burner
- wire with wooden handle
- 6 known solutions {Hint: you will need to write them down.}
- 1 unknown solution {Hint: it is one of the known compounds.}

{5} **Method**

{7} 1. Make a data table like the one shown. In the first column list the known solutions (and the unknown). In the second column list the metallic ion present (recall the 'metal' portion of chemical formula).

Solution	Colour of Solution	Metallic Ion	Colour of Flame

2. Review the safety procedures for using a Bunsen burner. Put on your safety goggles.
3. Move to your assigned station.
4. Make qualitative observations of the colour of the solution and record your observations.
5. Ignite the Bunsen burner and then adjust the burner to produce the hottest flame possible.
6. Place the wire in the flame to remove any residue. Dip the hot wire into the solution. Place the wire back into the flame and observe the flame colour. Record the colour of the flame. (You may need to repeat the process several times until you are certain of the colour produced.)
7. Move to the next station and repeat steps 4 to 6 for each of the remaining known and unknown compounds.
8. Clean up your work station and return your apparatus. Wash your hands.

{2} **Conclusion**

Answer the initial question.

Analysis (Be sure to use complete sentences when answering the following!)

1. Answer the following questions in your Analysis section:

{3} (a) What was the identity of the unknown solution? How could you tell?

{3} (b) What is the significance of conducting flame tests? Explain.

{3} (c) Explain why or how the metallic ions produce different colours?

{4} (d) Explain how you might test a sample of an unknown white solid to determine if it was table salt (sodium chloride). No taste tests allowed!