Student Sheet

In this practical I will be:

- Observing and recording the findings of the practical
- Providing oral and written explanations of my observations, based on scientific evidence and understanding.
- Comparing and grouping materials on the basis of their observable properties.

Introduction:

A local priest has claimed that he has the ability to directly talk to the gods, such as Anubis and Osiris. As an ancient Egyptian science-artist you are highly sceptical of his claims. After going to see this priest it turns out that he is turning flames different colours by throwing different ground minerals on to the flame. Obviously it isn't the gods' doing but you are intrigued as to what is happening. You decide to investigate further…

Equipment:

(Wear safety glasses and tie back long hair)

Method 1:

- Saturated calcium ethanoate solution (must be saturated)
- Ethanol (IDA)
- Lithium chloride (LiCl) solution in a spray bottle; 1 spatula amount in 100 cm^3 water
- Copper(II) chloride ($CuCl_2$) solution in a spray bottle;1 spatula amount in 100 cm^3 water
- Sodium chloride (NaCl) solution in a spray bottle; 1 spatula amount in 100 cm^3 water
- 2 heat resistant mats
- 1 spatula
- 1 beaker (250 cm^3)

Method 2:

- Lithium chloride (LiCl) solution in a beaker; 1 spatula amount in 100 cm^3 water
- Copper(II) chloride ($CuCl_2$) solution in a beaker; 1 spatula amount in 100 cm^3 water
- Sodium chloride (NaCl) solution in a beaker; 1 spatula amount in 100 cm^3 water
- 1 heat resistant mats
- Bunsen burner
- 12 cm length of nichrome or platinum wire

Method 3:

The following solutions each in a 250 cm^3 conical flask:

- 2 M calcium chloride (IRRITANT)
- 1 M copper(II) chloride (IRRITANT)
- 2 M lithium chloride (IRRITANT)
- 2 M potassium chloride (low hazard)
- 1 M strontium chloride (IRRITANT)
- 2 M sodium chloride (low hazard)

Access to:

- Plenty of spills soaked in water overnight.
- Bunsen burners or adjustable commercial blow torch
- Matches
- Dry spills

Method 1:

1. Pour 50 cm^3 of the saturated calcium ethanoate solution into the 250 cm^3 beaker. Carefully add ethanol to the calcium ethanoate.
2. Stir until a solid is formed. If no solid is formed add more ethanol.
3. Using a spatula carefully lift out the solid and place it on a heat resistant mat.
4. Let it stand for a minute to allow it to dry enough to be lit.
5. Use a lighted splint to light the solid.
6. Spray the flame with the lithium salt solution. Note the colour and record the result.
7. Spray with the copper salt solution. Note the colour and record the result.
8. Spray with the sodium salt solution. Note the colour and record the result.
9. Put the flame out by carefully placing the other heat resistant mat on top of it.

Method 2:

1. Take the nichrome or platinum wire and create a small loop at the end by bending the wire.
2. Light the Bunsen burner.
3. Turn the collar on the Bunsen burner so that you have an invisible or pale blue flame.
4. Burn the loop end of the wire to remove any dust.
5. Dip the loop into the lithium salt solution.

6. Place the wet loop on the edge of the Bunsen flame.
    - Observe and record the colour seen.
7. Burn the loop end of the wire to remove any lithium salt.
8. Dip the loop into the copper salt solution.
9. Place the wet loop on the edge of the Bunsen flame.
    - Observe and record the colour seen.
10. Burn the loop end of the wire to remove any copper salt.
11. Dip the loop into the sodium salt solution.
12. Place the wet loop on the edge of the Bunsen flame.
    - Observe and record the colour seen.

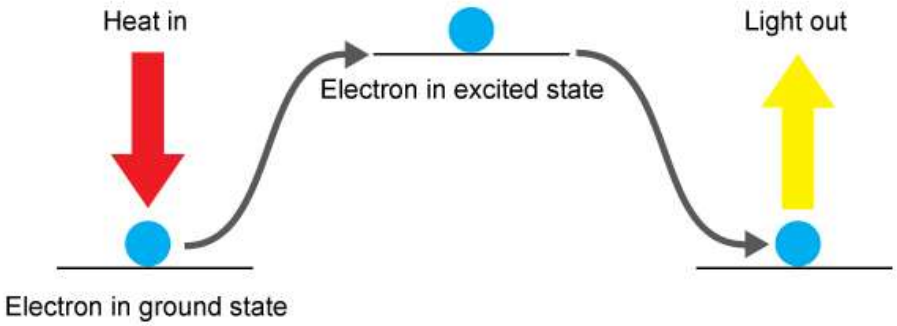
Method 3:

1. Put a dry spill into each of the metal salt solutions in conical flasks and leave.
2. Use a dry spill to light the Bunsen.
3. Take one of the spills from one of the conical flasks containing a metal salt solution.
4. Wave your spill over the Bunsen flame and observe its colour. Then extinguish the used spill and dispose of it.
5. Record the metal salt solution and the flame colour.
6. Repeat steps 2 to 4 for each of the other metal salt solutions you have been provided with.

Theory:

Calcium ethanoate is a very hygroscopic solid. This means it absorbs and coordinates with water very easily. When ethanol is added to a saturated aqueous solution of calcium ethanoate it forms a white gel. This is because the calcium ethanoate is relatively insoluble in ethanol, as opposed to water, so it precipitates as an inflammable solid, a firelighter that burns with a very clear flame so that any colour given to the flame is due to the metal ion in the salt solution.

When a metal salt solution is sprayed onto the flame the electrons in the metal are excited and jump from one electron shell level to the next highest shell level. They are said to be **excited**. They cannot remain there so as they return to the original shell, known as the **grounded state** the energy gained is lost in the form of light known as **emission**.



The colour of the light depends upon the metal (lithium(I) gives a magenta red-pink flame, calcium an orange red flame, potassium a lilac flame, strontium a crimson red flame, copper(II) gives a blue or green flame and sodium(I) gives a yellow flame). These colours are also often used in fireworks to give the different colours we see when they burn. Sodium is also used in some street lights and that is why they appear yellow when on.

If the flame is looked at through a spectroscope it will give a characteristic spectrum. This is used in chemistry to analyse a material for type and concentration of atoms. Chemists 'burn' the substance and measure the frequency (colour) of the light given out. This process is called Atomic Emission Spectroscopy.