For Teachers **Pyrotechnics lab experiences with CRMs**

Module 1

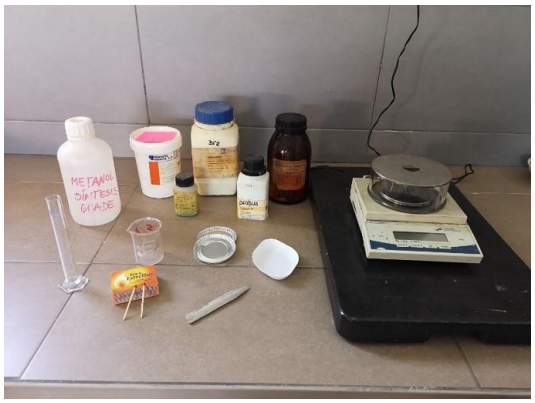
Objective: Luminescence colour effect

Necessities

Reagents	Formula		Quantity
Boric acid	H_3BO_3		2 g
Potassium hydroxide	KOH		3 g
Copper(II) chloride	$CuCl_2$		2.5 g
Lithium chloride	LiCl		2 g
Sodium bicarbonate	$NaHCO_3$		3.5 g
Methanol (methyl alcohol)	CH_3OH		5 x 8 mL

List of materials/tools

- Latex and fire-resistant gloves, safety glasses, lab coat
- Weighing scale
- Spatula
- Test tube
- Beaker
- Aluminum container
- Matches



Procedure

- First, get and measure each element on the weighing scale, using separate containers for each substance, as it is shown in the photo. For this step, tare the weighing scale with a plastic container. Then, with a spatula, pour the approximate amount of the solutes indicated in the initial table.

- For safety reasons, the following steps must be done only for one substance and then repeat the procedure for the other ones.
  - Get 8 mL of methanol measured in a test tube for each substance.
  - Once the solute and solvent are prepared with the required amount, both must be blended in a beaker. The solution will not be completely homogenous, except for copper chloride and the sodium bicarbonate solutions.
  - Afterwards, fill the aluminum container with the solution and move it to a fire-resistant surface.
  - Light the solution with a match and record the colour observed.

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Additional Safety Notes

- All experiments must be performed by and under the supervision of an adult.
- Use appropriate protective clothing: safety glasses, lab coat, latex gloves during the solutions preparation and fire-resistant gloves during ignition and combustion.
- Methanol is very flammable and toxic, so avoid contact (skin, eyes and clothes) and do not inhale it. The solution should always be ignited on a fire-resistant surface.
- It is safer to burn each substance solution individually, rather than all of them at once.

Conclusions

These experiments demonstrate the capacity of the valence electrons of atoms to absorb energy and emit it in the form of electromagnetic radiation when they return to their ground state, at wavelengths (colours) specific to each element, corresponding to their electromagnetic emission spectra.

The different colours obtained in fireworks are based on the same principle, although using a different ignition source, as well as emergency flares.

Similarly, in astronomy, the colours of the stars also indicate the elements in their photosphere, which are classified according to their spectrum into seven different types.

Questions/Quiz  and Solutions

Q1) Can an incandescent phenomenon generate cold colours?

No.

Q2) What is the difference between deflagration and combustion?

The reaction's speed of deflagration is much higher than combustion.

Q3) Which is the main element of the black powder?

Potassium nitrate KNO_3.

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Q4) Which four elements are needed to make a pyrotechnic reaction?

Fuel, comburent, ignition spark and a chain reaction.

Q5) What colour is the most difficult to produce in a pyrotechnic reaction?

Blue.

Q6) Why do we use methanol?

Because its flame does not emit colour. This useful characteristic helps to watch clearly the colour produced by certain elements.

Q7) What colour produces copper chloride?

Blue, and firstly green tones.

Q8) Match the element with the colour that produce.

1-e 2-a 3-d 4-c 5-b

1. Boric acid	a. Blue
2. Copper chloride	b. Pink
3. Lithium chloride	c. Orange
4. Sodium bicarbonate	d. Magenta
5. Potassium hydroxide	e. Green