

Electron configurations, PES and periodic trends

AP Chemistry · Lab

Name: _____ Date: _____ Class: _____

When metal ions are heated in a flame, their electrons absorb energy and release it as light. In this lab you observe flame colours and use them to estimate photon energies, linking colour to energy levels.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 1

Aim

To compare the colour of light emitted by metal ions in a flame, and relate the colours to electron energy levels.

Equipment

- Bunsen burner and heat-proof mat
- Wooden splints soaked in 0.5 mol/L solutions of lithium, sodium, potassium, calcium and barium chlorides
- Handheld spectroscope or diffraction grating
- Beaker of distilled water

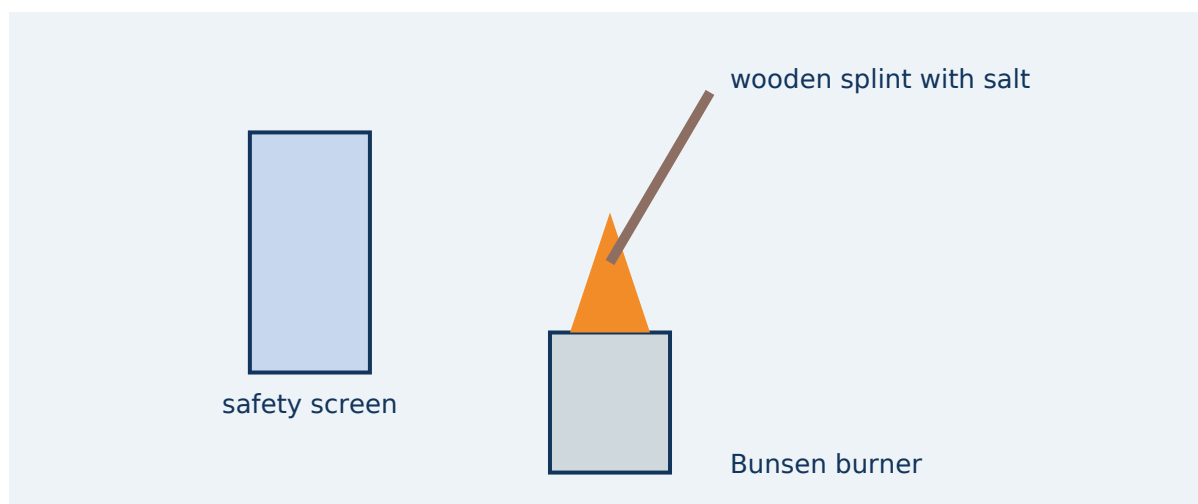
Safety

Safety

Wear goggles and tie back long hair. Use only the solutions provided and keep them away from the flame. Put used splints into the beaker of water.

Method

1. Light the burner and adjust it to a blue, non-luminous flame.
2. Hold a soaked splint in the edge of the flame for 5 seconds.
3. Record the colour, and view it through the spectroscope to note the strongest wavelength.
4. Rinse the splint holder, wait for the flame to return to blue, then test the next solution.



Flame test set-up: the splint is held in the hot edge of a non-luminous flame.

Results

Ion	Colour	Strongest wavelength (nm)
Li ⁺	crimson	671
Na ⁺	yellow	589
K ⁺	lilac	766
Ca ²⁺	orange-red	622
Ba ²⁺	green	524

Analysis questions

Question 1 Photon energy in eV

Use $E = 1240/\lambda$ (λ in nm, E in eV) to calculate the photon energy for each ion.

Question 2 Photon energy in joules

Use $E = hc/\lambda$ with $h = 6.626 \times 10^{-34}$ J·s and $c = 2.998 \times 10^8$ m/s to confirm the energy for sodium, in joules.

Question 3 Order of energies

Arrange the ions in order of increasing photon energy.

Question 4 Origin of the light

Explain how an excited electron produces light of one specific wavelength.

Question 5 Trend in group 1

Explain why lithium, sodium and potassium emit different colours although each has one valence electron.

Question 6 Reliability

The colour of Na^+ appears in every flame because of contamination. Explain how this could mislead the experiment and suggest a precaution.

Question 7 Improvement

Suggest a method to measure the wavelengths more accurately than by eye.