Lab 3: Flame Tests — Emission & Electron Transitions

Name: _____ Partner(s): _____

Date: _____ Period: _____

Purpose:

Observe emission colors of metal ions and relate to electron transitions and quantized energy.

Standards: *HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-8*

Materials & Equipment:

• Bunsen burner; striker; nichrome loop or wooden splints

• 0.5 M solutions: NaCl, KCl, $CaCl_2$, $CuCl_2$; unknown(s)

• Beakers for rinsing; distilled water; watch glass; safety gear

Procedure:

1. Light burner and adjust to a steady blue flame.

2. Clean loop: heat to red; rinse; repeat until no color appears in flame.

3. Dip loop into a salt solution; place in hottest part of flame; record color precisely.

4. Rinse and repeat for each known; then test unknown(s) and identify.

5. Record intensity/persistence; note possible contamination and how you mitigated it.

Data & Observations:

Use precise descriptors (e.g., lilac, apple-green, brick-red).

Compound	Observed Flame Color	Intensity/Persistence	Notes
NaCl			
KCl			
$CaCl_2$			
$CuCl_2$			
Unknown			

Analysis Questions:

1. Explain why discrete flame colors appear for different ions in terms of electron transitions and photon energy.

2. Two groups observed different hues for the same ion. Identify two plausible causes and how to reduce them.

3. How could you distinguish a mixture of Na^+ and K^+ using flame tests and/or simple filters?

Conclusion (CER):

1. **Claim**: Identify the unknown(s) based on your flame test evidence.
2. **Evidence**: Cite specific observed colors and intensities compared to known references.
3. **Reasoning**: Explain how electron transitions and quantized energy lead to characteristic colors.
4. **Error/Improvement**: Discuss contamination or technique issues and how you reduced them.

Lab 3: Flame Tests — Emission & Electron Transitions — Rubric

*Weights: Only **Analysis & Explanations (×2)** and **Conclusion (×2)** are doubled.*

Criterion	1	2	3	4	5
Preparation & Safety	Unprepared; unsafe actions; repeated reminders.	Partially prepared; inconsistent safety; several reminders.	Prepared; follows all rules; few reminders.	Proactive safety; models correct technique to peers.	Exemplary; anticipates and mitigates risks; mentors others.
Data & Observations	Minimal or vague color notes; missing samples.	Basic color words only; limited detail or qualifiers.	Complete colors with adequate detail for ID.	Detailed colors with intensity/persistence; comparative notes.	Exceptional precision; clear rationales for identifications; contamination tracked.
Analysis & Explanations (×2)	Incorrect/irrelevant; lacks link to transitions.	Partial link to transitions; generic reasoning.	Correct link to quantized transitions with support.	Strong reasoning; error analysis and mitigation included.	Insightful; connects spectra to energy differences; discusses limitations.
Conclusion (×2)	No/weak claim; unsupported.	Vague claim; limited evidence.	Clear claim with some observational support.	Well-supported claim; multiple precise observations cited.	Compelling claim; integrates observations with theory convincingly.
Clarity & Mechanics	Disorganized; frequent grammar/format issues impede understanding.	Partly organized; several errors; hard to follow at times.	Generally clear; minor errors; readable structure.	Well organized; concise; almost no errors; visuals/tables support text.	Polished, professional scientific writing; precise vocabulary; flawless formatting.