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Course: FVS Chemistry AB 19.3

Teacher: Kerr

Question: How can you use flame color to identify the metal ion in an unknown compound?

Claim: If an unknown metal ion's flame color matches that of a known metal ion, then the metal ion likely is the same because metal ions produce characteristic colors when burned.

Evidence:

Ionic Compound in Solution	Observed Flame Color
<i>HCl</i> Solution (baseline)	blue
0.5M calcium chloride (<i>CaCl</i> ₂)	orange-red
0.5M sodium chloride (<i>NaCl</i>)	orange-yellow
0.5M barium chloride (<i>BaCl</i> ₂)	pale green
0.5M lithium chloride (<i>LiCl</i>)	red
0.5M copper(II) chloride (<i>CuCl</i> ₂)	blue-green
0.5M cesium chloride (<i>CsCl</i>)	blue-violet
Unknown Solution #1	red
Unknown Solution #2	blue-violet

Lab Results

Metal ion in Unknown Solution #1: Lithium

Metal ion in Unknown Solution #2: Cesium

I know that the claim is true because all studied metal-chloride salts have different colors. The *LiCl* salt, for example, burns a characteristic red which is backed up by an identical chemical solution burning the same color. All other examples on the above list have unique colors, and all samples of the same ions produce the same colors (as can be logically expected). The other example of the last property allowing identification of a given metal ion is *CsCl*, the second unknown solution which is blue-violet in both cases. This also gives a good clue as to the investigative question: one can determine the given metal ion of an unknown substance by cross-checking its flame test with the flame test of known substances.

Justification (Reasoning) of the Evidence:

The ability to identify which metal ion is in a given unknown substance makes sense because when heating occurs from the Bunsen Burner, electrons within the metal ion become excited when they absorb the light. Then, they release photons in line with their atomic (emission) spectrum. The mixture of these photons produces a specific color—the characteristic color of the flame. Because atomic spectra are unique, any given set of compounds with different metal ions will always have different characteristic colors. These are also consistent between two atoms of the same element, further corroborating previously noted properties. As described in the evidence section, these properties of consistency and uniqueness mean that a cross-checking procedure would work to identify an unknown ionic compound's metal ion.