Experiment 8 – Spectroscopy

Name name Lab Section 432

Results and Discussion

Table 1. Data Table 1: Wavelength Calibration of Spectroscope

Color of Line	Position on Spectroscope	Wavelength (nm)
Red	6.35	635nm
Green	5.60	560nm
Yellow	6.00	600nm
Blue	5.00	500nm
Violet	4.50	450nm

Table 2. Data Table 2: Light Source

Light Source	Wavelength Range	Region(s) of Maximum Intensity
Candle	450nm-700nm	Green
Incandescent bulb	450nm-700nm	Green
Bunsen burner	405nm-610nm	Blue

Table 3. Data Table 3: Atomic Line Spectra of the Balmer Series of Hydrogen(Chemistry the Central Science 12th Edition)

Color of Line	Position on Spectroscope	Calculated Wavelength (nm)	Literature Wavelength (nm)	Percent Error
Red	6.80	680nm	656nm	3.65%
Blue	5.00	500nm	486nm	2.88%
Teal	4.55	455nm	434nm	4.84%

Table 4. Data Table 4: Determination of Electron Transitions

Color of Line	Wavelength	Frequency	Energy	Transition

	(nm)	(Hz)	(J)	
Red	680nm	$4.41*10^{14}$ Hz	$2.92*10^{-19}$ J	3→2
Blue	500nm	$6.00*10^{14}$ Hz	$3.98*10^{-19}$ J	4→2
Teal	455nm	$6.59*10^{14}$ Hz	$4.37*10^{-19}$ J	5→2

Table 5. Data Table 5: Flame Emission Spectra

Element	Color of Flame	Color of Emission Lines	Position	Wavelength
Sodium	Orange	Orange	6.10	610nm
Copper	Green and blue	Green	5.50	550nm
Lithium	Red	Red	6.50	650nm
Iron	Orange	Orange	6.00	600nm
Potassium	Peach	Orange	6.15	615nm

Table 6. Data Table 6: Unknown Substance

Color of Flame	Color of Emission Lines	Position	Wavelength	Elements in Unknown Mixture
Teal, green, red, orange	Red, yellow, green	Red=6.80 Yellow=6.00 Green=5.50	680nm 600nm 550nm	Lithium, Copper, Sodium

Conclusion:

This experiment was supposed to show you how to use the spectroscope to compare various continuous emission sources, get the atomic line spectra of light emitted from discharge tubes, and to calculate the photon wavelengths, frequencies, and energies from the line spectra data. This experiment did all of that and we were able to learn about all of those things through the various experiments. Students are able to compare the calculated vs the literature values for the wavelengths which do have some differences. For example, there was a 3.65% error for red, 2.88% error for blue, and 4.84% error for teal. Also, in our results we calculated the frequency and energy for each color using the c=wavelength*v and E=hv. Also, for the most part the calculated wavelengths for each color tends to fall within the range for that color. With Table 5 you also learn what color flame and emission each of the elements have and for the most part the color of the flame matched the color of the emission lines except for potassium where the color of the flame was peach and the color of the line was orange. Furthermore, we observe different light sources and their wavelengths. It might be surprising that both the candle and light bulb are the same along with the same color and the Bunsen burner however was different in wavelength and color. As the temperature of the solid is raised, more of the radiation is emitted at shorter wavelengths. Also, the unknown substance was the most colorful and consisted of various elements to create the various colors.

The results from this experiment appear accurate and we did do what the objectives of the experiment were. They help the students learn more about how to calculate the wavelengths, frequencies, and

energies. It also shows the importance of knowing the wavelengths, frequencies sand energies. In addition, students do learn about the Bohr model of the hydrogen atom and also learn about transitions which is accompanied by emission or absorption of a discrete amount of energy. Also, the wavelengths and colors help us identify different elements. This could also help us identify different chemicals. It helps us understand energy levels better as well. Plus, spectroscopy is used in astronomy and telescopes as well as in other things. An issue that we had with the experiment was that we had issues with the unknown substance. There were two bottles and we were only supposed to have one? Also we aren't 100% sure on the elements in the unknown substance however we got lithium, copper, and sodium. Furthermore, it was hard at times to see the wavelengths but for the most part it was fine. But overall the experiment taught a lot about the wavelengths, frequencies, and energies.