Ande Lloyd

The Investigation of Analyzing Unknown Elements Through The Emission of Colors of Light

Introduction:

This experiment was done to understand how light can be used to identify different elements.

The Bohr Model of the atom shows a positively charged nucleus with an electron orbiting it. The electron orbits at certain emission level and when certain light rays hit the electron it causes it to jump to different an energy level. After a while the electron will go down do its original energy level. The quantum mechanical model of the atom shows these different energy levels but in an electron cloud. The cloud represents the probability of where the electron may be. The quantum mechanical mode relates to the Bohr model because in the Bohr model it shows exactly where the electron is. Actually it is not that simple. In the quantum mechanical model instead of showing rings around the nucleus, the cloud takes its place. That way it is more accurate because it is not known where the electron is at a given time. The frequency on light is related to its wavelength because the more energy a wavelength has the higher the frequency. And the higher the frequency of light determines the color of the light. Blue light is the highest frequency and red light is the lowest that we can see.

Since A hundred years ago many chemists have been exploring the structure of the atom. And even today we don't fully understand what it looks like. But a man named Thomson came discovered that electrons by electronically charging hydrogen gas then using positively charged magnets and negatively charged magnets to find that atoms are positively charged or negatively charged. He discovered that atoms have a positive charged base. But the electrons, which are, considered not the base have a negative charge. Thomson thought the electrons where inside the nucleus. Another chemists named Rutherford specified that part of the atom was contained in a small, dense nucleus and had the electrons orbiting like planets orbit a sun. Hence the Bohr model was created to simulate the orbiting electrons and how wavelengths can change the energy level of the electron.

Spectroscopy is the study of the interaction between matter and various light emissions. Spectroscopy is used to identify various elements because each element emits it own unique set of spectrum lines. When studying spectroscopy many use a spectrometer that is a device that filters light through a small slit then through a prism and separates all the different colors. Each color is a different wavelength from the electron releasing energy as it drops down energy levels. Scientists have tested over and over and found patterns for each element. They have then created a visual representation for each element, and when they find a new pattern of spectrum lines it could possibly be a new element.

Discussion:

This experiment was preformed to gain a better understanding of the structure of the atom, modern atomic theory, and how spectroscopy is used to identify elements. The expected results were not to correctly identify each substance but see the methods of how spectroscopy is used, and seeing first hand the process of how to identify elements.

Part 1:

A variety of elements were burned and the color of their flame was recorded to classify two unknown elements. All of these were colorless so it can be said that there is no correlation between the color of the substance and the color of the flame. The color of the flame must be based on the metals because all the substances had Chlorine (Cl) in it, which is a non-metal. All the substances were different colors because it can be stated that the metals are what is causing the difference in colors. It can be justified that $BaCl_2$ accounts for Unknown 1 because the size of the flam was similar and it was the same shade of green. (figure 1) The logical explanation for this is that they are the same element. The same accounts for Unknown 2, which was red and LiCl was also red. From only having the given substances to compare to the two unknowns the significant of these explanation is accountable. These results might be wrong because comparing some of the elements to the unknown there was more than one element that was similar. One solution to this is to find the most similar element justify the unknown element with that. Again there is room for error in doing this.

Solution	Flame Color
$BaCl_2$	Green
LiCl	Red
KCl	Yellow
$CaCl_2$	Violet blue
$RbCl_2$	Violet
NaCl	Pink
Unknown 1	Green
Unknown 2	Red

Figure 1

Part 2:

For part two of the experiment a spectrometer was used to determine the maximum wavelengths, and the intensity of each substance. For Unknown #6, which had a wavelength of 775.1nm and an intensity of 0.108rei (figure 3) is most like KCl, which had a wavelength of 773.5nm and an intensity of 0.281rei (figure 2). The difference in intensity can be explained by the possible presence of sodium and potassium, which are commonly found in commercial available salts. It can be determined that unknown #6 is KCl. The significance of these results are that the difference between the two wavelengths of Unknown #6 and KCl are very little, which means the results were accurately recorded. Also given that none of the other substances came close to the same wavelength as Unknown #6 it is apparent that Unknown #6 is KCl.

Intensity vs. wavelength graphs relate to emission lines because like emission lines no two elements are the same. Each element will have a different wavelength and intensity just like each element will have its own set of emission lines. Comparing the two wavelength vs. intensity graphs is another way to identify an unknown element. The significance of this is that each element emits a certain wavelength and if it is pure it will have a certain intensity. The tools used to acquire the results are very accurate considering it is a digital spectrometer it will produce precise results. The only problem with this is the result were not gathered first hand, but obtained second hand. This could create loophole in the interpretation of the results. The best solution would be to do the lab again first hand.

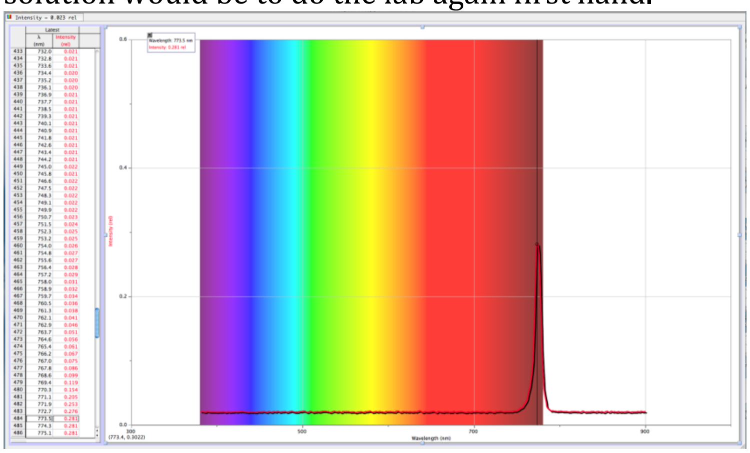

Figure 2: wavelength vs. intensity for KCl
Peak: 773.5nm, 0.281rei

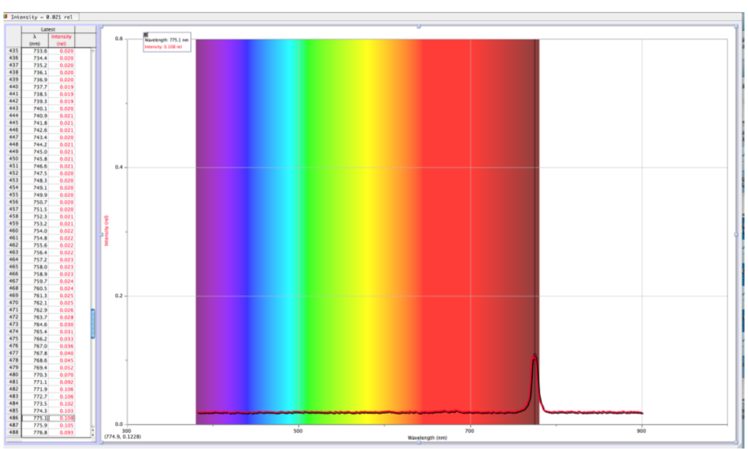

Figure 3: wavelength vs. intensity for Unknown #6
Peak: 775.1nm, 0.108rei

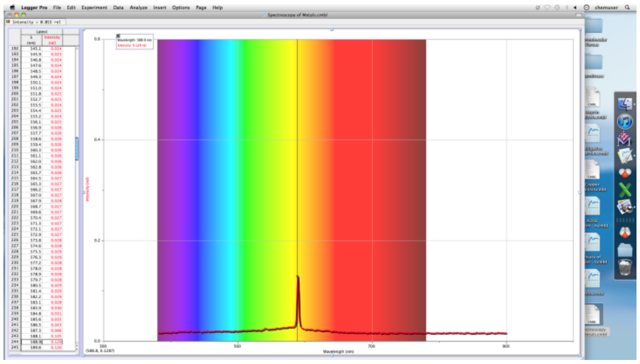

Figure 4: wavelength vs. intensity for NaCl
Peak: 588.9nm, 0.129rei

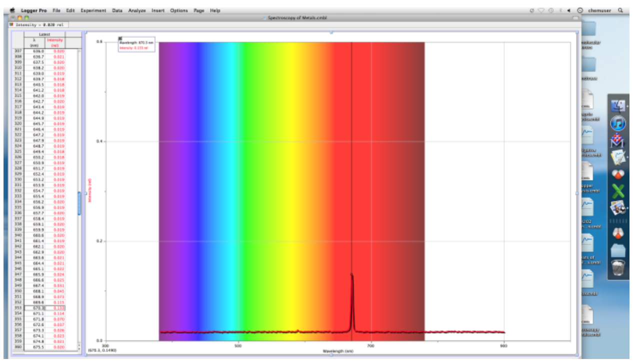

Figure 5: wavelength vs. intensity for LiCl
Peak: 670.3nm, 0.133rei

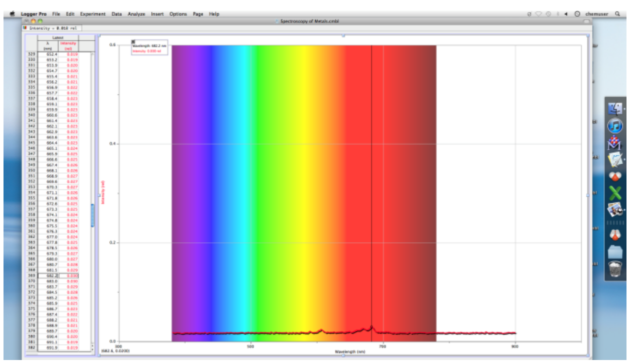

Figure 6: wavelength vs. intensity for $SrCl_2$
Peak: 682.2nm, 0.030rei

<u>Part 3:</u>

For part three, three different spectrum tubes were analyzed through a spectroscope. The emission lines were drawn onto the visible spectrum templates, and then compared to professional visible spectrums to identify the unknown elements. Unknown C was estimated to be hydrogen because the emission lines are between 420nm and 700nm (figure 9). Unknown B is estimated to be Lithium because the visible emission lines are between 400nm and 600nm (Figure 8). Unknown D is estimated to be Neon because the most visible emission lines are between 520nm and 690nm(figure 7). These results may not be significant because it was hard to produce accurate results using the spectroscope. Lining up the slit was hard because it often moved do to human error and it was hard to see where to draw the emission lines because it was hard to see the nm scale with light over it. A possible solution for this problem is to secure the spectroscope on an unmoving plain so that you would not have to touch it or move it. This would produce more accurate results.

Cesium is an example of an element discovered through spectroscopy. In 1860 a group of chemists were examining the emission lines of various known elements, and when the elements were chemically removed two blue lines appeared. Since they could not find any other element with those same blue lines it can be concluded they have discovered a new element. And the element was called Cesium named after the Latin word *coesius* meaning “sky blue.” The significance of this is that all elements have their unique set of emission lines. And when you can find a new set of emission line it can be drawn that a new element has been discovered.

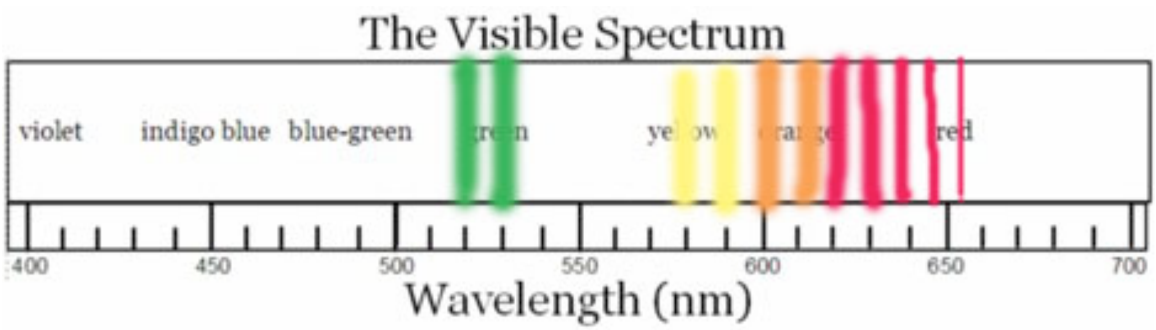

Figure 7: Emission Spectrum of Unknown D

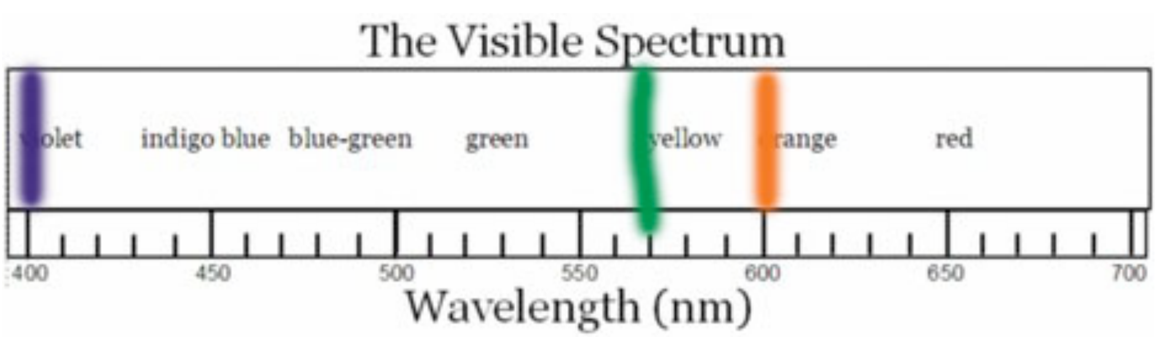

Figure 8: Emission Spectra of Unknown B

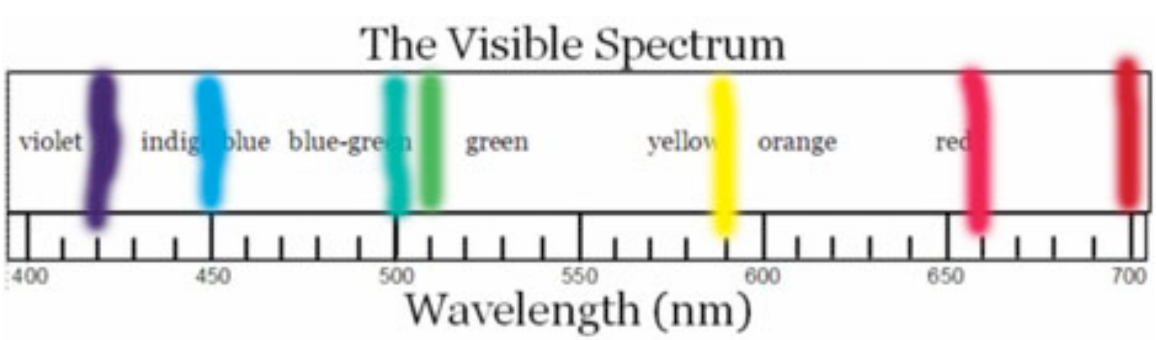

Figure 9: Emission Spectra of Unknown C