Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Hydrogen Spectra Lab**

Guiding Question: Which element, of the elements tested, will emit a color that is correlated to the movement of an electron from the 6th level to the 2nd?

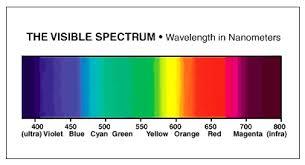
Background Information: In 1885 Balmer and Rydberg observed that when hydrogen gas is excited by an electric current, it emitted light which produced a visible spectrum when resolved through a prism. They then identified the wavelengths of the spectral lines using the following formula

**En=-2.178x10-18 (1/nf2 – 1/ni2)**

In 1913, Bohr suggested that electrons of hydrogen moved in circular orbits around the nucleus. The electrons were held in those orbits due to two opposing forces, the attraction of the electrons and the protons as well as the momentum of two similarly charged and moving electrons. He described the electron having the lowest energy moving around the nucleus at the closest distance as the ground state (n=1). If energy was absorbed by the electron, it would jump up to a higher energy level and be in the excited state. Depending on the amount of energy absorbed, electrons could jump up into many different energy levels (n=1,2,3…). Naturally, the electrons would fall back down, releasing energy in the form of light. This could occur in one or more steps. Regardless, energy difference between levels could be calculated using equation 2 and 3:

**∆E= hυ c=λv**

This equation, however, is only accurate for the hydrogen atom because it does not take into account the electrostatic interaction between electrons or the shielding effect of inner electrons. But the general idea can be used for all atoms. The electromagnetic spectrum is given below. In this experiment, you will calculate the energy, wavelength, and/or frequency for each of the visible emission lines of hydrogen. The spectroscope used will not have a scale (like the one intended for this lab), so a scale has been made for you in the data section. The scale is based on helium’s spectra.



Pre-lab Questions:

1. The element sodium emits 3.37x10-19J/atom of energy.
   1. Calculate the frequency of this light.
   2. Calculate the wavelength of this light.
   3. In what region of the ER spectrum would the sodium emission fall?
   4. What color is the light?
2. a. Calculate the energy associated with an electron falling from level 2 to 1.
3. Calculate the wavelength of light produced in this emission.
4. What part of the electromagnetic spectrum does this emission correlate to?
5. Why will we be assuming all of the visible spectra are a result of electrons falling to level two instead of level one?

Procedure:

1. Observe spectra of hydrogen, Helium and Neon and record your observations in the box below.
2. Using the data table, graph the spectral lines for Helium and then color those lines based on what you see in the spectra and the chart on page 1.

Data Collection:

**Helium (nm)**

|  |
| --- |

300 400 500 600 700 800

**Hydrogen (nm)**

|  |
| --- |

300 400 500 600 700 800

**Neon (x 10-19 J)**

|  |
| --- |

6 5 4 3 2

| He | H | Ne |
| --- | --- | --- |
| *Wavelength (nm)* | *Wavelength (nm)* | *Energy (J))* |
| 438.8 | 410.1 | 3.68x10-19 |
| 443.8 | 434.0 | 3.39 x10-19 |
| 447.1 | 486.1 | 3.34 x10-19 |
| 471.3 | 656.2 | 3.29 x10-19 |
| 492.2 |  | 3.27 x10-19 |
| 501.6 |  | 3.22 x10-19 |
| 504.8 |  | 3.19 x10-19 |
| 587.6 |  | 3.16 x10-19 |
| 667.8 |  | 3.13 x10-19 |
|  |  | 3.11 x10-19 |
|  |  | 3.10 x10-19 |
|  |  | 3.05 x10-19 |
|  |  | 3.01 x10-19 |
|  |  | 2.87 x10-19 |
|  |  | 2.82 x10-19 |

Calculations: (Show all work with proper sig figs and units!)

1. Using the helium data, calculate the frequency and energy of the line with the shortest wavelength.
2. Using the helium data, calculate the frequency and energy of the line with the longest wavelength.
3. Using the hydrogen data, calculate the frequency of all of the lines.

|  |  |
| --- | --- |
|  |  |

1. Using the hydrogen data, calculate the energy of all of the lines.

|  |  |
| --- | --- |
|  |  |

1. Using the neon data, calculate the frequency and wavelength of the line with the most energy.
2. Using the neon data, calculate the frequency and wavelength of the line with the least energy.

**Claim**: Answer the guiding question.

**Evidence**: Show relevant data and calculations that support your claim. Then explain how the data is interpreted.

**Justification**: Provide necessary scientific concepts that support your claim and evidence.

