Name: ___________________________________ Date: __________________

Lab – Atomic Emission Spectroscopy

Objective: To observe the visible spectra of various gases and calculate the energy of three different wavelengths. To calculate the transitions and colors produce by hydrogen according to Bohr's model of the atom.

Equipment:
Power supply, diffraction glasses

Prelab:

1. Draw and label (only those that start from the 7th energy level or lower) the following on an atomic energy level diagram:
   a. Lyman Series
   b. Balmer Series
   c. Paschen Series
   d. Brackett Series
   e. Pfund Series
   f. Humphreys Series
2. For each series, give the category of emr (e.g. ultraviolet) to which it belongs.

Procedure:
Place a diffraction grating in front of your eye and slide or rotate it until you can observe the spectrum lines on either side of the discharge tube. Draw the spectrums of three different gasses below and record the colors and lines you see in a data table for further clarification.

Example:

Sample: Mercury Gas

Purple: 1 weak band 400 nm
Blue: 1 moderate band 434 nm
Green: 1 moderate band 545 nm

Calculations:

1. Choose 1 color line from each of the three different samples you drew and calculate its energy using the following equations: $E=h\nu$ and $C=\lambda\nu$

   (λ_{He} = 402 nm, λ_{Ne} = 598 nm, and λ_{Ar} = 475 nm)

2. Calculate the energy of the 4 spectral lines of hydrogen viewed through the spectroscope using the same two equations.

   (λ= 656 nm, 486 nm, 434 nm, and 410 nm)

3. Use the equation $\frac{1}{\lambda} = R_{\infty}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ to determine the wavelength of the energy emissions from electron transitions that would produce visible light in a hydrogen atom (Balmer series). R_{∞} is the Rydberg constant. The variable n_i represents the initial energy level (the level the electron started on), and n_f is the final energy level (the level the electron falls to). Please remember to show all work.

   Remember that once you simplify the equation you will find $\frac{1}{\lambda}$, **not** λ. Give your answers in nanometers.

4. Consider the spectrum you drew for hydrogen. Match the colors seen with its corresponding electron transition and energy calculated above.

5. Were the wavelengths you saw for the hydrogen atom consistent with the wavelengths you calculated in number 3 above? Why or why not?

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6. Calculate wavelengths for the remaining transitions. Use the electromagnetic spectrum to identify the type of emr.