The Modern Atomic Model **Name**_____

Spectral Lines

Read from **Lesson 1: Physics in the Early 20th Century** in the **Chemistry Tutorial Section, Chapter 5** of **The Physics Classroom**:
Part a: Emission Spectrum of the Elements Part b: The Photon Part c: Bohr's Quantized Energy Levels

Here is the line spectrum of helium:

Image Source: Wikipedia

1. Complete the following table using the appropriate equations and constants about the different colored lines found in the line spectrum of helium.

Color	Wavelength, λ	Frequency, f	Energy, E
Red	668 nm		
Yellow		5.10×10^{14} Hz	
Green			3.97×10^{-19} J
	471 nm		
			4.45×10^{-19} J

2. An element is heated, and a photon of light is emitted. This particular photon of light has 8.67×10^{-15} J of energy.
   a. What is the frequency of the emitted light?

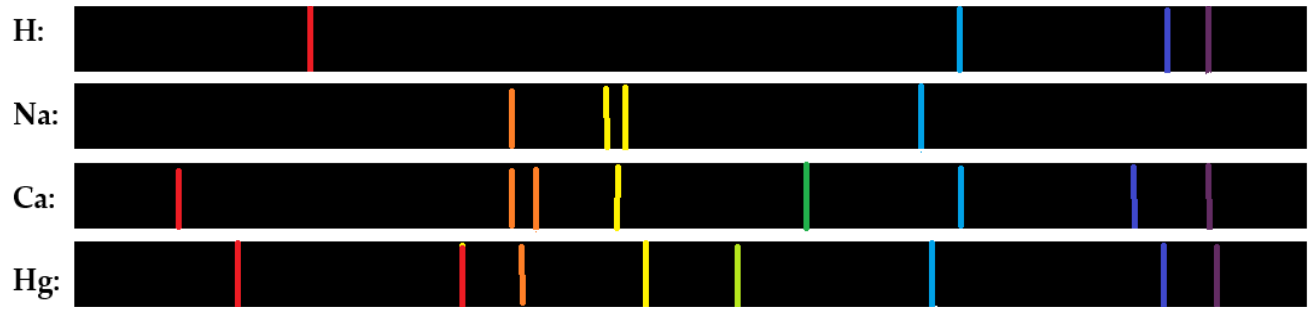
   b. What is the wavelength of the emitted light? (give your answer in nanometers and meters)

   c. How does the speed of this emitted light compare to the speed of a photon of visible light? Explain your answer.

   d. How does the energy of this emitted light compare to the speed of a photon of visible light? Explain your answer.

Early Models of the Atom

3. Answer the following questions about the line spectra of four elements and a line spectrum of a mixture of gases shown below.
   Line spectra of known elements:



   Mixture of gases line spectrum:

   a. Which of the four elements are present in this mixture of gases? Which are not present? Explain your answers.

   b. Why do larger elements like mercury produce more colored lines in their line spectrum than smaller gases like hydrogen?

   c. Consider the red, green, and violet line shown in the line spectrum of calcium. If these colored lines were produced by the following energy level transitions:

E4 to ground state	Ground state to E3	E1 to ground state
E2 to E1	E3 to ground state	Ground state to E4

   which one could have produced the red line?

   which one could have produced the green line?

   which one could have produced the violet line?