Name:__________

A Quest for Quantum

1. For each group of terms or persons, **PICK ONE** and explain. For persons, fully explain their role in the evolution of the atomic model. Note the marking scheme. One mark is equivalent to one good point of information. Diagrams are valid responses

a) Dalton, Thomson or Rutherford (2 marks)

b) line spectra or energy level diagram (2 marks)

c) electromagnetic spectrum or mass spectrometer (2 marks)

d) quantum hypothesis or photoelectric effect (2 marks)

2. Fill out the following table to show the possible quantum numbers in the first three princple energy levels for a one electron hydrogen. Be sure to use the Aufbau principle (as well as the Pauli exclusion principle)

n	l	m_l	m_s	# e^- per energy level	# e^- per energy shell

3. Do you know your quantum numbers?

Symbol	Allowed Values (Use Set Notation)	Physical Properties And/or Name

4. For the quantum number l (i.e. angular momentum) it has been suggested that there is the possibility of l=5. If this is so, how many different l=5 elements could exist. What is the minimum number of de Broglie wavelengths that are required to produce an l=5? Make clear and concise reference to the other three quantum numbers in your answer.

5. Write the complete electron configuration for the newly discovered element, Schlenkium, symbol Slk. The atomic number of this element is 118, making it the next noble gas.

6. Complete the following table. The first line is done as an example

Element Symbol	n	l	m_l	m_s	Electon Configutration Ending
$_{56}Ba$	6	0	0	+1/2	$6s^2$
$_{72}Hf$					
	3	2	-2	0.5	
					$5p^2$
					$4f^9$
	5		3	-1/2	
$_{71}Lu$					

7. Why are multi-electron atoms considerably more complicated than a single electron atoms such as hydrogen. How does this relate to the relative energy for different values of quantum number l

8. The Rydberg constant is itself a combination of different constants. Use the constants listed to determine the correct value of the Rydberg constant. Then perform a complete unit analysis. Be sure to start with the format "units ="

$$R = \frac{-e^4 m}{8\varepsilon_o^2 h^3 c}$$

$e = 1.6022 \times 10^{-19}$ C (fundamental unit of charge)
$m = 9.110 \times 10^{-31}$ kg (resting mass of an electron)
$\pi = 3.1415926536$ (circumference / diameter for a circle)
$\varepsilon_o = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$ (dielectric constant)
$h = 6.626 \times 10^{-34}$ Js (Planck's constant
$c = 3.00 \times 10^{8}\ ms^{-1}$ (speed of light)

$J = \frac{kgm^2}{s^2}$ $N = \frac{kgm}{s^2}$

9.

$$\frac{1}{\lambda} = 1.09737 \text{ x } 10^{7} \text{ m}^{-1} \left[\left(\frac{1}{n_i^2} \right) - \left(\frac{1}{n_f^2} \right) \right]$$

Look what light through yonder window duth break! Is it the sun? Is it the moon? No of course not, it is the third line in the Balmer Series of hydrogen. And what is the wavelength of yonder light? To figure that out, show a calculation for n=5 to n=2! Show a separate conversion to express your final answer in nanometers (1 x 10^9 nm = 1 m).

10. Using the equation from question 9, determine the initial and final states for:

a) emission of 93.73 nm

b) absorption of 1874.61 nm

wavelength	emitted or absorbed	n_i	n_f
93.73 nm	emitted		
1874.61 nm	absorbed		