Name:__________

A Quest for Quantum

1. For each question provide information points that help to explain and/or differentiate (i.e point out the differences) Note the marking scheme. One mark is equivalent to one good point of information, therefore brief answers are sufficient. Diagrams are valid responses

a) Dalton (1 marks)

Thomson (2 points)

Rutherford (2 points)

b) absorption spectra (2 points)

emission line spectra (2 points)

c) Heisenberg uncertainty principle, $\sigma_x \sigma_p \geq \frac{\hbar}{2}$ (1 point)

d) photoelectric effect (2 points)

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=4. If this is so, how many different l=4 elements could exist (i.e what would the width of the "g" block be). What is the minimum number of de Broglie wavelengths that are required to produce an l=4? 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, Wattonium, symbol Wa. The atomic number of this element is 116, making it a member of the oxygen group.

6. Complete the following table.

element	n	l	m_l	m_s	end of config.
$_{16}S$					
					$5d^3$
		3	−2	−½	4
$_{32}Ge$					
					$1s^2$
					$5f^{13}$
	4	0	0	+½	
	4	2	−1	+½	
					$6d^1$
$_{70}Yb$					

7. How many elements wide would the periodic table be if the spin quantum number could have values of −3/2, −1/2, +1/2, +3/2 ? Explain briefly

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.

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

Show a calculation for n=5 to n=3! 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 376.97 nm
b) absorption of 3738.53 nm
c) absorption of 93.03 nm
d) emission of 1004.67 nm

wavelength	emitted or absorbed	n_i	n_f
376.97 nm	emitted		
3738.53 nm	absorbed		
93.03 nm	absorbed		
1004.67 nm	emitted		