K	C	A	T
17	5	26	8

/64 = %

Name:_____

A Quest for Quantum

1. Match each definition or description with the best word

	responsible for the "discovery" of the principle quantum number	A	absorption spectra
	responsible for the discovery of the nucleus	B	Aufbau Principle
	distinct wavelengths of light either emitted or absorbed (from a continuous spectra wavelength light source)	C	Bohr
	no two electron may share the same set of all four quantum numbers, at least one quantum number must be different	D	emission spectra
	gradual increase in photon energy can be used to determine the binding energy of an electron to metal atoms on the surface of a metal target	E	Heisenberg uncertainty principle
	when electrons are added to a bare nucleus they will position themselves as close to the nucleus as possible	F	Hund's Rule
	caused be multiple different combinations of $n_i \rightarrow n_f$ transitions such that $n_f < n_i$	G	line spectra
	the energy contained in atoms is not continuous (any value possible), but instead exists as simple multiples of small discrete amounts of energy	H	Pauli Exclusion Principle
	responsible for the discovery of the electron	I	photoelectric effect
	can be observed whenever a continuous spectra light source is placed behind a gas phase sample of an element or compound or any combination there of	J	quantum hypothesis
	electronic states that have the same value for n and l will fill one electron per m_l value first in order to reduce electron-electron repulsion	K	Rutherford
	it is not possible to know both the position and momentum of any small particle	L	Thomson

K	C	A	T
12			

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

K	C	A	T
		8	

3. Do you know your quantum numbers?

Symbol	Allowed Values {Use Set Notation}	Physical Properties And/Or Name

/5K

4. For the second 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.

/5T

K	C	A	T
5			5

5. Write the complete electron configuration for the newly discovered element, Breenium, symbol Bn. The atomic number of this element is 117, making it a member of the halogen group.

/3A

6. Complete the following table.

element	n	l	m_l	m_s	end of config.
					$5d^6$
$_{56}Ba$					
	4	2	−2	−1/2	
					$5p^5$
$_{59}Pr$					
	5	3	−1	−1/2	
					$6d^1$
$_{58}Ce$					
	4		+3	−1/2	
					$4f^{11}$

/10A

7. If m_s = −7/2, −5/2, −3/2, −1/2, 0, +1/2, +3/2, +5/2, +7/2 (in other words there are 9 possible values for m_s). Use this information to predict the width of the s,p,d and f block and then use this information to determine the entire width of the periodic table.

s ➜	
p ➜	
d ➜	
f ➜	
total ➜	

/3T

K	C	A	T
		10	3

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)

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

/3A

/5A

K	C	A	T
		8	

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 the ninth line in the Balmer series. Show your calculation for a situation in which the atom absorbs the energy of an incoming photon. Show either a separate conversion to express your final answer in nanometers (1 x 10^9 nm = 1 m) OR a conversion factor that adjusts the unit in the above equation to nm^{-1}. Be sure to use proper format for all parts of this question.

/5C

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

a) emission of 97.20 nm
b) absorption of 1944.04 nm
c) absorption of 396.91 nm
d) emission of 1004.67 nm

/8T

wavelength	emitted or absorbed	n_i	n_f
97.20 nm	emitted		
1944.04 nm	absorbed		
396.91 nm	absorbed		
1004.67 nm	emitted		

K	C	A	T
	5		8