Chemistry: Quantum Model TH Quiz

Name: Answer Key

1. Dalton, in his atomic model, explained that atoms combine in whole number ratios. Explain what he meant by this and how it applies to the Law of Definite Proportions.

Atoms are individual units and when they combine to form compounds they do so in specific ratios. Because atoms are not able to be broken down and combine as particles to form a specific compound. This leads us to the Law of Definite Proportions

2. Match the name & the discovery together

1. c	Thomson	a. identified neutrons through nuclear bombardment activities
2. f	Rutherford	b. used canal rays to find positive particles
3. d	Millikan	c. used cathode rays to find negatives particles
4. b	Goldstein	d. calculated the mass and charge of the electrons
5. a	Chadwick	e. used emitted X-rays to identify the number of protons
6. e	Moseley	f. used α-particles to identify very dense positive regions of atom

3. Finish the chart for the following

Name	symbol	atomic #	mass #	# of electrons	# of protons	# of neutrons
a. carbon-13	^{13}C	6	13	6	6	7
b. Molybdenum-97	^{97}Mo	42	97	42	42	55
c. Gallium-69	^{69}Ga	31	69	31	31	38

4. Fill in the Chart

Subatomic Particle	Charge	Mass (amu)_	Location in atom
proton	+1	1	nucleus
electron	−1	1/1827	outside nucleus in orbits (orb. tals)
neutron	0	1	nucleus

5. Which of the following changes in energy levels of a an electron would yield the shortest wavelength: $n_3 \rightarrow n_1$, $n_4 \rightarrow n_2$, or a $n_5 \rightarrow n_3$. Explain your answer.

An $n_3 \rightarrow n_1$ electron fall is part of the Lyman series which means these will always release ultraviolet light whereas the $n_4 \rightarrow n_2$ releases visible light and $n_5 \rightarrow n_3$ release infrared. Ultraviolet light has shorter wavelength, higher frequency and higher energy photons

6. A certain color of light with a wavelength of 7.25×10^{-7} m is emitted from a certain atom. (Show all your work)
   a. Calculate the frequency of this wave

$c = \lambda \cdot \upsilon \Rightarrow \upsilon = \frac{c}{\lambda}$ $\quad \frac{2.998 \times 10^{8}\ \text{m/s}}{7.25 \times 10^{-7}\ \text{m}} = 4.14 \times 10^{14}\ \text{s}^{-1}$

   b. Calculate the energy of this wave

$E = h\upsilon \Rightarrow E = h\frac{c}{\lambda}$ $\quad \frac{6.626 \times 10^{-34}\ \text{J}\cdot\text{s} \times 2.998 \times 10^{8}\ \text{m/s}}{7.25 \times 10^{-7}\ \text{m}} = 2.74 \times 10^{-19}\ \text{J}$

   c. What type of electromagnetic wave is this? (from the spectrum)

$\frac{7.25 \times 10^{-7}\ \text{m} \times 1 \times 10^{9}\ \text{nm}}{1\ \text{m}} = 725\ \text{nm} = \text{visible light}$

7. Write an electron configuration for the following elements
   a. carbon $1s^2 2s^2 2p^2$
   b. copper $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
   c. germanium $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$

8. Mendeleev was the first scientist credited with creating a periodic table. Using what we know now of the quantum model, explain the reason why atoms in the same families have the same properties.

Elements in the same families (columns) all share the same number of electrons in the outer shell. This is called the valence shell and thus the valence electrons are those electrons in the valence shell.

9. Using the periodic table as a guide for writing electron configurations, list the two tricks identified in class.

the d-block (transition metals) fall back 1 energy level from the period and f-block (inner transition metals) fall back 2 energy levels from the period

BONUS: Using orbital diagrams explain why calcium and chlorine bond in a 1:2 ratio.

Ca : $\underline{\uparrow\downarrow}:\underline{\uparrow\downarrow}, \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}:\underline{\uparrow\downarrow}, \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}, \underline{\ }\ \underline{\ }\ \underline{\ }\ \underline{\ }\ \underline{\ }:\underline{\uparrow\downarrow}$

Cl : $\underline{\uparrow\downarrow}:\underline{\uparrow\downarrow}, \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}:\underline{\uparrow\downarrow}, \underline{\uparrow\downarrow}\ \underline{\uparrow\downarrow}\ \underline{\uparrow}$

Chlorine has 7 valence e^- and has room for 1 more e^-. Calcium has $2e^-$ in the valence shell. So it takes 2 chlorine atoms to pull both valence e^- from a calcium atom