Chemistry: Quantum Model 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 bond together to make compounds and these compounds always have the same ratio of elements. This showed that matter is composed of individual units called atoms. The Law of Def. Proportions restates this by saying compounds have a definite composition of elements and their ratios.

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; e⁻ cloud
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 $n_5 \rightarrow n_3$.

↳ highest energy change = shortest wavelength

λ 725 nm

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

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

   b. Calculate the energy of this wave

$E = h \cdot \nu = \frac{6.626 \times 10^{-34} \cdot 2.998 \times 10^{8}\ m/s}{7.25 \times 10^{-7}\ m} = 2.74 \times 10^{-19}\ J$

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

visible - red light

7. Write an electron configuration **and** orbital diagram for the following elements

   a. carbon $1s^2 2s^2 2p^2$

   $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow$ $\uparrow$ __

   b. copper $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

   $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow$

   c. germanium.

   $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$

   $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow$ $\uparrow$ __

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.

atoms in the same family have the same number of valence electrons, which determines how atoms will react

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

Ca $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: _____ : $\uparrow\downarrow$

Cl $\uparrow\downarrow$: $\uparrow\downarrow$; $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$: $\uparrow\downarrow$, $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow$

Ca has 2 valence e⁻ and chlorine has 1 too few - Ca gives 1 e⁻ to 2 Cl atoms!