Ch. 4 Test Review – The Arrangement of Electrons in Atoms

Before taking this test, make sure you have done the following things to prepare:

1) watched the lecture videos for Ch. 4,
2) reviewed your video logs and guided reading for Ch. 4,
3) studied the flashcards from Ch. 4,
4) reviewed your daily work assignments and quizzes from Ch.4, &
5) complete this test review.

On this test you will need to know how to solve for wavelength() or frequency using the speed of light. Make sure you can use the formula: $c = \lambda \cdot f$. You will also need to be able to solve for the energy of a photon using this formula: $E = h \cdot f$. You will be provided the values for c & h since they are universal constants. Also make sure you know how to do electron configuration the long way, the noble gas electron configurations (AKA, the shortcut), and orbital filling diagrams.

Knowledge:

1. How does wavelength and frequency relate? (As one increases does the other one increase or decrease?) Is this a direct or inverse relationship? **Wavelength (λ) and frequency (f) are the inverse of each other. If the wavelength is long, the frequency is low, and if the wavelength is short the frequency must be high.**
2. Define wavelength and frequency. What is the symbol for each? **Wavelength, (λ) measured in meters, is the distance between corresponding point on a wave and frequency (*f*, measured in hertz is inverse seconds ($^1/_s$)) is the number of waves that pass a given point in a specific time.**
3. What is the energy of a photon related to? **The energy of a photon is directly related to the frequency of the light "wave" or particle that carries the energy. Remember that $E_p = h \cdot f$ where h is Planck's Constant, and f is the frequency.**
4. What is a line emission spectrum? **The Line-emission spectrum is a series of specific wavelengths of emitted light created when the visible portion of the light from an excited atom is shined through a prism. Remember that visible light is like a fingerprint and it is different for each light source. Also, remember that we looked at the various light bulbs and light sources through the diffraction (3-D Glasses) and saw the portions of ROYGBIV that were created by the line emission spectrum.**
5. Explains hydrogen's line-emission spectrum and who discovered what we know about it. **Bohr discovered the line emission spectrum for Hydrogen. He discovered that there are multiple energy levels that Hydrogen's one electron can jump to and fall from and when it returns to the ground state from the excited state is when it emits light.**
6. What does the Bohr model state about where an electron is? **The Bohr model hypothesized that hydrogen's electron orbited the nucleus in a fixed path.**
7. What is the lowest energy state of an atom? **The lowest energy state of an atom is the ground state.**
8. What type of electromagnetic radiation has the highest energy? (Hint: The highest frequency is the highest energy.) **Gamma Rays have the highest frequency/energy and therefore the shortest wavelength.**
9. What type of EM radiation has the longest wavelength? **Radio waves have the longest wavelength and therefor the lowest frequency.**

Problems:

10. If the frequency of a light is 3.2 X 10^{15}Hz, what is the wavelength?

$$\lambda = \frac{c}{f} = \frac{3.0 \; x \; 10^8 m/s}{3.2 \; x \; 10^{15} Hz} = 9.37x10^{-8}m$$

11. What is the frequency of an EM wave with a wavelength of 5 X 10^{-6} m?

$$f = \frac{c}{\lambda} = \frac{3.0 \; x \; 10^8 m/s}{5.6 \; x \; 10^{-6} m} = 5.35 \; x \; 10^{13} Hz$$

12. How much energy is in a photon with a frequency of 2.3 X 10^{13} Hz?

$$E_{photon} = h \cdot f = 6.626\ x\ 10^{-34} Js \bullet 2.3\ x\ 10^{13}\ Hz = 1.5\ x\ 10^{-20}\ Joules$$

13. How much energy is in a photon with a wavelength of 2.1 X 10^{-8} m *(2steps).*

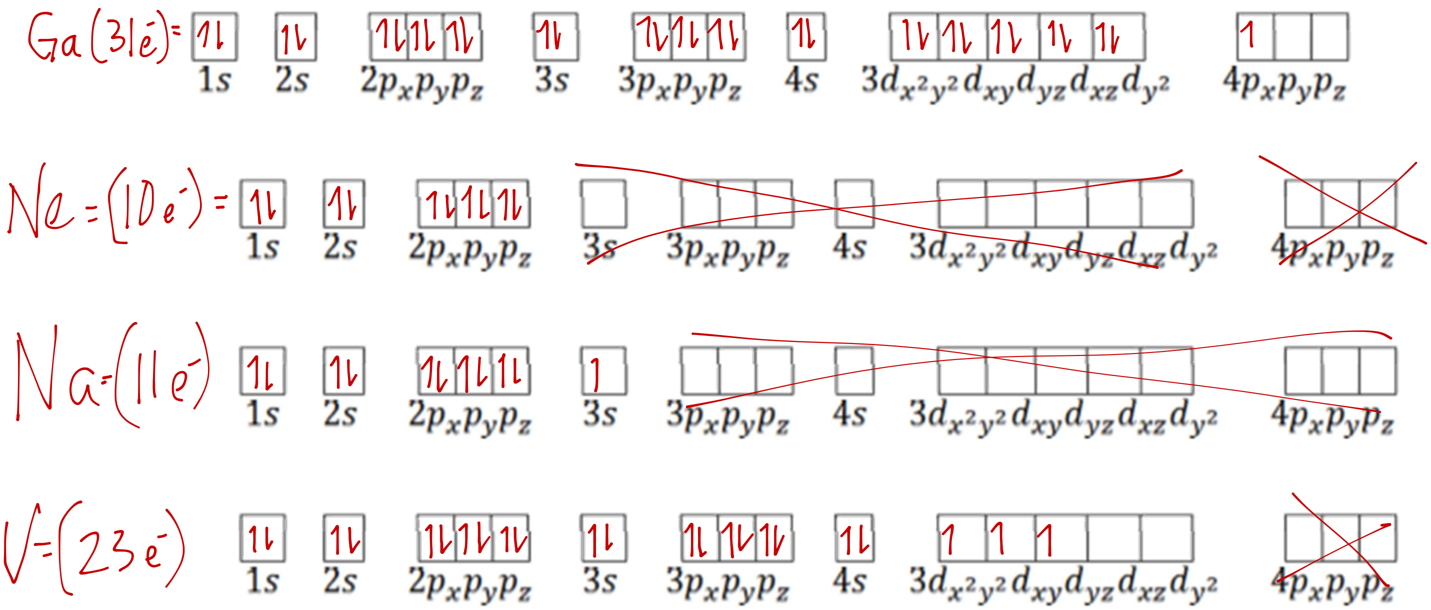
Step 1: Determine the Frequency of the light:

$$f = \frac{c}{\lambda} = \frac{3.0\ x\ 10^{8} m/s}{2.1\ x\ 10^{-8} m} = 1.4\ x\ 10^{16} Hz$$

Step 2: Use the Frequency to calculate E_{photon}

$$E_{photon} = h \cdot f = 6.626\ x\ 10^{-34} Js \bullet 1.4\ x\ 10^{16}\ Hz = 9.3\ x\ 10^{-18}\ Joules$$

14. Can you draw orbital diagrams for the following: Ga, Ne, Na, V, (orbital diagrams use the boxes below with electrons represented by arrows. On the test, you will simply have to look at pre-filled boxes to select the correct answer from multiple choice answers.



15. Write the electron configuration for the following atoms: B, K, F, Na, Ar, As, Ca, Kr.

B (5 e^-) = $1s^2 2s^2 2p^1$

K (19 e^-) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

F (9 e^-) = $1s^2 2s^2 2p^6$

Na (11 e^-) = $1s^2 2s^2 2p^6 3s^1$

Ar (18 e^-) = $1s^2 2s^2 2p^6 3s^2 3p^6$

As (33 e^-) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$

Ca (20 e^-) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Kr (36 e^-) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

16. Write electron diagrams for the following using noble gas notation: Fe, Ni, N, Mg, Al

Fe (26 e) = [Ar]$4s^2 3d^6$

Ni (28 e) = [Ar]$4s^2 3d^8$

N (7 e) = [He]$2s^2 2p^3$

Mg (12 e) = [Ne]$3s^2$

Al (13 e) = [Ne]$3s^2 3p^1$