THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
ACADEMIC YEAR 2022
TERM 1
CHE 1000: INTRODUCTORY CHEMISTRY

ASSIGNMENT SHEET 2 **3rd May 2023**

Answer all the problems in a HARD COVER book and submit in ROOM 124 before 10:00 hrs on Monday, 7th May 2023

1. What is a wave? Explain the following terms associated with waves: wavelength, frequency, amplitude.
2.
   a. List the types of electromagnetic radiation in descending order with respect to energy and frequency.
   b. The following are representative wavelengths in the infrared, ultraviolet, and x-ray regions of the electromagnetic spectrum, respectively: 1.0×10^{-6} m, 1.0×10^{-8} m, and 1.0×10^{-10} m. What is the energy of a photon of each radiation? Which has the greatest amount of energy per photon? Which has the least?
3.
   a. What is the wavelength (in nanometers) of blue light having a frequency of 8.6×10^{13} Hz?
   b. What is the frequency (in Hz) of blue light having a wavelength of 566 nm?
4.
   a. A photon has a wavelength of 624 nm. Calculate the energy of the photon in electron volts (ev).
   b. Calculate the wavelength of light emitted when each of the following transitions occur in the hydrogen atom. What type of electromagnetic radiation is emitted in each transition? $n = 3$ and $n = 2$
5. The first line of the Balmer series occurs at a wavelength of 656.3 nm. What is the energy difference between the two energy levels involved in the emission that results in this spectral line?
6. Calculate the wavelength (in nanometers) of a photon emitted by a hydrogen atom when its electron drops from the n = 6 state to the n = 4 state.
7.
   a. Explain the statement, Matter and radiation have a “dual nature.”
   b. What is the de Broglie wavelength (in nm) associated with a 2.5-g Ping-Pong ball traveling 35 m/s?
8.
   a. How is the concept of electron density used to describe the position of an electron in the quantum mechanical treatment of an atom?

b. An electron in a certain atom is in the n = 2 quantum level. List the possible values of *l* and ml that it can have.
c. List all the possible subshells and orbitals associated with the principal quantum number n, if n = 6.

9.

a. Explain the meaning of diamagnetic and paramagnetic. Give an example of an element that is diamagnetic and one that is paramagnetic. What does it mean when we say that electrons are paired?
b. The ground-state electron configurations listed here are incorrect. Explain what mistakes have been made in each and write the correct electron configurations.
   i. Al: $1s^2 2s^2 2p^4 3s^2 3p^3$
   ii. B: $1s^2 2s^2 2p^5$
   iii. F: $1s^2 2s^2 2p^6$

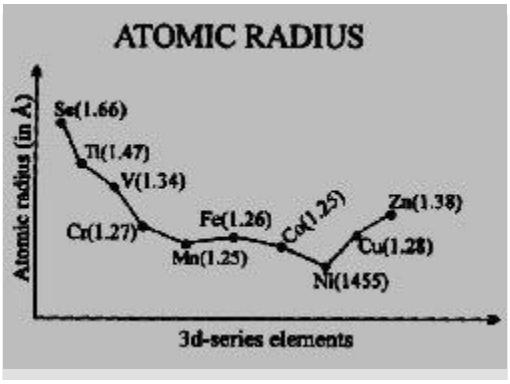
10. Draw atomic orbital diagrams representing the ground-state electron configuration for each of the following elements
   i. Nickel metal
   ii. cobalt
   iii. chromium

11.

a. Why is the first ionization energy of sulphur smaller than the first ionization energy of phosphorus?
b. Why are ionization energies always positive quantities?
c. Why does the fluorine atom have a larger first ionization energy than the oxygen atom?

12. From their positions in the periodic table, arrange the atoms in each of the following series in order of increasing electronegativity.
   a. C, F, H, N, O
   b. Br, Cl, F, H, I
   c. F, H, O, P, S

13. Arrange the species in each group in order of increasing ionization potential, and explain in each case the reason for the sequence: Fe, Fe^{2+}, Fe^{3+}
14. Explain why atomic radius in d block initially decreases then remains constant and finally increases at the end.



15. Why zirconium and Hafnium have nearly same atomic sizes?

16.

a. Base on their positions in the periodic table, list the following atoms in order of increasing radius: Cs, Ca, Rb, Mg
b. The ionic radii of the ions S^{2-}, Cl^{-}, and K^{+} are 184, 181, 138 pm respectively. Explain why these ions have different sizes even though they contain the same number of electrons.