CHM 111 Chapter 6 Worksheet and Study Guide

Purpose: This is a guide for your as you work through the chapter. The major topics are provided so that you can write notes on each topic and work the corresponding problems.

This should serve a s a study guide as you go on to do the problems in Sapling and take the quizzes and exams.

The Problems are embedded in the Topics and Space for Notes

Topic 1: Section 6.1 Electromagnetic Energy

By the end of this section, you will be able to:

- Explain the basic behavior of waves, including travelling waves and standing waves
- Describe the wave nature of light
- Use appropriate equations to calculate related light-wave properties such as period, frequency, wavelength, and energy
- Distinguish between line and continuous emission spectra
- Describe the particle nature of light
- Relevant equations: $c = \upsilon\lambda$ $E = nh\upsilon$

Notes:

6.1.1 What is a wave?

6.1.2 Explain the difference between traveling wave and standing wave.

6.1.3 Describe the wave nature of light (how do we know that light is a wave (experimental data)?

6.1.4 Use appropriate equations to calculate related light-wave properties such as period, frequency, wavelength, and energy. $c = \upsilon\lambda$ $E = nh\upsilon$

6.1.5 Define frequency and know the common units of frequency.

6.1.6 Define wavelength.

6.1.7 Define amplitude.

6.1.8 What is a continuous Spectrum and what is a line spectrum? Draw them!

6.1.9 Discuss the particle nature of light. Include the work of Planck and Einstein.

<u>Sample Questions Section 1.</u>

6.1 (A) What is the frequency of light with a wavelength of 590 nm?

6.1.(B) What is the wavelength of light with a frequency of 7.9×10^{18} Hz?

6.1.(C) What is the energy of 1 photon of light with a wavelength of 0.011 nm? What is the energy of 1.00 mole of photons with this wavelength?

6.1. (D) Describe the results of the photoelectric effect and Einstein's explanation of what is occurring.

Topic 2: Section 6.2.The Bohr Model

By the end of this section, you will be able to:

- Describe the Bohr model of the hydrogen atom
- Use the Rydberg equation to calculate energies of light emitted or absorbed by hydrogen atoms

Notes:

6.2.1 What are the assumptions that Bohr made in his model of the Hydrogen atom?

6.2.2 Define ground state electron and excited state electron. What occurs (in terms of the position of the electron) when energy is absorbed? Released? Draw the model of the atom and what occurs when energy is absorbed and released.

6.2.2 Be able to use the Bohr equation! There are multiple forms of this equation (some are called the Rydberg equation). Find one that works for you!

Sample Questions Section 6.2

6.2 (A) One of the lines emitted by the H atom is at 397 nm.

1. Calculate the energy of the light.

2. If the electron starts in n=2, what is the n value for the final level?

6.2.(B) How did the Bohr model fail?

Topic 3: Section 6.3 Development of Quantum Theory

By the end of this section, you will be able to:

- Extend the concept of wave–particle duality that was observed in electromagnetic radiation to matter as well
- Understand the general idea of the quantum mechanical description of electrons in an atom, and that it uses the notion of three-dimensional wave functions, or orbitals, that define the distribution of probability to find an electron in a particular part of space
- List and describe traits of the four quantum numbers that form the basis for completely specifying the state of an electron in an atom

6.3.1 Bohr assumed that electrons are simply particles. How did this assumption fail to describe atoms other than H?

Describe the work of De Broglie and Davisson and Germer. How do we know that an electron can also behave like a wave?

6.3.2 Describe what we mean by the quantum mechanical theory of the atom. How does this differ from Bohr's model?

Include the work of Schrödinger and Heisenberg.

What is an orbital? How does it differ from an orbit?

What is meant by the "probability" of finding an electron in a 3-D space?

Draw an example of each type of orbital.. s, p d and f.

List the 4 quantum numbers. What are the possible values and what do they describe?

Sample Questions Section 6.3

6.3. A) What is the De Broglie wavelength of an electron moving at 3.0×10^7m/s?

6.3. (B) How many orbitals are in:

1. $n = 6$

2. $n = 3, l = 1$

3. $n = 4, l = 2, m_l = -1$

6.3. (C) Assign an acceptable missing value.

(A) $n = ?,\ l = 3,\ m_l = -2$ (B) $n = 4,\ l = ?,\ m_l = -2$

Topic 4: Section 6.4 Electronic Structure of Atoms (Electron Configurations)

By the end of this section, you will be able to:

- Derive the predicted ground-state electron configurations of atoms
- Identify and explain exceptions to predicted electron configurations for atoms and ions
- Relate electron configurations to element classifications in the periodic table

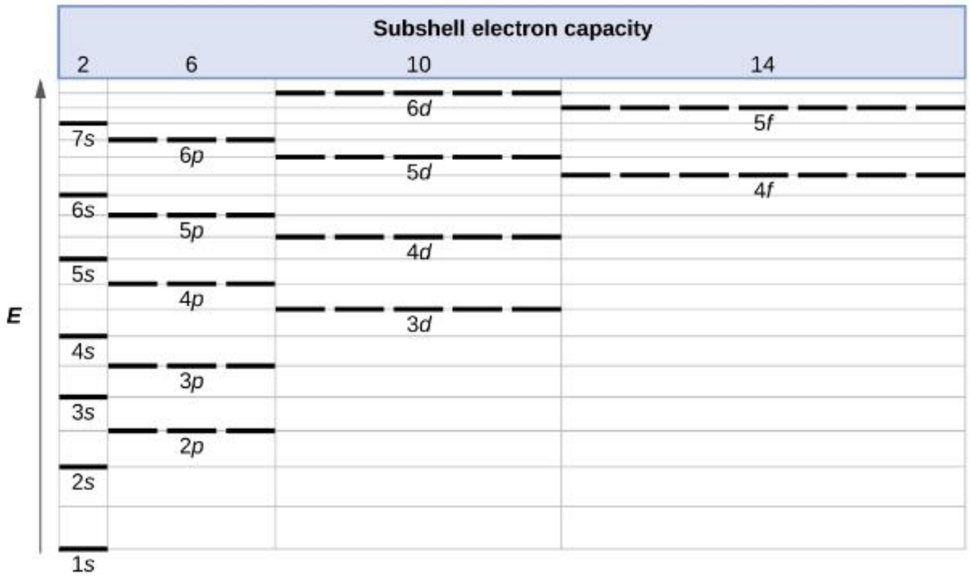
6.4.1 State:

The Aufbau Principle.

Hund's Rule.

Pauli exclusion principle.

How do these three rules allow us to write electron configurations?



Sample Question 6.4.1 (A) Write the electron configurations of elements 1 – 20. Use both the long hand and the core abbreviated format. Understand core and valence electrons.

6.4.2 Exceptions. Understand Z_{eff} and exceptions to our simple solution to the H atom. Understand Diamagnetic and paramagnetic.

Sample Question 6.4.2

(A) Write the electron configuration for:

Ag and Cr

6.4.2 Ions.

Sample Questions

6.4.2 (B) Be able to write the electron configurations for the ions in the main group elements (groups 1 – 8).

6.4.2 (C) Write the electron configurations for some transition metals. Understand why 2+ is a common charge.

6.4.2 (D) Understand how the electron configuration of the atoms and their ions are consistent with our understanding of the properties of the elements.

(A) Cu^{+} ____ (diamagnetic)

(B) Sn^{2+} ____

(C) Se^{2-} ____

6.4.2.(E) Compare the electron configurations for F, Ne and Na. Show how the electron configurations predict the properties of each element (metal, nonmetal.. number of electrons lost or gained., etc.)

Topic 5: Section 6.5 Periodic Variations in Element Properties

By the end of this section, you will be able to:

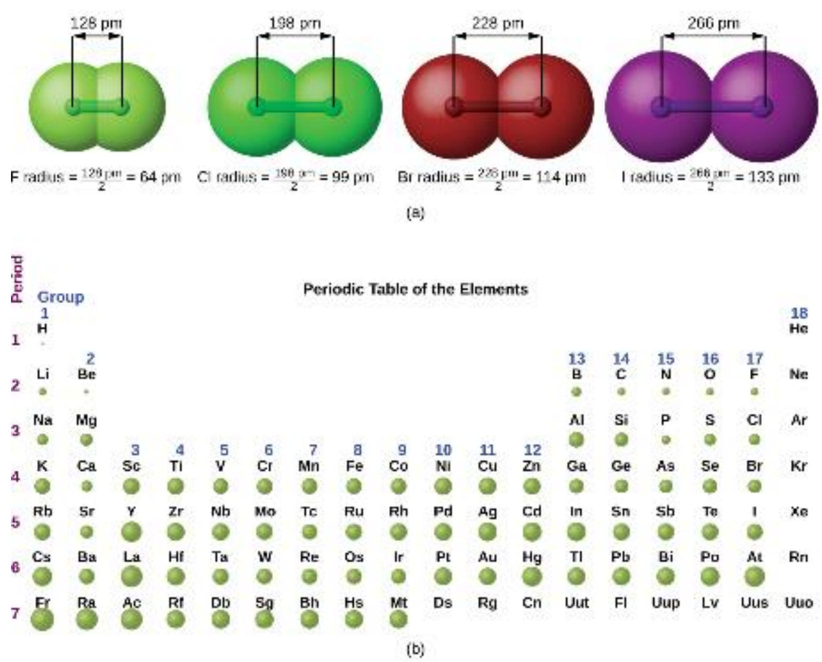
- Describe and explain the observed trends in atomic size, ionization energy, and electron affinity of the elements

Define Atomic radius. (Also understand ionic radius)

Define Ionization Energy.

Define Electron Affinity.

What are the trends observed in Atomic radius, Ionization Energy and Electron Affinity. Show the trends on:



Sample Question Section 6.5

6.5. (A) Periodic trends. Circle the element with the correct property.

1. Smallest atomic radius	Mg	or	Cl
2. Largest Electron Affinity	Br	or	F
3. Largest ionic radius	K^+	or	Br^-

(B) Which element is described by each? (Hint: Group 4 contains C and Group 8 contains Ne.)

1. Largest atomic radius in group 3 _______________
2. Largest atomic radius in Period 2 _______________
3. Highest IE in group 3 _______________
4. In Period 3 with IE_1= 170kJ, IE_2=350kJ, IE_3=1800kJ _______________
5. Forms 3– ion so that the ion has the configuration [Ne] $3s^2$ $3p^6$ _______________