Name: _____ Date: _____

AP Chemistry – Unit Homework – Atomic Structure

Skills

- Be able to calculate the wavelength of electromagnetic radiation given its frequency or its frequency given its wavelength.
- Be able to order the common kinds of radiation in the electromagnetic spectrum according to their wavelengths or energy.
- Understand the concept of photons, and be able to calculate their energies given either their frequency or wavelength.
- Be able to explain how line spectra of the elements relate to the idea of quantized energy states of atoms.
- Be familiar with the wavelike properties of matter.
- Understand how the uncertainty principle limits how precisely we can specify the position and the momentum of the subatomic particles, such as electrons.
- Know how the quantum numbers relate to the number and type of orbitals, and recognize the different orbital shapes.
- Be able to draw an energy-level diagram for the orbitals in a many-electron atom, and describe how electrons populate the orbitals in the ground-state of an atom, using the Pauli Exclusion Principle and the Hund's rule.
- Be able to use the periodic table to write abbreviated electron configurations and determine the number of unpaired electrons in an atom.

Readings

Zumdahl Chemistry: Chapter 7.1-7.8, 7.11-, p. 275-298, 302-319
OpenStax Chemistry: Chapter 6, p. 277-342

Problems

<u>Electromagnetic Energy</u>
Zumdahl Chapter 7, p. 321 #15-17, 31-39, 41-44
OpenStax Chapter 6, p. 332 #2-12, 15

AP Question
Microwave ovens use microwave radiation to heat food. The energy of the microwaves is absorbed by water molecules in food, then transferred to other components of the food.

a. Suppose that the microwave radiation has a wavelength of 11.2 cm. How many photons are required to heat 200 mL of coffee from 23°C to 60°C?
b. Suppose the microwave's power is 900 W (1 W = 1 J/s). How long would you have to heat the coffee, assuming 100% efficiency?

<u>The Bohr Model</u>
Zumdahl Chapter 7, p. 322 #45, 47, 49, 50
OpenStax Chapter 6, p. 333 #16, 17, 28, 29, 30

Name: _____ Date: _____

AP Question

A certain line in the spectrum of atomic hydrogen is associated with the electronic transition in the H atom from the sixth energy level (n = 6) to the second energy level (n = 2).

a. Indicate whether the H atom emits energy or whether it absorbed energy during the transition. Justify your answer.
b. Calculate the wavelength, in nm, of the radiation associated with the spectral line.
c. Account for the observation that the amount of energy associated with the same electronic transition (n = 6 to n = 2) in the He^+ ion is greater than that associated with the corresponding transition in the H atom.

<u>Quantum Theory</u>

Zumdahl Chapter 7, p. 322 #57-62
OpenStax Chapter 6, p. 334 #31-37, 41, 42, 44

AP Question

Silver is an exception to the aufbau principle.

a. Draw the orbital diagram for silver following the aufbau principle.
b. Show why silver is an exception to the aufbau principle by identifying how it should be drawn, and explaining why this is the case.

<u>Electron Configuration</u>

Zumdahl Chapter 7, p. 323 #66-69, 71, 73-75, 80, 83
OpenStax Chapter 6, p. 335 #48, 49, 52-58, 60, 61

AP Question

a. Draw the orbital diagram for an arsenic atom.
b. Write the ground state electron configuration for an arsenic atom.
c. Write the set of four quantum numbers for each of the outermost electrons in a single As atom when it is in its ground state.
d. Is an isolated arsenic atom in the ground state paramagnetic or diamagnetic? Explain.
e. Explain how the electron configuration of the arsenic atom in the ground state is consistent with the existence of the following known compounds: Na_3As, $AsCl_3$ and AsF_5.

Name: _____ Date: _____

AP Chemistry – Unit Homework – Periodicity

Skills

- Understand the meaning of effective nuclear charge, Z_{eff}
- Use the periodic table to predict the trends in atomic radii, ionic radii, ionization energy and electron affinity
- Understand how the radius of an atom changes upon losing or gaining electrons
- Recognize there is a jump in ionization energy that occurs in successive ionizations, and when the ionization corresponds to losing a core electron
- Connect irregularities in electron affinity to electron configuration
- Relate periodic trends to chemical reactivity and physical properties of elements, especially the alkali/alkaline earth metals and halogens

Readings

Zumdahl Chemistry: Chapter 7.12, p. 309-314

Problems

Periodicity

Zumdahl Chapter 7, p. 324 #85, 87, 89, 92-95, 97, 99, 101

AP Question

	First Ionization Energy (kJ/mol)	Second Ionization Energy (kJ/mol)	Third Ionization Energy (kJ/mol)
Element 1	1251	2300	3820
Element 2	496	4560	6910
Element 3	738	1450	7730
Element 4	1000	2250	3360

The table above shows the first three ionization energies for atoms of four elements from the third period of the periodic table. The elements are numbered randomly. Use the information in the table to answer the following questions.

a. Which element is most metallic in character? Explain your reasoning. (Ms. Hayduk's note: an element that is metallic in character makes positive ions easily, and exhibits strong physical and chemical properties of metals.)
b. Identify element 3. Explain your reasoning.
c. Write the complete electron configuration for an atom of element 3.
d. What is the expected charge for the most common ion of element 2?
e. A neutral atom of which of the four elements would have the smallest radius?

Summary Questions

Zumdahl Chapter 7, p. 325 #115, 117, 120, 121, 124, 128, 135, 140, 141