Study Guide for Midterm Exam Matter and Motion Fall 2015

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We have covered chapters R, 1, 2, 3, 4, & 5 in *Chemistry: An Atoms First Approach* by Zumdahl and Zumdahl. Constants, nonmetric conversion factors, a periodic table, and electronegativity chart will be provided on the exam. You will need to know formulas for density, molar mass, and molarity. Plan to bring a calculator and something to write with.

Chapter R (Measurements and Calculations in Chemistry)

- General Vocabulary Terms: precision, accuracy, density, solid, liquid, gas, mixture, pure substance, homogeneous, heterogeneous, physical change, chemical change, element, compound, atom, molecule
- Be able to use a provided conversion factor to change from one unit to another
- Know the metric system and how to convert within the metric system
- Know the difference between a theory, hypothesis, and law; and be able to explain why we have such few laws
- Be able to write numbers in standard notation and scientific notation; and be able to translate between the two forms
- Know what significant digits are, why they are used, and how to use them
- Know the density formula and be able to do calculations with density

Chapter 1 (Chemical Foundations)

- General Vocabulary Terms: Law of Definite Proportions, Law of Conservation of Mass, radioactivity, isotope, mass number, atomic number, mole, joule, allotrope, diatomic, polyatomic,
- Understand the scientific method and be able to explain it with sentences and diagrams
- Know the parts of an atom, the appropriate charges, and where each is located in an atom
- Be able to make a prediction for the most abundant isotope of a given element
- Be able to use and write an elemental symbol in standard and nuclear notation
- Be able to determine the number of subatomic particles from standard and nuclear notation
- Know the key components of Dalton's atomic theory
- Understand the difference between radiation and radioactivity

Chapter 2 (Atomic Structure and Periodicity)

- General Vocabulary Terms: electromagnetic radiation, frequency, wavelength, node, dual nature of light, s block, p block, d block, transition metals, metals, nonmetals, metalloids or semimetals, ionization energy, Pauling Exclusion Principle, Hund's Rule
- Be able to explain in words and with diagrams the properties of a wave: frequency, wavelength and their relationship to energy
- Be able to calculate the energy of a photon
- Know the quantum numbers, how each are determined, what each represents, how they are related to the periodic table
- Know the orbital shapes and how many orientations in space are expected
- Be able to provide an electronic configuration in standard and box notation
- Know and be able to apply the periodic trends for atomic size and ionization energy
- Know the most electronegative elements and be able to explain why knowing these are important
- Understand how size changes as a neutral atom becomes a cation or anion
- Be able to use the periodic table to predict most likely ion charge, the number of valence electrons, block location, and expected bonding behavior between two atoms

Chapter 3 (Atoms to Moles)

- General Vocabulary Terms: average atomic mass, Avogadro's number, chemical equation, reactant side, product side, coefficients, ionic bond, covalent bond, metallic bond
- Be able to calculate the average atomic mass of several isotopes
- Be able to calculate molar mass for a compound
- Be able to convert between mass, moles, and molecules or atoms
- Know how to determine the type and number of atoms in a given chemical formula
- Be able to determine if a given compound is ionic or covalent
- Know how to name ionic compounds

• Know how to name covalent compounds
• Know the polyatomic ions
• Be able to write formulas for ionic compounds if provided the name
• Be able to write formulas for covalent compounds if provided the name

Chapter 4 (Bonding: General Concepts)
• General Vocabulary Terms: Electronegativity, polarity, valence electrons, octet, octet violation, resonance, ionic bond, covalent bond, coordinate covalent bond, polar bond, octet rule, valence electrons, Lewis structure.
• Be able to determine the number of valence electrons for “s block” and “p block” elements.
• Understand the concept of electronegativity and know its periodic trends as well as know the most electronegative elements.
• Be able to explain in words and with diagrams the difference between a covalent bond and a polar covalent bond
• Be able to write Lewis Structures (including those that violate the octet rule)

Chapter 5 (Molecular Structure and Orbitals)
• General Vocabulary Terms: VSEPR theory, hybridization (Valence Bond or VB theory), sigma bond, pi bond, s orbital, p orbital, d orbital, electronic geometry, molecular geometry, resonance, bonding orbital, antibonding orbital, bond order.
• Be able to determine the number of electronic groups around a central atom.
• Be able to apply VSEPR theory and determine electronic and molecular geometry
• Be able to determine if a given compound is polar
• Be able to determine the hybridization expected in a compound using VB theory
• Know how to apply VB theory to describe bonding: sigma, pi, orbital overlaps
• Be able to interpret an MO diagram and predict bond stability from adding or removing electrons.
• Be able to describe the difference between MO theory and VB theory.