Final Exam Study Guide

- Tuesday, December 19th
- 30% of the term
- Time: 9h00 – 12h00 (3 hours)
- Local: BiblioTEC
- Responsible for objectives in:
  - **Units 2 to 4 (approximately 40%)**
  - **Unit 5 to 8 (approximately 60%)**
- Types of questions **Multiple-choice, Short-Answer,** and **Multi-concept Questions.**
- The Evaluation Information Sheet will be given with the test.
- To obtain full credit for questions involving calculations, you must show the steps and formulas used and express answers to the correct number of significant figures.
- Non-programmable Scientific Calculator will be the only one accepted.
- Model kit (only **unlabeled** pre-made molecules are allowed).

- **Objectives:**

  - **Unit 1: Experimentation and Measurement**
    NOTE: The following is needed to solve calculations in general.
    1. Write numbers in scientific notation and use prefixes for multiples of SI units.
    2. Report the answer of a calculation to the correct number of significant figures.
    3. Change a measurement into different units using appropriate conversion factors

  - **Unit 2: Chemical Composition**
    1. Be familiar with the Periodic Table of Elements.
    2. Indicate the atomic number, group number, and period number for an element whose position in the periodic table is given.
    3. Determine the mass number, atomic number, and number of protons, neutrons, and electrons from an isotope symbol.
    4. Identify an element given the mass and number of atoms or moles.
    5. Classify bonds as ionic or covalent.
    6. Determine the number of electrons and protons from chemical symbol and charge.
    7. Convert between name and formula for all types of ionic compounds and covalent compounds.
    8. Calculate formula weight, molecular weight, and molar mass, given a chemical formula or structure.
    9. Convert between mass, moles, and molecules or atoms of a substance.
    10. Percent composition, empirical formulas and molecular formulas
    11. Combustion analysis

- **Unit 3: Mass Relationships in Chemical Reactions**
  1. Balance a chemical reaction.
  2. Relate the amount (moles or mass) of reactants and products in a balanced equation using stoichiometry.
  3. Determine which reactant is limiting and calculate the theoretical yield of the product and the amount of excess reactant.
  4. Calculate the percent yield and percent atom economy.
  5. Compare the percent yield and percent atom economy.
  6. Calculate the percent composition given a chemical formula or structure.
  7. Determine the empirical and molecular formula, given the mass percent composition and molecular weight of a compound.
  8. Determine the empirical and molecular formula, using data from combustion analysis data and molecular weight.

- **Unit 4: Reactions in Aqueous Solutions**
  1. Classify a reaction as precipitation, acid–base neutralization, or oxidation–reduction.
  2. Write complete, balanced molecular equation, complete ionic equation, and net ionic equation by identifying spectator ions in a reaction.
  3. Use solubility guidelines to predict the solubility of an ionic compound in water.
  4. Solve stoichiometry problems with precipitation reactions.
  5. Calculate the molarity of a solution given the mass of solute and total volume.
  6. Calculate the amount of solute in a volume of solution with a known molarity.
  7. Calculate the concentration of ions in a strong electrolyte solution and after a reaction.
  8. Convert between moles and volume using molarity in stoichiometry calculations.
  9. Assign oxidation numbers to each atom in a compound.
  10. Identify redox reactions, reduced species, oxidized species, oxidizing agents, and reducing agents.

- **Unit 5: Periodicity**
  1. Convert between wavelength and frequency of electromagnetic radiation.
  2. Calculate the energy of electromagnetic radiation in units of J/photon or kJ/mol, when given the frequency or wavelength.
  3. Describe the photoelectric effect and explain how it supports the theory of particle-like properties of light.
  4. Compare the wavelength and frequency of different electron transitions in the Bohr model of the atom.
  5. Use the Balmer–Rydberg equation to calculate the wavelength and energies of electronic transitions in the hydrogen atom.
  6. Identify and write valid sets of quantum numbers that describe electrons in different types of orbitals.
  7. Apply the orbital notation to designate the quantum numbers of electron orbitals.

8. Identify an orbital based on its shape and describe it using a set of quantum numbers.
9. Assign a set of four quantum numbers for electrons in an atom.
10. Explain how the Pauli Exclusion Principle allows sets of four quantum numbers to describe each electron in an atom.
11. Predict the order of filling of subshells based upon energy.
12. Assign the electron configuration to atoms in the ground state, or ions.
13. Determine the number of unpaired electrons in main-group and transition-metal ions.
14. Draw orbital filling diagrams for the ground state of an atom, or an ion.
15. Identify atoms from orbital filling diagrams or electron configurations.
16. Understand and apply the concept of effective nuclear charge to the following periodic trends: ionization energy, atomic radius, ionic radius, electronegativity, and electron affinity.

- **Unit 6: Covalent Bonding**
  1. Predict trends in bond length and bond dissociation energy.
  2. Use bond dissociation energies to estimate ΔH for a reaction.
  3. Classify bonds as nonpolar covalent, polar covalent, or ionic based on periodic trends.
  4. Predict whether a given molecule has a dipole moment and draw its direction.
  5. Predict trends in bond dissociation energy based on both atomic size and polarity of the bond.
  6. Draw Lewis structures for molecules with multiple bonds, expanded octet, and with more than one central atom.
  7. Draw resonance structures when appropriate to depict the delocalization of electrons.
  8. Calculate the formal charge on each atom in a Lewis structure.
  9. Use the formal charge to evaluate the contribution of different resonance structures to the resonance hybrid.

- **Unit 7 Bonding Theories**
  1. Using Lewis structures, predict the geometry, bond angles, and overall shape of a molecule or ion using VSEPR.
  2. Using Lewis structures, determine hybridization, bond angles, sigma (σ) and pi (π) bonds.
  3. Determine the type of hybrid orbitals based upon the number of charge clouds around an atom.
  4. Using valence bond theory, draw the orbital overlap characteristic of σ and π bonds.

- **Unit 8 Intermolecular Forces**
  1. Identify the types of intermolecular forces experienced by an ion or molecule.
  2. Relate intermolecular forces to physical properties such as melting point, boiling point, and solubility.