Chem 101 Exam 3 Objectives

Note: this is not an exhaustive list! It is just meant to give you a place to start! Questions may be asked that don't appear on this list and some questions may require you to integrate multiple topics.

Part 1: Heat and Energy

- Define energy as it relates to chemical processes.
- Classify a given process as endothermic or exothermic.
- Draw an energy diagram for a given process including being able to explain how the diagram shows:
  - The relative energies and stability of the products and reactants
  - The activation energy required to start the process
  - Whether the process is endothermic or exothermic with respect to the system
  - The overall energy lost or gained by the system in the process

Part 2: Atomic Structure & History

- Explain the development and progression of our understanding of atomic structure beginning with Dalton. Be able to explain the contributions each of the following made to the development of atomic theory.
  - Dalton's and Dalton's Atomic Theory
  - J.J. Thomson
  - William Thompson
  - Ernest Rutherford
  - Niels Bohr
  - Erwin Schrodinger (idea of orbitals and quantized energy levels)
- Identify the subatomic particles that make up the nucleus.
- Describe the Bohr model of the atom.
- Describe today's model of the atom and how it has been modified from the Bohr model.
- Explain the difference between quantized and non-quantized (continuous) energy levels and how these relate to colors of light emitted.
- Explain demonstrations related to this idea, for example:
  - What happens to electrons in an atom when it is heated under a Bunsen burner
  - Why light is given off and why it is a specific color and not white light instead (white would represent a continuous spectrum of energy)
  - Why all different elements give off different specific colors of light (because they each have unique numbers and arrangements of electrons)
- Define an orbital and explain why probability is important in discussing the atom

Part 3: The Periodic Table

- Define the s, p, d, and f blocks of the periodic table as well as principle energy levels (n=1, n-2, etc.)
- Write an electron configuration for any neutral element (both long form and noble gas shorthand notation). This includes elements that have electrons that are found in the f-obitals.
- Write an electron configuration for a common cation or anion.
- Determine the number of unpaired electrons in an electron configuration in an energy diagram.

- Explain the difference between ground and excited states in terms of electron configurations and orbital diagrams - interpret an excited state electron configuration and determine which element it represents.
- Define and explain the trends on the periodic table for
    - Atomic radius
    - Ionization energy
    - Electronegativity
- Rank any set of neutral atoms based on increasing or decreasing radius, ionization energy, and electronegativity
- Define and give an isoelectronic series for a given set of atoms and ions. (Ex. He, Li^{+}, Be^{+2})
- Rank atoms and ions in an isoelectronic series in order of increasing radius or ionization energy
- Rank atoms and ions of the same atom in order of increasing radius or ionization energy (Ex. Na, Na^{+}, Na^{+2})

Part 4: Bonding & Molecular Structre

- Explain the difference between an intermolecular force and intramolecular bond.
- Explain the differences between nonpolar covalent, polar covalent, and ionic bonding.
- Rank a series of bonds based on polarity.
- Draw Lewis structures for any molecule including molecules that do not obey the octet rule:
    - Duet rule for hydrogen
    - Beryllium (4 electrons around central atom) and boron (6 electrons around central atom).
    - Atoms in row three or below can exceed the octet rule and can have 10 or 12 electrons around the central atom.
- Determine the geometry, shape, and bond angles of any Lewis structure. (Note: you will not be given the molecular shape chart on the exam and will need to have it memorized.)
- Determine whether a given molecule is polar or non-polar.
- Define and describe the three common intermolecular forces;
    - London dispersion forces
    - Dipole-dipole forces
    - Hydrogen bonding
    - Ion-ion interactions
- Determine the intermolecular forces present between molecules of particular substance.
- Rank a series of molecules based on their relative boiling points due to the strength of their intermolecular forces.