# Pre-AP Chemistry Midterm Study Guide

**Unit 1 - Atomic Structure**

- Determine the amount of protons, neutrons, and electrons in a neutral atom or an ion.
- Use mass spectroscopy data to determine the number of isotopes and average atomic mass of an atom.
- Be able to write a full ground-state electron configuration of an element.
- Interpret photoelectron spectroscopy data to determine the identity of an element and which peak corresponds to each subshell within the electron configuration of the element.

**Unit 2 - Periodicity**

- Know the common family names on the periodic table.
- Be able to identify the number of valence electrons of an element.
- Understand that the atomic radius decreases across a period because of the increase in the number of protons (greater effective nuclear charge) which increases the attraction between the nucleus and the valence electrons.
- Understand that the atomic radius increases down a group or family because the valence electrons reside in a greater principal quantum energy level which results in those valence electrons being further from the nucleus.
- Understand that as the atomic radius gets smaller, the ionization energy or energy to remove a valence electron increases due to the greater attraction between the nucleus and those valence electrons.
- Be able to identify the number of valence electrons from a successive ionization energy chart.
- Be able to identify which element will have the greatest relative electronegativity.

**Unit 3 - Ionic Compounds**

- Be able to determine the common oxidation number (or charge) of an element using the periodic table, photoelectron spectroscopy data, and successive ionization energy chart.
- Be able to draw an ionic compound's particulate diagram.
- Understand the physical properties of an ionic compound (solid, brittleness, electrical neutrality, poor conductors of electricity).
- Understand the two methods that can allow an ionic compound to conduct electricity (dissolve in water and melting).

**Unit 4 - Covalent Molecules**

- Understand the difference between a substance that has ionic bonds and one that has covalent bonding.
- Be able to draw Lewis dot structures for common substances such as $CH_4$, $NH_3$, $H_2O$, as well as diatomic molecules such as $H_2$, $N_2$, $O_2$, $F_2$, $Cl_2$, $Br_2$, and $I_2$.
- Using the VSEPR model, be able to identify common geometric shapes such as linear, trigonal planar, tetrahedral, trigonal pyramidal, and bent, as well as their respective bond angles of 180°, 120°, 109.5°, 107°, and 105°.
- Understand that the bond angles of tetrahedral, trigonal pyramidal, and bent (all four bonding sites) decrease due to the increasing number of unshared pairs of electrons.

**Unit 5 - Intermolecular Forces**

- Understand the difference between a physical change (breaking and forming of intermolecular forces of attractions during a change in the state of matter) and a chemical change (breaking and forming of intramolecular bonds during a chemical reaction).
- Be able to identify the particle diagrams and understand the physical properties of common substances with intermolecular attractions such as covalent network (network of atoms, poor conductors of electricity, very high melting points), metallic (sea of delocalized electrons with lattice of positive ions), malleable, ductile, great conductors of electricity), ionic (lattice of positive and negative ions, brittle, poor conductors of electricity), and molecular (solids, liquids and gases covalently bonded).
- Be able to draw and identify intermolecular forces such as hydrogen bonding attractions between two or more substances.
- Be able to identify the relative boiling and melting points of substances due to their intermolecular forces of attractions such as hydrogen bonding, dipole-to-dipole, and London dispersion forces.
- Identify the predominant intermolecular forces present in common substances such as $NH_3$, $H_2O$, HF, -OH (hydrogen bonding); $PH_3$, $H_2S$, HCl, C=O (dipole-to-dipole), and $CO_2$, $CH_4$, $H_2$, $N_2$, $O_2$, $F_2$, CH's (London dispersion forces).

**Unit 6 - Chemical Reactions**

- Be able to write and identify net-ionic chemical reactions such as precipitation and oxidation-reduction reactions.
- Be able to predict physical observations given a net-ionic chemical reaction such as in precipitation and oxidation-reduction reactions.
- Be able to write and identify balanced chemical reactions for combination and decomposition reactions.
- Be able to identify the products of a combustion chemical reaction ($CO_2$ and $H_2O$).

**Unit 7 - Molar Calculations**

- Calculate the number of moles of a substance given the number of grams. (grams / Molar Mass = moles)
- Calculate the number of grams or particles of a substance given the number of moles. (moles x Molar Mass = grams or moles x $6.02 \times 10^{23}$ = particles)
- Calculate the mass percentage of an element in a chemical compound. (Molar Mass of an element / Total Molar Mass of the Compound x 100%)
- Calculate the empirical formula of a compound given the mass percentage of each element. (% of element / Molar Mass = moles…divide by the smallest # of moles to determine the ratio of moles)

**Unit 8 - Stoichiometry**

- Using the balanced chemical reaction, use a molar ratio to calculate the moles of one substance when given the moles of another substance.
- Using a balanced chemical reaction, calculate the number of grams of a substance given the number of grams of another substance.
- Using a balanced chemical reaction, determine which substance will be the limiting reactant and which substance will be in excess.
- Using a balanced chemical reaction, be able to draw and interpret particle diagrams showing the reactants or products.