**Chapter 8 – Chemical Equations**

Be able to predict chemical reactions

Use Activity Series and Solubility Rules.

**Chapter 10 – Modern Atomic Theory**

**wavelength** (λ): distance between peaks

**frequency** (ν): number of crests passing by a

given point in 1 s; given in 1s =hertz (Hz)

Wavelength (λ) is inversely related to

frequency (ν) and energy (E):

– As λ↑ → ν↓, Ε↓ or As λ↓ → ν↑,Ε↑

**Electromagnetic Spectrum:**

* Continuum of radiant energy
* Gamma (γ) rays to radio waves
* The visible spectrum makes up a small portion
* Red light at 700 nm is lower in energy than blue light at 400 nm

**Bohr Theory of the Atom**

* Electrons move in quantized orbits called “energy levels” around nucleus
* **ground state:** electron(s) fill the lowest energy level(s) before any in higher level(s)
* **excited state:** electron(s) in higher energy level(s) before lower levels are full
* When an atom absorbs energy, e− jumps from lower energy to higher energy level.
* When an e− drops from a higher energy to lower energy level, it releases energy, sometimes as light → atomic emission spectra

**Schrödinger’s** equation → probability of finding the electron in a given region in space

→ probability density = electron cloud

→ “shape” of atomic orbitals

**Atomic Orbital Shapes**

* reflect the “probability density” for an electron in a given orbital
* As **principal energy level** (**n**=1, 2, 3,…) increases, the orbital size increases.
* Energy levels divided into sublevels (s, p, d, f)
* Know shapes and number of s, p, and d orbitals (e.g. one s, three p, five d orbitals).
* Be able to write ground state **electron**
* **configurations for any neutral atom or ion**
	+ Write using full notation and core notation
* (Noble Gas abbreviation)
* Recognize extra stability gained with filled and half-filled d orbitals (Cr, Mo, Cu, Ag)
* Account for electrons gained or lost for ions
* Know Representative Elements usually form ions that are **isoelectronic** with a Noble Gas Know definitions for atomic radius, metallic character, and ionization energy.

**Chapter 11 – Chemical Bonds**

Know **Periodic Trends for**

• **Atomic radius:**

* Increases down a group
* Decreases left to right across a period because effective nuclear charge increases
* **Metallic Character:** same trends as atomic radius
* **Ionization Energy (IE):**
* Decreases down a group
* Increase left to right across a period
* Opposite trend as atomic radius since
* IE ↓ as atomic radius ↑

**core electrons:** innermost electrons in filled

shells

**valence electrons:** outermost electrons

* The group number for each element is equal to its number of valence electrons
* Recognize that only valence electrons are gained, lost, or shared during chemical reactions.
* Draw **Electron Dot Symbols** for atoms and ions.

**Chemical bond:** what holds atoms or ions together in a compound

**Ionic bond:** electrostatic attraction holding cations and anions together in an ionic compound

**Ionic compounds** exist as 3D networks of ions.

* The formula indicates the **ratio** of ions.
* At 25°C ionic compounds are solids with very high melting points.

**Electronegativity (EN):** ability of an atom **in a bond** to draw electrons to itself

* Know F is most electronegative; further away from F, less electronegative an atom.

**Covalent bond:** sharing of electrons between two nonmetal atoms

**Nonpolar covalent bond:** equal sharing of electrons by two atoms with equal EN

* Electron density is even distributed between the two atoms.

**Polar covalent bond:** unequal sharing of electrons by 2 atoms with different EN

values → **dipole** (separation of charges)

* Electron density is concentrated towards the more electronegative atom.
* **dipole moment:** quantitative measure of the polarity of a bond.
* The greater the EN difference, the more polar the bond.

→ Rank different bonds in terms of increasing polarity.

Use **delta notation (**δ**+ and** δ**-) and a dipole**

* **Arrow** to indicate which atom in a bond is more electronegative.

**Octet rule:** atoms bond such that each has 8 electrons, except H only needs 2 electrons.

**Draw Lewis Structure for Molecules**

1. Count total number of valence electrons, then divide by 2 to get # of electron pairs.
2. Draw skeleton structure
* Least electronegative element in center, and H and F are always outer atoms
1. Connect all the atoms by drawing lines to represent single bonds
* Distribute remaining electrons around outer atoms, then central atom until each has an octet.
* Make double or triple bonds only if an atom does not have an octet.
* H and F only form single bonds.

**Resonance structures:** two or more structures representing a single molecule with delocalized electrons that cannot be

Described fully with only one Lewis structure

* Recognize which molecules require resonance structures.
	+ Know “delocalized electrons” are shared by three or more atoms in a molecule.
	+ Note: The delocalized electrons do NOT oscillate between atoms. They are **always** shared by the atoms, but there’s no other way for us to represent this.
	+ Know the relative length and strength of bonds with delocalized electrons.

**Molecular Geometry (or Shape)**

* Use Lewis structure and to get 3D shape and bond angles:
	+ AX2 → linear → 180°
	+ AX3 → trigonal planar → 120°
	+ AX4 → tetrahedral → 109.5°
	+ AX2E → bent → <120°
	+ AX3E → trigonal pyramidal → <109.5°
	+ AX2E2 → bent → <109.5°

**Chapter 12: Gases**

* Know the properties of gases.
* Know definitions: vacuum, gas pressure, atmospheric pressure, compressibility
* Recognize that atmospheric pressure decreases with altitude.
* Be able to convert between units of pressure: 1 atm ≡ 760 torr ≡ 760 mmHg = 14.7 psi
* Know how changes in volume, temperature, and number of particles affect gas pressure.
* Use **ideal gas law** (**PV=nRT)** to solve for P, V, n, or T (in Kelvins).

$$R=\frac{0.0821 L\*atm}{mol\*K}$$

* Given 2 sets of conditions, solve problems using

$\frac{P\_{1}V\_{1 }}{T\_{1}}= \frac{P\_{2}V\_{2 }}{T\_{2}}$, including canceling variables that stay the same to simplify. Recognize the temperatures (T’s) must be in Kelvins.

* **Solve for stoichiometry problems involving gases**
* Recognize that STP is standard temperature and pressure, defined at 0°C and 1 atm.
* **Dalton’s Law of Partial Pressure:**
* Use Dalton’s Law (Ptotal = P1 + P2 + P3 + …) to solve for total pressure or the partial pressure of one gas in a mixture
* **Kinetic Theory of an Ideal Gas**
* Know the kinetic theory of gases regarding particle volume, particle motion, attraction, collisions, and the average kinetic energy of each particle being proportional to the temperature.
* **Diffusion**: gradual mixing of molecules gas molecules by virtue of their kinetic motion
* **Effusion**: process of a gas under pressure escaping from a container via small opening
* Be able to identify the order that several gases escape out of a container by using their molar masses

**Real (Non-ideal) Gases**

* Recognize the conditions (low pressure, high temperature, large container volume) for gases to behave ideally and why.

**Chapter 18: Nuclear Chemistry**

* Know atomic notation
* Know different types of decay: α, β and γ, positron, electron capture
* Predict products for α, β and other nuclear reactions
* Write and balance nuclear equations
* Know term: parent and daughter nuclide
* Identify relationship between stability of nuclides and # of protons and neutrons
* Identify differences between nuclear reactions and chemical reactions
* Know applications of nuclear chemistry
* Solve problems involving half-life