Semester 1 Chemistry Final Exam – Review Notes

Chapter 1: The Science of Chemistry

- Key Terms and Definitions
- Physical Change versus Chemical Change ; Physical Properties versus Chemical Properties
- Kinetic Molecular Theory and the States of Matter
- Metric / Imperial Units Conversions – must memorize and know how to convert between metric prefixes
- Mass vs. Weight and Density Calculations
- Classification of Matter and Various Ways to Separate Mixtures

Chapter 2: Matter and Energy

- Key Terms and Definitions
- Energy (Potential versus Kinetic in a Molecular perspective) and Work
- Temperature vs. Heat and Converting between different Temperature units (Fahrenheit, degree Celsius, Kelvin)
- Heating Curve; (Phase Change versus Temperature Change)
- Exothermic Process versus Endothermic Process; First Law of Thermodynamics (Conservation of Energy)
- Steps and Reasons of the Scientific Method; Scientific Law, Theories and Hypothesis
- Law of Conservation of Mass and Calculations
- Physical Model versus Conceptual Model
- Uncertainty, Precision, Accuracy, Reliability; Calculating with Scientific Notations and Significant Digits
- Dimensional Analysis (Unit Factor Method) with Significant Digits
- Calculating Heat Amount when Temperature Change ($q = mc_P\Delta T$)

Chapter 3: Atoms and Moles

- Key Terms and Definitions
- Calculations involving Law of Conservation of Mass – Lavoisier
- Calculations involving Law of Definite Proportion using Mass Ratios – Proust
- Be able to recognize the use of Law of Multiple Proportions – Dalton
- Early Atomic Theories – Aristotle, Democritus, and Alchemy
- Dalton Atomic Theory
- Discovery of Electrons – Ben Franklin (electricity in lightening), J.J Thomson (Cathode Ray Tube, charge to mass ratio, Plum Pudding Atomic Model), Millikan Oil Drop Experiment (mass and charge of an electron)
- Rutherford Nuclear Model and the Gold Foil Experiment
- Properties of Protons, Electrons and Neutrons
- Atomic Numbers (# of Protons and Electrons), Mass Number, Calculating the number of Neutrons, Isotopes
- Monoatomic, Diatomic and Polyatomic Elements
- Wavelength, Frequency and Electromagnetic Spectrum (memorize different type of EM-waves, their relative frequencies, wavelength and energies)
- Diffraction Grating, Spectroscopes and Atomic Spectrum
- Max Planck's Photon Hypothesis, Einstein Photoelectric Experiments and the Particle-Wave Duality of Light
- Heinsenberg Uncertainty Principle (cannot ascertain the speed and velocity of an electron), DeBroglie's Electron Wave (electrons can behave like waves at high velocity) – leads to Schrödinger Wave Equations – leads to Probability Model
- Bohr Atomic Model (know how to draw), Energy Levels, Electron Shells or Orbits, Electrons being quantized
- Photon Emissions and Adsorptions due to electrons moving down and up between orbits
- Quantum Probability Model, Atomic Orbitals (Subshells types – s, p, d, f and the max. number of electrons they hold)
- Electron Configurations, Hund's Rule of electron pairing in p, d, f orbitals, Pauli's Exclusion Principle – electrons spin (two electrons per orbitals), and Bohr Energy Level Diagram
- Average Atomic Mass (Calculations)
- Calculating with Mass, Moles and Molar Mass

Chapter 4: The Periodic Table

- Key Terms and Definitions
- Triads and Law of Octaves
- Mendeleev's contributions to the Periodic Table of Elements and the Periodic Law
- Valence Electrons and the Octet Rule
- Properties of Metals and Non-Metals
- Different Groups (Families) and Transition Metals / Inner Transition Metals (Lanthanides and Actinides)
- Shielding Effect and Effective Nuclear Charge, and their effects on the Periodic Trends (Atomic Radii, Ionization Energies, Electron Affinity, Electronegativity, Boiling and Melting Points)
- Be able to order elements of different Periodic Trends (see point above)

Chapter 5: Ions and Ionic Compounds

- Key Terms and Definitions
- Valence Electrons and their relationships to groups of elements on the Table along with their chemical & physical properties
- Ions (Cations and Anions), Bohr Energy Level Diagram of Ions
- Transition Metals and Using Roman Numerals for naming them
- Charge Type of Metals and Non-metals, Charges of Representative Groups of Elements
- Ionic Equations and Electron Configurations of Atoms and Ions
- Periodic Trend of Ionic Radii
- Ionic Compounds, Lattice Energy and Ionic Bonds, Potential Energy Diagram for the Formation of Ionic Compounds
- Properties of Ionic Compounds
- Monoatomic and Polyatomic Ions
- Nomenclature of Ionic Compounds and Hydrates

Chapter 6: Covalent Compounds

- Key Terms and Definitions
- Covalent Bond and Covalent Compounds
- Bond Length and Bond Energy
- Dipole, Polar and Non-polar Covalent Bond, Bond Polarity and Bond Strength
- Metallic Bonds
- Nomenclature of Covalent Compounds (use prefixes); Common Names of some Covalent Compounds
- Lewis Structures, Single, Double and Triple Covalent Bonds
- Bonding Electrons Pairs and Lone Pairs
- Bond Energy and Bond Length of Multiple Bonds
- Drawing Lewis Dot Diagram for Covalent Molecules and Polyatomic Ions (use of Octet Rule and Exceptions to Octet Rule), Resonance Structures
- VSEPR (Valence Shell Electron Pair Repulsion), Effective Electron Pairs
- Geometry of Covalent Bond based on Effective Electron Pairs and # of Lone Pairs around the Central Atoms
- Polarity of Polyatomic Molecules and its effect of Melting and Boiling Points of Covalent Compounds