

Exam 3 Study Guide

December 7, 2023

This is a checklist based on the lecture and textbook materials. It is not expected to be an all encompassing study guide and provides a guideline for your studies.

Newer Material

Chapter 11: Bonding Theories

- Valence Bond Theory - hybridized orbitals corresponding to the electronic arrangement
- Molecular Orbital Theory - advantages and disadvantages
- Nuances between Valence Bond Theory and Molecular Orbital Theory
- Definition of a bond in terms of atomic orbitals
- Sigma (σ) and Pi (π) bonds - how they are formed
- Bonding and antibonding orbitals
- Filling in the electrons for the molecular orbitals of diatomic atoms

Chapter 12: Liquids and Solids

- Intramolecular and intermolecular forces - what are the difference?
- Types of intermolecular forces
- Textbook definition of dispersion vs Prof. Nguyen's manuscript to describe dispersion
- Ranking boiling point, melting point, vapor pressure, and viscosity
- Phase changes and heating curve - calculating amount heat
- Liquids boil at what vapor pressure assuming that the liquid is at ground level
- Phase diagrams - triple point, critical point, melting, sublimation, and vaporization
- Classification of solids

- Types of unit cells - simple cubic, body-centered cubic, and face-centered cubic

Chapter 13: Solutions

- Different concentration units - molality, percent by mass, mole fraction, and molarity
- Understand how to convert from one concentration unit to another
- Colligative properties (nonelectrolyte and electrolyte) - boiling point elevation, freezing point depression, and osmotic pressure
- Concept of vapor pressure lowering due to presence of solute

Material from Exams 1, 2, and 3

Chapter 1: Matter and Energy

- Classification - pure substance and mixture
- Different states of matter and its properties - solid, liquid, and gas
- Physical vs chemical changes
- Conservation of Energy
- Conservation of Mass
- Scientific notation e.g. $164.23 = 1.6423 \times 10^2$

Significant figures

- What do significant figures imply?
- Leading, sandwiched, and trailing zeroes
- Rounding rules for multiplying, division, addition and subtraction
- Combining multiple steps
- Unit conversion and prefixes
- Scientific method and examples where scientific method is applied

Chapter 2: Atoms, Ions, and the Periodic Table

- Dalton's Atomic Theory
- Law of definite proportions
- What are atoms made of?
- Millikan's oil-drop experiment

J.J. Thompson

- Cathode-ray tube experiment
- Plum Pudding Model
- Isotopes, atomic number, and mass number
- What are ions?
- Mass spectrometer
- Relative atomic mass calculation
- Periodic Table and its classifications

Chapter 3: Chemical Compounds

- Classifying ionic and molecular compounds
- Familiarize with the periodic table symbols and memorize polyatomic ions
- Understand the oxidation states for elements
- Naming rules for ionic and molecular compounds
- Naming acids

Chapter 4: Chemical Composition

- Mass percent composition formula
- The concept of the mol (Avogadro's number)
- Finding molar masses
- Molarity (mol/L)
- Dilutions ($M_1V_1 = M_2V_2$)

Chapter 5: Stoichiometry

- Chemical equations
- Mole ratios - converting from one compounds to another
- Meaning of mole ratios
- Limiting reagent problems
- Theoretical yield and percent yield
- Molarity (mols/L)
- Dilution problems ($M_1V_1 = M_2V_2$)
- Molarity of ions
- Stoichiometry with molarity

Chapter 6: Thermochemistry

- Kinetic energy vs potential energy
- Sign conventions (+/-)
- Internal energy - work and heat
- State function
- Endothermic, exothermic reactions and effects of catalysts
- Calculating heat ($q = mc\Delta T$) and thermal equilibrium
- Calorimetry calculations
- Standard enthalpy and enthalpy of reaction
- Hess' Law

Chapter 7: Gases

- Boyle's Law
- Charles' Law
- Avogadro's Law
- Assumptions of ideal gas law

Chapter 8: The Quantum Model of the Atom

- Relationship wavelength λ , frequency ν , and speed of light c
- Relationship between light energy and frequency and wavelength
- Electromagnetic spectrum (Radio waves, Microwaves, IR, visible light, UV vis, X-ray, and gamma rays)
- Bohr Model of the atom and its limitation
- Rydberg equation
- Quantum numbers (n, l, m_l, m_s) and atomic orbitals
- Heisenberg Uncertainty principle, Pauli Exclusion principle, Aufbau principle, and Hund's rule
- Electron configurations (long and short handed)

Chapter 9: Periodic trends

- Valence and core electrons
- Atomic and ionic radius

- Electronegativity trends
- Ionization Energy and Electron Affinity

Chapter 10: Covalent Bonding

- Lewis structure and steps to draw compounds
- Octet rule and exceptions to the octet rules
- Resonance structures and hybrid structure
- Nonpolar/Polar bonds and electronegativity

Chapter 11: Molecular Shape

- Define VSEPR Model
- Electronic arrangement/structure and Geometric Structure
- Nonpolar/Polar molecules