Final Exam Outline

GHP Chem
2024-2025

Unit 1: Science and Measurement

Section 1: The Scientific Method

a. Steps in the method
b. Experimental design
    a. Hypothesis statement
    b. independant/dependant variables
    c. controls

Section 2: Classification of Matter

a. Classify matter into the 4 categories: element, compound, heterogeneous mixture, or homogeneous solution
b. Describe matter as heterogeneous or homogeneous

Section 3: Chemical and Physical Properties

a. Describe a property as chemical or physical
b. Describe a property as intensive or extensive
c. Describe a change as chemical or physical

Section 4: Significant Digits

a. Count sig digs in any number - rules!
b. Round answers to the correct number of significant digits
    - multiplication/division
    - addition/subtraction
c. Density calculations

Section 5: Dimensional Analysis

a. Solve dimensional analysis calculations
b. More complex conversions:
    - Multi-unit calculations
    - squared/cubic value

Unit 2: Atomic Structure and Nuclear Chemistry

Section 1: The Discovery of the Atom - Research History

a. Major Scientists and their experiment/discovery
    - Thomson
    - Rutherford
    - Millikan
    - Bohr
    - Schrodinger

Section 2: Basic Nuclear Structure

a. Parts of the atom
b. Nuclear symbols

Section 3: Average Atomic Mass

a. Definition of isotopes
b. Calc average atomic mass from table of isotopic abundances
c. Calc of %A from average and masses of isotopes

Section 4: Types of Radiation

a. Types of nuclear radiation
    - Names
    - Nuclear symbols

Section 5: Radiation Reactions

a. definition/format of a reaction
b. Conservation of Matter
c. Writing balanced radiation reactions
    - From description
    - Fill in the blank
d. ID fission vs fusion

Section 6: Nuclear Stability

a. Forces acting in the nucleus
b. Ideal ratio of protons to neutrons - plot
c. Determine nuclear stability
    - Plot p:n ratio/ID stability
    - ID likely rad type released

Unit 3: Electron Configurations and the Periodic Table

Section 1: Bohr Model Electron Configurations

a. Basic description of the model
b. Rules for filling electrons in Bohr Models
    - MAX electrons/ring
    - sequence
c. Draw Bohr model diagrams given elements and charges

Section 2: Spectroscopy

a. Properties of light:
    - wavelength, frequency, and energy
    - Equations - no calcs needed
b. Basic quantum mechanics
    - Electron jumps in model
    - Energy absorption/release during jumps
    - Color of light in spectrum as a result
c. Predict spectrum of light from Bohr model

Section 3: Schrödinger Model Electron Configurations

a. Changes from Bohr
    - Wave Particle Duality
    - E-e repulsion
    - Uncertainty Principle
b. New picture of the atom
    - Basic orbital shapes
    - How electrons fill orbitals

Section 4: Box Diagrams

a. General rules for filling box diagrams
b. Draw box diagrams from template
c. Write shorthand configs
d. Write noble gas configs

Section 5: Mendeleev and the Periodic Table

1. Basic organization
    a. Atomic #/mass
    b. groups/periods
2. Advanced organization
    a. E-config patterns
    b. Trends preview
3. ID periodic groups on PT
4. Examples of common properties in element groups

~~Section 6: Periodic Trends~~

~~a. Trends in AR, EN, and IE~~
    - ~~ID from the shape of a plot~~
    - ~~Use to sort atoms in order~~
~~b. Coulomb's Law, Atomic Radius, and forces acting on electrons~~
~~c. Explain exceptions in trends~~
    - ~~Based on Octet rule~~
    - ~~Based on sizes of orbital~~

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Unit 4: Chemical Bonding and the Properties of Molecules

Section 1: Types of Chemical Bonds

a. Ionic vs Covalent bonding
b. The octet rule
c. Factors that affect bond strength/length

Section 2: Chemical Nomenclature

a. Naming/writing formulas for ionic compounds
b. Naming/writing formulas for covalent compounds

Section 3: Molar Mass and Percent Composition

a. Calculate molar mass
b. Calculate percent composition of any element in a compound

Section 6: Lewis Dot Structures

a. Draw LDS for any covalent compound
b. Draw multiple isomers for a chemical formula

Section 7: VSEPR Theory

a. Explain VSEPR Theory
    i. Valence Shells
    ii. Electron Pairs
b. Predict VSEPR shapes
    i. Simple shapes - 1 central atom
    ii. Complex shapes - 2+ central atoms

~~Section 8: Polarity~~

~~a. Define polarity~~
~~b. Discuss impact of molecular polarity on properties of a compound~~
~~c. Predict bond polarity~~
~~d. Predict molecular polarity~~

Unit 5: Chemical Reactions

Section 1: Balancing Equations

a. Role of conservation of matter
b. Balance chemical reactions

Section 2: Types of Chemical Reactions

a. Identify a reaction as fitting into one of the 6 rxn types we identified

Section 3: The Mole Concept and Conversions

a. Definition of a mol
b. Atomic Mass vs Molecular Weight
c. Convert between mols/mass/numbers of particles/volume of solution

Section 4: Stoichiometry

a. Mol-to-mol ratios
b. Stoichiometry calcs starting/ending in different units
c. Mol conversions
    i. Mass → mols
    ii. Vol of Gas → mols
    iii. # particles → mols

Section 5: Limiting Reactants

a. What are limiting/excess reactants?
b. Determine the LR via calculations
c. Determine the yield of a chem reaction
d. Determine the amount of XS reactant left over

Section 6: Percent Yield

a. Actual vs Theoretical yield
b. Calc % yield of a reaction given an actual yield
c. Explain meaning of % yield over/at/under 100%

Unit 6: Thermodynamics

Section 1: Heat and Temperature

a. Heat and systems
b. Specific heat
c. q = mCΔT calcs

Section 2: Enthalpy and Heat Stoichiometry

a. Definition of enthalpy
b. Definition of State Functions
c. Endothermic vs exothermic reaction
d. Enthalpy diagrams
e. Enthalpy Stoichiometry calcs

Section 3: Calorimetry

a. Describe the design and use a of calorimeter
b. Calcs
    i. Measuring specific heat
    ii. Measuring ΔH_{rxn}

Section 4: Calculating ΔH: Heats of Formation

a. Definition of Heats of Formation
b. Definition of Bond Enthalpy
c. Calculating ΔH from Heats of Formation

Section 5: Calculating ΔH: Hess' Law

a. Definition of Hess' Law
b. Calculating dH using Hess' Law

~~Section 6: Entropy, Gibb's Free Energy, and Reaction Spontaneity~~

~~a. Definition of Entropy (ΔS)~~
~~b. Definition of Gibb's Free Energy (ΔG)~~
~~c. Predict Spontaneity (no calcs)~~

Unit 8: States of Matter

Section 1: States of Matter and Phase Diagrams

a. Compare different properties of the 4 states of matter
b. State changes
c. Inter/Intramolecular forces defined
d. Phase Diagrams
    a. ID phase from plot
    b. ID phase changes

Section 2: Kinetic Molecular Theory

a. Properties of a gas: pressure, volume, temperature, and amount
b. Definition/postulates of KMT
c. Math relationships from KMT
    a. ID if direct or inverse
    b. Explain via forces/collisions

Section 3: Gas Laws

a. Solve for P, V, n, or T in any gas law equation
b. Gas Stoichiometry and PV=nRT