*Honors Chemistry*

# Final Exam Chapter Summaries

## FIRST SEMESTER

### Chapter 1: Chemical Foundations

SI units: meters, liters, grams
metric prefixes: kilo, centi, milli, micro
precision & accuracy
percent accuracy error (formula)
random and systematic error
significant figures: counting & in calculations
exponential notation
dimensional analysis (conversion factors)
density
classification of matter: pure substances, mixtures, solutions, elements, compounds
physical & chemical changes
physical & chemical properties

### Chapter 2: Atoms, Molecules and Ions

atomic theory
Rutherford's experiment
structure of atom
nucleus
protons, electrons, neutrons
atomic number, mass number
isotopes
nuclear symbol
molecules & ions
periods & groups
regions of the Periodic Table: main groups, transition metals, inner transition metals
noble gases, halogens, alkali metals, alkaline earth metals
metals, nonmetals, metalloids
ionic & covalent compounds
names of ionic compounds
names of binary covalent compounds
names of acids
formulas of compounds from name

### Chapter 3: Stoichiometry

atomic mass
molar mass (molecular mass)
moles
Avogadro's number
conversions: # particles ↔ moles ↔ mass
percent composition (mass percent)
empirical formula
percent composition ↔ formula
finding molecular formula from simplest formula and molar mass
formula from experimental data
percent composition conversions
writing and balancing chemical equations
reactants, products, coefficients
types of chemical reactions
composition, decomposition, single replacement, double replacement
mass/mole conversions in chemical reactions (stoichiometry)
limiting reactant, excess reactant
theoretical yield, experimental yield
percent yield

### Chapter 4: Chemical Reactions in Water Solutions

electrolytes & nonelectrolytes
strong vs. weak electrolytes
ionization equations
molarity
calculations involving molarity
finding the molarity of a solution
using molarity as a conversion factor
solution preparation
dilution: $\mathbf{V_1 \times M_1 = V_2 \times M_2}$
precipitation reactions
reading a solubility table
molecular equations
net ionic equations
stoichiometry of precipitation reactions
common strong & weak acids & bases

**Chapter 7: Atomic Structure & Periodicity**

wavelength ($\lambda$), frequency ($\nu$)
$\lambda \nu = c$
atomic spectra
Bohr model of the hydrogen atom
ground state, excited states
quantum theory
electron clouds
orbitals
principle energy levels ($n$)
sublevels ($s, p, d, f$): electron capacity and relative energies
possible values for 4 quantum numbers ($n$, $l$, $m_l$, $m_s$)
ground state electron configuration of atoms
abbreviated electron configurations
outer electron configuration
valence electrons
orbital diagrams
atomic radius
ionization energy
electron configuration & the Periodic Table
reactivity of elements & the Periodic Table

**Chapter 8: Bonding Concepts**

valence electrons
ionic bonding
covalent bonding
electronegativity
dipoles
electron configuration of ions
sizes of ions
lone pairs of electrons, bonding pairs
Lewis structures
Octet rule
exceptions to Octet rule
resonance
formal charge
molecular geometry: linear, tetrahedral, trigonal pyramid, bent, trigonal planar, trigonal bipyramid, octahedral, see-saw, T-shaped, square pyramid, square planar
polarity

**Chapter 22: Organic Chemistry**

properties of organic compounds
saturated and unsaturated hydrocarbons
alkanes, alkenes, alkynes
name alkanes
prefixes for 1-10 carbons
draw structures
structural isomers
aromatic hydrocarbons
functional groups
alcohols
carboxylic acids
formic acid, acetic acid
amines
esters
amides
condensation reactions (formation of esters and amides)
addition polymers
condensation polymers
polyesters and polyamides
homopolymers & copolymers
draw monomer from polymer and vice versa
polypeptides

**SECOND SEMESTER**

## Chapter 6: Thermochemistry

heat content = enthalpy
change in heat content (ΔH)
heat content diagrams
endothermic & exothermic processes
thermochemical equations
calorimetry:

$$Q = c \times m \times \Delta T$$

joules, calories
specific heat
$\Delta H_f°$, definition & use of table
Hess' Law
complete combustion
ΔH/mole conversions

## Chapter 5: Gases

Kinetic-molecular theory
  pressure
    barometer, manometer
  temperature
absolute zero temperature
relationship between pressure, volume, temperature
  Boyle's Law
  Charles' Law
Ideal Gas Law
R = 0.08206 L atm/mol K
molar volume
STP
molar volume @ STP = 22.4 L
molar mass and density of a gas
gas stoichiometry
partial pressure

formulas:

$P_{total} = P_X + P_Y + \ldots$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$PV = nRT$

$$d = \frac{mm}{mV}$$

$$P_1 = \left(\frac{n_1}{n_T}\right) P_T$$

## Chapter 10: Liquids and Solids

Differences between gas, liquid, solid
sublimation
Relationship of interparticle forces and $\Delta H_{fus}$, $\Delta H_{vap}$, melting pt and boiling pt
vapor pressure
equilibrium vapor pressure of water as f(T)
relative humidity
dew point
boiling point
heating curve
critical temperature & pressure
phase diagrams
  triple point, critical point
Intermolecular forces:
  London dispersion forces, dipole forces, hydrogen bonds
Properties of the following types of solids (conductivity, melting points, solubility): molecular, network covalent, ionic, metallic

**Chapter 11: Properties of Solutions**

solute
solvent
concentration
- molarity
- mass percent
- mole fraction
- molality

conversions between concentration units
molecular and ionic solutes
nonpolar and polar solutes and solvents
hydrophobic and hydrophilic substances
electrolytes and nonelectrolytes
Saturated, supersaturated and unsaturated solutions
solubility and temperature
solubility and pressure
colligative properties
- vapor pressure lowering
- boiling point elevation
- freezing point depression

van't Hoff factor
calculate number of moles, concentration or molar mass from freezing point

**Chapter 19: Radioactivity**

what makes elements radioactive
alpha emission
beta emission
nuclear equations
half-life
nuclear fission
- production of radioactive waste
- chain reaction

nuclear fusion

**Chapter 12: Chemical Kinetics**

reaction rate
- definition
- average rate for a time interval

rate laws
- order
- calculation of order and *k* from concentration and rate

factors affecting rate (and why)
- concentrations of reactants, temperature, surface area, catalysts

reaction mechanisms
- elementary steps
- rate equations for single step reactions
- multistep reactions
- rate determining step

activation energy
- relation to temperature
- relation to rate

energy diagrams
activated complex (transition state)
catalysis

**Chapter 13: Equilibrium**

definition of equilibrium
factors affecting equilibrium: temperature
equilibrium constant, *K*
- expression for *K* from equation
- only gases and aqueous
- relate to extent of reaction

find *K* for a reaction from *K* of related reactions
Reaction quotient, Q, & its relationship to *K*
calculation of *K* from concentrations at equilibrium and vice versa
LeChatelier's Principle
- statement of principle
- effect of adding or removing product or reactant
- effect of changing volume or pressure
- effect of changing temperature

relationship between temperature and *K* for endothermic and exothermic reactions
effect of changes on yield and rate

**Chapter 14: Acids and Bases**

properties of acids and bases
Bronsted-Lowry model
conjugate acid/base pairs
amphoteric substances
$K_W$: relationship between $[H^+]$ and $[OH^-]$
definitions of pH and pOH
defining acids and bases in terms of pH, $[H^+]$, pOH, and $[OH^-]$
find pH from $[H^+]$ and $[OH^-]$
strong and weak acids and bases
ionization equations
$K_a$ and $K_b$
  expressions for $K_a$ and $K_b$
  relationship to strength of acid or base
  relationship between $K_a$ and $K_b$
calculation of $K_a$ or $K_b$ from pH and concentration
calculation of pH from $K_a$ or $K_b$ and concentration
acid-base properties of salt solutions

**Chapter 15: Applications of Aqueous Equilibria**

acid-base reactions
buffers
  how they work
  significance of $pK_a$ of buffer
  Henderson-Hasselbach equation
  calculations relating $[A^-]/[HA]$ to pH
  how to prepare buffers
acid-base titrations
  equivalence point
  shape of titration curves
  relation of strength of acid or base to pH of equivalence point
pH indicators
  relevance of $pK_a$ of indicator

**Chapter 16:**

$K_{sp}$
  expression for $K_{sp}$
  calculations of equilibrium concentrations from $K_{sp}$ and vice versa
  relationship to extent of solubility
calculations of concentrations of ions that form precipitates
common ion effect

**Chapter 4/18: Electrochemistry**

definitions from Chapter 4
  oxidation and reduction
  oxidizing and reducing agents
  oxidation number
  oxidation-reduction reactions
balancing oxidation-reduction reactions
voltaic cells
  anode and cathode
  direction of electron and ion flow
  porous barrier/salt bridge
standard reduction potentials
  relationship to $E^o_{ox}$ and $E^o_{red}$
applications of values for $E^o$:
  calculation of cell voltage ($E^o$)
  reaction spontaneity
  strength of oxidizing and reducing agents
electrolytic cells