FINAL Review

Final Exam:
Tuesday, December 7, 8:00 – 10:00 am, 312
Lincoln Hall

On OWL
- **ChemWorks Review Topics**
- **Mastery Review Topics**

On Website:
- **Harris Review Topics**
- **Zumdahl Review Topics**
- **Equation Sheet for Final**

2 hour final (+ extra 5 minutes)
300 points

FINAL Review

KNOWN TOPICS

- Isotopes
- Lewis Structures
- Balancing Redox Reaction by Half-Reaction Method
- Titrations
- Nomenclature
- Formulas / % Composition / Molar Mass
- Stoichiometry Calculations
- Colligative Properties
- Buffers
- Basics of a Systematic Treatment

Z Ch 1, 2 (Atoms, Molecules, Ions / Nomenclature)

Atomic Theory
- conservation of mass
- law of definite / multiple proportions
- Avogadro's Hypothesis

Building Blocks of the Atom
- electrons
- protons
- neutrons
- isotopes

Periodic Table (periods / groups)
- metals / nonmetals / metalloids
- main group
  - alkali / alkaline earth metals
  - chalcogens / halogens
  - inert (noble) gases
- transition elements
- lanthanides / actinides

Nomenclature
- elements
- monatomic / polyatomic / positive / negative ions
- compounds (including acids)
- ordering elements in binary compounds

Z Ch 3 (Stoichiometry)

Relative Atomic Masses
- isotopes
- mole
- molar mass: atoms <-> moles <-> mass

Formulas
- % composition
- mass data
- chemical analysis

Chemical Equations
- balancing
- stoichiometry
  - mass <-> moles <-> molarity or volume
  - limiting reagent
- yields
  - theoretical
  - actual
  - %

Z Ch 4 (Chemical Reactions)

Types of Chemical Reactions
- dissolution
- precipitation
- acid / base
- oxidation /reduction

Working with Solutions
- dissociation / ionization
- electrolytes / polarity
- composition
  - mass % / mole fraction
  - molarity / molality
  - mixing or diluting
  - density: mass <-> volume

Precipitation Reactions
- solubility table
- balanced / total / net ionic reactions

Strong Acid/Base Reactions (Arrhenius)
- acid + base –> salt + water (neutralization)
- reactions with metal /nonmetal oxides
- reactions with carbonates / sulfites / NH_4^+ cmpds
- acid / base anhydrides

Redox Reactions
- oxidation numbers
- moles of electrons transferred
- balance via half-reaction method (in acid or base)

Titrations – acid / base, redox

Z Ch 13 (Bonding, Lewis, VSEPR)

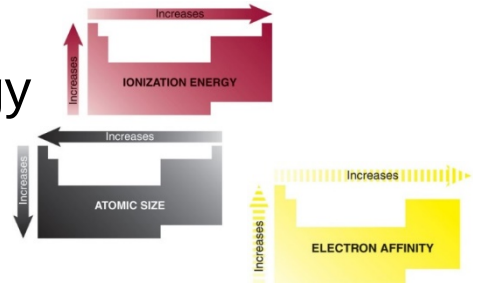
omit 13.5 – 13.8, hyperconjugation

Bonding

- ionic
- covalent
- polar covalent

Periodic Trends

- ionization energy
- size
- electron affinity
- electronegativity
- acidity/basicity



electronegativity/size effect

- acidity

Lewis Structures (obtain the “best” structure)

- resonance
- formal charge
- valence shell expansion

Valence Shell Electron Pair Repulsion (VSEPR)

- electronic geometry
- molecular geometry (shape)
- repulsions: BP/BP < BP/LP < LP/LP

Molecular Polarity

- polar bond
- bond dipoles
- molecular dipoles

Z Ch (Gases, Kinetic Theory, Real Gases)

omit 5.12

How Barometer Works

Gas Laws (don't memorize - ABC)

- combine with $PV = nRT$
- absolute zero
- density and molar mass
- $P_{tot} = P_A + P_B + \ldots$ (Dalton)
- $P_A = \chi_A P_{tot}$
- stoichiometry

Real Gases

- attractive forces
- repulsive forces
- van der Waals (predicts phase transition)
- compare ideal / real / van der Waals

Kinetic Theory

$PV = nRT = {}^1/_3 Nm\langle u^2 \rangle$

kinetic energy / mol only depends upon T

$u_{rms} = \sqrt{(3RT / M)}$ (work with)

Maxwell Boltzmann

- effect of mass
- effect of temperature

Graham's law of effusion

collisions (work with equations)

- with wall: $Z_W = (N / V) A ({}^1/_4 \langle u \rangle)$
- intermolecular: $Z = (N / V) \pi d^2 \sqrt{(2)} \langle u \rangle$
- mean free path: $l = 1 / \sqrt{(2)} (N / V) \pi d^2$

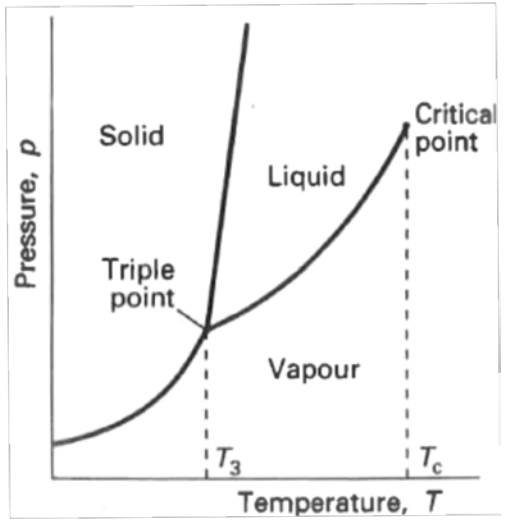
Z Ch 16 (Forces/Phases); Petrucci

Intramolecular Forces (bonding)
- ion / ion
- covalent
- metallic

Intermolecular Forces (nonbonding)
- ion / ion
- ion / dipole (H bond, strong)
- dipole / dipole
- ion / induced dipole
- induced dipole / induced dipole

Phase Transitions (normal => 1 atm)
- melting
- boiling
- subliming

Phase Diagram (*P* versus *T*)
- *s* / *l*, *s* / *g*, *l* / *g* equilibrium coexistence line ("Y")
- triple point
- critical point



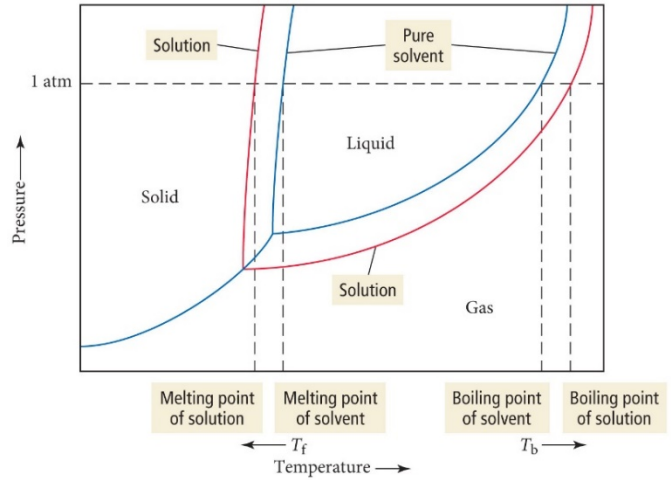
Z Ch 17 (Solutions/Colligative Properties)

Solution Composition

- mass percent
- mole fraction
- molarity
- molality
- using density

Colligative Properties

- *vapor pressure lowering* – Raoult's law (for solvent)
- Henry's law (for solute)
- *boiling point elevation*
- *freezing point depression*
- *osmotic pressure*
- electrolytes and van't Hoff "i" factor



Z Ch 6 (Chemical Equilibrium)

Equilibrium Constant

- law of mass action
- activity/activity coefficient
- K (molarity)
- K_P (partial pressures)
- reaction quotient, Q
- mathematics
  - multiply reaction by n
  - reverse reaction
  - add reactions
  - subtract reactions

Solving Equilibrium Problems

- homogeneous/heterogeneous reactions
- approximations
- using quadratic formula

Le Châtelier's Principle, change of

- temperature
- total pressure
- volume
- concentrations/partial pressures

Z Ch 7.1 – 7.4, 7.6 (Strong Acids and Bases)

Brønsted Lowry

- definition of acid/base
- conjugate acid/conjugate base
- autoionization
- know 7 common strong acids
- know soluble strong bases
- strength of acids/bases

pH scale

- depends upon water autoionization
- temperature dependence
- meaning of neutrality, acidity, basicity

these concepts used in most acid / base problems

H Ch 8.4, 9 (Systematic/ Monoprotic Acid-Base)

systematic treatment of equilibrium

- mass balance
- charge balance
- why and when needed
- for strong acids/bases
- for weak acids/bases [$K = x^2/(F - x)$]

acidity/basicity of salt solutions

- strong acids/bases
- conjugates
- meaning of neutrality, acidity, basicity

buffers

- what are they
- identify them
- quantitative response to added H^+, OH^-
- preparation
  - moles of acid or base and its conjugate
  - molarities of acid or base and conjugate
  - strong acid + weak base
  - strong base + weak acid
- Henderson-Hasselbalch
- setting up and using an ICE table

H Ch 10 (Polyprotic Acid-Base Equilibria)

omit 10.6

polyprotic acids and bases

write acid reactions

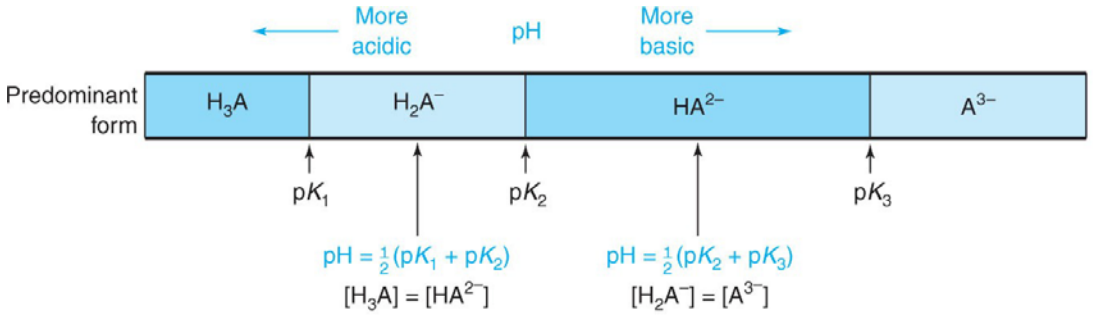
identify amphoteric species

intermediate form

how to determine pH from √

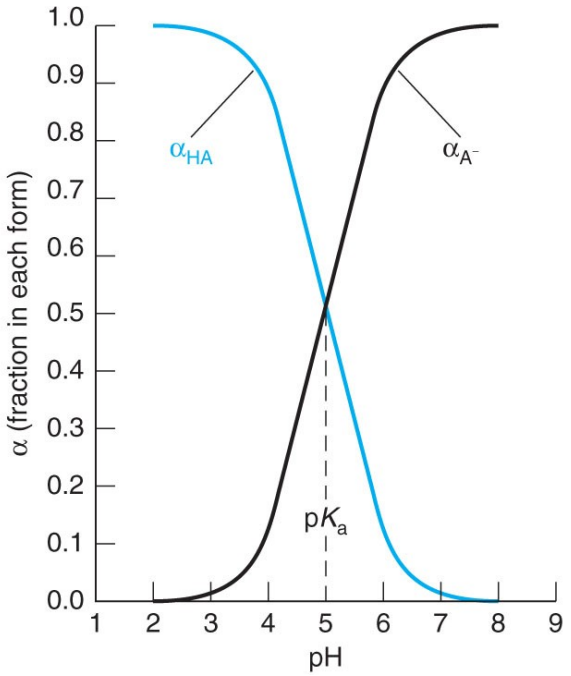
$pH = ½ (pK_{a1} + pK_{a2})$

principal species



buffers

fractional composition and plots



H Ch 11 (Titrations)

omit 11-5 – 11-8, 11-10

titrations

- strong acid/strong base
- weak acid/strong base
- weak base/strong acid
- polyprotics
  - $pH = \frac{1}{2} (pK_{a1} + pK_{a2})$

principal species

buffers

levelling effect