

Honor's Chemistry: Final Exam Study Topics

Introduction to Chemistry

- law of conservation of mass
- law of conservation of energy
- pure science vs. technology
- organic / inorganic compounds
- scientific law
- theory
 - phlogiston vs. combustion theory of burning
- hypothesis
- properties of acids and bases
- the scientific method
 - controlled experiment
 - avoid bias (Drunken Goldfish book)
 - conclusions must follow logically from data
- quantitative and qualitative observations
- graphing (line, bar, pie)
- laboratory equipment
- SI System (Metric System)
 - base units [meter, second, liter, gram]
 - derived units
 - prefixes [kilo-, base, deci-, centi, milli-, micro, atomo-]
- Measurement
 - scientific notation
- Accuracy vs. precision
- Conversion Factors
- safety
 - Material Safety Data Sheet
 - Chronic vs. Acute exposure
 - LD₅₀ values

Matter and Energy

- reactants and products

- chemical and physical properties

 - extensive vs. intensive properties

 - color, boiling point, density, mass

- chemical and physical changes

- states of matter (solid, liquid, gas)

 - phase diagram

 - sublimation (solid --> gas)

- energy: potential and kinetic

$$KE = \frac{1}{2} mv^2$$

- endothermic and exothermic reactions

 - effect of catalyst (activation energy)

- Nuclear energy

 - fission (splitting atoms) & fusion (joining nuclei)

 - half-life (radioactive decay)

- heat vs. temperature

 - temperature scales (Celsius, Kelvin, Fahrenheit)

$$^{\circ}\text{F} - 32 = 1.8 ^{\circ}\text{C} \quad \& \quad ^{\circ}\text{C} + 273 = \text{K}$$

 - absolute zero

 - calorimetry problems – heating curve

 - (specific heat, latent heat, heat of fusion, heat of vaporization)

 - latent heat

- Classification of Matter

 - pure substances: elements and compounds vs. mixtures

 - heterogeneous and homogeneous mixtures

 - solution (alloys), colloid, suspension

- atoms – H O B r F I N C l twins (diatomic), P₄ S₈ (polyatomic), allotropes

- SI base units

- conversions

- density

 - Archimedes Principle – water displacement method

- metals, nonmetals, metalloids

- Separation techniques

 - magnetism, distillation, chromatography, centrifugation, decant, evaporation, electrolysis

- Problem solving

 - Fermi approximations

Atomic Structure

development of model of atom

Greek, Dalton, Thomson, Rutherford, Bohr, Quantum mechanical model

Cathode Ray tube – electrons

Gold-foil experiment – nucleus (atom mostly empty space)

alpha particles (He^{2+} nucleus) deflected away

Geiger-counter

Bohr model – electrons in fixed orbit

Quantum mechanical model – electrons in orbitals (*s*, *p*, *d*, and *f*-orbitals)

electrons, protons, neutrons

electron configuration

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$ [shorthand configuration]

excited state vs. ground state

Filling order of electrons in atom

Aufbau Principle (bottom to top);

Pauli Exclusion Principle (two electrons per orbital);

Hund's Rule (most unfilled orbitals)

light (dual nature...particle & wave)

electromagnetic spectra ...IR...ROYGBIV...UV...

high frequency...short wavelength (high energy)

$c = f / \lambda$ ($c = 3 \times 10^8 \text{ m/s}$) $E = h f$ ($h = 6.6 \times 10^{-34} \text{ J/Hz}$)

continuous vs. quantized energy

emission spectra

lyman series (UV), balmer series (visible), paschen series (IR)

periodic table

atomic number (# protons), mass number (# protons + # neutrons)

isotopes (same element (# protons) but different # neutrons)

isotope notation: C-12 vs. C-14

ions (same element (# protons) but different number of electrons)

cations (+) charge: formed from metals that lose electrons

anions (-) charge: formed from non-metals that gain electrons

average atomic mass

$\text{AAM} = (\% \text{ A})(\text{mass A}) + (\% \text{ B})(\text{mass B}) + \dots$

Periodicity (Periodic Table Trends)

Mendeleev & Mosely

atomic mass vs. atomic number

group, period

names of elements (Greek, location, planets, people, Latin, synthetic)

names of families and groups...alkali metals, alkaline earth metals, transition metals, halogens, noble gases, lanthanide and actinide series, coinage metals, metalloids, essential elements

trends in atomic / ionic radius

down a column (family) atoms get larger due to increasing shielding effect

across a period (horizontally) atoms get smaller due to increased coulombic attraction

valence electrons

ionization energy

cations, anions

electronegativity

nuclear fission and nuclear fusion

Avogadro's number

molar mass, moles, atoms

properties of metals

salts – metal & non-metal

properties of ionic compounds

strong bonds, high melting points, rigid

Nomenclature & Chemical Formulas

oxidation number

apparent charge

finding formulas from oxidation number

naming compounds

binary (with fixed charge – Group 1, 2, Ag, Zn, Al)

binary (with variable charge)

Stock system (uses Roman numeral to signify charge on metal ion)

Old system “-ic” (higher oxidation state) & “-ous” (lower oxidation state)

polyatomic ions

memorize “-ates” PO_4^{3-} , SO_4^{2-} , CO_3^{2-} , NO_3^{1-} & CN^{1-} , OH^{1-}

“-ites” one less oxygen

“hypo ___-ite” two less oxygen

“per ___-ate” one more oxygen

percentage composition (by mass)

formula of a hydrate $\text{MN} \cdot \text{XH}_2\text{O}$

properties of covalent compounds

ionic (transfer electrons), covalent (share electrons), hydrogen bonds

Lewis “dot” structures

single, double, triple covalent bonds

structural diagrams

empirical formula / molecular formula

mole island

1 mole = 22.4 L @ STP = 6.02×10^{23} particles = Molar Mass

The following is a brief list of many of the topics we covered first semester. All topics covered on the final may not be listed below. Use your own notes to check for completeness.