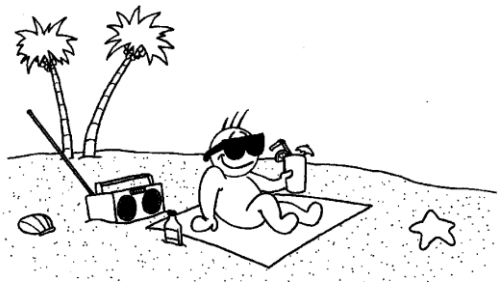
GHS Honors Chemistry
Final Exam Review Topics 2018



1. **Units of Measure:**
   - Significant Figures: know how to determine the correct sig figs for addition/subtraction, as well as multiplication/division.
   - Units of Measure and their conversions:
   - Conversions for mass (gram conversions), volume (units of Liter), temperature (Celsius to Kelvin), & length (meter).
   - Calculation for Density (g/ml) = (g/cm^3)

2. **Properties & Changes of Matter:**
   - Differentiate between pure substances (elements and compounds) vs. mixtures (heterogenous & homogeneous)
   - Can pure substances be separated by physical or chemical means? Compounds can be separated to elements only by chemical means.
   - What about mixtures … how are they separated (i.e. distillation for separation of a liquid mixture via boiling point differences, filtration via solubility differences, physical separation)?
   - Differentiate between physical & chemical changes
   - Define the changes of matter based on the Kinetic Molecular Theory of Matter … how do gases, liquids, and solids differ with respect to their KE, their properties (volume & shape).

3. **Electron Structure & Configuration:**
   - Know the major discoveries in the history of the atom; i.e. what were the experiments of Thomson, Rutherford, etc. that led to their discoveries about the atom.
   - # of protons, neutrons, and electrons for an atom or ion.
   - The maximum number of orbitals in a specific energy level = n^2; the maximum number of electrons in an energy level = $2n^2$.
   - Electron configuration using the s,p,d,f notation.
   - All of the s,p,d,f electrons configs that you determine are Ground State configs. Be able to write, and/or recognize what an excited state would look like (i.e. an electron absorbs a quantum of energy to move to a higher orbital).
   - Conversion of wavelength of light to frequency and energy using $c = \lambda v$, and $E = hv$.
   - Quantum Numbers … be able to determine the correct n, L, m_L, and m_S values for a given electron. Remember this? n = principal quantum number, L = 0,1,2, … n-1, m_L = -L … 0 … +L, and m_s = +1/2 or -1/2
   - What are isotopes?
   - How can you calculate the average atomic mass of an atom using the % occurrence of each isotope in nature?
   - What is the predicted charge based on an element's position in the periodic table?
   - Be able to determine the oxidation number (charge) of an ion using these predicted charges from the periodic table (i.e. the charge of Pt in K_2PtCl_4)

- What are the trends for the Periodic Table:
  a. Where are the metals, nonmetals, and metalloids on the Periodic table?
  b. What are the trends in Electronegativity, Electron Affinity, Atomic Size, Metallic character, Ionization Energy

4. Nuclear Chemistry:

- What are the subatomic particles? What are their notations?
- What is natural radioactivity?
- Why are nuclei naturally unstable and radioactive? (i.e. elements above Atomic No. 83 are all radioactive, because their neutron to proton ratio is too high.
- What is artificial transmutation; i.e. fission, fusion?
- Be able to complete a nuclear reaction (capture or emission/decay) based on the arithmetic using the atomic number and the mass number of alpha and beta partcles, and neutrons.
- What is half life? Calculate the remaining material after x number of $t_{1/2}$'s. Predict the half life given total time passed, and fraction of original material leftover.

5. Bonding:

- What is the difference between an ionic bond, a polar covalent bond, and a non-polar covalent bond?
- What are the properties of an ionic compound, or crystalline structure? Ionic solids have high melting points and are nonconductive. They become conductive only when dissolved or melted.
- Don't forget metallic bonds, and their "sea of electrons," which gives metals their properties of conductivity, malleability, ductility, etc.
- Be able to identify the bond types within a molecule.
- Predict Molecular Shapes based on the VSEPR Theory: you should be able to immediately recognize the basic shapes of tetrahedral (AX_4), trigonal pyramidal (AX_3E), Bent (AX_2E_2), trigonal planar (AX_3), and octahedral (AX_6)
- Be able to draw the molecules using the shortcut method that we went over in class, filling the ligands with an octet, counting the electrons, and then comparing that # to the valence e- available from each atom.
- Predict molecular polarity based on the polarity of the bonds within a molecule, and the symmetry of the molecule itself.

6. Properties and Nature of water:

- Know the properties and nature of water and its effects on surface processes.
- Like dissolves like
- Density of water compared to other substances
- Solubility of water with other non-polar and polar substances
- Expansion of water as it freezes
- Boiling point elevation and Freezing point depression

7. Formula Writing, Naming, & Chemical Reactions:

- Be able to write the chemical formula for an ionic compound based on the oxidation number, or charges, that are derived from the periodic table.
- Name ionic compounds … this includes know the names of those hated polyatomic ions.
- Name covalent compounds (using mono, di, tri, etc.).
- Name, draw, and/or identify saturated and unsaturated hydrocarbons, including alkanes, alkenes, alkynes, and aromatics.
- What are the five types of chemical reactions? Be able to recognize them, and predict the products for simple examples or single replacement, double replacement, synthesis, decomposition, and combustion.

8. Mole Conversions, Chemical Equations, & Stoichiometry:

- Moletown Conversions, or if you're not so inclined, conversions from grams to moles (& back) using the Molar Mass, molecules to moles (& back) using Avogadro's Number of 6.02×10^{23} molecules/mole, and moles to liters of gas at STP (& back) using 22.4 Liters/mole.
- Balancing Chemical Reactions
- Formula Weights:
  - Determine the Empirical Formula from % by weight
  - Determine the Molecular Formula from % Weight, and actual Molecular Weight
  - Determine the % Composition of each element from a molecular formula.
- Stoichiometry, and More Stoichiometry. Know how to perform:
  - Standard Stoichiometry at STP
  - Limiting Reactant Stoichiometry
  - Stoichiometry at T & P other than STP using the Ideal Gas Law of PV=nRT.
- Stoichiometry of volumes at constant T & P with Avogadro's Law of direct comparison of volume

9. Thermochemistry:

Part A: Heat of Phase Changes

- Describe the changes of matter based on the Kinetic Molecular Theory of Matter.
- What are the names for the phase changes, and know which are endothermic? Which are exothermic?
- Be able to interpret the following diagrams:
  - Phase Change (or Heat) Diagram, calculating Q along the curve with $Q = mc\Delta T$ and $Q = Hm$.
  - A Phase Diagram: Where are the normal phase transitions at 1 atm pressure? Where's the triple point? The Critical Point? What do they represent?
  - A Vapor Pressure Curve: where's the normal Boiling Point? What constitutes boiling of a liquid, with respect to atmospheric pressure and vapor pressure of that liquid? How does atmospheric pressure and temperature affect vapor pressure?

- Calculate the Specific Heat of a metal with Q lost = Q gained in a calorimeter experiment.

Part B: Heats of Reactions

- What are the three ways that endothermic/exothermic reactions are written:
  - As $+\Delta H$ (endothermic), and $-\Delta H$ (exothermic)
  - In the thermochemical reaction: value added to the left side in an endothermic reaction, the right in an exothermic reaction
  - As a Potential Energy curve.
- Determine the **Heat of the Reaction** using Hess's Law, Heats of Formation (Heat of Products – Heat of Reactants), and Bond Energies (Broken – Formed).
- Apply stoichiometry for the heat or a reaction … kJ/mole of a reactant or product
- Using a **Potential Energy Curve**, determine the Heat of a Reaction (ΔH), the Activation Energy, and demonstrate how adding a catalyst changes the PE Curve.
- Predict the change in **Entropy or ΔS (disorder)** from a chemical reaction using the factors discussed in class; i.e. Entropy is increased with:
  - increase in concentration
  - increase in the volume of a gas
  - increase in temperature
  - decrease in particle size
  - changing phases from solid to liquid to gas
  - dissociation of an ionic solid
- A negative ΔG signifies that the forward reaction is spontaneous, and the reverse is not. Predict the spontaneity of a reaction based on the signs of ΔH and ΔS (i.e. like the prediction table worksheet with reactions).
- Calculate the Gibbs Free Energy using $\Delta G = \Delta H - T\Delta S$

10. Solutions:

- **"Like Dissolves Like."** Can you predict which compounds would be soluble in water? Which would be soluble in a non-polar solvent? Which compounds would be electrolytic? This topic has a strong connection with molecular polarity.
- **Factors Affecting Solubility**: For both solids and gases that are dissolved in liquids.
- **Solubility Curves**: Interpret the Solubility curve to determine saturation, precipitation, etc.
- **Molarity (M)** calculations (mol/liter)
- **Molality (m)** calculations (mol/kg of solvent)
- Preparing Dilutions & Solutions: $M_1V_1 = M_2V_2$
- **Colligative Properties** … Freezing Pt. Depression and B.P. Elevation calculations using molality.

11. Kinetics:

- Describe the changes in the rate of a reaction based on **Collision Theory**. Anything that increases the "exchange or collision" of reactants will make the reaction faster. These include:
  - **Increased Temperature**: faster movement, harder collisions
  - **Increased Concentration**: more stuff, more collisions
  - **Decreased Particle Size**: Decreased particle size increases surface area
  - **Pressure on a Gas**: compressed gas molecules collide more often
  - **Dissolving solids**: solids would react slowly
  - **And adding Catalysts**: provides an alternate reaction pathway with a lower Energy of Activation.
- Determine the rate law, based on experimental data. **Be able to write the rate law, determine the overall rate, and calculate the rate constant (k) from existing experimental data (table).**

Equilibrium:

- What does it mean for a reaction to be in equilibrium? The rates of the forward and reverse reactions are the same. The concentrations of the reactants & products are constant, but not necessarily the same as each other.
- Determine the K_{eq} for a reaction. **Be sure to include only the products and reactants that are gaseous or aqueous.**
- What does the K_{eq} tell us? **$K_{eq} > 1$** tells us that the equilibrium is product favored, while a **$K_{eq} < 1$** tells us that the equilibrium favors the reactants.
- Apply **Le Chatelier's Principle** to predict the shift in equilibrium with a variety of applied "stresses." Which stress changes the K_{eq} value … only Temperature!

12. Acids and Bases

- **Distinguish an acid from a base:** Write formulas for acids and bases.
- **Properties of acids and bases:** Distinguish between acids and bases using their properties.
- **pH scale:** Draw and label the pH scale
- **Calculation pH and pOH:** $pH = -\log [H^+]$
  $pOH = -\log [OH^-]$
  $pH + pOH = 14$
- **Neutralization reactions:** Write neutralization reactions