

*This list is a general guideline to help you study. It is NOT a definitive list. There are potentially things on here that will not show up on the test, and there are potentially things not on the list that will show up on the test. Material that appeared in Daily Practice Problems, Notes, Homework, Classwork, Labs, Study Materials, topics from Honors Chem, etc all have the potential to appear on the test.*

**Directions:**

- Rank each of the following according to a 1 – 5 scale, where a “5” means you can teach another student and a “1” means I never learned this. **You need to be HONEST with yourself on these rankings.**
- Highlight each objective that you gave a 1 or 2.
- Circle each objective that you gave a 3
- Box each objective that is gave a 4 and 5
- Use these to help prioritize your studying. Remember – it may not be time effective to spend all your time on a “1” if you could improve several topics from a 2→3, or 3→4, etc.

**0 – Honors Review**

- \_\_\_\_\_ I remember the topics taught in Honors Chem and my summer assignment!
  - Chemistry basics, Atomic Structure, Electrons, Periodic Table, Bonding and Structure, Reactions, Stoichiometry, Advanced Chemical Ratios, Gas Laws, Thermochemistry, Solutions, Kinetics, Equilibrium, Acid Base, ~~Redox~~

**1 – Thermochemistry**

- \_\_\_\_\_ Calculate kinetic energy based on mass and velocity
- \_\_\_\_\_ Define kinetic and potential energy
- \_\_\_\_\_ Describe the 1<sup>st</sup> Law of Thermodynamics
- \_\_\_\_\_ Define a state function
- \_\_\_\_\_ Be able to write thermochemical equations for endothermic and exothermic reactions
  - \_\_\_\_\_ Draw, label & interpret potential energy diagrams for both endothermic & exothermic reactions
  - Be able to Label:
    - \_\_\_\_\_ PE of reactants, products & activated complex
    - \_\_\_\_\_ Activation energy of forward & reverse reactions
    - \_\_\_\_\_ Heat of reaction
- \_\_\_\_\_ Define enthalpy
- \_\_\_\_\_ Be able to tell from the  $\Delta H$  if a reaction is endothermic or exothermic
- \_\_\_\_\_ Be able to perform calorimetry problems to solve for a variety of variables
- \_\_\_\_\_ Be able to describe the difference between Specific Heat and Specific Heat Capacity, and when you would use one versus the other with regards to calorimetry problems
- \_\_\_\_\_ Define standard state conditions
- \_\_\_\_\_ Be able to explain why the standard heat of formation for an element and standard state conditions is zero
- \_\_\_\_\_ Be able to calculate the heat of reaction ( $\Delta H$ ) given the heats for formation for products & reactants
- \_\_\_\_\_ Be able to use Hess's Law to calculate ( $\Delta H$ ) for a reaction/process, including manipulating reactions by multiplying or reversing them
- \_\_\_\_\_ Be able to calculate energy change during a reaction by using bond energy data

**2 – Thermodynamics**

- \_\_\_\_\_ Describe the difference between thermodynamics and kinetics
- \_\_\_\_\_ Define enthalpy
- \_\_\_\_\_ Define entropy (in a better way than “chaos”)
- \_\_\_\_\_ Define spontaneity
- \_\_\_\_\_ Define  $\Delta G^\circ$ , and  $\Delta G$
- \_\_\_\_\_ Know the Gibbs-Helmholtz equation
- \_\_\_\_\_ Know what the sign on  $\Delta G^\circ$  is when a reaction is spontaneous
- \_\_\_\_\_ Understand the 2<sup>nd</sup> Law of Thermodynamics – the connection between the entropy change of the universe and spontaneity
- \_\_\_\_\_ Know which signs on  $\Delta H^\circ$ ,  $\Delta S^\circ$  are favorable
- \_\_\_\_\_ Understand the connection between reversibility of a process and the spontaneity of the process
- \_\_\_\_\_ Know under what conditions a change will always be spontaneous or never be spontaneous
- \_\_\_\_\_ Know under what temperature conditions unfavorable combinations of enthalpy and entropy may result in a reaction still being spontaneous

- \_\_\_\_\_ Understand what factors increase or decrease entropy of the system
- \_\_\_\_\_ Be able to make educated prediction on which scenarios would have more entropy than others
- \_\_\_\_\_ Given a thermochemical equation for a chemical or physical change, be able to predict the spontaneity by assessing the signs of  $\Delta H$  &  $\Delta S$
- \_\_\_\_\_ Be able to calculate  $\Delta H^\circ$ ,  $\Delta S^\circ$ ,  $\Delta G^\circ$  mathematically in a variety of ways
  - \_\_\_\_\_ Using formation values, Hess's Law, Gibbs-Helmholtz Equation, etc
- Know how thermodynamics and equilibrium are related conceptually and mathematically
  - \_\_\_\_\_  $\Delta G = 0$  at equilibrium
  - \_\_\_\_\_ Identify equilibrium on a graph of Gibbs Free Energy
  - \_\_\_\_\_  $\Delta G = \Delta G^\circ + RT \ln(Q)$
  - \_\_\_\_\_ Know the connection between  $\Delta G$ ,  $K$  and  $Q$  at equilibrium and in predicting which direction a reaction will proceed when not at equilibrium
  - \_\_\_\_\_ Be able to use  $\Delta G^\circ = -RT \ln(K)$  to solve for a variety of variables
  - \_\_\_\_\_ Be able to graph  $\ln(K)$  versus  $(1/T)$  to get a linear plot that can be used to determine  $\Delta H^\circ$  and  $\Delta S^\circ$  using the slope and the intercept
  - \_\_\_\_\_ Remember that phase changes are equilibriums and you can calculate the temperature at which they occur using Gibbs Free Energy calculations

### 3 – Kinetics

- \_\_\_\_\_ Use Collision Theory to describe how chemical reactions occur
- \_\_\_\_\_ Describe the difference between effective & ineffective collisions
- \_\_\_\_\_ Know the factors that influence reaction rate
- \_\_\_\_\_ Describe how changes in temp, pressure, concentration & surface area effect reaction rate
- \_\_\_\_\_ Describe how the nature of the reactants influences reaction rate
- \_\_\_\_\_ Describe how the presence of a catalyst affects reaction rate
- \_\_\_\_\_ Be able to indicate the effect of a catalyst on a PE diagram
- \_\_\_\_\_ Understand that rate laws are determined experimentally
- \_\_\_\_\_ Understand that rate orders match the coefficients for the rate determining step, not necessarily the coefficients in the overall reaction
- \_\_\_\_\_ Be able to write a rate expression in terms of any reactant or product
- \_\_\_\_\_ Be able to use a tangent line to calculate the instantaneous rate for a reaction
- \_\_\_\_\_ Be able to use a graph of concentration over time to identify reactants versus products, and determine stoichiometric ratios for each
- \_\_\_\_\_ Method of Initial Rates to determine the differential rate law
  - \_\_\_\_\_ Determine orders of each reactant
  - \_\_\_\_\_ Determine the overall order of a reaction
  - \_\_\_\_\_ Determine numerical value of rate constant
  - \_\_\_\_\_ Determine units of the rate constant
- \_\_\_\_\_ Be able to write the integrated rate law for  $0^{\text{th}}$ ,  $1^{\text{st}}$ ,  $2^{\text{nd}}$  order reactions
- Graphical analysis for integrated rate laws
  - \_\_\_\_\_ Determining rate order by finding a linear relation based on which item is plotted versus time
    - $0^{\text{th}}$  order = [ ] vs. time,  $1^{\text{st}}$  order =  $\ln[ ]$  vs. time,  $2^{\text{nd}}$  order =  $1/[ ]$  vs. time
  - \_\_\_\_\_ Using linear plot  $y = mx + b$  format to determine rate constant and other things from graphing of the integrated rate laws
- \_\_\_\_\_ Calculating Half-life based on which order reaction it is
- \_\_\_\_\_ Be able to explain how the length of the half-life does, or does not, change based on starting concentrations for  $0^{\text{th}}$ ,  $1^{\text{st}}$ ,  $2^{\text{nd}}$  order reactions
- \_\_\_\_\_  $0^{\text{th}}$ ,  $1^{\text{st}}$ ,  $2^{\text{nd}}$  integrated rate laws
- \_\_\_\_\_ Identify catalysts and intermediates in a rate law
- \_\_\_\_\_ Be able to write a rate law with no intermediates present by exploiting equilibrium of fast steps in the mechanism to substitute other things for the intermediate in the rate law
- \_\_\_\_\_ Use the Arrhenius equation to solve for a variety of variables
- \_\_\_\_\_ Use rearrangements of the Arrhenius equation to find various values  
(remember that every temperature has a unique  $k$  value, so you can graph the  $k$  value at various temperatures)
  - \_\_\_\_\_ Linear relation with rate constant and  $T$  in Kelvin
  - \_\_\_\_\_ Use the slope of your straight line plot of  $\ln(k)$  vs.  $(1/T)$  to find  $E_a$ , and the intercept to find the frequency factor
  - \_\_\_\_\_ Use the "Two Point" format when you only have two data points
- \_\_\_\_\_ Relationship of kinetics with equilibrium (challenging)
- \_\_\_\_\_ Show how a change in temperature or addition of a catalyst affects a Maxwell Distribution Curve
- \_\_\_\_\_ Describe what a pseudo  $1^{\text{st}}$  order reaction would be and how you would manipulate the experiment to do it.