**Ch. 13 States of Matter**

* Kinetic theory: all matter is made of tiny particles that are in constant motion; solids vibrate, liquids roll around, gases flit in all directions
  + All collisions of gas particles are perfectly elastic, which means no energy is lost
  + Gas pressure is the result of the large amount of collisions occurring on the walls of a container
    - As temp increases, velocity increases, so kinetic energy increases, which drives pressure up
    - Realize that average kinetic energy is a bell curve distribution (see page 388) …there is some variation shown but overall trends are measurable
  + Liquids have more intermolecular attractions than gases, so there is cohesion
    - These are lower in liquids which vaporize/evaporate more readily, which generates a higher pressure in the vapor phase (gas), which is called “high vapor pressure.”
      * Yes, as you raise the temperature, more particles in the liquid phase overcome these attractions, so the material vaporizes more readily, until you reach the temperature where all attractions are overcome…the boiling point
    - At a given temperature, below the boiling point, there are always some particles going from liquid to gas, and an equal amount going from gas to liquid…this is an equilibrium
    - As the surrounding pressure is lowered, it is easier for particles to move from liquid to gas phase…this is why we pressurize with a pressure cooker and pressurize your coolant system on a car…to raise the boiling point so that it doesn’t change phase/state.
  + Solids have their particles organized in crystal lattices and can only vibrate…if enough energy is given to them, but not enough for them to go from solid to liquid, we perceive this as they are getting hotter!
* Phase Diagram…see page 403
  + For a given combination of pressure and temperature, any substance will have a specific phase/state.
    - Think of the movement possible and you should be able to deduce this, as the pattern is constant
    - Triple point: where it can be solid, liquid, and gas…usually low T and P

**Problems: arrange bubble into concept map (406), 51, 55, 56, 65,71**

**Ch. 14 The Behavior of Gases**

* Compressibility: the concept that as pressure increases, the volume of a gas decreases
* Gas laws
  + Boyle’s law: at constant T: P1V1 = P2V2 (inversely proportional)
  + Charles’ law: at constant pressure: V1/T1 = V2/T2 (directly proportional)
  + Gay-Lussac’s law: at constant volume: P1/T1 = P2/T2 (directly proportional)
  + THE Combined Gas Law (all three rolled together):

P1V1/T1 = P2V2/T2

Caveats:

* all units must match (pressures, volumes, temperatures)
* all temperatures must be in Kelvins

**Ideal Gases**

* models used to allow us to understand the behavior of gases in the real world
* Ideal Gas Law
  + PV = nRT
    - P=pressure, V=volume, n=number of moles of gas, R=gas constant, T=temperature

Caveats:

* all units must match (pressures, volumes, temperatures)
* all temperatures must be in Kelvins

**Dalton’s law of Partial Pressures**

* in a mixture of gases, the total pressure is the sum of the pressures of all of the constituent gases (think pie chart!) page 432

**Graham’s law of effusion**

* in a nutshell, smaller molecules, moving at higher velocities, effuse faster than larger, slower molecules

**Problems: 46, 55, 57, handouts for practice**

**Ch. 15: water and aqueous systems**

* Being such a polar molecule, water has unique properties
  + Surface tension: the cohesion of the molecules tries to pull into a sphere but is flattened by gravity
  + Surfactants: short for surface active agents, these interfere by getting between water molecules and disrupt hydrogen bonding, which can affect surface tension and allows for soaps/detergents to interact with “soils” and effectively remove them in water
* Water as a solid: unique…the crystal lattice overcomes some of the hydrogen bonds, separating the molecules further than when in a liquid state, thus…ice floats with a lower density than liquid water
* Solution process: water solvated ions off solid crystal…see page 451
* Electrolytes: compounds which dissociate into ions in water and are capable of carrying an electric current
  + Strong means dissociates completely/largely
  + Weak means only dissociates a small amount, so #ions is low
* Hydrates…you already know about these
* Heterogeneous systems: can see components
  + Suspensions: material will settle out after agitation
  + Colloids: material stays in solution; typically has scattering of light (Tyndall Effect), think fog, milk, jello, aerosols in air, smoke

**Problems: 36, 43, 49, 66, 70**

**Ch. 16: Solutions**

I think you know most of this from your other activities, but read through, and find any questions that you would like to discuss.

**Problems: 51, 53**

**Ch. 17: Thermochemistry**

* The study of energy changes during chemical reactions and changes in state/phase
* Heat always flows from a warmer to a cooler object (unless work is done on the system)
* Exothermic: heat flows out of the system
* Endothermic: heat flows into the system
* Heat capacity: depends upon mass and composition
* Specific heat: the amount of heat to raise 1 g of a substance 1⁰C
* Q=mc∆T; heat = (mass)(specific heat of material)(change in temp)
* Calorimetry: the precision study of heat released/absorbed in reaction systems
* Change of state/phase: there is no temperature change during the phase change…all the incoming/outgoing energy is involved in the change of state
* Heat of solution: during the process of formation of a solution, heat is either released or absorbed…the solution will either cool or warm.

**Problems: 3, 13, 14, 19, 30, 32 (use table, page 530), 56, 62**

**Ch. 18 Reaction Rates and Equilibrium**

* Collision theory: reactions can occur only if the reactants collide with sufficient energy to overcome the amount needed to activate the reaction (see curve, pg. 543; realize that this reaction shows an exothermic reaction, as the energy of the products is lower than that of the reactants; endothermic is also possible, again with the activated complex being at a higher level than either reactants or products.
* Catalysts: see graph, pg. 547…lowers activation energy to better enable reaction occurring
* Reversibility of reactions: most reactions can go in both directions, and this equilibrium can be manipulated (Le Chatelier’s principle). This is that a system will shift its position in order to relieve a stress applied to it. This is a big deal…google Haber process for an important example.
* Equilibrium constant: a mathematical expression involving concentrations indicating whether a reaction goes toward products or reactants.
  + If Keq is >1, products are favored
  + If <1, reactants are favored
* Solubility equilibrium: same thing for dissolution, same idea…even if something is “insoluble,” there might be a very small amount that does dissolve, and yes, as scientists, we measure this. Read section 18.3
  + Common Ion Effect: adding a material with one of the ions of the salt present will have a negative effect on that material’s solubility
* Entropy: the universe prefers a more disorganized system, so anything which moves a system into more gas phase or liquid phase, if originating at a more organized state, will be favored.
* Enthalpy: the universe prefers a lower energy place, so same deal…lower energy systems are favored
* Free energy: the blend of entropy and enthalpy which determines the direction of the system

**Problems: 6, 7, 16, 17, 23, 31, 48, 52**

**Ch. 19: Acids, Bases, and Salts**

* Acids taste sour, can be either strong or weak electrolytes, typically generate hydrogen gas when reacting with metals
* Bases taste bitter, will be slippery, can be either strong or weak electrolytes, and almost never are something we ingest.
* Acids will burn on your skin, while bases don’t really elicit a sensation…this is why I think bases are much more dangerous, as they can be causing damage and you really aren’t aware!
* Arrhenius theory of acids and bases
  + Acids yield hydrogen ions in aqueous solution
  + Bases yield hydroxide ions in aqueous solution
* Bronsted-Lowry theory of acids and bases (expands the definition somewhat)
  + Acids are hydrogen ion donors
  + Bases are hydrogen ion acceptors
* Conjugate acids and bases: read 591-592 carefully!
* Lewis Theory of acids and bases (again, an expansion of the definition)
  + Acids are electron pair acceptors
  + Bases are electron pair donors
* pH: a measure of the concentration of hydrogen ions in a solution
  + pH = -log[H+]
  + Kw = [H+][OH-]
  + Read 19.2, pages 594-604
* Strengths of acids/bases is dependent upon degree of dissociation…see table 605
* Neutralization reaction: specific form of double displacement/replacement
  + Acid + base 🡪 salt + water
    - Salt does not mean NaCl!!!!!
  + Titration: procedure for neutralization reaction, allowing for measurement of unknown, calculations similar to dilution formula, must account for multiprotic or multibasic substances (if more than one H+ or OH- is present)
* Buffers are solutions where the pH remains relatively constant when acid or base are added

**Problems: 7, 9, 11, 15, 20, 30, 33, 41, 81, 119**

**Ch. 20: Oxidation/Reduction Reactions (Redox)**

* Mnemonics:
  + OIL RIG oxidation is loss, reduction if gain (of electrons)
  + LEO goes GER loss of electrons is oxidation, gain of electrons is reduction
* Refers to shift of electrons in a given reaction
  + Total number of electrons lost must equal total number of electrons gained
    - Yes, this is another moment where we are doing BALANCING!
* Where do we see this?
  + Corrosion! Most oxidation reactions: rusting, aluminum corrosion, the sacrificial zinc electrodes on boat motors, are all examples where redox reactions are occurring.
* Oxidation numbers…I think you already get these, right? See page 639 for the rules!

**Problems: 1, 9, 10, 17, 34, 39, 51**

**Ch. 21: Electrochemistry**

* The study of chemical reactions based on redox cells…where we measure the changes of energy involved in oxidation and reduction reactions
* This relates back to our activity series…the more active metal will be more readily oxidized!
* Read this chapter…it will help you understand our world where our daily intensive use of batteries is something which we could not live without.
* Realize that our practical processes of electroplating are basically forcing the reaction to occur using much electrical energy. We do this to put a less reactive metal on the surface of a more reactive metal to protect it…think chrome plating a steel bumper.

**Problems: 29**