Jonathan Lam
Dr. Nuzzo
H. Chem. per. 7
9 / 24 / 15

Honors Chemistry Chapters 2 & 3 Study Guide

Safety

- review first quiz and sheet

SI

- Systéme Internationale d'Unités
- base units:
    - time: second (s)
    - length: meter (m)
    - mass: kilogram (kg)
    - temperature: kelvin (K) (celsius [C] - 273)
        - measured with thermometer, in which small pressure differences caused by heat changes move it up and down
    - amount of substance: mole (mol)
    - electric current: ampere (A)
    - luminous intensity: candela (cd)
- derived units: cannot be measured with base units:
    - volume: sterer (st, m^3), liter (L, dm^3)
    - density: g/cm^3
- prefixes:
    - giga (G): 1 000 000 000
    - mega (M): 1 000 000
    - kilo (k), 1 000
    - hecto (h): 100
    - deka (D): 10
    - (unit)
    - deci (d): 0.1
    - centi (c): 0.01
    - milli (m): 0.001
    - micro (μ): 0.000 001
    - nano (n): 0.000 000 001
    - pico (p): 0.000 000 000 001

Significant Figures

- an instrument with a unit and a precision
- all measured numbers + one guessed digit (usually to the tenth of the smallest precision of the instrument — see http://chemistry.stackexchange.com/questions/37649 about non-base-ten precisions)
- counting:
    - see http://www.chemteam.info/SigFigs/SigFigRules.html for details
    - all non-zero digits
    - all zeroes between two sigfigs
    - all trailing zeroes after the decimal point
    - all zeroes to the tenudo mark (-) or the period (.) if given
    - placeholder zeroes (to show magnitude only) are not sigfigs
        - use scientific notation or the above marks to show magnitude with the right number of sigfigs

    - in absolute notation, the number of sigfigs in the first factor (not ten) is the number of sigfigs
    - exact numbers (such as 100 [not a measurement] or $\frac{12in}{1ft}$ [an exact conversion factor, can be used in dimensional analysis]) have an infinite number of sigfigs (round to the other number)
- operations:
    - adding / subtracting: round to the least precision
    - multiplying / dividing: round to the least number of sigfigs
- rounding:
    - see http://www.chemteam.info/SigFigs/Rounding.html for details
    - if next number > 5 round up
    - if next number < 5 round down
    - if next number = 5 and last number is odd round up
    - else don't round (if next number = 5 and last number is even)

Scientific Notation

- used to easily show numbers with a large or small magnitude with the correct number of significant digits
- form: $num \times 10^n$
- "num" is written with the correct number of sigfigs
- operations:
    - adding / subtracting:
        - convert to an equivalent power of ten
        - add nums
    - multiplication / division
        - multiply nums and powers of tens separately

Accuracy and Precision

- accuracy = how close a value is to an accepted value (a value considered true)
    - percent error used to describe accuracy: $PE = \frac{OV - AV}{AV} \times 100\%$
    - need to know accepted value to know if a measurement is accurate
- precision = how close a series of measurements are to one another
    - need to know multiple measurements and the precision of the instrument to know whether or not the measurements are precise
- do not have to go together or apart — can come in any combination

Graphs

- to visually show data, get a better sense of the data
    - table is better for exact measurements, but not as good for overall viewing
- type of graph to best suit data
    - pie: show percentage of a whole
    - bar: compare values of different categories
    - line: show a related set, a relation between two variables
        - usually change over time

Physical and Chemical Properties

- physical:
    - characteristics that can be observed without changing the substance
    - usually can use senses

    - things that will always be true of the substance
        - the magnetization of a metal rod is a physical property
    - extensive vs. intensive:
        - extensive:
            - properties that depend on the amount of the substance
            - examples: weight, mass, length
        - intensive:
            - properties that do not depend on the amount of a substance - the same for any amount
            - usually these are unique to a substance and a single one can be used to determine what it is
            - examples: density, color, state of matter at room temperature
    - includes states of matter (see below)
- chemical:
    - how a substance reacts (or doesn't react) to another substance
    - can only be observed through a chemical reaction
    - examples: flammability, reactivity to water, ability to rust/tarnish/corrode

Physical and Chemical Changes

- physical:
    - do not change the chemical makeup of the substance, but alter it in some way
        - usually the appearance or state of matter is altered
    - usually reversible, especially state of matter
    - examples: cutting, grinding, painting, chewing
- chemical:
    - change the makeup of the solution (making and breaking bonds to create new compounds/substances) to make new substances or turn the original substance into one
    - usually irreversible
    - examples: rusting, tarnishing, corroding, digesting, rotting, combustion
    - signs:
        - new / different physical properties (e.g. color)
        - formation of a gas/precipitant
        - creation of an odor
        - change in mass
        - creation of energy (heat or light)

Classifying Matter

- matter: anything that has mass and volume: all the physical "stuff" in our world
    - (pure) substances: matter with an unchanging composition, only made of one type of particle
        - element: the smallest part of an element, cannot be separated by physical or chemical means (a single atom or molecules of a single element [e.g. H_2 or O_2])
        - compound: a pure substance with two or more different elements chemically combined; properties are usually very different than constituent elements
            - molecular compound: covalently-bonded compounds
            - ionic compound: ionically-bonded compounds
    - mixtures: matter with multiple pure substances not chemically bonded
        - homogeneous mixtures (solutions): mixtures that are consistent and uniform throughout, and generally cannot be separated with mechanical means

        - heterogeneous mixtures: mixtures that are not consistent (individual parts can be identified, and it is generally much easier to separate, most of the time physically)

Laws of Matter

- law of conservation of mass
    - the mass of the products is the same as the mass of the reactants — no mass is created or lost
- law of definite proportions
    - for any amount of the same substance, the proportions of the masses of its constituent elements will always be the same
- law of multiple proportions
    - if different compounds are formed with the same elements, then the proportions of the elements will be different in every compound
    - "If two elements form more than one compound between them, then the ratios of the masses of the second element which combine with a fixed mass of the first element will be ratios of small whole numbers."

States of Matter

- solid
    - lowest energy state
    - incompressible
    - tightly packed atoms, sometimes in a regular pattern (a crystal lattice)
    - have a fixed volume and shape
    - solid deposited in a liquid solution during a chemical reaction is called a precipitate
- liquid
    - medium energy state
    - virtually incompressible
    - loosely packed atoms, can slide past one another
    - have a fixed volume but not a definite shape (fits the container)
- gas
    - high energy state
    - compressible
    - high energy atoms, filling up the space, moving rapidly
    - fills the space provided, no fixed volume or shape (fits the container)
    - vapor: the gaseous state of a substance that is not gas at room temperature
        - example: steam
- plasma
    - very high energy state
    - found on stars, and only in lightning on Earth

Mixture Separation Techniques

- filtration
    - separating solids from liquids with a porous barrier
    - example: salt from water
- distillation
    - using the different boiling points of mixture components to separate them
    - boil at the boiling points of all the components, from lowest to highest, letting them condense back into liquid form in between each time for collection
    - example: petroleum distillation, separation of a saline water solution

- crystallization
    - creating extremely pure substances dissolved in a solution
    - example: rock candy, some precious gems
- chromatography
    - dissolving a mixture in a solvent (mobile phase) which carries the mixture through a material (the stationary phase) to create a chromatogram
    - uses the different properties of the materials in the mixture and how they react to the stationary phase to separate them — some will travel further than others, showing the different substances
    - example: paper chromatography

Extra

- do word search
- know classmates' hobbies
- READ DIRECTIONS (don't anticipate); pay attention