NoBS Calculus

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Author's Notes

NoBS

NoBS strives for succinct guides that use simple, smaller, relatable concepts to develop a full understanding of overarching concepts.

Dedication

Jeffrey Wang: "To all those that helped me in life: this is for you."

Sources

This guide borrows certain material from the following sources, which are indicated below and throughout the paper will be referenced by parentheses and their names:

- (Schwartz) Martin Schwartz, University of North Texas

Part I
Atoms, molecules, and ions

Review your first semester of eighth grade science class.

Part II
Stoichiometry

Woo mix stuff together in proportions to form new things in proportions
    Basically chemical equations

Part III
Chemical reactions

There are three kinds: ionic, acid-base, and redox.

Part IV
Gases

$$PV = nRT$$

Part V
Introductory thermochemistry

Hess's Law? More like Hiss's Law.

Part VI
Quantum theory and atomic structure

1 Waves

- A wave is an oscillation that results in a movement of energy. Light has characteristics of both waves and particles.
- Two characteristics of waves
  - **wavelength** (λ, length) - distance between wave peaks
  - **frequency** (ν, per time) - number of peaks that pass a point in one second - HEY BTW "ν" IS NOT "v" IT'S CALLED NU kthxbai jk get back to studying
- Frequency related inversely to wavelength:

$$\nu \propto \frac{1}{\lambda}$$

- Product of wavelength, frequency is **speed of light** (c, length per time)
  - Relationship: $\lambda\nu = c = 2.998 \times 10^8 m/s = 3.00 \times 10^8 m/s$
  - Remember inverse relationships were $xy = k$? The "k" in this case is c, or the speed of light.
  - For any given wavelength, divide c by the wavelength to get the frequency.
  - Also, for any frequency, divide c by the frequency to get wavelength.
  - This c is seen in the famous equation $E = mc^2$.

2 Quantum theory

Energy

- Planck discovered energy comes in discrete "packets" called quanta. (Ergo, quantum theory.) So you can't break it apart. Just like how atoms are the smallest subdivision of matter, quanta are the smallest subdivision of energy.
- This is how we determine how much energy something truly has.
- Planck's constant = number of joules of energy a quantum (packet of energy) has = h $= 6.63 \times 10^{-34} J \cdot s$
- When electrons move down energy levels, they lose energy. This energy goes into photons, which are emitted from atoms. Photons have wave-like properties. Therefore, we can use that wave stuff to figure out the energy given by photons.

- Energy of each photon proportional to light frequency: $E_{photon} \propto \nu$
- $E_{photon} = h\nu = \frac{hc}{\lambda}$. (You can substitute ν for $\frac{c}{\lambda}$ because $\nu = \frac{c}{\lambda}$, per the waves section we just went over.)
- Multiply energy of a photon by Avogadro's number and hey look what you get, a mole of energy

Quantum numbers

- Use quantum numbers to determine what electron is in what orbital
- Four quantum numbers
- n - **principal quantum number**
  - $n = 1, 2, 3$
  - Determines energy level and size of orbital (Lower energy level vs higher energy level. Higher energy levels means larger orbitals)
- l - **azimuthal quantum number**
  - $l = 0, 1, 2, ..., n - 1$
  - Determines number and shape of orbitals
  - Better known as spdf
- m_l - **magnetic quantum number**
  - $m_l = -l, ..., -1, 0, 1, ..., l$
  - Determines orientation of orbitals (Basically, only two electrons per orbital, so you have to make different "orientations" of the same orbital for each two electrons)
- m_s - **spin quantum number**
  - $m_s = -\frac{1}{2}, \frac{1}{2}$
  - Determines "spin" of electron (because you get two electrons to an orbital, but they have to be going different ways, so this is how it's identified as going one way or another)
- **Pauli Exclusion Principle** - no two electrons can share the same set of quantum numbers. (For example, this means they can have the same principal, azimuthal, and magnetic quantum numbers, but the couldn't have the same spin quantum number!)

Part MMMMMMMMMM
Practice exercises

1 Blah blah

Problem 1.1 *Amil adds 1.75M of $HC_2H_3O_2$ into his daily juice blend. Assuming he drinks this juice blend thrice a day and his stomach pH before drinking the juice is 2.3, what is the pH of his stomach after all three juices were swallowed? (Amil drinks 100mL of acetic acid per cup, and his stomach can hold 1L of content. He has 50mL of stomach acid. Assume he fills up his stomach completely.)*