CHEMISTRY QUICK SHEET

Mole: is a chemical mass unit, that is defined as 6.022 x 10^{23} amount of particles (atoms, molecules or some other units). The mass of a mole is molecular weight in grams. **Example**: 1 mole of NH_3 has 6.022 x 10^{23} molecules, and weighs about 17 grams.

Molarity (a concentration unit) = $\frac{\text{Number of Moles of solute}}{\text{Number of Liters of solution}}$

Molality (a unit of concentration) = $\frac{\text{Number of moles of solute}}{\text{Number of kilograms of solvent}}$

Normality (a concentration unit) = $\frac{\text{Gram equivalent weights of solute}}{\text{Number of liters of solution}}$

Gram equivalent weight= $\frac{\text{Molecular weight of an element (or compound) expressed in grams}}{\text{Valency of the element, or of each cation/anion in the compound}}$

Example: Carbon-12 has an equivalent weight of 3 grams (Valency of Carbon-12 is 4)

Strong acid: an acid that is completely dissociated in an aqueous (water) solution. **Examples**: HCl, HBr, HI, HClO4, HNO3, H2SO4

Strong base: a base that is completely dissociated in an aqueous (water) solution. **Examples:** KOH, NaOH, RbOH, CsOH

Weak acid: an acid that is partially dissociated in an aqueous (water) solution.
Weak base: a base that is partially dissociated in an aqueous (water) solution.
Examples of Weak acids/Weak bases: Acetic acid (CH3COOH), HF, H2CO3, Citric acid, NH4OH

pH=- log ([conc. of H+ ion])= log 1/([H+ ion conc.])
pOH=- log ([conc. of OH- ion])= log 1/ ([OH- ion conc.]), pH= 14- pOH

Acid dissociation constant:

$HA \longleftrightarrow H^+ + A^-$, $K_a = \frac{[H^+][A^-]}{[HA]}$

Base dissociation constant:

$BOH \longleftrightarrow B^+ + OH^-$, $K_b = \frac{[OH^-][B^+]}{[BOH]}$, $pK_a + pK_b = 14$

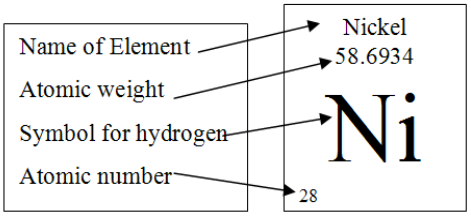
Henderson- Hasselbalch equation:

$pH = pK_a + \log \frac{[A^-]}{[HA]}$, $pOH = pK_b + \log \frac{[B^-]}{[BOH]}$

Equilibrium constant:

$aA + bB \longleftrightarrow cC + dD$, Example: $C_6H_{12}O_6 + 6O_2 \longleftrightarrow 6CO_2 + 6H_2O$

Equilibrium constant $K = \frac{[A]^a [B]^b}{[C]^c [D]^d}$



The **Nucleus**, at the center of the atom, contains the heavier protons and neutrons.
Electrons orbit around the nucleus in electronic shells. The first electronic shell can contain a maximum of 2 electrons, the second electronic shell can contain a maximum of 8 electrons, the third electronic shell, a maximum of 18 electrons, etc.

Neutron: The particle in the atomic nucleus with a mass = 1 atomic mass unit, and charge = 0 (neutral)

Atomic number: The number of protons in an element. If the element is neutral, atomic number is also equal to the number of electrons in the element.
Atomic weight: The average mass of an atom of an element, usually expressed relative to the mass of Carbon 12, which is assigned 12 atomic mass units (amu).
Molecular mass: the sum of the atomic masses of the atoms in a molecule.
Isotrope: different forms of a single element that have the same number of protons (atomic number), but differing numbers of neutrons (different atomic weight). **Examples:** Carbon 12 and Carbon 14 are both isotopes of Carbon, one with 6 neutrons and one with 8 neutrons (both with 6 protons).

Valency: the number of electrons needed to fill the outermost shell of an atom. **Examples:** neutral Carbon atom has 6 electrons, an electron shell configuration of $1s^2 2s^2 2p^2$, and has a valence of 4, since 4 electrons can be accepted to fill the 2p orbital. Group I has 1 valence electron, Group II has 2 valence electrons, and so on.
Cation: Ion with positive charge(s), **Example**: K+ (potassium ion), Ca2+ (calcium ion)
Anion: Ion with negative charge(s), **Example**: PO4 3- (phosphate ion), CO3 2-(Carbonate ion)
Lewis structures: are an opportunity to better visualize the valence electrons of elements.
Homogeneous solution: This is a uniform mixture consisting of only one phase. **Examples**: gasoline, margarine, etc.
Heterogeneous solution: The parts of a heterogeneous composition can be mechanically separated from each other. **Examples**: salad, trail mix, sand in water, etc.
Solute: the substance that is dissolved in a solution. **Example**: salt in water
Solvent: It is the substance in which the solute is dissolved. **Example**: water
Solution: A homogeneous mixture of two or more substances.

Buffer: A solution containing either a weak acid and its salt or a weak base and its salt, which is resistant to changes in pH. **Examples**: Na2CO3 and H2CO3, Acetic acid and Sodium acetate, H3PO4 and K3PO4

Ideal Gas Law: PV = nRT, where P is pressure, V is volume, n is number of moles, and T is temperature in Kelvins. The gas constant R= 0.0821 liter·atm/mol·K
Kelvin = Celsius + 273.15. Also note: 0 K is 'absolute zero', and there are no negative Kelvin temperatures.
Noble gas: elements found in **Group 8** at the far right of the Periodic Table. **Examples:** Helium, argon, xenon
Halogens: nonmetal elements in **Group 7** of the Periodic table. **Examples:** Flourine, Chlorine. Bromine, Iodine

Covalent bonds: bind atoms tightly **to each other** in stable molecules, but weakly to other molecules in the material. They have low melting points. **Example**: Carbon tetrachloride is a non-polar covalent molecule (CCl_4), with a Melting point is -23°C.
Ionic bonds: are between atoms (ions) that show strong attractions **to other ions** in their vicinity. They have high melting points. **Example**: solid NaCl is an ionic molecule, with a Melting point of 800°C.
Intermolecular hydrogen bonding is responsible for the high Boiling point of water (100 °C)

Hexagonal Closest Packed (HCC): described as ABABAB, with 14 atoms (7 in each of 2 layers). 12 nearest neighbors – 6 in plane, 3 above and 3 below. **Packing efficiency is 74%**
Cubic Closest Packed (CCP): described as ABCABCABC, with14 atoms (the 4 successive layers having 1, 6, 6, and 1 atoms). 12 nearest neighbors – 6 in plane, 3 above and 3 below. **Packing efficiency is 74%.**

Body Centered Cubic (BCC): This is not a closed packed structure, and is a more open and softer structure. 8 nearest neighbors. **Packing efficiency is 68%**.