Water,pH,Buffer Cheat Sheet

by rhettbro via cheatography.com/133961/cs/27499/

Water

the solvent for virtually all of biochemistry, ~70% of the mass within each cell is water

Carbon has **four electrons** in the **outer shell** - these hybridise into 4 sp^3 hybrid orbitals as tetrahedron. If symmetrical, the angle is **109.28 degrees**.

WATER AS A SOLVENT (**substances** such as household sugar **dissolve in water**, means that their molecules **separate** from each other, each becoming **surrounded** by water molecules.)

When a substance dissolves in a liquid, the mixture is termed a **solution**.

The dissolved substance is the **solute**, and the liquid that does the dissolving is the **solvent**.

Water is an excellent solvent for many substances because of its **polar bonds**.

Covalent bond	**Inside a molecule**
Hydrogen bond	**between molecules**
Polar bonds (H2O)	**uneven charge**
Non-polar bonds (O2)	**even charge**

Henderson-Hasselbalch equation

$$\text{pH} = \text{p}K_a + \log \frac{[conjugate\ base]}{[weak\ acid]} \text{ (for weak acid)}$$

$$\text{pOH} = \text{p}K_b + \log \frac{[conjugate\ acid]}{[weak\ base]} \text{ (for weak base)}$$

pH (potential hydrogen)

The **acidity of a solution** is defined by the **concentration of H+ ions** it possesses.

pH scale	**pH = -log10[H^+]**
pure water pH (7)	**[H^+] = 10^{-7}** moles/liter
acids	substance, **proton (H^+) donors**
bases	substance, **proton acceptors (such as OH^-)**

Water can act as both a weak acid and a weak base.

pH (potential hydrogen) (cont)

Acids in an aqueous environment	proton moves from one molecule to the other

pH is a measure of **acidity (<7)** or **alkalinity (>7).**

Higher amounts of protons in a solution	results in a lower pH (acidic)
Lower amount of protons	results in a higher pH (basic, or alkali)

Different Enzymes have different **optimal pH** according to their environment.

The **strength of an acid** is measured by its **dissociation constant, Ka.** The **larger** the **Ka** the more it **dissociates** and the **stronger the acid**.

The **pH** of a solution of a **weak acid** and **its conjugate base** is related to the **concentration of the acid and base** and the **pKa** by the Henderson-Hasselbalch equation.

When **ph < pKa**, the **weak acid predominates**. When **pH > pKa**, the **conjugate base predominates**.

Buffers

A solution which pH **resists** change upon addition of either small amounts of strong acid or strong base are added.

(consist of a weak acid and its conjugate base)

BUFFER CAPACITY - is related to the concentrations of the weak acid and its conjugate base,

The greater the concentration of the weak acid and its conjugate base, the greater the buffer capacity.

$H_2PO_4^-$ / HPO_4^{2-} is the principal buffer in cells, H_2CO_3 / HCO^{3-} is an important buffer in blood.

Buffers work because the concentration of the weak acid and base are kept in the narrow window of the titration curve.

Biological Buffer Systems

Maintenance of intracellular pH is vital to all cells:

1. Enzyme-catalyzed reactions have optimal pH,
2. Solubility of polar molecules depends on H-bond donors and acceptors,
3. Equilibrium between CO2 gas and dissolved HCO3- depends on pH.

Buffer systems in vivo are mainly based on:

1. Phosphate, concentration in millimolar range,
2. Bicarbonate, important for blood plasma,
3. Histidine, efficient buffer at neutral pH.

Buffer systems in vitro are often based on sulfonic acids of cyclic amines:

HEPES, PIPES, CHES.