Acids, Bases & Salts

Acids and Bases

- Dealing with ions
- Arrhenius theory – an acid which contains hydrogen and can dissociate in water to produce positive hydrogen ions

  e.g. $HX + H_2O \leftrightarrow H^+ (H_3O^+) + X^-$

  – A base reacts with a protonic acid to give water (and a salt)

  e.g. $HCl + NaOH \rightarrow NaCl + H_2O$
- BrØnsted-Lowry Theory – acids are proton donors; bases are proton acceptors

  e.g. $HCN + H_2O \leftrightarrow H_3O^+ + CN^-$

  HCN is an acid, in that it donates a proton to water. Water is acting as a base, as it accepts that proton
- Lewis Theory – an acid accepts a pair of electrons; a base donates a pair of electrons

  e.g. $HCl + NaOH \rightarrow NaCl + H_2O$

- The strength of an acid depends on the extent to which is dissociates and is measured by its dissociation constant Ka

Strong and weak acids and bases

- Strong acid – fully dissociates in water, i.e. almost every molecule breaks up to form H^+ ions
- Some strong acids are…HCl, H_2SO_4, HNO_3

- Weak acid – partially dissociates in water
- Some weak acids are…carboxylic acids such as CH_3COOH, C_2H_5COOH

- Strong base – fully dissociates in water, i.e. almost every molecule breaks up to form OH^- ions
- Some strong bases are….NaOH, compounds which contain OH^- ions or O^{2-} ions

- Weak base – partially dissociates in water
- Some weak bases…nitrogen-containing compounds, such as NH_3

- Strengths can be determined by the acid or base dissociation constant

Acids

- Act as proton donors
- Electron pair acceptors
- Strong acids dissociate fully in water.
- Weak acids partially dissociate.

- K_a: acid dissociation constant

$$HA + H_2O \rightarrow H_3O^+ + A^-$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

- Higher K_a values mean stronger acids

Bases

- Act as proton acceptors
- Electron pair donors
- Strong bases dissociate fully in water
- Weak bases partially dissociate
- K_b: base dissociation constant

Properties of acids

- pH less than 7
- React with certain metals to liberate hydrogen gas.
- Soluble in water release H^+ ions in solution.
- Strong acid can damage the skin and be dangerous.

Properties of acids

- Neutralizes bases
- They react with carbonates and bicarbonates to give off carbon dioxide gas.
- Good conductors of electricity

Properties of base

- pH greater than 7
- Dissolves fats and oils
- Usually forms OH^- ions in solution
- Neutralizes acids
- Soluble bases are called alkaline e.g sodium hydroxide, NaOH, potassium hydroxide KOH and ammonium hydroxide NH4OH

Properties of base

- Base are oxides or hydroxides of metallic elements
- Bases and alkalis will react with acids to neutralize them, forming salts plus water.
- Acid + Base → salt +water
- Acid |+alkali → salt +water

salts

- A salt is a neutral substance produced from the reaction of an acid and a base (Neutralization Reaction).
- Composed of the negative ion of an acid and the positive ion of a base.
- Examples: KCl, $MgSO_4$, Na_3PO_4

Neutralization Reaction

- A neutralization reaction is the reaction of an acid with a base to produce salt and water.
- Example

$H_2SO4 + NaOH \rightarrow NaHSO_4 + H_2O$

Prepared of salts

Salts can be prepared from several methods. Any particular method chosen depends on whether the salts are soluble or not. Soluble salts are prepared by methods which involve crystallization, while insoluble salts are prepared by methods which involve precipitation.

Prepared of salts

1. Preparation of Salts by The Action of An Acid Upon a Metal:

- This method is used to prepare soluble salts. E.g. the addition of granulated zinc to a dilute solution of tetraoxosulphate (VI) acid - effervescence of hydrogen occurs.
- $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

- 2. **Preparation of Salts by Double Decomposition**
- This method is used to prepare insoluble salts. lt involves the reaction between two soluble compounds to produce one soluble and one insoluble products. E.g. To prepare lead (II) tetraoxosulphate (VI) - suitable reactants for this are lead (II) trioxonitrate (V) and tetraoxosulphate (VI) acid (or any other soluble tetraoxosulphate (VI), e.g. Na_2SO_4).
- $Pb(NO_3)_2(aq) + H_2SO_4(aq) \rightarrow PbSO_4(s) + 2HNO_3(aq)$

- Or $Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + 2NaNO_3(aq)$
- Other salts which can be prepared by double decomposition are:
- - Barium tetraoxosulphate (VI)
- $BaCl_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s)$ white precipitate + $2HCl(aq)$
- - Lead (II) chloride
- $Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$

- - Calcium trioxocarbonate (IV)
- $CaCl_2(aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaCl(aq)$
- The principle behind double decomposition reactions is that the reactants decompose to their respective ions, and then reconstitution of the ions take place to form the insoluble salts, which are precipitated.

Ion in the body and fluids

- Electrolytes: an element or compound that, when melted dissolved in water or another solvent, dissociates into ion and is able to conduct an electric current.
- Electrolytes: are minerals in your body that have an electric charge. They are in blood, urine and body fluids. Maintaining the right balance of electrolytes helps your body, fluids. Maintaining the right balance of electrolytes helps your bodys blood chemistry, muscle action and other processes

- Levels of electrolytes in our bodies can become too low or too high. That can happen when the amount of water in your body changes, causing dehydration or over-hydration. Causes include some medicines, vomiting, diarrhea, sweating or kidney problems.
- Fluid balance
- The amount of water gained each day equals the amount lost.
- Electrolyte balance
- The ion gain each day equal the ion loss.
- Acid-base balance
- H+ gain is offset by their loss

- These electrolytes are involved in metabolic activities and are essential to the normal function of all cells. Concentration gradients of sodium and potassium across the cell membrane produce the membrane potential and provide the means by which electrochemical impulses are transmitted in nerve and muscle fibers.
- **Factors that affect body fluids are:**
- Age . (80 % Baby , 60 % Adult , 40 % aged client)
- Gender.
- Body fat content

- **The ECF and the ICF are two distinct fluid compartment**
- Intracellular Fluids (ECF): All fluids inside cells. The cytosol of cells Makes up about two-thirds of the total body water(2/3 66 %).
- Extracellular Fluids(ECF): All fluids outside cells.

❖Major components include the interstitial fluid.(25%)

❖Plasma (Intravascular fluids=inside) .(5-8 %)

❖Minor components include all other extracellular fluids, respiratory , urinary tracts . (1-2 %)

- Fluid moves freely within ECF compartment
- Water losses are normally balanced by gains Eating, Drinking, Metabolic generation

Composition of body fluids

The fluids circulating throughout the body in extracellular and intracellular fluid spaces contain

1.Electrolytes

•Dissociate (ionic bonds).

• Charged particles. (electricity).

• Responsible for osmotic activity.

2.Minerals

3.Cells

4. Water.

• Water moves between ICF & ECF which end to change in solute concentration.

•The exchange is regulated by hydrostatic & osmotic pressure.

•Changes of solute concentration in any compartment affect water flow.

5. Non electrolytes.

- ❖ Do not dissociate.
- ❖ Mostly organic molecules
- ❖ Do not contribute in osmotic activity.

Fluid Exchanges

- Osmosis: is the net movement of water from an area of low solute concentration across a semi-permeable membrane.
- Diffusion: is the net movement of solute from an area of high solute concentration to an area of lower solute concentration.
- Excretion is any process which gets rid of unwanted metabolic products. This includes carbon dioxide, in the air we breathe out; nitrogen and salts in sweat ; urine; bile pigments in fecal; hair and nails can also be considered excretion
- The main organs concerned with excretion in the body are the kidneys

- Isotonic: the solution being compared have equal concentration of solutes.
- **Hypertonic:** the solution with the higher concentration of solutes.
- **Hypotonic:** the solution with the lower concentration of solutes.

Electrolytes in Body Fluids

Calcium is the most abundant mineral in the body. Calcium salts are structural components of bones and teeth. Ca+2 which are primarily extracellular cations, function in blood clotting, neurotransmitter release, and contraction of muscle. Ca+2 level is controlled by parathyroid and calcitriol.

- In general, imbalances in calcium concentrations affect the bones, kidney and gastrointestinal tract. Calcium also influences the permeability of cell membranes and thereby regulates neuromuscular activity.
- Sodium affects the osmolality of blood and therefore influences blood volume, pressure and the retention or loss of interstitial fluid.
- Potassium affects muscular activities, notably those of the and the heart, intestines and respiratory tract and also affects neural stimulation of the skeletal muscles.
- Mg+2 ion intracellular cations that act as cofactors for enzymes.