**14.3 Acid and Base Strength**

**Aqueous solutions of acid and bases are most commonly used so it is convenient to use and acid’s tendency to donate a proton to water, or a base’s tendency to accept a proton from water, as a measure of their strength.**

**Strong Acids.**

* Acids that ionise completely in solution are called strong acids.
* Strong acids donate protons easily.
* Solutions of strong acids would contain ions with virtually no unreacted acid molecules remaining.
* Hydrochloric, sulphuric and nitric acid are the most common strong acids.

**Weak Acids.**

* Acids that do not completely ionise in solution are known as weak acids.
* Pure ethanoic acid is a polar molecular compound that ionises in water to produce hydrogen ions and ethanoate ions.
* In a 1M solution of ethanoic acid, less than 1% of the molecules are ionised at any one time.
* So at 25oC, in a 1M solution of ethanoic acid, the concentration of CH3COOO-(aq) and H+(aq) ions is only 0.004M. This is shown in an equation by the presence of reversible arrows.

**Strong Bases**

* The ionic compound sodium oxide (Na2O) dissociates in water, releasing sodium ions (Na+) and oxide ions (O2-).
* The ions react completely with the water: accepting a proton to form hydroxide ions (OH-).
* The oxide ion is an example of a strong base. Strong bases accept protons easily.

**Weak Bases.**

* Ammonia is a covalent molecular compound that ionises in water by accepting a proton. The ionisation can be represent by:
* Ammonia is behaving as a base because it has gained a proton. Water has donated a proton and so is behaving as a base.
* Only a small proportion of the ammonia molecules ionise, so that a 1M solution contains mostly ammonia molecules with some ammonia ions and hydroxide ions.
* Ammonia is a weak base in water.

**Polyprotic Acids.**

* Some acids can donate more than one proton from each molecule and are called polyprotic.
* The number of protons donated will depend on the structure of the molecule.
* An acids can be:
  + Monoprotic
    - Can only donate one proton and include hydrochloric (HCl), hydrofluoric acid (HF) and nitric acid (HNO3)
  + Diprotic
    - Can donate two protons and include sulfuric acid (H2SO4) and carbonic acid (H2CO3)
  + Tripotic
    - Can donate three protons and include phosphoric acid (H3PO4) and boric acid (H3BO3)
* Sulfuric acid (H2SO4) is diprotic and ionises in two stages.
  + Stage 1
    - Sulfuric acid is a strong acid and the first stage ionisation occurs to completion so that no H2SO4 molecules are found in solution.
  + Stage 2
    - The HSO4- ion formed in stage one can also act as an acid. In a 1.0M solution only a small proportion of those ions react further to produce H3O+ ions and SO42- ions.
    - HSO4- is a weak acid. A solution of sulphuric acid therefore contains hydrogen ions, hydrogen sulfate ions and sulfate ions
* Phosphoric acid (H3PO4) can ionise in three stages.
* Phosphoric acid is a weak acid and in a 1.0M solution only a small percent of the protons are donated at each ionisation satge.
* The extent of the ionisation decreases progressively from stages one to three

**Write the three stages of ionisation for phosphoric acid.**

**Strength verses Concentration**

* When referring to solutions do not confuse the terms strong and weak with concentrated and dilute.
* Concentration and dilute describe the amount of an acid or base dissolved in a given quantity of solution.
* Strong and weak refer to the complete or partial ionisation of the solution. Strong acids and bases react completely while weak react partially.

Text Book Questions: 6, 7 and 8.

Worksheet 31