Dynamic Equilibrium

Dynamic equilibrium is a condition of a specified system which obtains when macroscopic properties of that system, like P, T, V, E, H, S, ni (moles of each component i), and Mi (molarity of each component i) are not changing with time, even while microscopic processes are indeed still occurring.

Examples of dynamic equilibrium:

- The **vapor pressure experiment**: equilibrium between the liquid and gaseous phases of a pure substance.
- **Solubility of gases (and solids) in liquids**: equilibrium between the pure gas (or pure solid) and a liquid solvent **saturated** with the gaseous (or solid) substance. The concentration of the gas (or solid) when equilibrium has been reached (at a specified temperature) is called the **solubility** of the substance in that liquid at that temperature.
- Chemical equilibrium: a state in a specified chemical system at some specified temperature in which concentrations (and amounts) of products and reactants are not changing with time.

In all these cases dynamic equilibrium obtains if we wait long enough so that measurable properties are no longer changing with time. Dynamic equilibrium occurs when forward rates are equal to reverse rates. Rates of processes, and in particular rates of chemical reactions, fall under the subject of **kinetics**, while equilibrium states and the prediction of these equilibrium states fall under the subject of **thermodynamics**.

When a specified system exhibits dynamic equilibrium we say the system is in an "**equilibrium state" or just a "state**". This is a much broader meaning of the word "**state**" than is initially introduced in typical Chem 1A texts. Here we are not talking about solid, liquid, and gaseous "**states**" even though a single phase system can be in an equilibrium state if the measurable macroscopic properties are not changing with time.