# Topic 8 Test Study Guide

## Ways of measuring and calculating heat content

- Calorimetry
- Hess's Law
- Heats of Formation
- Bond Energy (Chemical Bonds) – know how to find $\Delta H$ using bond energies

**1st Law of Thermodynamics** (Law of Conservation of Energy)– The total energy of the universe is constant and cannot be created or destroyed

**State functions –** property of a system that changes independently of pathway

- **Total energy transferred** is independent of the pathway and therefore a **state function**
- **Work and heat** are dependent on the pathway (way energy is distributed) and are **not state functions**

**2nd Law of Thermodynamics – The entropy of the universe is always increasing.** (Heat cannot, of itself, pass from cold body to hot body. )

**Hess's Law of Heat Summation –** If a series of reactions are added together, the enthalpy change for the total reaction is the sum of the enthalpy changes for the individual steps.

**Bond Energy –** the energy required to break a given chemical bond

- Heat – flow of energy due to temperature difference, transfer/flow of energy from hot to cold
- Temperature – a measure of random motions of the components of an object

- Random motions of the components of an object constitute (make up) the thermal energy of that object. The flow of energy called heat is the way in which thermal energy is transferred from hot object to colder object.
- System and Surroundings – ex. Striking and burning a match
    - System – Reactants and products – focus
    - Surroundings – air in room, anything other than reactants and products – everything else in universe
- Exothermic – energy flows out of system
    - Ex. Combustion of match – burned match has lost potential energy transferred through heat to surroundings.
    - In exothermic reaction – Some PE stored in chemical bonds is converted to thermal energy (random KE) via heat
- Endothermic – absorbs energy from surroundings (heat flows into system)
    - Ex. Boil water to form steam
- Thermodynamics – study of energy
    - +x = endothermic
    - –x = exothermic

**Enthalpy**

- Enthalpy(Thermodynamics) – a special energy function (H) used to find out how much energy is produced (exo) or absorbed (endo) by a given reaction
- $\Delta H_p$ = heat
    - Under constant pressure, the change in enthalpy equals (the energy that flows as) heat
- Calorimeter – used to determine heat associated with a chemical reaction
- **One of the most important characteristics of enthalpy is that it is a state function, meaning that the change in enthalpy for a given process is independent of the pathway for the process.**
    - So, in going from a particular set of reactants to a particular set of products, the change in enthalpy is the same whether the reaction takes place in step or in a series of steps – **This principle is known as Hess' Law**

- **Energy as a driving force**
  - **Energy spread** – means that in a given process, concentrated energy is dispersed widely. This distribution happens every time an exothermic reaction occurs. For ex. When a Bunsen burner burns, the energy stored in the fuel is dispersed into the surrounding air. This process increases the random motions of the molecules in the surroundings. (Happens in every exothermic process)
  - **Matter spread** – molecules of a substance are spread out and occupy a large volume.
  - **These two factors are important driving forces that cause events to occur. – Processes are favored if they involve energy spread and matter spread. – they lead to greater entropy**
  - **** Entropy –** a function used to keep track of the natural tendency for the components of universe to become disordered ($\Delta S$ is used for disorder/randomness). Ice has lower entropy (more order, lower S value) and gas has a higher entropy (less order, higher S value).
  - **Spontaneous process** – occurs in nature without outside intervention (happens on its own)
    - **A process is spontaneous only if the entropy of the universe increases as a result of the process. – all processes that occur in the universe lead to a net increase in the disorder of the universe. The universe is always heading toward disorder – we are plunging toward total randomness(heat death of universe)**