5a. Chemical Energetics I

Definitions

Standard enthalpy change of formation: SECOF of a substance is the energy change when one mole of the pure substance in a specified state is formed from its constituent elements at standard states, under standard conditions of 298 K and 1 atm.

Standard enthalpy change of combustion: SECOC of a substance is the energy released when one mole of the substance is completely burnt in excess oxygen at 298 K and 1 atm.

- For strong acids and bases the enthalpy involves the combination of 1 mole of H+ ions with 1 mole of OH- ions to form 1 mole of H2O
- Neutralisations involving weaker acids are generally less exothermic as they are only partially ionised, external energy is required to fully dissociate them.

Standard enthalpy change of neutralisation: SECON is the energy change when an acid and a base react to form one mole of water at 298K and 1 atm.

Standard enthalpy change of atomisation: SECOA of an **element** is the energy absorbed to form one mole of gaseous atoms from the element in its standard states at 298 K and 1 atm.

Standard enthalpy change of atomisation: SECOA of a **compound** is the energy absorbed to form gaseous atoms from one mole of the compound at 298K and 1 atm. OR the energy required when one mole of _____ is broken into its constituent gaseous atoms.

Bond energy: BE of an X-Y bond is the **average** energy absorbed when 1 mole of X-Y bonds are **broken in gaseous state**. (to form constituent elements in their gaseous form)

lonisation energy: IE of an element is the energy absorbed when one mole of gaseous atoms loses mole of electrons to give one mole of singly positively charged positive gaseous ions.

Electron affinity: EA of an element is the energy change when one mole of gaseous atoms acquires one mole of electrons to give one mole of singly negatively charged gaseous ions.

Lattice energy: LE is the energy released when one mole of the solid ionic compound is formed from its constituent gaseous ions.

Standard enthalpy change of hydration: SECOH of an ion is the energy released when one mole of the gaseous ion is hydrated.

Standard enthalpy change of solution: SECOS of a substance is the energy change when one mole of the substance is completely dissolved in a solvent to form an infinitely dilute solution.

5b. Chemical Energetics II

Definitions

Entropy: Entropy is a measure of the disorder of matter and energy in a system, the more disordered a system, the larger its entropy.

- Dissolution of an ionic solid in water causes an increase in entropy as the ions, which were previously held rigidly in the solid are now free to move around in the liquid.
- HOWEVER, the hydration process of the ions decreases randomness about the ions as it puts the hydrating water molecules into an orderly arrangement around it through ion-dipole interactions.
- Therefore, for salts which contain highly charged ions, dissolution could result in a decrease in entropy.
- Increase in temperature → more packets of energy available to spread out in the system, thus resulting in more ways to spread them out and hence an increase in entropy.
- Exergonic (feasible) VS Energonic (not feasible)

Questions

1. Why do experimental lattice energies differ from theoretical lattice energies? (experimental more exothermic)

Ans: It is assumed that a pure ionic compound is formed, hence the partial covalent character (due to polarisation of anion by cation \rightarrow sharing of electrons) is not accounted for, leading to discrepancies.