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BORN-HABER CYCLES, ENTROPY & GIBBS FREE ENERGY
CHEAT SHEET

Born-Haber Cycles

- Lattice enthalpy cannot be measured directly, so there's a need to use the total enthalpy change is independent of the route taken.
- Born-Haber cycle is used to calculate lattice enthalpy.

Theoretical Lattice Enthalpies

- A perfect ionic model of a lattice assumes that all of the ions are identical and that positive distributed charge around them.
- The experimental lattice enthalpy value may differ from the calculated value giving evidence that some ionic compounds have partially covalent character.
- Positive only normally attract neighbouring negative ions.
- More polarisation = more covalent character.
- Small positively charged ions (high z_+) are more polarising than large positive ions, and large negatively charged ions (high z_-) are more polarisable than small negative ions (low z_-).

Dissolving Ionic Compounds

- Dissolving an ionic compound has two steps:
 - The bonds between the ions in the lattice break (endothermic).
 - Bonds between the ions and water is made (hydration = exothermic).
- Standard Enthalpy of Solution ΔH_{sol}^\ominus is the enthalpy change when one mole of ionic substance completely in sufficient solvent under standard conditions to form a solution in which the solute ions are far enough apart not to interact with each other.
- The hydration of ions requires the separation between the solvent and the solute to be of similar strength to the interactions between the positively and negatively charged ions in the lattice for that ion to dissolve.
- More exothermic will = more covalent. See water because of the favourable electrostatic interactions between the opportunity charged ions in the solvent and the ions.
- Standard enthalpy of hydration ΔH_{hyd}^\ominus is the enthalpy change when one mole of aqueous ions is formed from gaseous ions under standard conditions.
- The enthalpy of solution and the enthalpy of hydration provides another path to calculate the lattice enthalpy of dissolution / hydration.

Entropy

- Entropy can be thought of as a measure of disorder.
- The terms feasible or spontaneous are used to describe reactions that can take place on their own.
- It is a fundamental observation that in any spontaneous process, the total entropy of the universe will always increase.
- $\Delta S = S_{products} - S_{reactants}$
- $\Delta S^\ominus = S_{products}^\ominus - S_{reactants}^\ominus$
- Entropy increases during changes in state that give the particles access to a greater number of configurations.
- For a liquid to form a solid, the particles are more ordered and the molecules and particles have different numbers of modes of gas molecules. If the products have fewer modes, then entropy decreases.
- Fewer moles of gas = Fewer particles = Fewer configurations = Lower entropy.

Gibbs Free Energy

- Whether a reaction can happen spontaneously depends on the Gibbs free energy change and entropy change.
- $\Delta G = \Delta H - T\Delta S$
- $\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$
- ΔG^\ominus change in Gibbs free energy of the system (kJ mol^{-1})
- ΔS^\ominus change in entropy of the system ($\text{J K}^{-1} \text{mol}^{-1}$)
- Reactions are only feasible:
 - ΔG^\ominus is zero or negative.
 - Independent of independent of concentration.
 - Reactions may be feasible at one temperature and not another.
- To calculate the temperature at which a reaction becomes feasible, the Gibbs Free Energy equation has to be rearranged:
$$\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$$
$$\Delta G^\ominus = 0$$
$$\Delta H^\ominus = T\Delta S^\ominus$$
$$T = \frac{\Delta H^\ominus}{\Delta S^\ominus}$$
- Enthalpy also influences whether a reaction can occur. If the activation energy is too high or the rate of reaction is very slow then the reaction may happen even if the reaction is thermodynamically favourable.

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The reaction must take place in a laboratory, and the cell that makes the donor is not involved with the reaction.. Download (PDF) Rite, Chemistry A Level Notes Pdf Download Download (PDF) Honeycomb, Honeycomb A Level Notes Pdf Download Download (PDF).. The C-Cloning process needs to be performed in both the presence and absence of the donor cell: the active donor cells must be removed from the reaction mixture, they must be replaced, but they must never be present when the reaction mixture is being prepared.

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While some of our favorite reactions produce single-cell structures, others do not. If the donor cell is involved in both of these reactions, then you will observe different results. The best results may be obtained by adding one or more cells from either the experimental medium or culture medium to make sure the presence and/or presence of the donor is preserved. And we will examine this more further.. Chemistry level calculator for the Level 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29 and 30.. Chemistry level calculator for the Level 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29 and 30.. A level notes Pdf Download The Level Calculator for Chemistry Level 1-5. Chemistry level calculator for the Level 1-5.. A Chemistry level calculator for the A and B levels. Chemistry level calculator for the A and B levels.

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Born-Haber Cycles

- Lattice enthalpy cannot be measured directly, so Hess's law is used. The total enthalpy change is independent of the route taken.
- A Born-Haber cycle is used to calculate lattice enthalpy.

Theoretical Lattice Enthalpies

- A perfect ionic model of a lattice assumes that all of the ions are spherical and have evenly distributed charge around them. The experimental lattice enthalpy values differ from the calculated values, giving evidence that some ionic compounds have partially covalent character.
- Positive ions normally polarise neighbouring negative ions.
- More polarisation = more covalent character.
- Small, positively charged ions (like Li^+) are more polarising than large, positively charged ions, and large, negatively charged ions (I^-) are more polarisable than small, negatively charged ions (F^-).

Dissolving Ionic Compounds

- The bonds between the ions in the lattice break (endothermic).
- Standard enthalpy of hydration, $\Delta H_{\text{hyd}}^\ominus$, is the enthalpy change when one mole of an ionic compound is dissolved in sufficient water to form a solution of concentration 1 mol dm⁻³.
- The hydration of ions involves the interactions between the solvent water molecules (or OH^- and H^+ ions) and the ions. The interactions between the positively and negatively charged ions are lattice forces for the ions to dissolve.
- Ions dissolve well in polar solvents, like water, because of the hydrogen bonding interactions between the oppositely charged ions in the solvent and the ions.
- Standard enthalpy of hydration, $\Delta H_{\text{hyd}}^\ominus$, is the enthalpy change when one mole of aqueous ions is formed from gaseous ions under standard conditions.
- The enthalpy of solution and the enthalpy of hydration provide another approach to the calculation of lattice enthalpy.

Entropy

- Entropy can be thought of as a measure of disorder.
- The Boltzmann or Boltzmann equation is used to describe reactions that can take place on their own.
- It is a fundamental observation that in any spontaneous process, the total entropy of the universe will always increase.
- $\Delta S = S_{\text{products}} - S_{\text{reactants}}$
- ΔS change in the total entropy.
- ΔS_{system} Total standard entropy of the products.
- $\Delta S_{\text{surroundings}}$ Total standard entropy of the reactants.
- Reactions that produce gases result in an increase in entropy.
- Reactions that produce a larger number of particles than they give the particles will result in an increase in entropy.
- Reactions that produce a smaller number of particles than they give the particles will result in a decrease in entropy.
- The sign of an entropy change can be predicted from the number and products have different numbers of moles of gas molecules. If the products have fewer moles, then entropy decreases.
- Freeze: moles of gas = Fewer particles = Fewer configurations = Lower entropy.

Gibbs Free Energy

- Whether a reaction will happen spontaneously depends on the change in Gibbs free energy and entropy change.
- The Gibbs Free Energy Equation: $\Delta G = \Delta H - T\Delta S$
- ΔG change in Gibbs free energy (kJ mol⁻¹)
- ΔH change in enthalpy of the system (kJ mol⁻¹)
- T temperature of the system (K)
- ΔS change in entropy of the system (J K⁻¹ mol⁻¹)
- ΔG drives us to predict whether a reaction is feasible.
- Reactions are only feasible:
 - ΔG is zero or negative.
 - ΔG is negative at temperature = zero.
 - Reactions may be feasible at one temperature and not another.
- To calculate the temperature at which a reaction becomes feasible, the reaction has to be at equilibrium. This is because:
 - $\Delta G = 0$
 - $\Delta H = T\Delta S$
 - $T = \frac{\Delta H}{\Delta S}$
- Reactions that are feasible whether a reaction can occur if the reaction is not at equilibrium. The reaction will not occur if the reaction is thermodynamically favourable.

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