Dougherty Valley • AP Chemistry

**S-16**

Entropy and Free Energy

**STUDY LIST From Paul Groves**

I can…

The Driving Forces

🞏 State the two driving forces for reactions, Enthalpy (ΔH) and Entropy (ΔS).

🞏 State that Enthalpy (ΔH) tends toward a minimum and this means

* ΔH is negative
* ΔH is < 0
* heat is on the right (products)
* PE curve is downhill

🞏 State that Entropy (ΔS) tends toward a maximum and this means

* ΔS is positive
* ΔS is > 0
* the products are more disordered (spread out) than reactants
* the entropy curve is uphill

🞏 Calculate ΔH using Hess’s Law or q=mcΔT and moles of reactant.

Entropy

🞏 Define entropy (ΔS) as the randomness, disorder, or “spreadioutiness” of a system.

🞏 Calculate entropy (ΔS) using Hess’s Law with these differences:

* **elements** have values for entropy
* units for entropy are J⋅mol-1⋅K-1 rather than kJ⋅mol-1… (a conversion is usually needed).

🞏 Recognize changes in entropy.

Entropy increases, ΔS +, ΔS > 0:

* from solid ⭢ liquid ⭢ gas
* fewer moles (g) ⭢ more moles (g)
* simpler ⭢ more complex molecules
* smaller molecules ⭢ longer molecules
* ionic solids with strong attractions ⭢ ionic solids with weaker attractions
* separate solute & solvent ⭢ solutions
* gas dissolved in water ⭢ escaped gas

Spontaneity (Product-Favored)

🞏 Look at a reaction and state whether it is exothermic or endothermic.

🞏 State whether a reaction will be product-favored depending on ΔH, ΔS, and absolute temperature.

|  |  |  |
| --- | --- | --- |
| **ΔH** | **ΔS** | **Product-Favored…** |
| **+** | **+** | at higher temperatures |
| **** | **** | at lower temperatures |
| **** | **+** | at all temperatures |
| **+** | **** | never(reactant-favored at all temps) |

🞏 Explain that many books use the term “spontaneous” for “product-favored.”

 *A* ***spontaneous*** *reaction does not necessarily mean a* ***fast*** *reaction.*

 *The SPEED of a reaction is* ***Kinetics*** *(Ch 15)… we are discussing whether a reaction CAN OCCUR which is* ***Thermodynamics*** *(Ch 6 and Ch 20).*

🞏 Combine the effects of ΔH, ΔS, and Temperature to form ΔG, the Gibbs Free Energy: ΔG = ΔH - TΔS

 *Note watch your units for ΔH & ΔS*

ΔG<0, ΔG , product-favored reaction

 ΔG>0, ΔG +, reactant-favored reaction

ΔG=0, reaction is at equilibrium

🞏 Use the special case of **equilibrium** (e.g. boiling point or temperature when a reaction becomes spontaneous) to use the modified equation: ΔH = TΔS

Link with Other Chapters

🞏 Convert between K, ΔG, and E°

 using equations given on the AP Exam.