

GIBBS FREE ENERGY

Name _____

For a reaction to be spontaneous, the sign of ΔG (Gibbs Free Energy) must be negative. The mathematical formula for this value is:

$$\Delta G = \Delta H - T\Delta S$$

where ΔH = change in enthalpy or heat of reaction

T = temperature in Kelvin

ΔS = change in entropy or randomness

Complete the table for the sign of ΔG ; +, - or undetermined. When conditions allow for an undetermined sign of ΔG , temperature will decide spontaneity.

| ΔH | ΔS | ΔG |
|------------|------------|------------|
| - | + | |
| + | - | |
| - | - | |
| + | + | |

Answer the questions below.

- The conditions in which ΔG is always negative is when ΔH is negative and ΔS is positive.
- The conditions in which ΔG is always positive is when ΔH is positive and ΔS is negative.
- When the situation is indeterminate, a low temperature favors the (enthalpy / entropy) factor, and a high temperature favors the (entropy / enthalpy) factor.

Answer Problems 4-6 with always, sometimes or never.

- The reaction: $\text{Na}(\text{OH})_s \rightarrow \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) + \text{energy}$ will always be spontaneous.
- The reaction: $\text{energy} + 2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ will never be spontaneous.
- The reaction: $\text{energy} + \text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$ will sometimes be spontaneous. *temp is high*
- What is the value of ΔG if $\Delta H = -32.0 \text{ kJ}$, $\Delta S = +25.0 \text{ kJ/K}$ and $T = 293 \text{ K}$? -7360 KJ
- Is the reaction in Problem 7 spontaneous? yes
- What is the value of ΔG if $\Delta H = +12.0 \text{ kJ}$, $\Delta S = -5.00 \text{ kJ/K}$ and $T = 290. \text{ K}$? +1460 KJ
- Is the reaction in Problem 9 spontaneous? no