

Reaction Spontaneity and Reversibility: ($\Delta G = \Delta H - T \Delta S$)

Case	Spontaneity in Forward Direction	Chance for Reaction Reversibility (i.e. can the reaction go spontaneously in reverse?)	Equilibrium Establishment
ΔS positive, ΔH negative, ΔG negative	Spontaneous in forward direction at all temperatures. $\text{H}_2\text{SO}_4 \rightarrow 2\text{H}^+_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} + \text{heat}$	Very difficult to get the reverse reaction to occur spontaneously!	If / when equilibrium is reached, the reaction will have gone nearly to completion in the forward direction.
ΔS positive, ΔH positive	Can be spontaneous in forward direction. $\text{NH}_4\text{Cl}_{(\text{s})} + \text{heat} \rightarrow \text{NH}_4^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})}$ (High temp. favours ΔG negative)	Reverse reaction can possibly occur spontaneously.	Equilibrium will be reached relatively easily.
ΔS negative, ΔH negative	Can be spontaneous in forward direction. $\text{HCl}_{(\text{g})} + \text{NH}_3_{(\text{g})} \rightarrow \text{NH}_4\text{Cl}_{(\text{s})} + \text{heat}$ (low temp. favours ΔG negative)	Reverse reaction can possibly occur spontaneously.	Equilibrium will be reached relatively easily.
ΔS negative, ΔH positive, ΔG positive	Forward reaction is not spontaneous (at any temperature). E.g.: biosynthesis reactions	Reverse reaction occurs spontaneously.	If / when equilibrium is reached the reverse reaction will have proceeded almost to completion.