Entropy and Gibbs Energy

$\Delta S_{system} = \Sigma S_{products} - \Sigma S_{reactants}$

(Obtained from data tables)

$\Delta S_{surroundings} = \dfrac{-\Delta H_{system}}{T}$

(ΔH_{system} is often obtained by Hess's cycle calculations)

For a reaction to be spontaneous:

$\Delta S_{universe} > 0$

$\Delta S_{universe} = \Delta S_{system} + \Delta S_{surroundings}$

Multiply through by $-T$

$-T\Delta S_{univ} = \Delta H_{sys} - T\Delta S_{sys}$

and…

$\Delta G_{sys} = -T\Delta S_{univ}$

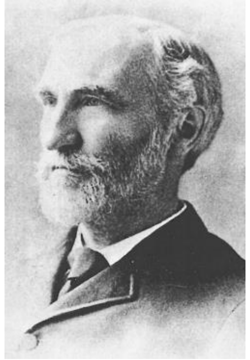
We refer to ΔG_{sys} as the ***'Gibbs energy' (sometimes called the 'free energy'*** **or** ***'available energy'*** as it's what is left after the 'heat demands of the universe have been met'. Put another way, it is the energy that is 'free' or 'available' to do useful work.

For a process to be spontaneous $\Delta G_{sys} < 0$

Compare with the feasibility of a chemical reaction being dependent upon $\Delta S_{univ} > 0$

$$\Delta G_{sys} = \Delta H_{sys} - T\Delta S_{sys}$$

The Gibbs Equation



Josiah Willard Gibbs

Conditions for Reaction Viability Thermodynamically

Reactions at Low *T*:

$T\Delta S_{sys} \longrightarrow 0$

$\Delta G_{sys} \cong \Delta H_{sys}$

To get a **-ve** ΔG_{sys} we need a **-ve** ΔH_{sys}

Reactions at High *T*:

$T\Delta S_{sys} >> \Delta H_{sys}$

$\Delta G_{sys} \cong -T\Delta S_{sys}$

To get a **-ve** ΔG_{sys} we need a **+ ve** ΔS_{sys}