Entropy

- Entropy is a measure of disorder in the system.
- Substance prefer disorder, so particles often move to increase entropy.
- solid $\xrightarrow{\text{increase in entropy}}$ gas
- Dissolving a solid also increase entropy.
- More moles means more entropy.
- Spontaneous (or feasible) is a change that will happen by itself - there is no need to give it energy.
- Just because a reaction is endothermic does <u>NOT</u> mean it cant be spontaneous.

example : Water evaporating → needs energy to break bonds BUT → Liquid → gas increases entropy.

example : $NaHCO_{3(s)} + H^+_{(aq)} \longrightarrow Na^+_{(aq)} + CO_{2(g)} + H_2O_{(l)}$

forms a gas and more moles ∴ increase in entropy!

Reactions won't happen unless total entropy change is positive.

UNITS

$JK^{-1}mol^{-1}$ ← $\Delta S_{total} = \Delta S_{system} + \Delta S_{surroundings}$

made up of

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

<u>and</u>

$$\Delta S_{surroundings} = -\frac{\Delta H}{T}$$

ΔH ← $Jmol^{-1}$

T ← K

(Gibbs)

Free-Energy Change

- ΔG is a measure used to predict if a reaction is feasible.

- If ΔG is negative or equal to zero it is theoretically feasible.

$$\underset{J\,mol^{-1}}{\Delta G} = \underset{J\,mol^{-1}}{\Delta H} - \overset{K}{T}\,\underset{J\,K^{-1}\,mol^{-1}}{\Delta S_{system}}$$

- feasibility depends on temperature.

- If reaction is exothermic (negative ΔH) AND a positive entropy change the ΔG is always negative.

(And vice versa!)

You can calculate the temperature when a reaction becomes feasible by rearranging the formula when ΔG = zero:

$$T = \frac{\Delta H}{\Delta S_{system}}$$

constant

variable

constant

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

variable

$$y = c + mx$$

← Straight line equation

variable constant constant variable

$\therefore \quad \Delta G = y$

$\Delta H = c$

$T = x$

$m = -\Delta S$ (slope of graph)

negative slope? $\frac{-y}{x}$

positive slope? $\frac{y}{x}$