Let's learn how to predict the sign of ΔS°_{rxn} or ΔS°

$2O_3(g) \longrightarrow 3O_2(g)$ $\Delta n_g = 3-2 = +1$

increase in gas molec.

ΔS° = +ve

$N_2(g) + O_2(g) \longrightarrow 2NO(g)$ $\Delta n_g = 2-2 = 0$

$\Delta S^\circ \approx 0$

$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$ $\Delta n_g = -1$

ΔS° = -ve

$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$

$\Delta n_g = -3$

ΔS° = -ve

2nd Law: $\Delta S_{UNIV} \geq 0$

$\Delta S_{UNIV} = \Delta S_{rxn} + \Delta S_{surr}$

$\Delta S_{UNIV} = \underbrace{\Delta S + \Delta S_{surr}}_{\geq 0}$

How do we calc ΔS and ΔS_{surr}?

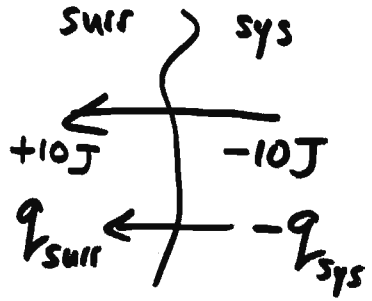
ΔS: $\sum S^\circ(P) - \sum S^\circ(R)$

$\Delta S_{surr} = \frac{q_{surr}}{T}$?

if we're @ high T... a little bit of q makes a much smaller increase in S (Shouting @ football game)

if we're @ low T... a little bit of q makes a large amount of disorder (shouting in lib.)

$$\Delta S_{surr} = \frac{-q_{sys}}{T}$$



$$= \frac{-q_{rxn}}{T}$$

$$\Delta S_{surr} = \frac{-\Delta H_{rxn}}{T}$$

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

already saw: $\Delta S^\circ = -198.5\ J/mol \cdot K$

however, $\Delta H^\circ = -92.6\ KJ/mol$

exothermic rxn.

$$\Delta S_{UNIV} = \Delta S + \Delta S_{surr} = \Delta S - \frac{\Delta H}{T}$$

$$\Delta S_{UNIV} = -198.5 \frac{J}{mol \cdot K} - \frac{-92,600\ J/mol}{298K}$$

@25°c

$$= -198.5 \frac{J}{mol \cdot K} + 310.6 \frac{J}{mol \cdot K}$$

$$= +112 \frac{J}{mol \cdot K} \Rightarrow \text{CAN HAPPEN!}$$

- Doesn't tell us how fast (kinetics)

Gibb's Free Energy

- this is a simpler way to predict if rxn can occur.

$$\Delta S_{UNIV} > 0$$

$$\Delta S + \Delta S_{surr} > 0$$

$$\Delta S - \frac{\Delta H}{T} > 0$$

$\times T$ (absolute >0) $\rightarrow$ $T\Delta S - \Delta H > 0$

$-24 < -12$ ($\times -3$)

$8 > 4$

($\times 3$) $24 > 12$

$\times -1$ $\rightarrow$ $\boxed{\Delta H - T\Delta S < 0}$

criterion for whether a rxn can take place.

Define: $G = H - TS$

Gibb's Free Energy

$\Delta G = \Delta H - T\Delta S$ (T does not change)

$\boxed{\Delta G < 0}$ ΔG has to be -ve for a rxn to happen

if $\Delta G = 0$: @ eqm

$\Delta G > 0$: rxn is impossible (fwds)