**Thermodynamics**

- \( \Delta G \) and \( K_{eq} \)
- Is the reaction worthwhile? → are we making good bonds?
- Good bonds = stronger bonds = \(-\Delta G\)
- \(-\Delta G\) = exothermic/exoergic → releases heat
- \(+\Delta G\) = endothermic/endoergic → absorbs heat

**Kinetics**

- Is it possible? → is the path to the products reasonable?
- \( \Delta G^\ddagger \), \( k \) speed
- Arrhenius equation: \( k = A e^{-\Delta G^\ddagger / RT} \)
- Low energy pathway
Closen look at $\Delta G$ (Gibbs Free Energy)

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

+\( \Delta G \) means more disorder.

**Entropy**

$\Delta G$ is a measure of disorder.

**Enthalpy**

$\Delta H = \text{Energy of Bonds lost} - \text{Energy of Bonds made}$

**Addition Reaction:**

$$\text{C} = \text{C} + \text{H-Br} \rightarrow \text{C} - \text{C}$$

- Bonds lost ($+ \text{C} = \text{C}$) and $\text{H-Br}$
- Gained: $\text{C-Br}$ and $\text{C-H}$ bond

$\Delta H = (62 \text{kJ} + 87 \text{kJ}) - (72 \text{kJ} + 101 \text{kJ})$

$$149 - 173 = -24 \text{kJ/mole}$$

**Entropy**

$\Delta S$ is a measure of disorder.

$$\text{A + B} \rightarrow \text{C}$$

2 molecules (mole) more disorder → 1 molecule (mole) more ordered → less free

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

$+\Delta S \rightarrow -\Delta G$
A closer look at the addition reaction: \[ \text{H} + \text{H}-\text{Br} \rightarrow \text{H} \text{H}^{+} \text{Br}^{-} \]

**Mechanism:**

1. **Step 1:** H to CO
2. **Step 2:** H to CO
3. **Path of least resistance:**
   - Lowest energy
   - Carbon with + charge
   - Has 3 carbons attached to 1.

**Regioselectivity:** H will selectively go to one carbon over the other.

**Carbocation stability:**
- 3° > 2° > 1° > (CH₃) methyl

**Geometry of Carbocation?**
- Hybridization: sp²
- Trigonal Planar (Flat)
- Donor: CH₃
- C-donor's positive density to C⁺ lower energy
- neighboing
- Hyper conjugation. C-H bond donates e- to the carbocation
The rate of the addition reaction is determined by carbocation stability.

2° cation: 

2 step reaction: 

Transition state: 

ΔG° ≠ * 

δ: is the transition state: Highest energy point

We are forgetting something!