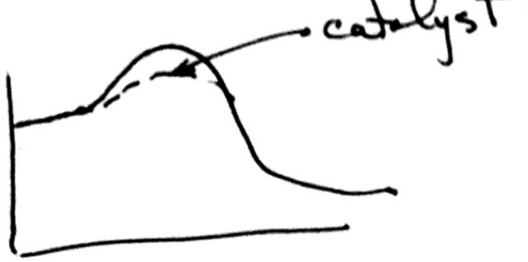
Homework 14

1. The entropy change for the "skating molecule" going to vapor (3 degrees of freedm) is less than for tightly bound surface molecule. This lowers A (freq. factor) for the "skater".

2. a)



b) No -- $\Delta G^{o\ddagger}$ $\Delta H^{o\ddagger}$ and $\Delta S^{o\ddagger}$ (for the formation of the transition state) changes but NOT ΔG^o ΔH^o & ΔS^o (implied as being for the reaction. [State variables... path independent!]

c) Reactions are slow! (favorable... but slow)

d) collision theory: reax cross section; probability of "effective collision" (P); E_a (and μ, reduced mass, to a small degree.

transition state: $\Delta H^{o\ddagger}$ $\Delta S^{o\ddagger}$ $\Delta G^{o\ddagger}$ K (transmission coeff; i.e., probability of conversion to product)

HW 14 (cont)

3. Rate $\propto$ k so find change of k with T

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right).$$

$$k_1/k_2 \simeq 12$$

4. Assume that "state of the egg" is the same in both cases (e.g., extent of reax; amnt of "products", etc is the same).

Thus, $t_{cook} \propto \frac{1}{k}$ (assumes 1^{ST} order in "egg")

$$\ln\left(\frac{k_1}{k_2}\right) = \ln\left(\frac{t_2}{t_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$E_a \simeq 72 \text{ kJ/mole}.$$

5. Reax rate doubles because k doubles

$$\ln\left(\frac{k_1}{k_2}\right) = \ln\left(\frac{2\cancel{k_2}}{\cancel{k_2}}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right).$$

$$E_a \sim 53 \text{ kJ/mole}.$$