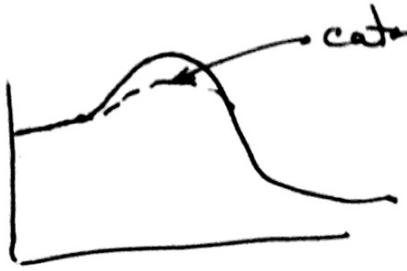
Homework 14

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 -- $\Delta G^{\circ\ddagger}$ $\Delta H^{\circ\ddagger}$ and $\Delta S^{\circ\ddagger}$ (for the formation of the transition state) changes but NOT $\Delta G^{\circ}$ $\Delta H^{\circ}$ & $\Delta S^{\circ}$ (implied as being for the reaction. [state variables... path independent!]

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

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

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

HW 14 (cont)

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

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

$$\frac{k_1}{k_2} \simeq 12$$

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 1st order in "egg")

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

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

5. Reax rate doubles because $k$ doubles ~~etc~~

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

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