

CHEM 1422 - Homework # 3

Chemical Kinetics

Due Feb 12, 2009 (2 PM)

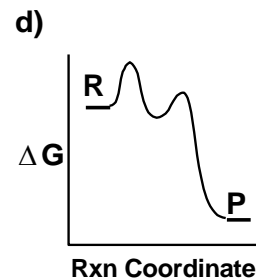
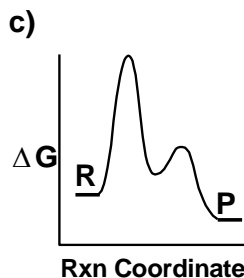
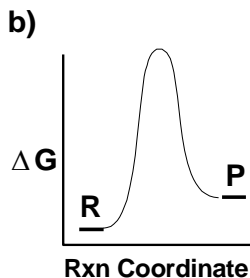
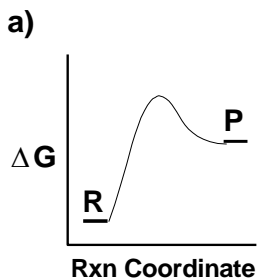
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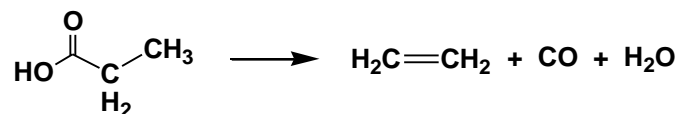
Check the box to the right if you want your graded homework to be placed out in the public rack outside Prof. Stanley's office. Otherwise you will have to pick up your homework from Prof. Stanley in person:

1. (3 pts) Which of the following energy diagrams best represents the *slowest* spontaneous reaction? Circle your choice. Give a brief, but clear, explanation for your answer below the diagrams.



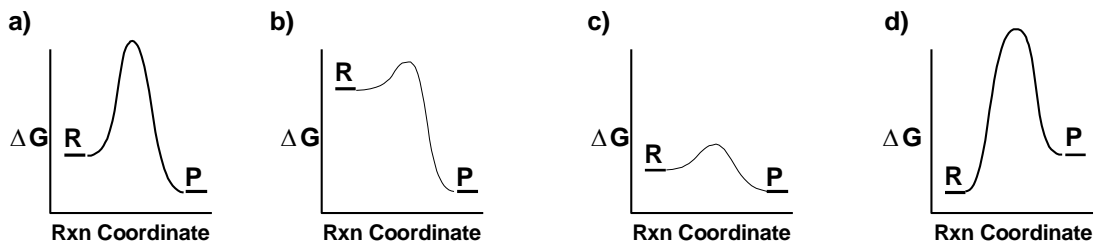
2. (5 pts) a) Describe in your own words and terms where the origin of the activation barrier comes from and what it represents in a chemical reaction. b) Given the same thermodynamic factors, consider the reaction of two *small* molecules or two *large* molecules with one another. Which pair should have the *higher activation energy*? Why?

3. (3 pts) Consider the following reaction and information:

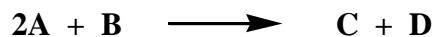


$$\Delta G = +100 \text{ kJ/mol} \quad \text{Activation Energy} = +400 \text{ kJ/mol}$$

Circle the energy curve shown below (**R** = reactants, **P** = products) that best represents the reaction described above? Give a brief, but clear, explanation for your answer below the diagrams.



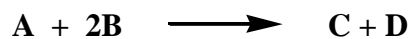
4. (5 pts) Consider the following reaction and kinetic data. Circle the correct kinetic rate expression for this reaction. Show all your work and/or discuss your reasoning.



- a) rate = $k[\text{A}][\text{B}]$ b) rate = $k[\text{A}]^2$ c) rate = $k[\text{B}]$ d) rate = $k[\text{B}]^2$ e) rate = $k[\text{A}][\text{B}]^2$

Exp #	[A]	[B]	Initial Rate ($M\text{sec}^{-1}$)
1	0.2 M	0.1 M	0.02
2	0.4 M	0.1 M	0.04
3	0.2 M	0.3 M	0.18
4	0.4 M	0.3 M	0.36

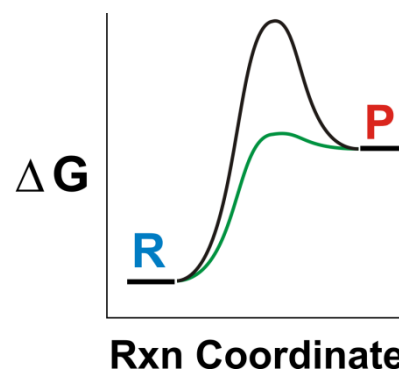
5. (5 pts) Consider the following reaction and kinetic data. Circle the correct rate constant for this reaction. Clearly show all your work including the rate law that you determine.



- a) $2.2 \times 10^{-6} \text{ M}^{-1}\text{sec}^{-1}$ b) $22 \text{ M}^{-1}\text{sec}^{-1}$ c) $220 \text{ M}^{-1}\text{sec}^{-1}$ d) $0.05 \text{ M}^{-1}\text{sec}^{-1}$ e) not enough data

Exp #	[A]	[B]	Initial Rate (Msec^{-1})
1	0.2 M	0.1 M	0.002
2	0.2 M	0.2 M	0.002
3	0.4 M	0.2 M	0.008
4	0.8 M	0.4 M	0.032

6. (4 pts) Catalysts can be used on non-spontaneous reactions to lower the activation barrier. If a catalyst lowers the activation barrier too much, however, a serious problem can arise. Consider the diagrams shown below. What is the problem for the catalyzed rxn with the lower activation energy? Why can a “substantial” activation barrier actually help an “uphill” chemical reaction if one wants to make as much product as possible?



7. (5 pts) A reaction has a initial rate of reaction of 0.001 Msec^{-1} at 70°C . This increases to 0.100 Msec^{-1} at 90°C . Calculate the activation energy for this reaction?