CH 302 Spring 2007 Worksheet 13

[A]	[B]	[C]	rate
0.10 M	0.10 M	0.10 M	1.4×10^{-4} M/s
0.20 M	0.10 M	0.10 M	2.8×10^{-4} M/s
0.37 M	0.25 M	0.10 M	8.09×10^{-3} M/s
0.37 M	0.25 M	0.05 M	3.24×10^{-2} M/s

For the data given above, find the order of the reaction with respect to the indicated species.

1. A

2. B

3. C

4. Assume the reaction does not depend on any other species besides A, B, and C. Write the expression for the rate of the reaction in terms of the rate constant k.

5. Calculate the rate constant k.

6. If $A = 10^8$ $M^{-1}s^{-1}$ and T = 298 K, what is E_a for this reaction?

You start out with 1.0 M A. Assume the rate of the reaction $2A \rightarrow A_2$ depends only one [A]. Assume that $A = 3.4 \times 10^8$ (units depend on the order), E_a = 65 kJ/mol, and T = 298 K. If the reaction is the given order in A, calculate the amount of A left after five minutes and the half-life of A.

7. Zeroth order

8. First order

9. Second Order

10. For a (a) zeroth, (b) first, and (c) second order reaction, a plot of _____ vs. t is linear.

11. The reaction $3A + 5/2\ B \rightarrow 2\ C + 4\ D$ has a rate constant k of 3.7×10^{-6} $M^{-2}s^{-1}$ at 298 K and 6.80×10^{-2} $M^{-2}s^{-1}$ at 600 K. Calculate the activation energy E_a for this reaction.

12. Calculate the pre-exponential factor A for the reaction in #11.

13. What would be k for the reaction in #11 at 0°C?

14. Write the rate expression for the following multi-step reaction.

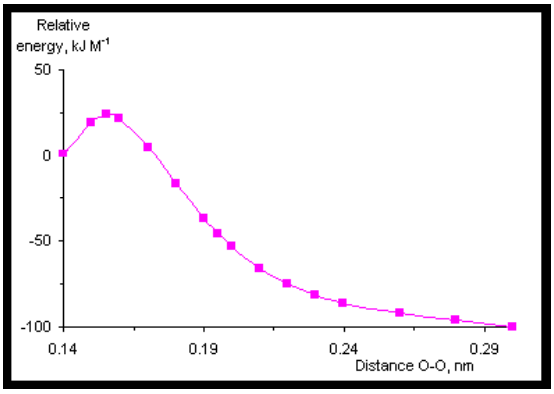
$O_3 \rightarrow O_2 + O$	fast
$O + O_3 \rightarrow 2\ O_2$	slow
$2\ O_3 \rightarrow 3\ O_2$	overall

15. Write the rate expression for the following multi-step reaction.

$(CH_3)_3CBr \rightarrow (CH)_3C^+ + Br^-$	slow
$(CH_3)_3C^+ + H_2O \rightarrow (CH_3)_3COH_2^+$	fast
$(CH_3)_3COH_2^+ + H_2O \rightarrow (CH_3)_3COH + H_3O^+$	fast
$(CH_3)_3CBr + 2\ H_2O \rightarrow (CH_3)_3COH + Br^- + H_3O^+$	overall

16. Write the rate expression for the following multi-step reaction.

$H_2O_2 + Br_2 \rightarrow 2\ H^+ + O_2 + 2\ Br^-$	slow
$2\ H^+ + 2\ Br^- + H_2O_2 \rightarrow Br_2 + 2\ H_2O$	fast
$2\ H_2O_2 \rightarrow 2\ H_2O + 2\ O_2$	overall



17. The above plot represents the energy profile of a reaction that involves breaking an O-O bond in terms of the O-O bond distance (treat this is a general "reaction coordinate"). Assume this is in 1 L of solution, so 1 kJ M^{-1} = 1 kJ mol^{-1}. Approximately what is ΔG for this reaction? What is E_a?

18. What is E_a for the reverse reaction?

19. Assume the reaction described by the plot is a simple reaction of the form $A \rightarrow B + C$ and is first order overall and first order in A. The reaction rate when [A] = 0.235 M is found to be 1.4×10^{-3} M/s. What is k for this reaction?

20. What is the preexponential factor A for the above reaction?