Homework #13-4: Collision Theory; Activation Energy & T Dependence of Rate Constants
Problems pg. 576 #31, 34, 35, 37, 39, 40, pg. 582 #109

13.31 Define activation energy. What role does it play in kinetics?

13.34 How can a highly exothermic (favored) reaction like the combustion of methane in oxygen be kept indefinitely without any apparent change?

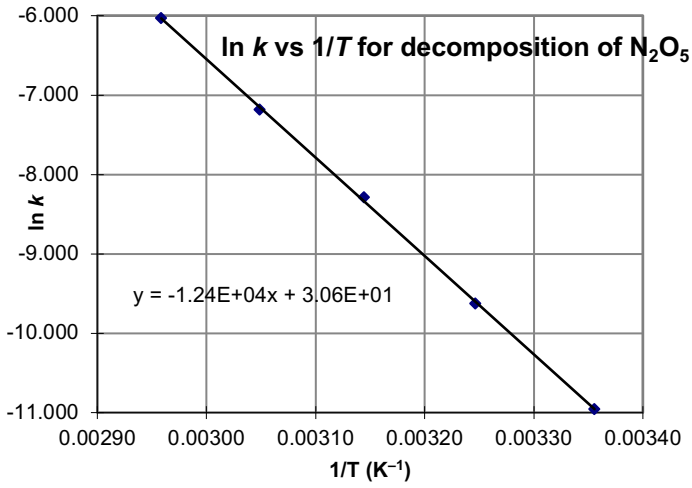
13.35 Sketch a potential energy vs. reaction progress plot for the following reactions:
a) $S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H° = -296$ kJ/mol
b) $Cl_2(g) \rightarrow Cl(g) + Cl(g)$ $\Delta H° = 243$ kJ/mol

13.37 The dependence of rate constant with temperature for the first-order reaction,

$$2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$$

is given in the table below. Use the graph of ln*k* vs. 1/T to calculate the activation energy for the reaction, in kJ/mol.

T (K)	k (s^{-1})	1/T (K^{-1})	ln k
298	1.74×10^{-5}	0.00336	–10.959
308	6.61×10^{-5}	0.00325	–9.624
318	2.51×10^{-4}	0.00314	–8.290
328	7.59×10^{-4}	0.00305	–7.184
338	2.40×10^{-3}	0.00296	–6.032



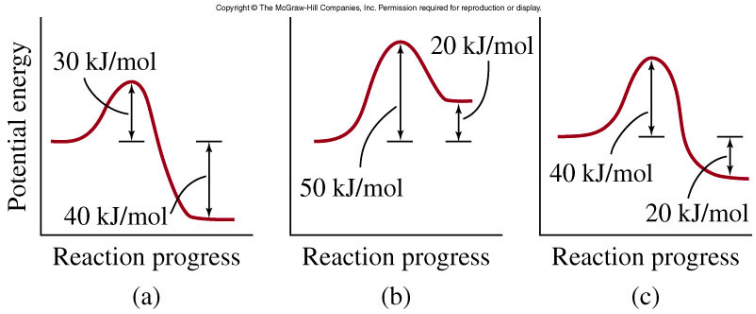
13.39 For the reaction,

$$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g),$$

$A=8.7\times10^{12}$ s^{-1} and E_a = 63 kJ/mol. What is k at 75°C? What order is the reaction?

13.40 The rate constant of a 1st order reaction is 4.60×10^{-4} s^{-1} at 350°C. If the activation energy is 104 kJ/mol, at what temperature, in °C, is the rate constant 8.80×10^{-4} s^{-1}?

13.109 Consider the potential energy profiles for the following three reactions:



(1) Rank the rates (slowest to fastest) of the reactions

(2) Determine ΔH for each reaction and state whether the reaction is exothermic or endothermic.

Answers: 37) 103 kJ/mol; 39) 3.0×10^{3} s^{-1}; 40) 368°C