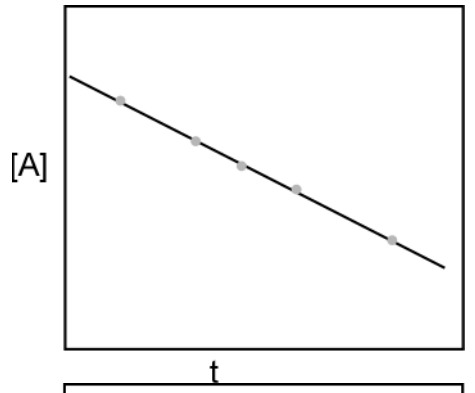
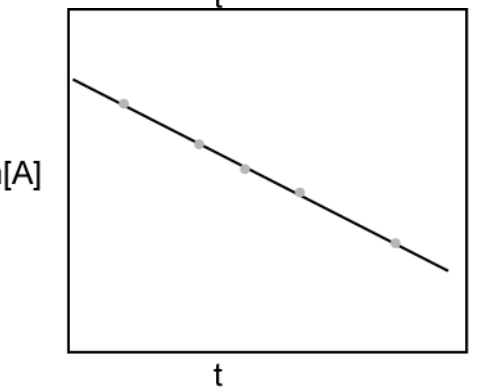
Announcements

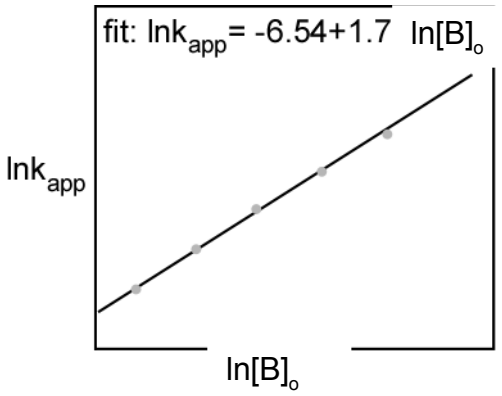
- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).
- Next exam on ΔG, Macronutrients, Kinetics and Smog one week from Today.
- Sample Exam 2 has been posted on web site in the Study Aids section.
- You will be getting an e-mail of suggested reading for the next section. None of it will be on exam 2, although we will start talking about it either the end of today or next Tuesday.

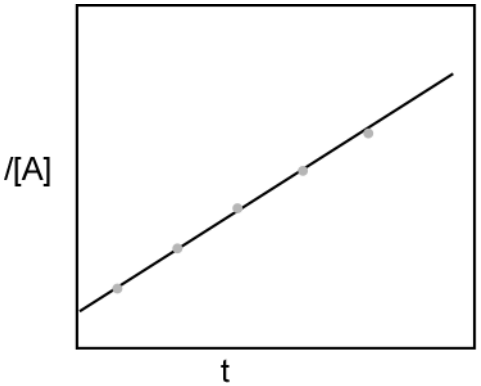
Review
Pseudo-order (Swamping) method

- Uses large excess of all but one reactant, so concentration of only the limiting reactant (A) changes significantly.
  - $-d[A]/dt = (k[B]_o^{\,b})[A]^a \approx k_{app}[A]^a$
  - 0^{th} order a = 0: $[A]_t = [A]_o - k_{app}t$
  - 1^{st} order a = 1: $[A]_t = [A]_o \exp\{-k_{app}t\}$
    - Linear: $\ln[A]_t = \ln[A]_o - k_{app}t$
  - 2^{nd} order a = 2: $1/[A]_t = 1/[A]_o + kt$
- Can determine k and b by varying $[B]_o$
  - $\ln k_{app} = \ln k + b \ln[B]_o$









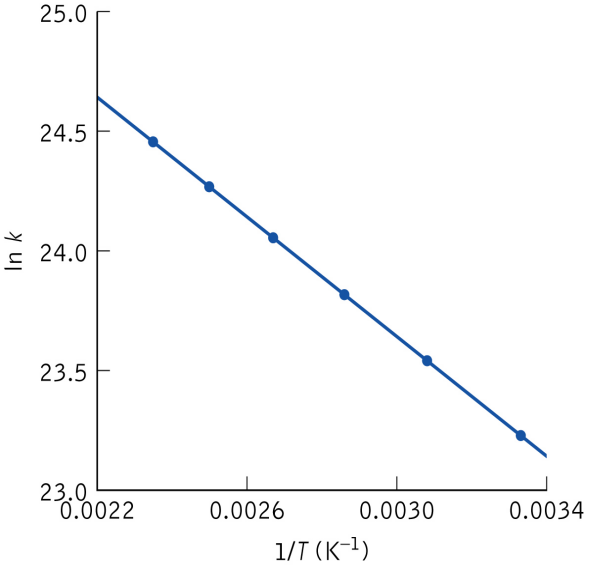
Review: Reaction Mechanisms

- Elementary Steps
  - Unimolecular: A --> P
    - Rate Law: -d[A]/dt=d[P]/dt = k[A]
  - Bimolecular: A + B --> P
    - Rate Law: -d[A]/dt=-d[B]/dt = d[P]/dt = k[A][B]
    - Also 2 A --> P has rate law -d[A]/dt = $k[A]^2$
- Mechanism consists of sequence of elementary steps.
  - Rate limiting or rate determining steps (overall rate is determined by slow step)
  - Steady state approximation (an intermediate product concentration stays the same during the reaction)

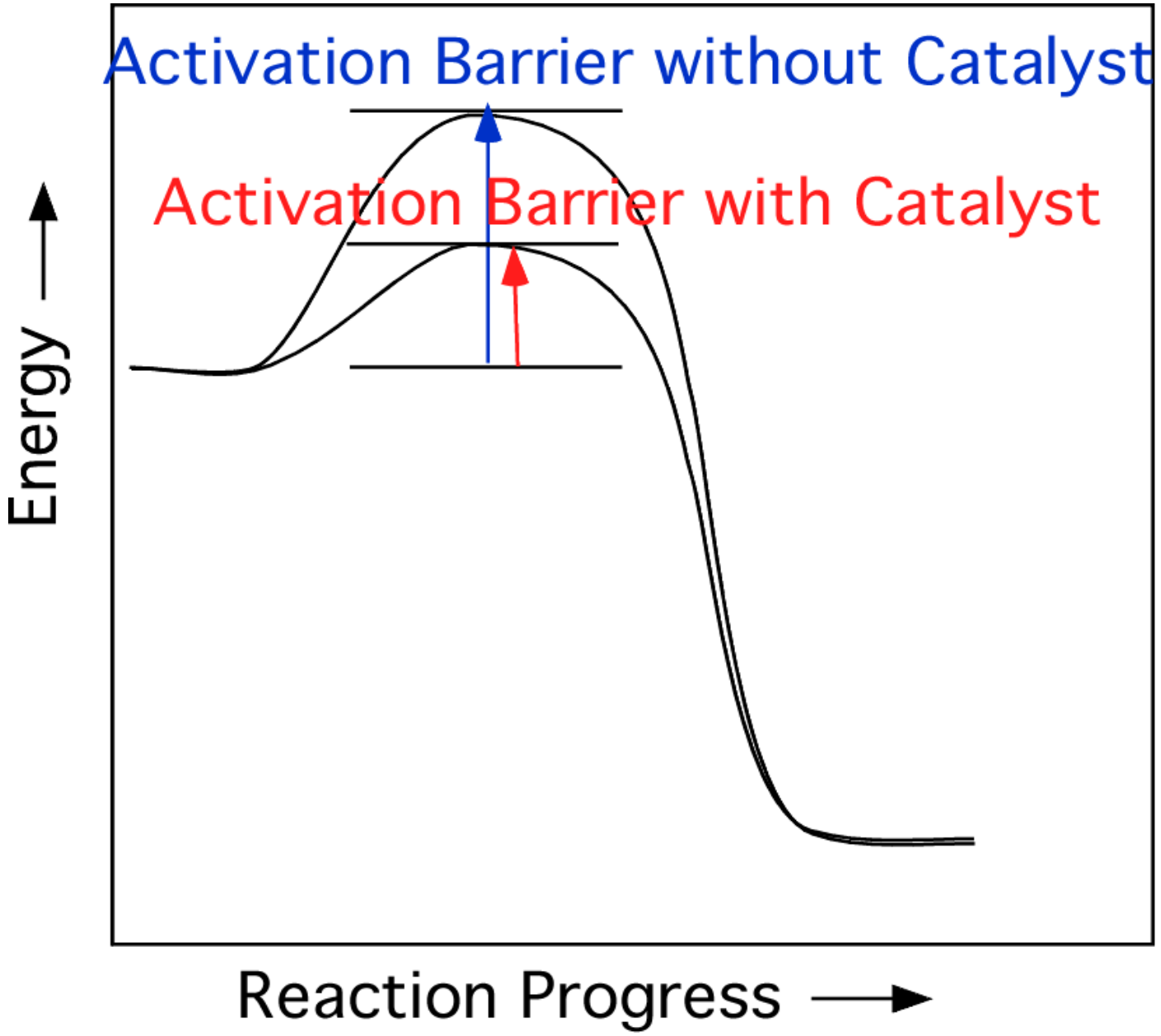
T dependence of $NO + O_3 \longrightarrow NO_2 + O_2$

T (K)	K ($M^{-1}s^{-1}$)	ln k	1/T (K^{-1})
300	1.21E+010	23.22	0.00333
325	1.67E+010	23.54	0.00308
350	2.20E+010	23.81	0.00286
375	2.79E+010	24.05	0.00267
400	3.45E+010	24.26	0.00250
425	4.15E+010	24.45	0.00235

$$\ln(k(T)) = \ln A - (E_a/R)\,(1/T)$$



Activation Energy and Catalysis



Heterogeneous Catalysis (Catalytic Converter)

Cartoon is for $3H_2 + N_2 \longrightarrow 2NH_3$

Chang Figure 14.18

Image at right courtesy of Dudley Metropolitan Borough Council of the UK.