Lecture 53 Rxn Rates & Temperature

Note Title 9/9/2011

Review: Rxn Rate Equation: $\text{rate} = k[A]^{1}[B]^{2}$

Arrhenius Equation: $k_T = A\, e^{-E_{af}/RT}$

- E_{af}: Forward Act Energy
- T: Temp (K)
- $R = 8.314\ J/mol\,K$
- A: Frequency Factor: Effective collision parameter.

A increase, k_T increase, rate increase

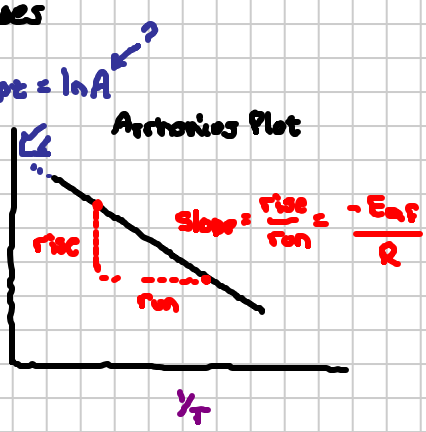
E_{af} increase, k_T decrease, rate decrease

T increase, k_T increases, rate increases

Alternative Arrhenius Eq.

$$\underbrace{\ln k_T}_{y} = \underbrace{\frac{-E_{af}}{R}}_{m}\cdot\underbrace{\frac{1}{T}}_{x} + \underbrace{\ln A}_{b}$$

y intercept = $\ln A$

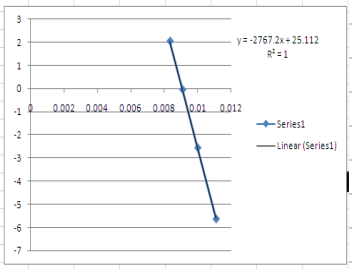


Example. $Cl_{(g)} + H_{2(g)} \rightarrow HCl_{(g)} + H_{(g)}$

Given the following info, calculate A & E_{af}

Exp	T	k	x: 1/T	y: ln k
1	90K	0.00357		
2	100K	0.0773		
3	110K	0.956		
4	120K	7.781		

Temperature (K)	k	1/T	ln(k)
90	0.00357	0.011111	-5.63519
100	0.0773	0.01	-2.56006
110	0.956	0.009091	-0.045
120	7.781	0.008333	2.051685



$y = -2767.2x + 25.112$

$\ln k = -2767.2\,\frac{1}{T} + 25.112$

Slope $= -E_a/R = -2767.2$

$E_a = (2767.2)(8.314) = 23{,}000\,J = 23.0\,kJ$

y intercept $= \ln A = 25.112$

$e^{\ln A} = e^{25.112}$

$A = e^{25.112} = 8.05 \times 10^{10}$