Participation Assignment
CHEM 1100-General Chemistry II

Name: **#6**

Section: 31, TR **Due Date: Thursday 1/24/2019**

Half-Life:

First Order

$\ln[A]_t = -kt + \ln[A]_0$

Second Order

$$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$$

1. In a dilute sodium hydroxide solution, the decomposition of hydrogen peroxide is a first order process:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

At 20 °C, the rate constant for this process is 1.8×10^{-5} 1/s. If the concentration of hydrogen peroxide is initially 0.300 M, how many hours will it take until the concentration drops to 0.150 M?

Rate constant: McMurry, J., Fay, R., *Chemistry*, 5th ed., Pearson Education, 2008, p452.

2. The decomposition of hydrogen iodide is a second order reaction:

$$2HI(g) \rightarrow H_2(g) + I_2(g)$$

The rate constant for this process is 5.13×10^{-4} M^{-1} s^{-1} at 410 °C. If the initial concentration of hydrogen iodide is 0.400 M, how many hours will it take until the concentration is 0.200 M?

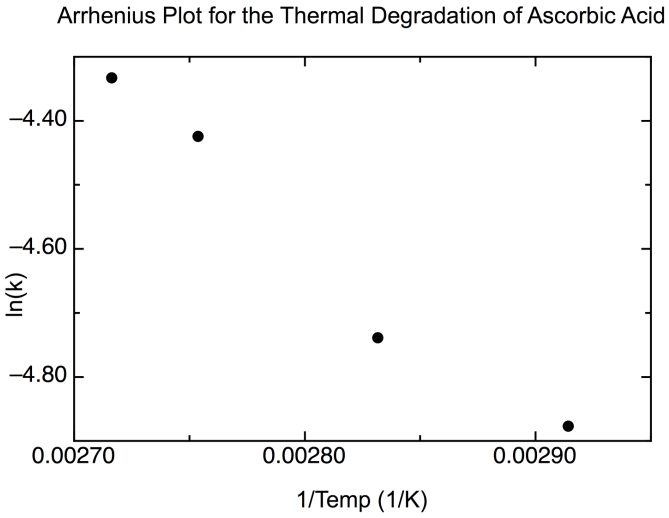
Rate constant: McMurry, J., Fay, R., *Chemistry*, 5th ed., Pearson Education, 2008, p460 (units for the rate constant modified).

Arrhenius equation: $k = Ae^{-Ea/RT}$ $\ln(k) = \ln(A) + \ln(e^{-Ea/RT})$

3. Determine the activation energy, in kJ/mol, for the thermal degradation of ascorbic acid in rose hips:

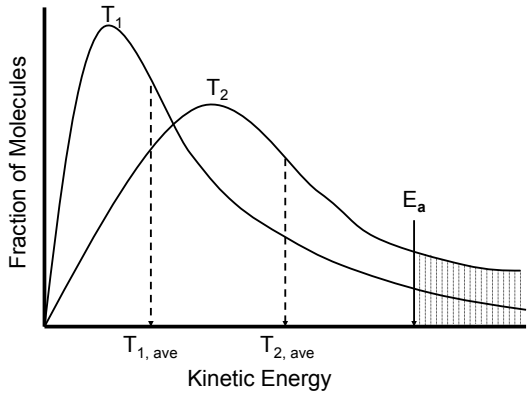
Temp(°C)	1/T (1/K)	k (1/min)	ln(k)
70	0.002914	0.00762	-4.877
80	0.002832	0.00875	-4.739
90	0.002754	0.01198	-4.425
95	0.002716	0.01313	-4.333

Karhan, M., Aksu, M., Tetik, N., Turhan, I., "Kinetic Modeling of Anaerobic Thermal Degradation of Ascorbic Acid in Rose Hip (*Rosa Canina* L) Pulp", *Journal of Food Quality*, 2004, *27*, p311.



Chemical Kinetics

Theoretical Models-Collision Theory



Chemical Kinetics

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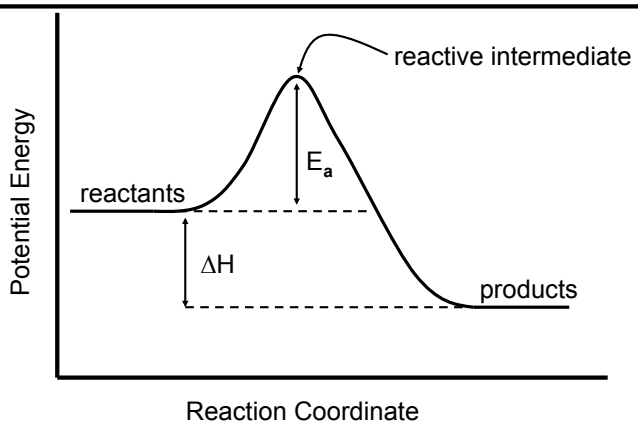
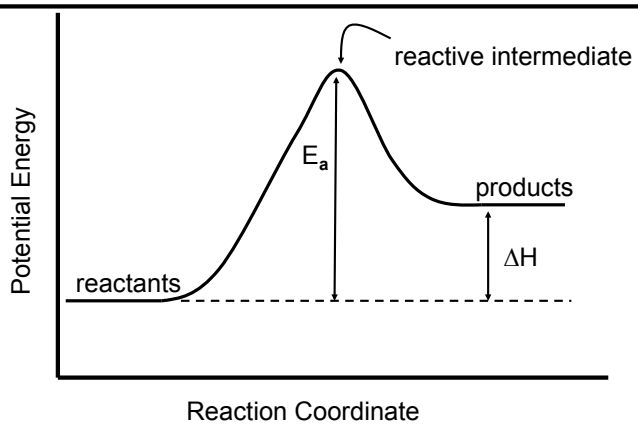


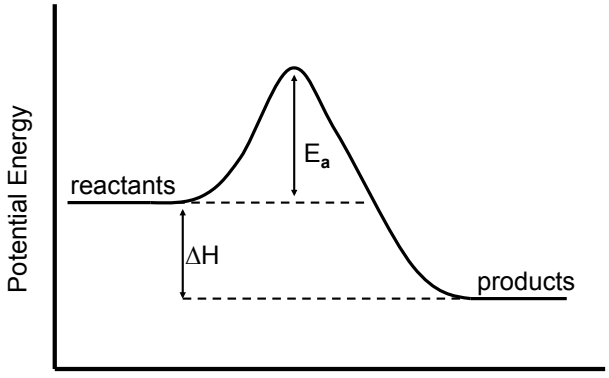
Chemical Kinetics

Theoretical Models-Collision Theory



Chemical Kinetics

Catalysts-Energy Diagram



Chemical Kinetics

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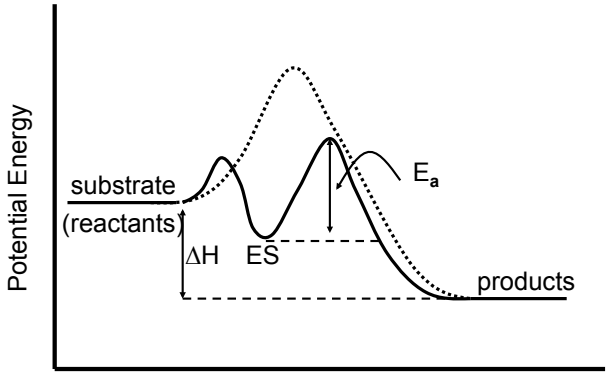

4. Define each of the following:

a. Reaction mechanism

b. Elementary step

c. Rate-determining step

d. Reaction (reactive) intermediate

e. Catalyst

Formation of Ozone

$$O_2(g) \rightarrow O(g) + O(g)$$
$$O_2(g) + O(g) + M \rightarrow O_3(g) + M$$
$$O_2(g) + O(g) + M \rightarrow O_3(g) + M$$

$$3O_2(g) \rightarrow 2O_3(g)$$

Decomposition of Ozone

$$O_3(g) \rightarrow O_2(g) + O(g)$$
$$O_3(g) + O(g) \rightarrow 2O_2(g)$$

$$2O_3(g) \rightarrow 3O_2(g)$$

Catalyzed Decomposition of Ozone

$$Cl(g) + O_3(g) \rightarrow O_2(g) + ClO(g)$$
$$O_3(g) \rightarrow O_2(g) + O(g)$$
$$ClO(g) + O(g) \rightarrow Cl(g) + O_2(g)$$

$$2O_3(g) \rightarrow 3O_2(g)$$

Unimolecular Step:

$A \rightarrow$ products

rate = k[A]

Bimolecular Step:

$A + A \rightarrow$ products

rate = $k[A]^2$

$A + B \rightarrow$ products

rate = k[A][B]

Termolecular Step:

$A + A + A \rightarrow$ products

rate = $k[A]^3$

$A + B + C \rightarrow$ products etc.

rate = k[A][B][C]

Decomposition of Hydrogen Peroxide

Uncatalyzed

$$H_2O_2(aq) \rightarrow H_2O(l) + O(g)$$
$$O(g) + H_2O_2(aq) \rightarrow H_2O(l) + O_2(g)$$

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Catalyzed (I^{1-})

$$H_2O_2(aq) + I^{1-}(aq) \rightarrow H_2O(l) + IO^{1-}(aq)$$
$$H_2O_2(aq) + IO^{1-}(aq) \rightarrow H_2O(l) + O_2(g) + I^{1-}(aq)$$

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Catalyzed (Catalase)

$$[\text{catalase-Fe(III)}] + H_2O_2(aq) + 2H^{1+}(aq) \rightarrow H_2O(l) + [\text{complex I-}H_2O\text{-Fe(V)}]^{2+}$$
$$[\text{complex I-}H_2O\text{-Fe(V)}]^{2+} + H_2O_2(aq) \rightarrow H_2O(l) + O_2(g) + 2H^{1+}(aq) + [\text{catalase-Fe(III)}]$$

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$