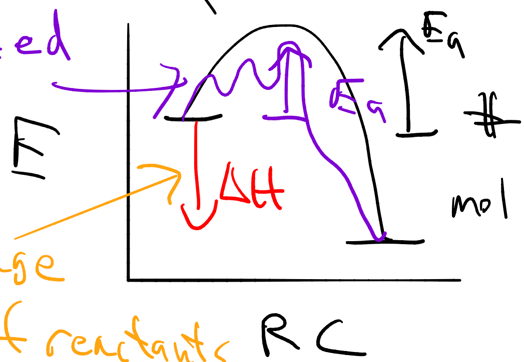
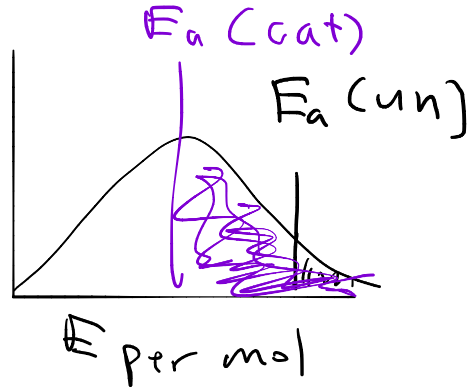
5/22/20

Exam #2 — Catalysts

uncatalyzed

catalyzed





No change in E of reactants or products by adding a catalyst → no effect on equilibrium

Catalyzed → lower E_a → more molecules with enough E to react → faster

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17.46 $K_p = 6.5 \times 10^4$ @ 308K

$$2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$$

At equilibrium $P_{NO} = 0.35$ atm $P_{Cl_2} = 0.10$ atm

What is the partial pressure of NOCl? (at equilibrium)

$$K_p = \frac{(P_{NOCl})^2}{(P_{NO})^2 (P_{Cl_2})}$$

$$6.5 \times 10^4 = \frac{(P_{NOCl})^2}{(0.35)^2 (.1)}$$

In a 0.20M solution of a weak acid, the acid dissociates 3%. L2

Calculate K_a.

	HA	$\rightleftharpoons$	$H^+_{(aq)}$	$A^-_{(aq)}$
I	0.20 M		0	0
C	$-x$		$+x$	$+x$
E	$0.20-x$		x	x

No simplifications needed! (no quadratic)

$$x = \underbrace{(0.03)}_{3\%}\underbrace{(0.20)}_{\text{original concentration}}$$

$x = 0.006$

$[HA]_e = 0.20 - 0.006 = 0.194$

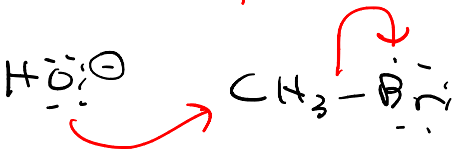
$[H^+] = [A^-] = 0.006$

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(0.006)^2}{.194}$$

$= 1.86 \times 10^{-4}$

$R = k[\ ][\ ]\ldots\ldots$

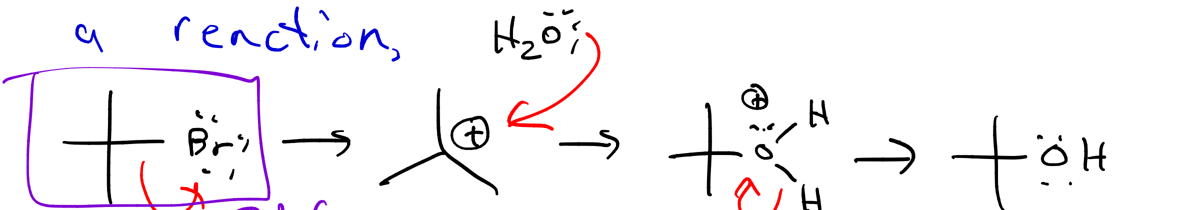
If the mechanism of the RLS is known, the rate law can be written from the stoichiometry of that reaction,



Both molecules involved simultaneously in only one reaction step

$R = k[OH^-][CH_3Br]$

There is absolutely no connection between an overall stoichiometric expression and the rate law for a reaction,



RLS

$(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr$

2 reagents

$R = k[(CH_3)_3CBr]$ ⇐ only one reagent

Method of initial rates

$$5A + 3B + 6C \rightarrow \text{Product}$$

trial	initial rate	initial [A]	initial [B]	initial [C]
1	6.0×10^{-6}	$\boxed{0.024}$	$\boxed{0.100}$	0.032
2	9.6×10^{-5}	$\boxed{0.096}$	0.100	0.032
3	2.0×10^{-6}	0.024	$\boxed{0.034}$	0.032
4	4.5×10^{-6}	0.012	0.300	0.064

same

In the method of initial rates, a control reaction is first run, then, the initial concentration of each reagent is individually varied in order to determine its effect on the rate of rxn.

The effect of A can be determined by comparing trials 1 & 2.

$$\frac{R_2}{R_1} = \frac{k[A]_2^a \cancel{[B]^b} \cancel{[C]^c}}{k[A]_1^a \cancel{[B]^b} \cancel{[C]^c}} = \frac{k[A]_2^a}{k[A]_1^a} = \left(\frac{[A]_2}{[A]_1}\right)^a$$

the ratio of rates in trials 1+2 depends only on [A]

[5

$$\frac{9.6\times10^{-5}}{6.0\times10^{-6}} = \left(\frac{0.96}{0.24}\right)^a$$

$$16 = (4)^a \qquad a = 2$$

$$R = k[A]^2[B]^b[C]^c$$

$$\frac{R_1}{R_3} = \left(\frac{[B]_1}{[B]_3}\right)^b$$ ← [A] and [C] are the same in trials 1 + 3

$$\frac{6.0\times10^{-6}}{2.0\times10^{-6}} = \left(\frac{0.100}{0.034}\right)^b$$

$$3 = 3^b \qquad b = 1$$

$$R = k[A]^2[B][C]^c$$