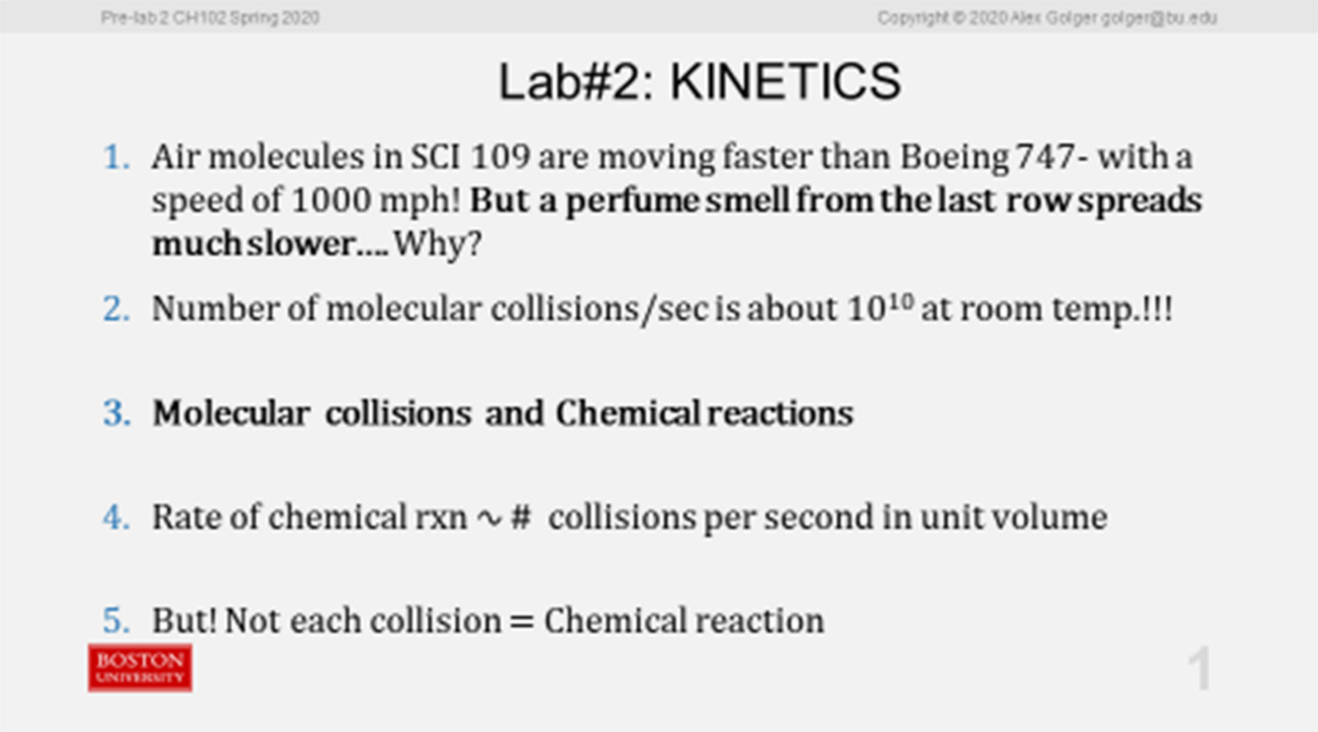
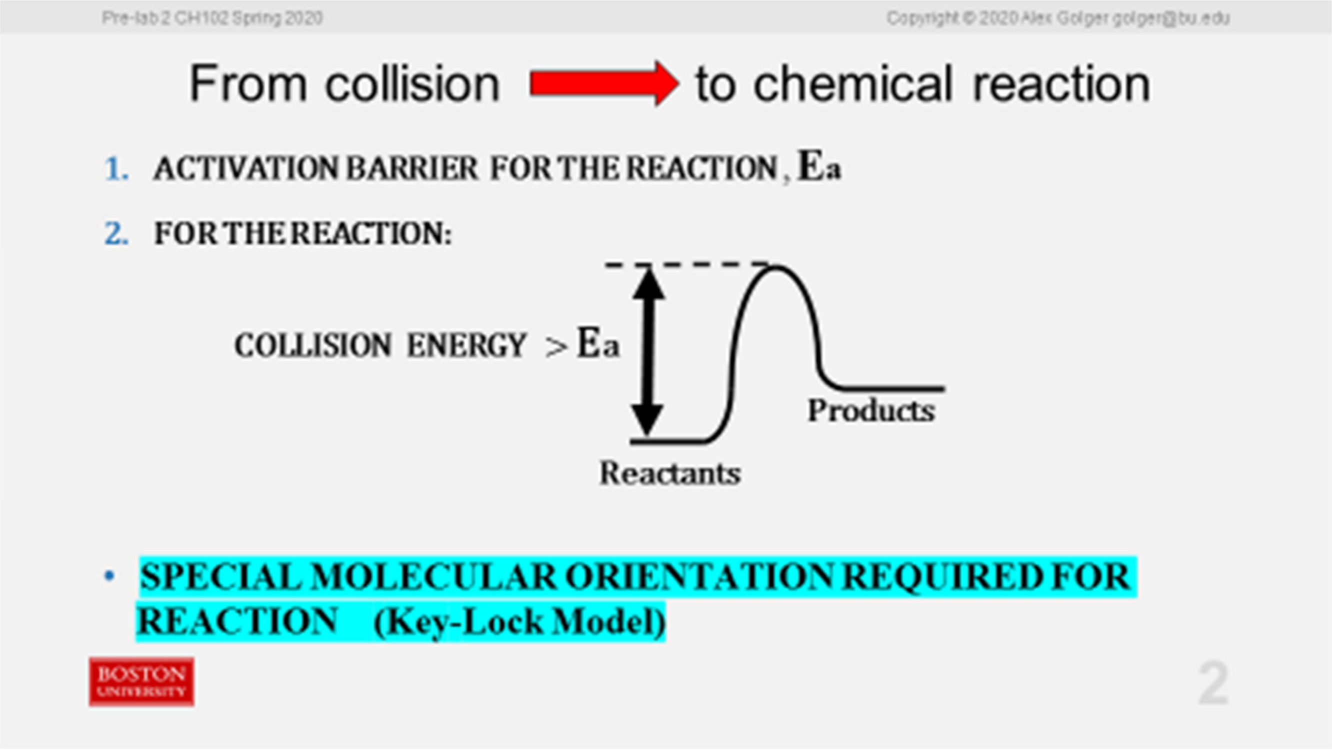


Lab#2: KINETICS

1. Air molecules in SCI 109 are moving faster than Boeing 747- with a speed of 1000 mph! **But a perfume smell from the last row spreads much slower....** Why?
2. Number of molecular collisions/sec is about 10^{10} at room temp.!!!
3. **Molecular collisions and Chemical reactions**
4. Rate of chemical rxn ~ # collisions per second in unit volume
5. But! Not each collision = Chemical reaction

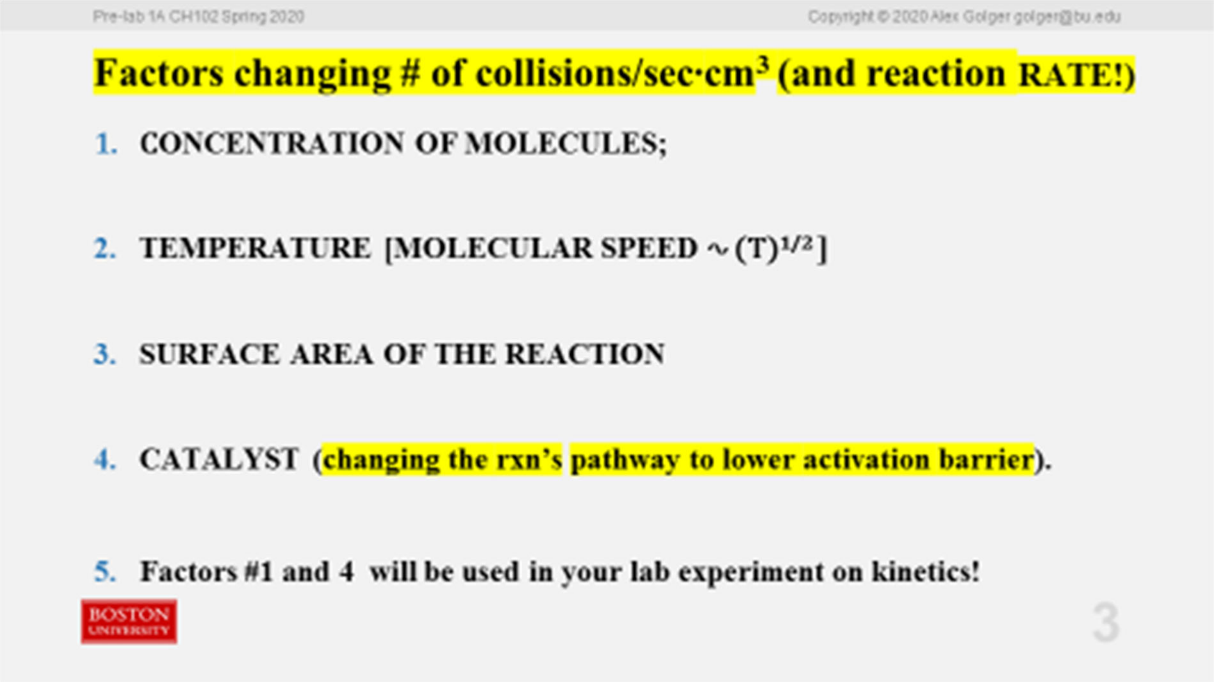


From collision → to chemical reaction

1. **ACTIVATION BARRIER FOR THE REACTION, E_a**
2. **FOR THE REACTION:**

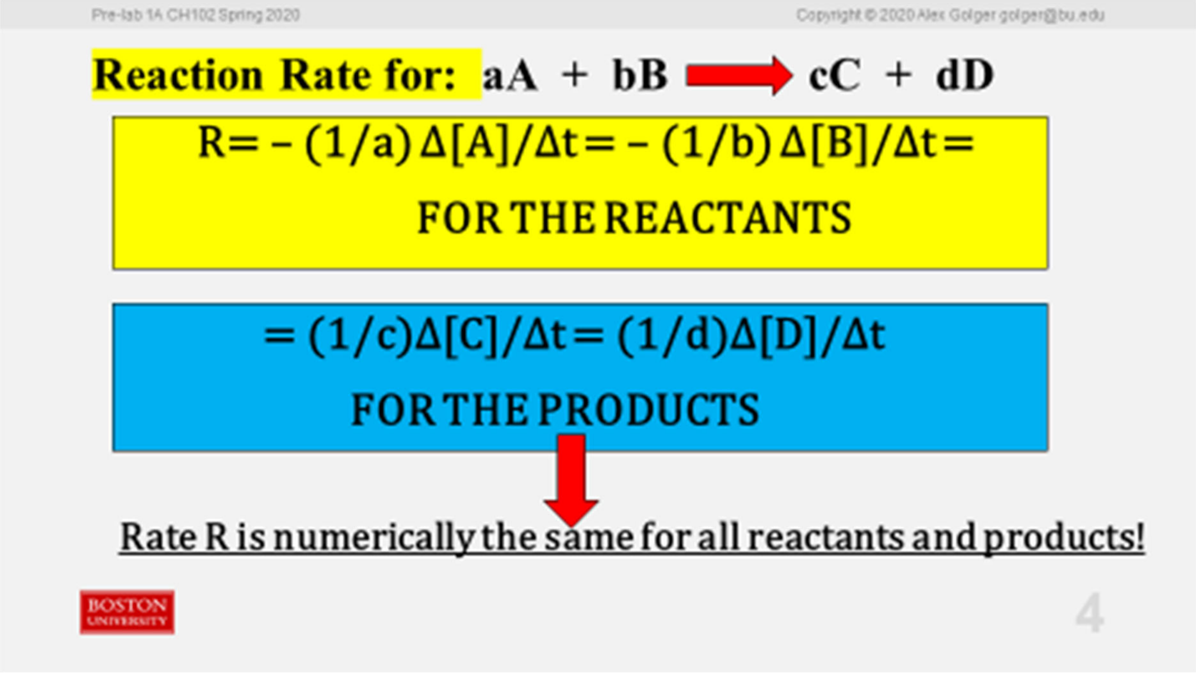
COLLISION ENERGY > E_a

- **SPECIAL MOLECULAR ORIENTATION REQUIRED FOR REACTION (Key-Lock Model)**



Factors changing # of collisions/sec·cm^3 (and reaction RATE!)

1. CONCENTRATION OF MOLECULES;
2. TEMPERATURE [MOLECULAR SPEED ~ $(T)^{1/2}$]
3. SURFACE AREA OF THE REACTION
4. CATALYST (changing the rxn's pathway to lower activation barrier).
5. Factors #1 and 4 will be used in your lab experiment on kinetics!



Reaction Rate for: $aA + bB \longrightarrow cC + dD$

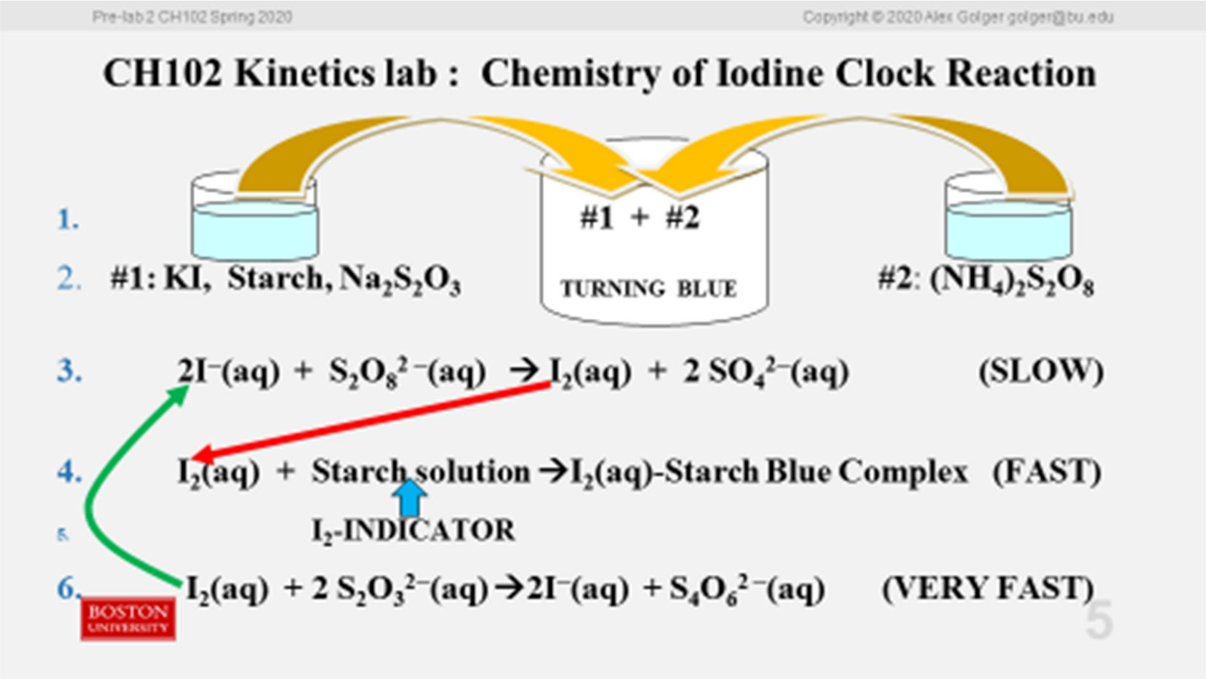
$$R = -(1/a)\,\Delta[A]/\Delta t = -(1/b)\,\Delta[B]/\Delta t =$$

FOR THE REACTANTS

$$= (1/c)\Delta[C]/\Delta t = (1/d)\Delta[D]/\Delta t$$

FOR THE PRODUCTS

Rate R is numerically the same for all reactants and products!



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CH102 Kinetics lab : Chemistry of Iodine Clock Reaction

1.

2. #1: KI, Starch, $Na_2S_2O_3$ #2: $(NH_4)_2S_2O_8$

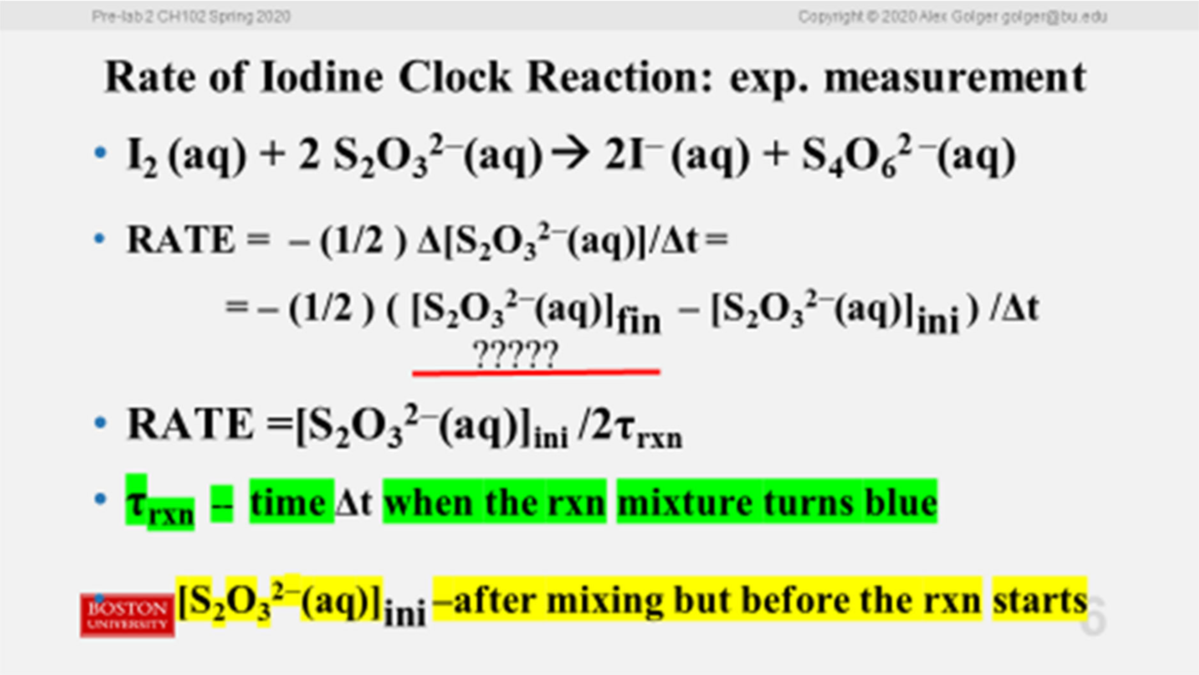
3. $2I^-(aq) + S_2O_8^{2-}(aq) \rightarrow I_2(aq) + 2\,SO_4^{2-}(aq)$ (SLOW)

4. $I_2(aq)$ + Starch solution → $I_2(aq)$-Starch Blue Complex (FAST)

5. I_2-INDICATOR

6. $I_2(aq) + 2\,S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$ (VERY FAST)

5



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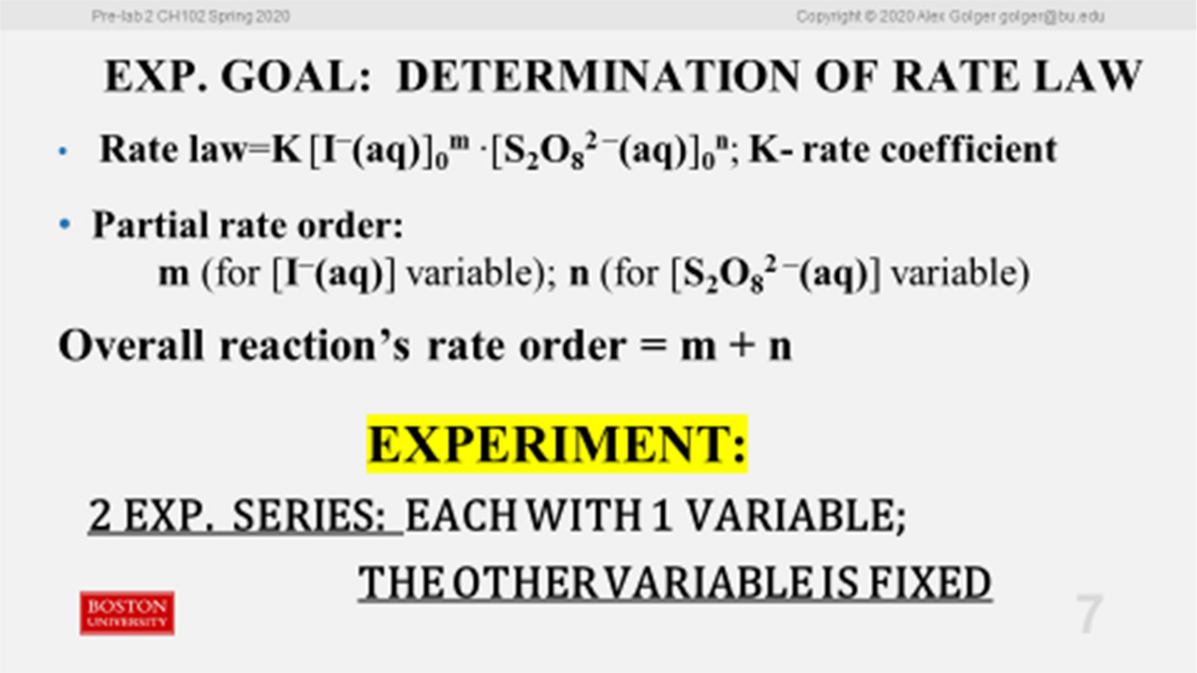
Rate of Iodine Clock Reaction: exp. measurement

- $I_2(aq) + 2\,S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$
- RATE = $-(1/2)\,\Delta[S_2O_3^{2-}(aq)]/\Delta t =$

$$= -(1/2)\,(\underset{?????}{\underline{[S_2O_3^{2-}(aq)]_{fin}}} - [S_2O_3^{2-}(aq)]_{ini})\,/\Delta t$$

- RATE $=[S_2O_3^{2-}(aq)]_{ini}/2\tau_{rxn}$
- τ_{rxn} – time Δt when the rxn mixture turns blue
- $[S_2O_3^{2-}(aq)]_{ini}$ –after mixing but before the rxn starts

6



EXP. GOAL: DETERMINATION OF RATE LAW

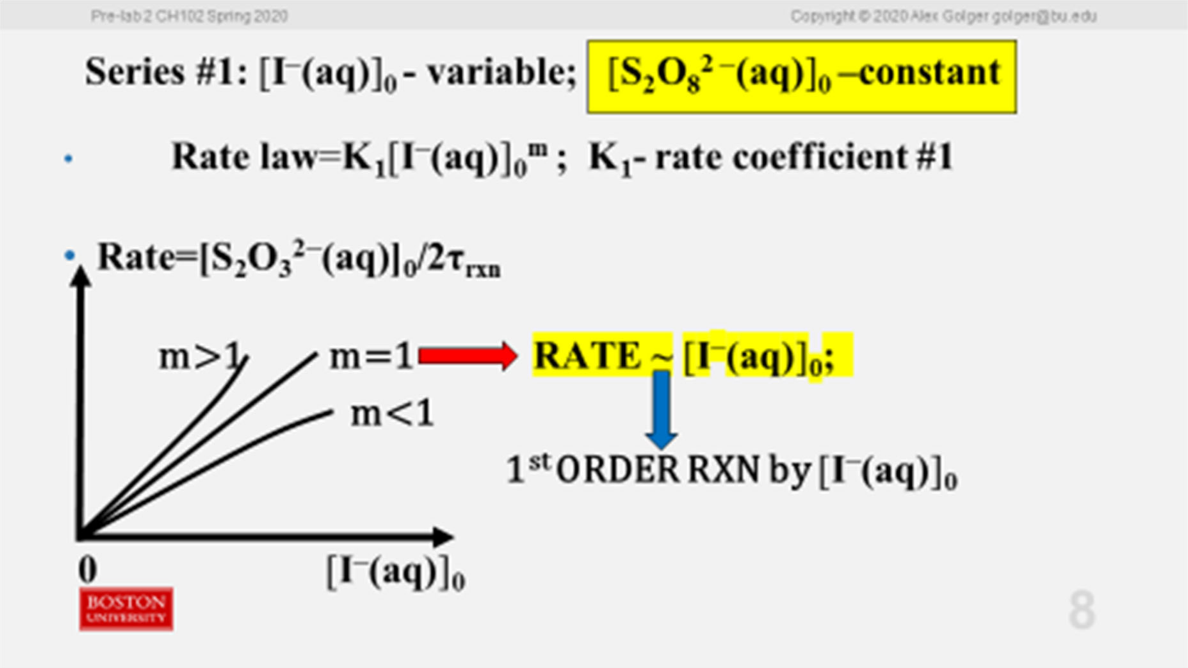
- **Rate law=K [I^-(aq)]$_0^m$ ·[$S_2O_8^{2-}$(aq)]$_0^n$; K- rate coefficient**
- **Partial rate order:**
  m (for [**I^-(aq)**] variable); **n** (for [**$S_2O_8^{2-}$(aq)**] variable)

Overall reaction's rate order = m + n

EXPERIMENT:

2 EXP. SERIES: EACH WITH 1 VARIABLE;

THE OTHER VARIABLE IS FIXED

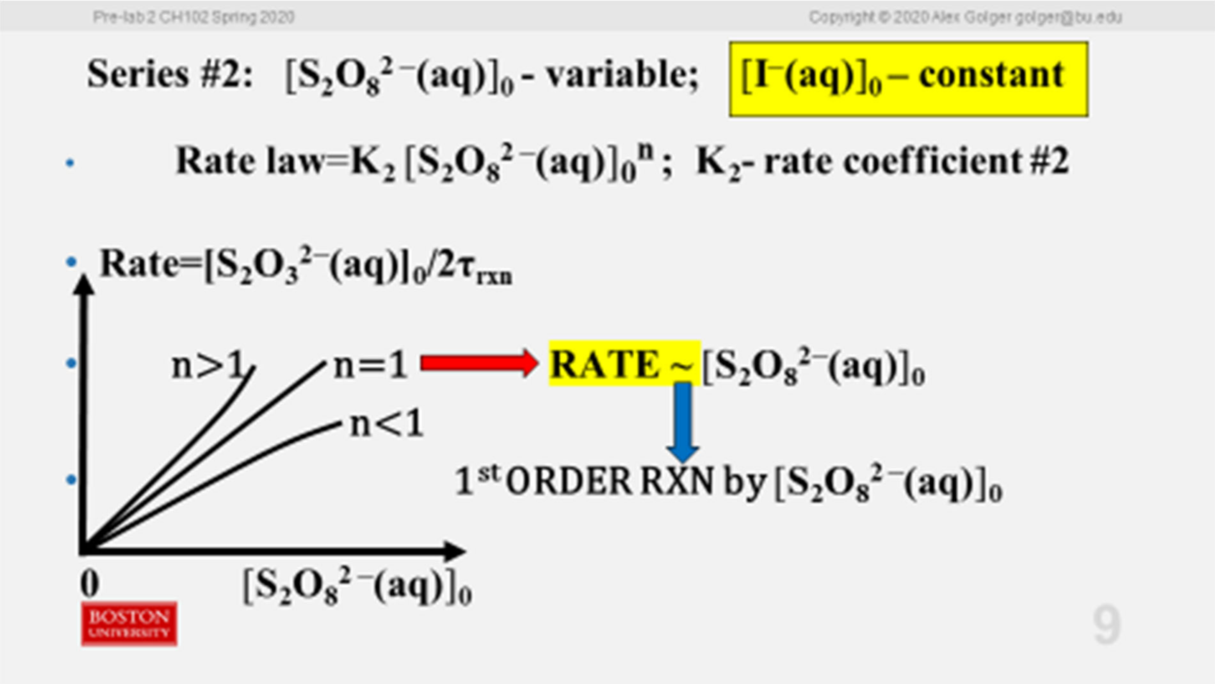


Series #1: [I^-(aq)]$_0$ - variable; [$S_2O_8^{2-}$(aq)]$_0$ –constant

- **Rate law=K_1[I^-(aq)]$_0^m$; K_1- rate coefficient #1**
- **Rate=[$S_2O_3^{2-}$(aq)]$_0$/2τ_{rxn}**

RATE ~ [I^-(aq)]$_0$;

1st ORDER RXN by [I^-(aq)]$_0$



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Series #2: $[S_2O_8^{2-}(aq)]_0$ **- variable;** $\boxed{[I^-(aq)]_0 - \text{constant}}$

- **Rate law=**$K_2\,[S_2O_8^{2-}(aq)]_0^{\,n}$**;** K_2**- rate coefficient #2**
- **Rate=**$[S_2O_3^{2-}(aq)]_0/2\tau_{rxn}$

n=1 → **RATE ~** $[S_2O_8^{2-}(aq)]_0$

1^{st} ORDER RXN by $[S_2O_8^{2-}(aq)]_0$

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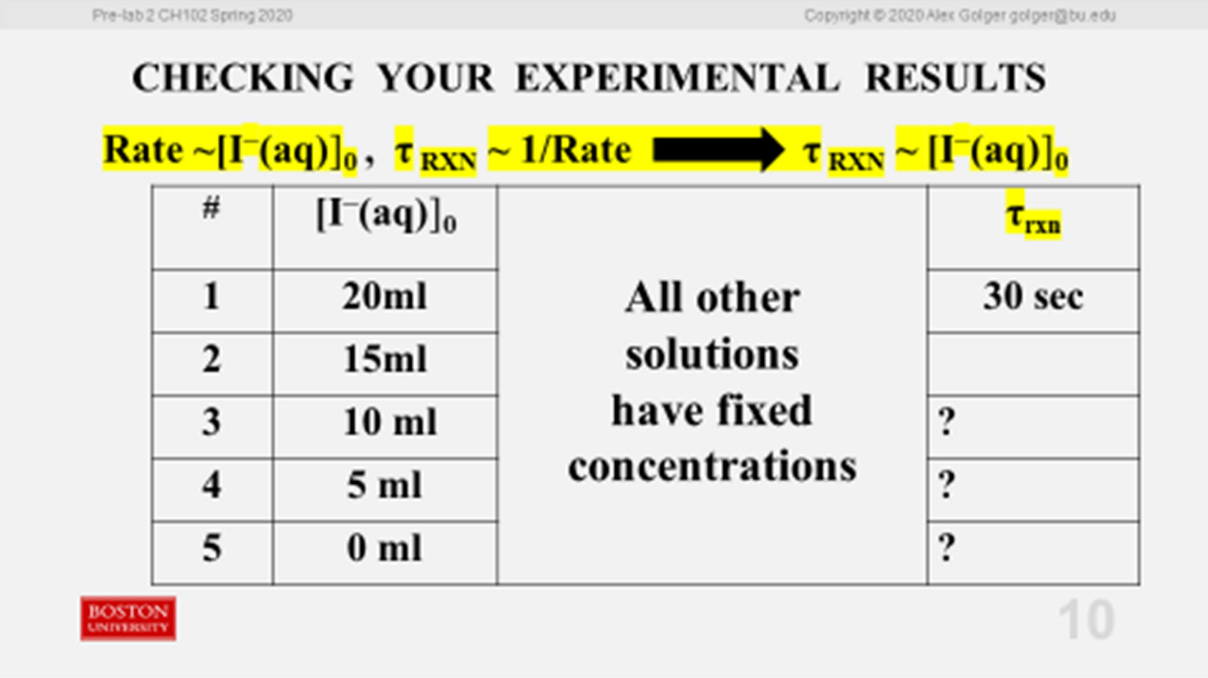

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CHECKING YOUR EXPERIMENTAL RESULTS

Rate ~$[I^-(aq)]_0$**,** τ_{RXN} **~ 1/Rate** → τ_{RXN} **~** $[I^-(aq)]_0$

#	$[I^-(aq)]_0$		τ_{rxn}
1	20ml	All other solutions have fixed concentrations	30 sec
2	15ml		
3	10 ml		?
4	5 ml		?
5	0 ml		?

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