

# INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

COURSE <u>(H117)</u>	ROLL NO. <u>23B0912</u>	NAME <u>Aditya Somapala</u>	
ASSIGNMENT NO. <u>4</u>		DUE DATE	SUB. DATE <u>9/10</u>

## Experiment 4: Oscillatory Chemical Reaction

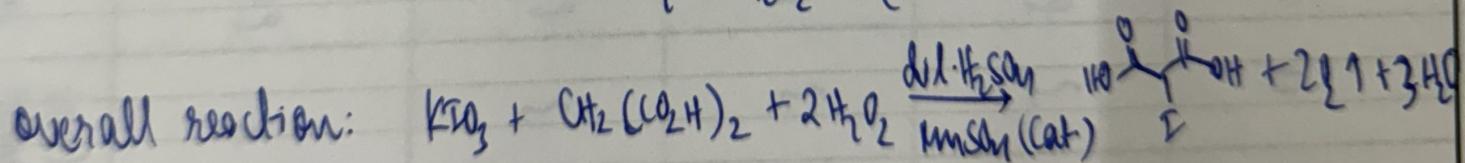
Aim:

- To introduce the concept of non-equilibrium thermodynamics with an example.
- To speculate on the possible causes and applications of an oscillating chemical reaction.

Theory: Briggs-Rauscher (BR) Reaction

Chemicals needed:

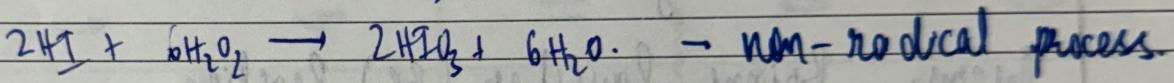
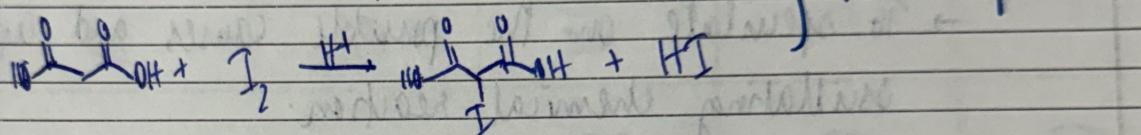
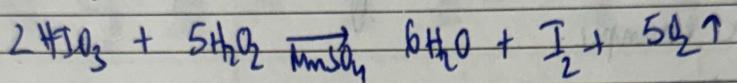
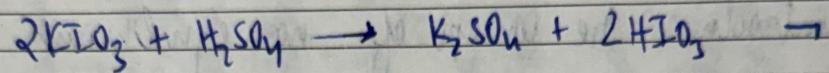
1. aq.  $KIO_3$  (0.02 M)
2. aq.  $H_2SO_4$  (0.05M)
3. aq. malonic acid (0.05M)
4. aq.  $MnSO_4$  (0.007 M)
5. aq. starch (0.01%)
6. aq.  $H_2O_2$  (0.06 M)



- It is an oscillatory reaction whose mechanism has many steps and intermediates.
- Two processes take place over the course of the reaction - a radical and a non-radical process.

- The radical processes do not need iodide ( $I^-$ ), so they occur first and are fast (i.e., high rate).
- When there is a lot of  $I^-$  in solution, that's when the non-radical process takes over. It is a slow process (i.e., low rate).

Overall reaction scheme:



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Observation:			
Time of 1st blue and blue period			
Time of 2nd blue			
Vol. of amt. of Starch (ml)	285	6	165
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	135	3	165
S.N.	1.	3	11
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	3	135
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	3	3	165
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	3	225
S.N.	2.	3	95
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	3	165
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	3	3	225
S.N.	3.	3	95
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	3	165
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	3	3	165
S.N.	4.	3	0
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	0	0
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	3	0	0
S.N.	5.	3	-
Vol. of amt. of HgSO <sub>4</sub> (ml)	3	-	-
Vol. of amt. of K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> (ml)	3	-	-
Remarks			

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## Interpretation:

Case-1: → There were 6 oscillations.

- Avg. oscillation time period is 15 s.
- The colors cycled from colorless to an amber yellow to a blue and back to colorless.
- At the end of the reaction, the solution stayed a dark blue color.

Case-2: → There were 4 (less) oscillations.

- Avg time period is 16 s. (more)
- The colors cycled from colorless to an amber yellow to a blue and back to colorless.
- At the end, the solution stayed a dark blue color.

Case-3: → There were 11 (more) oscillations.

- Avg time period is 13 s. (less)
- The colors cycled from colorless to an amber yellow to a blue and back to colorless.
- At the end, the ~~solution~~ stayed a dark blue color.

These are not interpretations,  
these are observations

- Case-4: → The blue color first appeared after 5s.  
→ As there was no malonic acid, there was no way to produce  $I^-$ , hence the reaction stopped at  $I_2$ .  
→ The colors cycled from colorless to amber yellow to blue and it stayed blue.  
→ No oscillations were observed.  
→ At the end, the solution stayed a dark blue color.
- Case-5: → No color change was observed.  
→ As no  $Mn^{2+}$  was there, no catalyst was present hence the reaction stopped.  
→ At the end, the solution stayed colorless.  
→ No oscillations were observed.