

Chemistry TAS Report

1. Experiment Number : 5
2. Date : 05/11/2007
3. Title : An Investigation of the Order of the reaction of Iodine with Propanone

4. Aims/Objective :

To determine the order of the reaction of Iodine with Propanone.

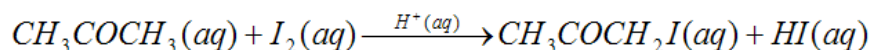
5. Introduction / Theory:

This reaction is first order with respect to propanone and first order with respect to the hydrogen ions which the reaction is catalyzed by. The order with respect to iodine can be determined by having a reaction mixture which the initial concentrations of propanone and hydrogen ions are very much larger than that of iodine. And only the concentration of the iodine is varied during the reaction and thus its effect on the reaction rate can be seen.

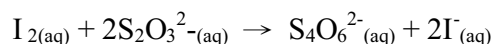
The above reaction can be followed by monitoring the concentration of iodine. The steps, samples from the reaction mixture from time to time are removed and these are analyzed for iodine, are involved.

6. Relevant Equations/Chemical Reactions Involved :

(1) Reaction between propanone and iodine :



(2) Reaction between iodine and thiosulphate(VI) ion (titration) :



7. Chemicals :

0.02 M iodine solution (Iodine dissolved in potassium iodide solution)

1 M propanone solution

1 M sulphuric acid

0.5 M sodium hydrogencarbonate solution

0.01 M sodium thiosulphate(VI) solution

Starch solution

8. Apparatus and equipment :

10.0 cm ³ pipette	1	Burette	1
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25 cm ³ measuring cylinder	1	Filter funnel	1
10 cm ³ measuring cylinder	1	White tile	1
100 cm ³ Beaker	2	Stop watch	1
250 cm ³ Conical flask	4	Pipette filler	1
Safety spectacle	1	Wash bottle	1

9. Procedure :

1. 25.0 cm³ of sulphuric acid and V₁ cm³ of propanone solution and V₂ cm³ of distilled water were measured by measuring cylinder into a conical flask.

Group	A	B	C	D
Volume of propanone solution(V ₁ / cm ³)	25.0	20.0	15.0	10.0
Volume of distilled water (V ₂ / cm ³)	0.0	5.0	10.0	15.0

2. 50.0 cm³ OF 0.02 M iodine solution was added by measuring cylinder to the propanone mixture as quickly as possible. Stop watch was started at the same time. And the content was mixed.
3. During the 5 minutes interval , 10.0 cm³ of the 0.5 M sodium hydrogencarbonate solution was measured and then added into another conical flask .
4. After 5 minutes, 10.0 cm³ of the reaction mixture was pipetted into the conical flask prepared in step 4. When it was done, the time should be noted.
5. The solution in step 4 was mixed and then titrated with 0.01 M sodium thiosulphate(VI) solution. Starch solution was used as indicator.
6. After 10, 15, 20, 25 and 30 minutes, 10 cm³ portions of the reaction mixtures in step 2 were withdrawn and the above procedure was then carried out each time.
7. The results were recorded.

10. Observations :

The solution changed from black to pale yellow at the end point.

11. Data, Calculation and Results :

Results of group A :

Time when reaction mixture was added to NaHCO ₃ / min	5	10	15	20	25	30
Final burette reading / cm ³	16.50	31.35	12.95	24.20	33.65	41.5

Initial burette reading / cm ³	0.30	16.50	0.40	12.95	24.20	33.65
Volume of Na ₂ S ₂ O ₃ / cm ³	16.20	14.85	12.55	11.25	9.45	7.85

12. Conclusion :

It was found that the order of the reaction with respect to iodine was zero.

13. Discussion :

1. [The required graph please refer to Appendix 1.]
2.
 - a) The function of the sodium hydrogencarbonate in step 3 is quenching.
 - b) The iodine concentration in the reaction fell throughout the experiment as iodine was consumed by propanone.
 - c) The slope of the straight line in the graph is the rate of equation.
 - d) The iodine concentration changed at a uniform rate throughout the experiment as the slope of the graph is constant.
 - e) The rate of iodine concentration is independent on the iodine concentration because the reaction is zero order with respect to iodine.
 - f) The order of reaction with respect to iodine is zero, i.e. $n = 0$
 - g) Iodine does not take part in the rate determining step of this reaction.
 - h) The intercept of the graph with the y-axis is the initial concentration of iodine.
 - i) The concentration of the sodium thiosulphate(VI) solution is 0.01M.

3.

Group / Pair No.	A	B	C	D
Gradient of graph / cm ³ min ⁻¹	- 0.284	- 0.255	- 0.220	- 0.180

[The required graph please refer to Appendix 2.]

- a) The gradient of the graph in Discussion 1 is directly proportional to the rate of reaction and volume of propanone solution is also directly proportional to its concentration.
 Since a straight line is plotted in the graph above, rate of reaction is directly proportional to the concentration of propanone. Thus, the order of the reaction with respect to propanone is 1.
- b) Rate equation :

$$\text{Rate} = k[\text{CH}_3\text{COCH}_3]^a[\text{I}_2]^b[\text{H}^+]^c$$
 Since $b = 0$ and $[\text{H}^+] = \text{constant}$
 So, $\text{rate} = k[\text{CH}_3\text{COCH}_3]^1$