Experiment 4
Studying the kinetics of a photochemical reaction using UV-Vis absorption spectroscopy

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I. Introduction

The reaction between Ammonium Oxalate and Iodine exhibits dormancy in dark conditions but high reactivity under light, resulting in the gradual disappearance of the solution's brownish color. This phenomenon can be quantified using Beer-Lambert's law, which states that absorbance is directly proportional to concentration, provided the molar extinction coefficient (ϵ) and path length (l) remain constant. The formula for Beer-Lambert's law is:

$$Absorbance = \epsilon \times C \times l \tag{1}$$

Utilizing UV-Vis absorption spectroscopy allows for the monitoring of this reaction's kinetics.

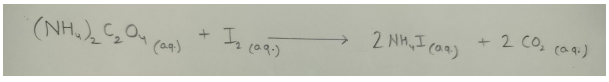


Fig. 1: Reaction between Ammonium Oxalate and Iodine

Safety Precautions:

i Always wear gloves and protective eyewear while working on the experiment to prevent skin and eye contact with the chemicals.

ii Handle the chemicals with care to avoid spills or splashes. Minimize direct contact with the chemicals to reduce the risk of exposure.

iii Use the laboratory apparatus carefully and diligently to prevent accidents or damage to equipment.

II. Experiment Details

A. Apparatus

1) Two test tubes
2) Aluminium foil
3) LED torch
4) Cuvette
5) Dropper
6) Gloves
7) Protective goggles
8) UV-Vis absorption spectrophotometer

B. Materials

1) Ammonium Oxalate
2) Iodine

C. Procedure

i Prepare a saturated Ammonium Oxalate solution.

ii Add 4 ml of Ammonium Oxalate solution in both test tubes and some drops of Iodine. The solution will turn dark orange.

iii Now, with the help of an aluminum foil, cover one of the test tubes and leave it as it is.

iv Keep the other test tube in front of a bright LED light.

v Start a timer of 10 minutes, and after every 10 minutes, take a sample from the test tube under the LED light.

vi Measure its absorbance and plot a graph between absorbance and time.

vii Continue taking the sample from the test tube until the solution turns transparent.

viii In the end, remove the aluminum foil from the other test tube and measure its absorbance.

III. Results

We plot the graph of absorbance vs. wavelength for each sample taken at intervals of 10 minutes, as mentioned in step (v) of the procedure.

A. Individual Graphs

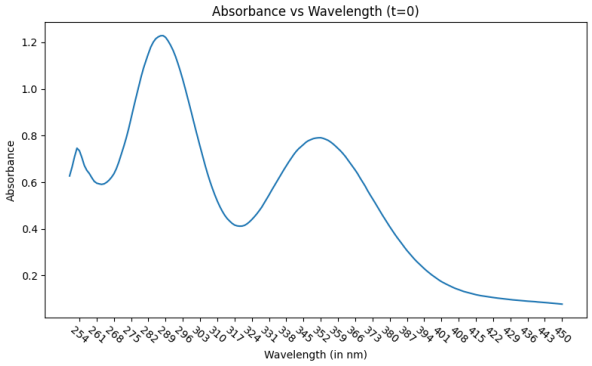


Fig. 2: Absorbance vs. Wavelength at t=0 minutes

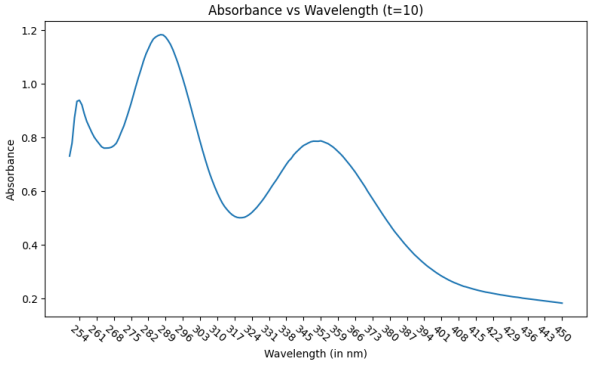


Fig. 3: Absorbance vs. Wavelength at t=10 minutes

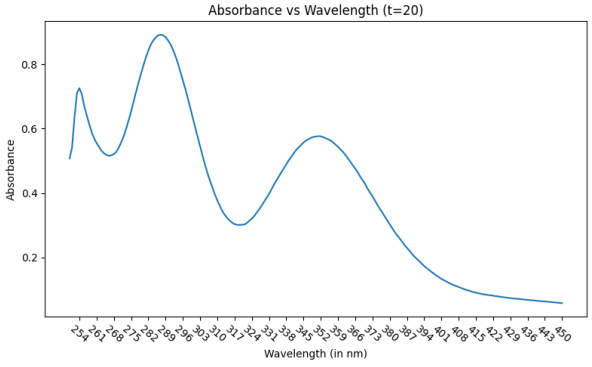


Fig. 4: Absorbance vs. Wavelength at t=20 minutes

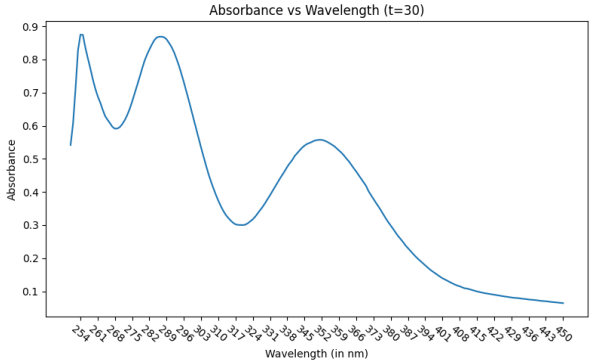


Fig. 5: Absorbance vs. Wavelength at t=30 minutes

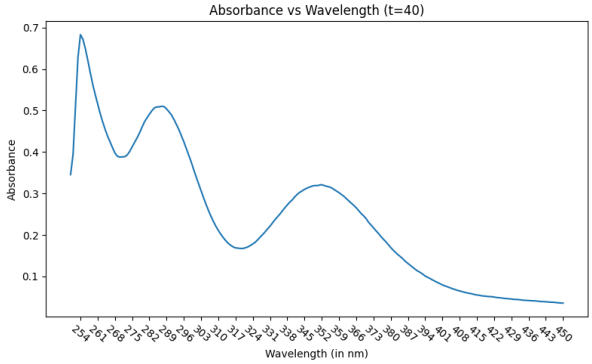


Fig. 6: Absorbance vs. Wavelength at t=40 minutes

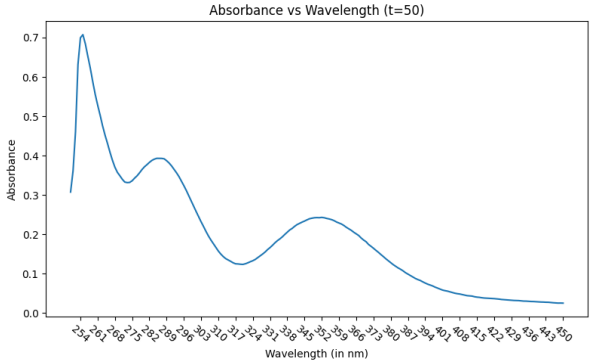


Fig. 7: Absorbance vs. Wavelength at t=50 minutes

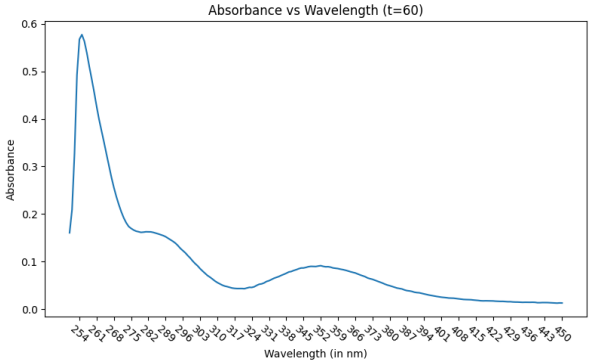


Fig. 8: Absorbance vs. Wavelength at t=60 minutes

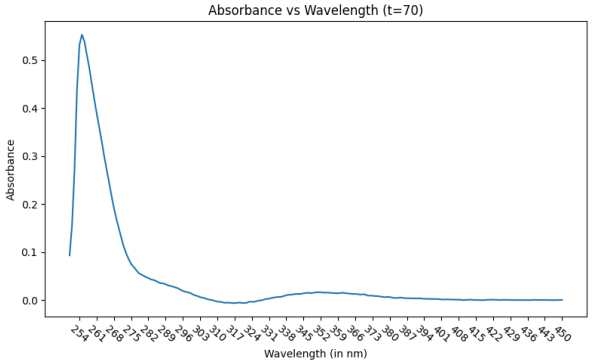


Fig. 9: Absorbance vs. Wavelength at t=70 minutes

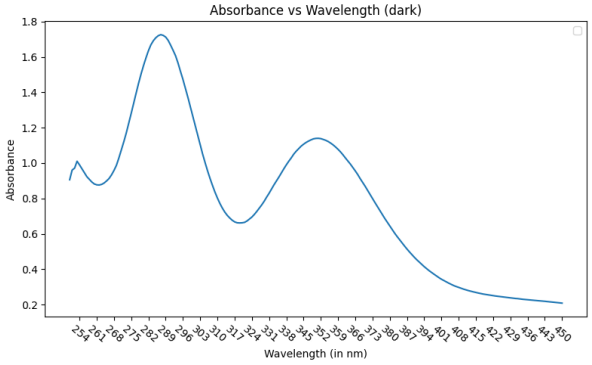


Fig. 10: Absorbance vs. Wavelength for test tube kept in the dark

B. Analysis

We now plot all these graphs on a single graph to compare the peaks across time.

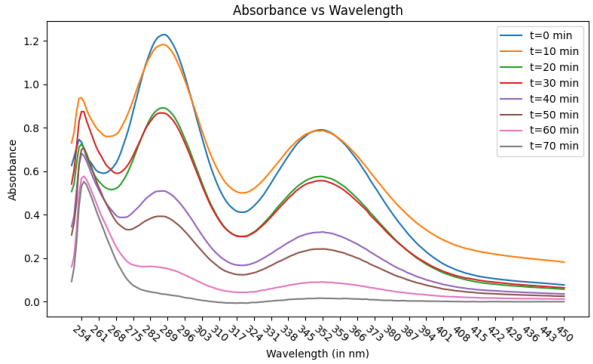


Fig. 11: Absorbance vs. Wavelength for all t

Now, focusing on the peak at 351 nm and plotting the absorbance value against time, we can comment on the kinetics of the reaction.

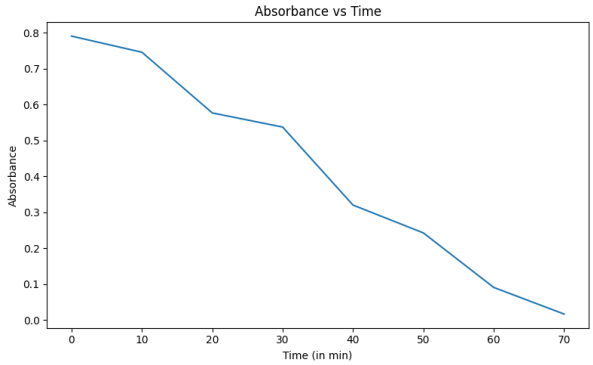


Fig. 12: Absorbance vs. Time

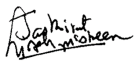
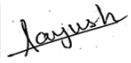
From the graph, we can say that absorbance decreases as time increases, whereas the absorbance of the test kept in the dark remains nearly constant. This suggests that the reaction is being driven forward by light, i.e., the formation of Ammonium Iodide is accelerated by light. The intensity of the brown color of the solution kept in light decreases with time, indicating the progress of removing Iodine from reactants or forming the products. At t = 70 minutes, the solution turns colourless, showing the completion of the reaction. The test tube, kept in the dark, stays brown in colour even after 70 minutes, indicating that very little or none of the Iodine is used, which tells that the reaction has not driven forward. The graphs of Absorbance vs. Time suggest that the reaction is a first-order reaction.

IV. Conclusion

In this experiment, we examined the kinetics of the reaction between Ammonium Oxalate and Iodine when exposed to light and kept in the dark. We observed that the colour of the solution changed from brown to colourless under light, indicating the need for a photocatalyst for the reaction to occur. We performed UV-Vis absorption spectroscopy at fixed intervals of time to measure the change in absorbance (hence

concentration) with time. We concluded from this data and the graphs that the reaction is a first-order reaction.

V. Author Contribution

Name	**Contribution**	**Signature**
Jaskirat Singh Maskeen (23110146)	Document structure, Results, and Conclusion, Took sample for cuvette	
Nishchay Bhutoria (23110222)	Introduction and Safety precautions, Took UV-Vis readings, and sample for cuvette	
Aayush Bundel (23110005)	Experimental details, Washing cuvette, Maintaining the timer	
Kavya Lavti (23110164)	Experimental details	
Kanhiyalal (23110155)	Equation, Gathering the chemicals, Maintaining the timer