KINETICS OF THE IODINATION OF ACETONE IN AN ACID MEDIUM BY VISIBLE SPECTROSCOPY

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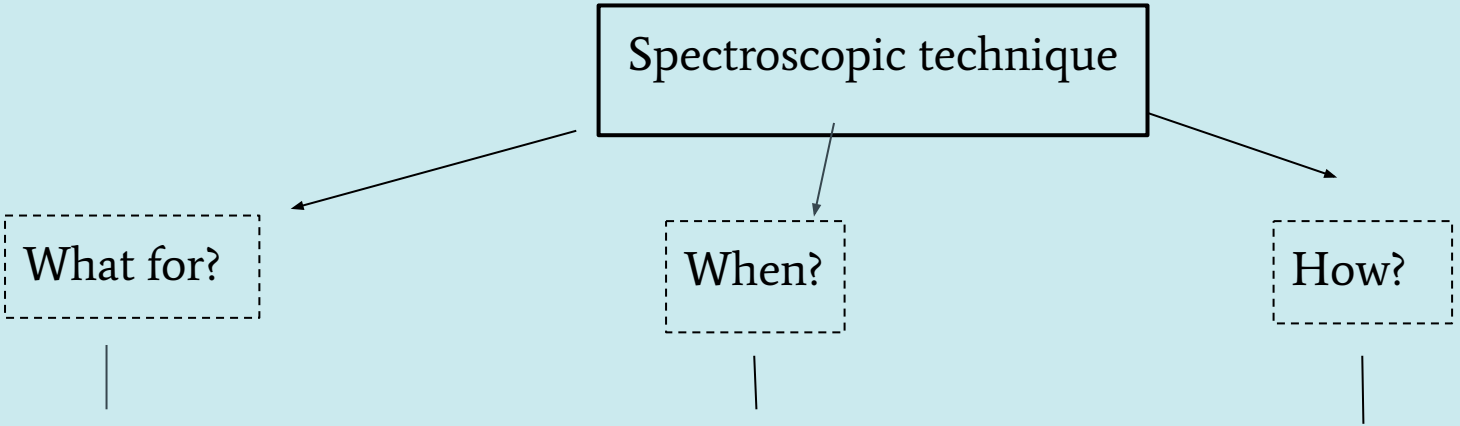
1. AIM

- Obtain the reaction order in terms of the different reagents.

- Apply the half-life method to determine the reaction order.

- Apply Beer's equation to follow a reagent's concentration variation over time.

2. THEORETICAL BACKGROUND



Beer's law

$$A = \varepsilon c l$$

A	Absorbance	
ε	Molar absorption coefficient	$M^{-1}cm^{-1}$
c	Molar concentration	M
l	optical path length	cm

- The half-life can be defined as the time it takes for the concentration of a reagent to fall to half of its original value.
- The “half-life method” involves measuring the half-life’s dependence on concentration.
- The half-life time varies differently depending on the order for the reagent.

$$\frac{t_{1/2}}{t'_{1/2}} = \left(\frac{c'}{c}\right)^{(n-1)}$$

The equation relates the the two periods of time.
n: order of the reagent

- The method consists of determining the half life time for different initial concentrations of a reagent.

The iodination of acetone reaction in an acid medium is:

$$CH_3 - CO - CH_3 + I_3^- \xrightarrow{HCl} CH_3 - CO - CH_2I + 2I^-$$

Where the I_3^- species is formed quickly in the presence of IK according to the equilibrium:

$$I_2 + I^- \rightleftharpoons I_3^-$$

The I_3^- ion is the only species in the reaction that absorbs radiation that is visible at 565 nm.

3. EXPERIMENTAL PROCEDURE

Prepare the following solutions:

1. 100mL of 5M acetone in water
2. 100mL of 0.5M HCl in water
3. 50mL of 0.05M I_2 in a 10% solution of IK in water

Prepare the spectrophotometer reference control solution in a 100mL Erlenmeyer flask:

- ❏ 1mL of acetone in water
- ❏ 1mL of distilled water
- ❏ 3mL of the acid solution

Prepare the reaction mixture in an Erlenmeyer flask by adding the component in this order:

	Acetone	Water	HCl	Iodine in iodide (while adding, stir it vigorously and start the timer)
1st order kinetics	5mL	6mL	5mL	5mL

Fill half a spectroscopy cell with this solution, clean the cell walls with soft tissue and insert the spectrophotometer.

Note down the absorbance values every 30 seconds, until the reaction has finished (absorbance close to zero)

Repeat the process with the following proportions:

	2nd order kinetics	3rd order kinetics	4th order kinetics
Acetone	5mL	5mL	3mL
Water	8mL	8mL	8mL
Acid	5mL	3mL	5mL
Triiodide	3mL	5mL	5mL

To transform absorbance directly into concentrations we need to obtain the molar extinction coefficient (molar absorption coefficient).

To do this, prepare the following solutions of I_3^- :

Test tube nº	1	2	3	4	5	6
I_3^- solution	1mL	1mL	1mL	1mL	1mL	1mL
Water	2mL	3mL	4mL	5mL	6mL	7mL

Measure the absorbance of each of the solutions at 565 nm using water as the control.

IMPORTANT:

- Clean the cell with deionised water and METHANOL (do not use ACETONE).
- Clean the optical walls with soft tissue, taking care not to scratch the surface.
- Do not use the hair dryer to dry the cell.
- Remember that not all the walls of the cell are transparent.

4. BIBLIOGRAPHY

https://egela.ehu.eus/pluginfile.php/2546940/mod_resource/content/2/10_Kinetics_AcetoneIodination.pdf