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NETCHEM Remote Access Laboratory Guide

Determination of Co(II) ions in homogeneous-catalytic reaction



In this exercise, you will:

- Measure the solution of Universal buffer, sulfanilic acid, hydrogen-peroxide, co(II) ions
- Measure absorbance during the time of indicatory and catalytic reaction
- Perform chemical analysis on UV-Vis spectrophotometer
- Calculate the kinetic equations for indicatory and catalytic reaction....
- Gain experience in UV-Vis spectrophotometer usage

Background

In this experiment, will examine the catalytic effect of Co (II) ions in indicator reaction and on the basis of the catalytic activity of Co(II) ions proved to develop a method for Co(II) determination in the solution.

In this experiment, we use UV-Vis spectrophotometer to measure two reactions: indicatory and catalytic reactions.

The measurement will be done at 370 nm. At wavelength of 370 nm the yellow complex is formed. By adding the Co(II) ions to the investigated system, it was noticed that the color was formed faster, which indicated the catalytic effect of Co(II) ions in the reaction.

The influence of the catalyst on the reaction rate can be explained by various mechanisms. The increase in the reaction rate under the influence of an catalyst can be explained by forming of an complex [38].

In the catalytic reaction, the mechanism of reaction is based on the complex formation between a metal ion and a substrate with a specific coordination number of the metal ion.



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Background

After investigation influence of the concentration of each reactant on the catalytic and indicator reaction rate it was determined optimum experimental conditions.

Under the optimal experimental conditions, the influence of Co(II) ions concentration on the reaction rate was investigated, and two calibration were obtained.

The equations of the calibration curve were calculated.

The calibration curve was constructed.



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Background

To determine the lowest possible determinable concentration of Co(II) ions, working conditions needed to be optimized.

Therefore, the dependence of the rate of reactions on the concentration of each of the reactants was determined.

For optimal concentration of each reactant, the one with the highest difference in reaction rate of catalyzed and inhibited reaction was chosen for further investigation.

A tangent method was used to process the kinetic data. The rate of the reaction was obtained by measuring the slope of the linear part of the kinetic curves to the absorbance-time plot (slope = dA/dt).

Material

For this lab exercise, you will need the following material :

- Universal buffer (pH=9.66),
- Sulfanilic acid (0.04 M),
- H_2O_2 (2M),
- $\text{Co(II)} \cdot 2\text{H}_2\text{O}$ (0.001 M).

Procedure:

- I. U Budarinovu posudu odmeriti 1ml SA, 5 ml pufera i dopuniti vodom do ukupne zapremine od 10 ml. Tako pripremljen rastvor termostatirati 10 min u vodenom kupatilu na $25\pm 0,1$ °C. Nakon termostatiranja promu kati rastvore, aktivirati štopericu i sipati rastvor u radnu kivetu spektrofotometra. Merenje po eti 1 min nakon mešanja rastvora. Utvrditi talasnu dužinu na kojoj e se vršiti dalja merenja.
- II. U Budarinovu posudu odmeriti 1ml SA, 5 ml pufera, 1 ml H₂O₂ i dopuniti vodom do ukupne zapremine od 10 ml. Tako pripremljen rastvor termostatirati 10 min u vodenom kupatilu na $25\pm 0,1$ °C. Nakon termostatiranja promu kati rastvore, aktivirati štopericu i sipati rastvor u radnu kivetu spektrofotometra. Merenje po eti 1 min nakon mešanja rastvora. Ovaj apsorpcioni spektar snimati 6 minuta da bi se utvrdila reakcija oksidacije indikatorske supstance sa H₂O₂.
- III. U Budarinovu posudu odmeriti 1ml SA, 5 ml pufera, 0,7 ml Co(II) jona, 1 ml H₂O₂ i dopuniti vodom do ukupne zapremine od 10 ml. Tako pripremljen rastvor termostatirati 10 min u vodenom kupatilu na $25\pm 0,1$ °C. Nakon termostatiranja promu kati rastvore, aktivirati štopericu i sipati rastvor u radnu kivetu spektrofotometra. Merenje po eti 1 min nakon mešanja rastvora.
- IV. Ovaj apsorpcioni spektar snimati 6 minuta da bi se utvrdio kataliti ki efekat Co(II) jona.
- V. Nakon što se na osnovu apsorpcionih spektara utvrdi kataliti ka aktivnost Co(II) jona i odabere željena talasna dužina, aparat se podesi u Time-drive metodu za snimanje kineti kih krivih.



Procedure:

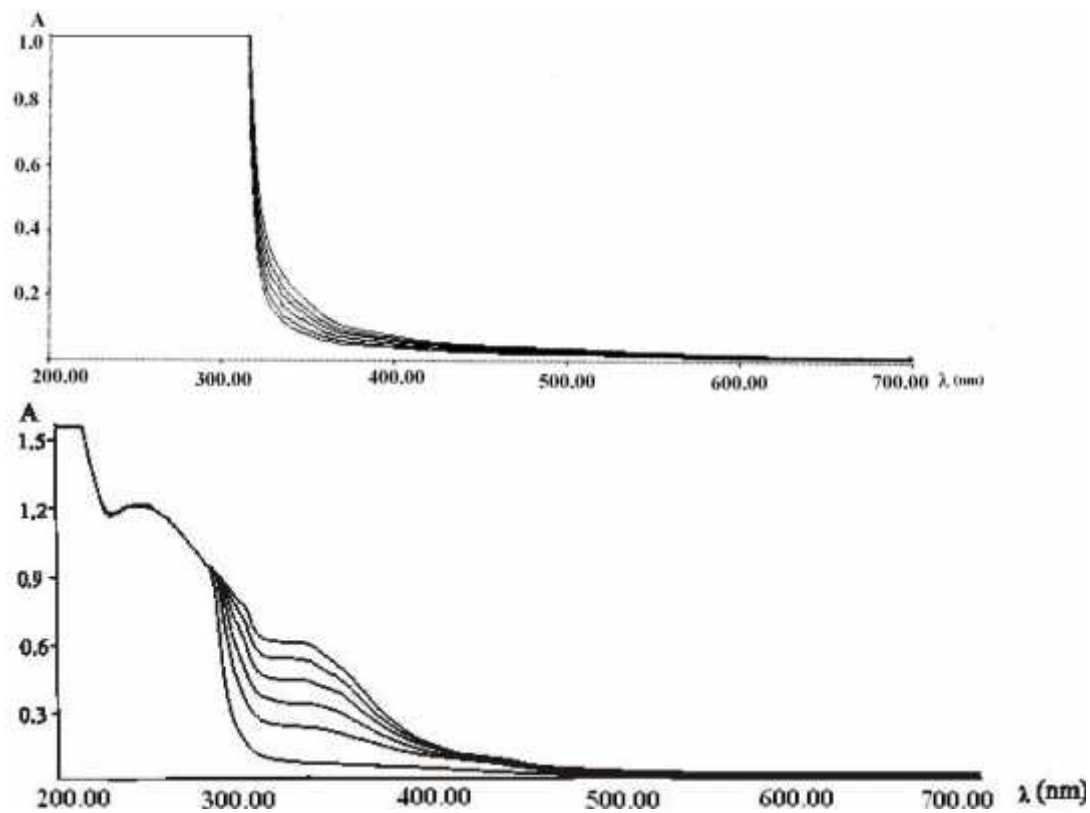
- I. U Budarinovu posudu odmeriti 1ml SA, 5 ml pufera, 1 ml H₂O₂ i dopuniti vodom do ukupne zapremine od 10 ml. Tako pripremljen rastvor termostatirati 10 min u vodenom kupatilu na 25±0,1 °C. Nakon termostatiranja promu kati rastvore, aktivirati štopericu i sipati rastvor u radnu kivetu spektrofotometra. Merenje po eti 1 min nakon mešanja rastvora. Uraditi snimanje i odrediti brzinu reakcije (tg).
- II. U Budarinovu posudu odmeriti 1ml SA, 5 ml pufera, 0,7 ml Co(II) jona, 1 ml H₂O₂ i dopuniti vodom do ukupne zapremine od 10 ml. Tako pripremljen rastvor termostatirati 10 min u vodenom kupatilu na 25±0,1 °C. Nakon termostatiranja promu kati rastvore, aktivirati štopericu i sipati rastvor u radnu kivetu spektrofotometra. Merenje po eti 1 min nakon mešanja rastvora.
- III. Postupak pod 5. ponoviti sa zapreminom Co(II) jona od 0,1 ml, a potom i od 0,3 ml.
- IV. Predstaviti grafi ki zavisnost brzine reakcije (tg) od koncentracije Co(II) jona i konstruisati kalibracionu pravu za tri koncentracije Co(II) jona (0,1 ml; 0,3ml; 0,7 ml).
- V. Obraditi rezultate merenja i izra unati jedna inu kineti ke krive koriste i kompjuterski program Origin 7.0. Izra unati statisti ke i analiti ke karakteristike kalibracione krive.





Material

Absorption spectra of indicatory reaction and catalytic reaction





DESCRIPTION OF REMOTE ACCESS	
1. NETCHEM COMMUNICATION SIDES	
(NOTE: NETCHEM Communication is defined as event that involves all kinds of internet interactions (in real time and not in real time) between participants via devices (PCs, laptops, tablets and mobilephones))	
host side (NOTE: Host side of NETCHEM Communication is defined as PC who invites other users to join the session)	participant's PC in classroom
guest side (NOTE: Guest side of NETCHEM Communication is defined as PC who joins the invitation to session)	participant's PC in laboratory
2. COMMUNICATION SOFTWARE	
Team Viewer	Meeting: No
	Remote control: No
	Meeting and Remote control simultaneously: No
Skype	Call 1:1: No
	Conference Call: Yes
3. COMMUNICATION HARDWARE	
on host side	1 PC for each participant
on guest side	1 PC, 1 headsets with microphone, camera
4. INFORMATION EXCHANGE TYPE	
Educational (one side is dominantly receptive)	Yes
	Place of Educator participant: guest side
	Number of educator(s): 1
	Place of student participant: host side
Consultative (two sides are equal in giving-receiving information)	Number of student participant(s): 15
	Number of host side participant(s): No
	Number of guest side participant(s): No





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Remote Access Connection Instructions

What makes these labs different and unique from other classroom experiments is that we have incorporated a section in each activity to remotely characterize your samples from your classroom.

Request a remote lab session specifying information such as: the day, the time, and the instrument you are interested in using by visiting our web site:

<http://netchem.ac.rs/remote-access>

You will see the list of partners with the instruments provided to choose from.

You will be contacted by a Remote Access staff member to set up a test run to ensure you are set up properly and have the required infrastructure.

Send samples or verify the in-house sample you would like us to prepare and load for characterization.

Send your samples to the Remote Access center that you chose on your request.

There are two communications software packages, that will allow us to communicate instructions and answer questions during the session.

- TeamViewer: You can obtain a free download at:

<https://www.teamviewer.com/en/index.aspx>

- Skype





Remote Access Connection Instructions

You will need:

- a) Computer with administrator access to install plug-ins and software
- b) An internet connection
- c) Speakers
- d) Microphone
- e) Projector connected to the same computer
- f) Web browser (Firefox preferred)

During the test run you can refer to this guide to perform the following steps, but it's very important that you only proceed with these steps during your scheduled times. You may interfere with other remote sessions and potentially damage equipment if you log in at other times.

- a) Open and logon to your Zoom/Team-viewer account. You will be given the access code to enter at the time of your test and then again during the remote session.
 - If you are using the Zoom software, Remote Access staff will give you the access code.
 - If you are using the Team-viewer software, Remote Access staff will give you the ID & password.
- b) You should soon see the Remote Access desktop and at this point you can interact with the icons on the screen as if it were your desktop.
- c) Switch to full screen mode by selecting the maximize screen option in the top right corner of the screen.
- d) Upon completion of the session, move your mouse to the top right corner of the screen, and click on the X to disconnect the remote session. It will ask if you want to end the remote session. Click Yes.





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Author, Editor and Referee References

This remote access laboratory was created thanks to work done primarily at University of Niš.

Contributors to this material were: __dr Emilija Pecev-Marinkovic_____

Refereeing of this material was done by: _____

Editing into NETCHEM Format and onto NETCHEM platform was completed by: _____





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References and Supplemental Material

The NETCHEM platform was established at the University of Nis in 2016-2019 through the Erasmus Programme.

Please contact a NETCHEM representatives at your institution or visit our website for an expanded contact list.

The work included had been led by the NETCHEM staff at your institution.

