Report Cover Page

AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH

Department of Natural Science (Chemistry)
Faculty of Science & Technology
Programs: B.Sc. Eng'g (EEE/CSE/IPE)
CHEM 1101: CHEMISTRY

Chemistry Lab Report

Semester: Spring **Session:** 2022-2023

NO EXPERIMENT, NO REPORT

Experiment No: 7
Name of the Experiment: Determination of ferrous ion (Fe^{2+}) in a supplied solution of iron salt by standard potassium dichromate ($K_2Cr_2O_7$) solution.

Date of Performance: 29-03-23, *Date of Submission:* 05-04-23

Course-Teacher: Dr. Mohammad Tariqul Islam

Instructions:

1. *A lab report consists of three parts: a cover page, body of the report and a data and results sheet (lab-sheet).*
2. *This is the cover page of a report and students will collect and preserve the lab-sheet of a particular experiment to be performed.*
3. *Body of the report includes-(1) Objective of the Experiment, (2) **Theory**, (3) Name of the Chemicals, (4) Name of the Apparatus, (5) Percentage of Error (if necessary) and (6) Discussion **(I. Precautions taken, II. Possible errors)**.*
4. *Use A_4-size off-set paper, write on one side of the paper by hand keeping suitable margin.*
5. ***Staple the lab-sheet at the end** of the report and **cover page on the top**.*
6. *Submit the report in time to avoid deduction of marks.*
7. *Students working in a group will write and submit the report individually.*
8. *Copying of the report from others is strictly prohibited.*

Name of the Student: TRIDIB SARKAR
ID No: 22-46444-1, *Section:* F, *Group:* 03

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Faculty comments: ....., *Signature:* .....
Date: .....

Objective: To know the amount of iron (Fe^{2+}) in a supplied solution of iron salt by standard $K_2Cr_2O_7$ solution.

Theory:

(i) **Method:** A redox titration is based on the neutralization reaction between the anylate and titrant. This one used a redox indicator to determine the endpoint. Frequently either the reactants or the titrants have colour intense enough that an additional indicator is not needed.

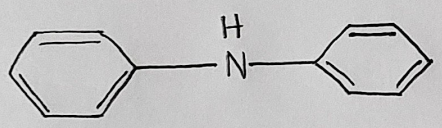
(ii) **Reaction:** Mohr's salt is ferrous ammonium sulphate to determine the amount of iron, a known value of solution titrated with $K_2Cr_2O_7$ with diluted H_2SO_4. $K_2Cr_2O_7$ oxidises $FeSO_4$ present in Mohr's salt into $[Fe_2(SO_4)_3]$.

1. $6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe_2(SO_4)_3 + K_2SO_4 + 7H_2O + Cr_2(SO_4)_3$

a) $6Fe^{2+} \longrightarrow 6Fe^{3+} + 6e$ (Oxidation half reaction)

b) $Cr_2O_7^{2-} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$ (Reduction half reaction)

(iii) Indicator: Diphenyl amine is the organic compound with the formula $(C_6H_5)_2NH$. It is a colourless solid, but samples are often yellow due to oxidized impurities. It shows a very clear colour change from green to violet when end point of the titration is reached.



Diphenyl amine, $(C_6H_5)_2NH$

Required chemicals:

Name of the chemicals		chemical formula
1. Iron salt solution	——	$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$
2. 5% Sulfuric acid	——	H_2SO_4
3. Conc. Phosphoric acid	——	H_3PO_4
4. Standard Potassium Dichromate solution	——	$K_2Cr_2O_7$
5. Diphenyl Amine indicator	——	Ph_2NH

Apparatus:

(i) Burette (50 ml)

(ii) Pipette (10 ml)

(iii) Conical flask (250 ml)

(iv) Volumetric flask (100 ml)

(v) Watch glass.

(vi) Pipette filler.

(vii) Dropper.

(viii) Stand and clamp.

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AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH (AIUB)

Department of Chemistry

Experiment 7

CHEM 1101: CHEMISTRY (EEE/CoE/CSE/IPE)

EXPERIMENT NO. 7: DETERMINATION OF FERROUS ION (Fe^{2+}) IN A SUPPLIED SOLUTION OF IRON SALT BY STANDARD POTASSIUM DICHROMATE ($K_2Cr_2O_7$) SOLUTION.

OBJECTIVE: To know the amount of iron (Fe^{2+}) in a supplied solution of iron salt by standard $K_2Cr_2O_7$ solution.

THEORY:

(i) Method: Redox titration

(ii) Reaction:

$$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe_2(SO_4)_3 + K_2SO_4 + 7H_2O + Cr_2(SO_4)_3$$

Redox half reactions: $6Fe^{2+} \rightarrow 6Fe^{3+} + 6e$ (Oxidation)

$Cr_2O_7^{2-} + 14H^+ + 6e = 2Cr^{3+} + 7H_2O$ (Reduction)

(iii) Indicator: Diphenyl amine, $(C_6H_5)_2NH$

APPARATUS:
Burette (50mL), pipette (10mL), conical flask (250mL), volumetric flask (100mL), watch glass, pipette filler, dropper, Stand and clamp etc.

REQUIRED CHEMICALS:

1. Iron salt solution,
2. 5% Sulfuric acid,
3. Conc. Phosphoric acid,
4. Standard $K_2Cr_2O_7$ solution,
5. Diphenyl Amine indicator

PREPARATION OF APPROX. 0.1N POTASSIUM DICHROMATE SOLUTION.

Transfer approx. 0.49 gram of pure $K_2Cr_2O_7$ into a 100 mL measuring flask and then dissolve it with distilled water up to the mark.

$$\textit{Strength of } K_2Cr_2O_7 \textit{ solution (S)} = \frac{\textit{Weight taken (in gm)} \times 0.1}{0.49} \text{ (N)}$$

0.51

$$= 0.10408 \text{ N}$$

Name: TRIDIB SARKAR ID No: 22-46444-1 Section (Group): F(03)

(Expt. 7 contd.)

PROCEDURE: Take 10 mL of the supplied iron salt (Mohr's salt) solution in a conical flask. Add 50 mL 5% sulfuric acid and 5 mL of conc. phosphoric acid. Then add 4-5 drops of diphenyl amine indicator and titrate slowly against the standard potassium dichromate solution drop wise maintaining an interval of few seconds between each drop until the addition of one drop causes the formation of intense purple or violet blue coloration which remains permanent and is unaffected by further addition of dichromate solution. Repeat the experiment at least thrice. Calculate the amount of iron per 500 mL of iron salt solution.

EXPERIMENTAL DATA:

Table: *Determination of the amount of iron in Mohr's salt solution using standard $K_2Cr_2O_7$ solution.*

No. of reading	*Vol. of Mohr's salt solution (in mL)*	*Vol. of $K_2Cr_2O_7$ (burette reading) (in mL)*			*Mean (in mL) (V)*
		Initial	*Final*	*Difference*	
1	10	0	4.70	4.70	4.83
2	10	4.70	9.50	4.80	
3	10	9.50	14.50	5.00	
4	10				

CALCULATIONS: 1 mL 1N $K_2Cr_2O_7$ ≡ 0.05584 gm of Fe^{2+}

Amount of iron in 10 mL of iron salt solution = 0.05584 × V × S gm
= 0.05584 × 4.83 × 0.10408 gm
= 0.02807 gm

Amount of iron in 500 mLof iron salt solution = 0.05584 × V × S × 50 gm
= 0.05584 × 4.83 × 0.10408 × 50 gm
= 1.40356 gm

Observe value of Fe^{2+} (in 500mL solution) = 1.40356 gm

Known value of Fe^{2+} (in 500mL solution) = $\frac{55.84 \times 10}{392.14}$ = 1.42398 gm

RESULTS:
Amount of Fe^{+2} ions in 500 ml of supplied Mohr's salts solution is 1.40 gm

PERCENTAGE OF ERROR:

$$\frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \times 100 = \frac{1.42398 - 1.40356}{1.42398} \times 100$$

$$= 1.43\%$$

Students should know

- Why it is necessary to use both the *sulfuric acid* as well as *phosphoric acid* in the reaction?
- Atomic weight, molecular weight of $K_2Cr_2O_7$ and $KMnO_4$.
- Could you use $KMnO_4$ instead of $K_2Cr_2O_7$?
- Why the solution shows light bottle green colour after addition of $K_2Cr_2O_7$.

Text: M. Mahbubul Huque and A. Jabber Mian, "Practical Chemistry", 2nd ed. (1972)

Discussion:

(i) Precautions:

a) The apparatus was washed first two times with normal water then one time with distilled water.

b) Care was taken when adding H_2SO_4 in the solution.

c) Care was taken while adding H_3PO_4 solution.

(ii) Possible errors:

a) Error might be occured when taking the burette reading.

b) Error might be occured when observing the value of Fe^{2+} in 500 ml solution.

c) Might have added more than 4-6 drops of $(C_6H_5)_2NH$.

d) Concentration and calculation error might be occured.