

**Use of Senior Secondary Chemistry Laboratory for the
Promotion of Practical Skills amongst the Students of Madhya
Pradesh**

PAC 16.17 (2017-18)

A Research Report

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

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Index

S. No.	Content	Page No.
1.	Chapter – 1 Introduction	1-9
2.	Chapter – 2 Review of Related Literature	10
3.	Chapter – 3 Tools and Techniques	11-14
4.	Chapter – 4 Analysis and Interpretation of Data	15-17
5.	Chapter – 5 Conclusion & Recommendations	18-21

Chapter -1

Introduction to Senior Secondary Chemistry Laboratory Kit

1.1 Introduction

Science is generally defined as the systematized body of knowledge. This may be true when applied with a narrow vision. When it comes to the comprehensive definition of science, the scientific methods, the scientific processes, the scientific attitude becomes equally important. The nature of science includes not only concepts but also the methods, which are used to find out these concepts. By their very nature the scientific processes involves experimentation. Experiments, activities and practical are the part and parcel of science instructions.

The importance of Experimentation and Practical work: Science instructions can never be imparted in isolation as it has influenced the every sphere of human life. It has now become imperative for the persons engaged in imparting instructions of science to see that the young and developing minds of the nation get a true feel of the subject. This is not possible unless the students appreciate the charm of investigation and the joy of exploring the nature. In order to provide the opportunities for investigation we need to focus on practical aspect of teaching science equally. Rather, it needs to be given more attention. The very promising feature of constructivism also advocates the importance of experimental / practical work for the young students. The main objective of practical work is to help the learner for development of scientific processes and principles. The promotion of basic skills and competencies is done very well through experimentation. The practical skills awake and maintain the curiosity in the learning environment.

The Picture of Science Class rooms: As mentioned in the knowledge commission, the status of science education across the country is not satisfactory. Many educational scientists also, time to time have stressed on the fact that the teaching of science needs to be improved. Our observation of science class room does not present a satisfactory picture of science teaching. The theory part is somehow taken

care of but when it comes to the experiment, the situation is not satisfactory. The observation in regard to science teaching is that the problems faced by teachers are related to infrastructure, maintenance of laboratories and the problems concern with environmental degradation. The problems our science teachers face related to practical / experiments in schools can be broadly categorized as infrastructure related and attitude related. There are many different ways to deal with the attitudinal problems but a root cause of this category of problems also has a common cause, related with the infrastructural facilities.

The Chemistry Laboratories: The crucial role of practical work and experiments in science curriculum is universally accepted. This is more so in chemistry, an experimental science. Laboratory work is an indispensable part of chemistry instruction. The practical work is not given due importance and seems to be marginalized even after strong recommendations made in various policy documents in our country.

Problems of Chemistry Laboratories There are multidimensional factors, responsible for negligence of laboratory work in chemistry. The setting up a conventional chemistry laboratory demands lots of financial support. The number of students in the chemistry class (as its common for BCZ and PCM group) is always high comparative to other disciplines. Increasing cost of chemicals, breakages of glassware and equipments, problems in disposal of chemical waste, handling of toxic materials, shortage of time to maintain the equipments etc are another noticeable reasons those are responsible for dilution of laboratory work in chemistry.

Problems may be overcome if we can have a laboratory programme with certain modifications. The change in overall laboratory setting is required which can provide a solution which would be cost effective, safe and technically more efficient. This should be able to ensure the optimum use of resources and promote the environmental values.

The Solution: The concept of Senior Secondary chemistry laboratory (previously known as micro scale chemistry laboratory) can be considered as one of the expected solutions related to chemistry experimentation at school stage as it has many advantages over traditional chemistry laboratory. The concept was first introduced about 30 years ago by D. W. Mayo, S. S. Butcher et al at Bowdoin College in

Brunswick. In India, NCERT has developed a kit with some innovative modification named as “**Micro Scale Chemistry Laboratory**” under the leadership of Prof H. O. Gupta. Later, this kit has been modified and named as **Senior Secondary Chemistry Laboratory Kit**. Literature survey reveal that many schools have taken up the projects related to MCL and enhanced the practical skills of the students.

1.1.1 What is Senior Secondary Chemistry Laboratory Kit?

It is an environmentally safe, pollution prevention method of performing chemical processes using small quantities of chemicals without compromising the quality and standard of chemical applications in schools. Micro scale techniques amounts to a total quality management approach to the use of chemicals. IUPAC has recognized this technique as small scale chemistry.

The Advantages of using **Senior Secondary Chemistry Laboratory Kit** –

1. Chemicals used are in milligrams and milliliters reduce the cost as well as risk of accidents in the laboratory.
2. This saves time as experiments are quick to perform.
3. Use of the kit reduces laboratory cost, maintenance cost and storage problem.
4. The use of kit promotes discipline in the lab and opportunities to repeat the experiment many times.
5. It supports the concept of green chemistry as it reduces use of chemicals and promotes waste reduction at the source itself. The use of kit provides the clean and congenial atmosphere in the laboratory.

Description of Kit – The kit is designed as a small portable **wooden box with revolving top** having circular racks to hold plastic dispenser for easy access to chemicals. Both sides of this box possess two small selves having partitions in it for keeping apparatus. There are a **total 42 items** in the kit. The MCL is designed in such a way where the students need not wander around in search of reagents and apparatus. There are two types of bottles in the kit – solid reagents / chemicals are stored in **plastic bottles** and liquid reagents are stored in polythene dispensing bottles (**squeeze bottles**). In order to avoid wastage and contamination squeeze bottles are designed to dispensed drop – wise. **W- tube** is a most attractive item of

this kit. This helps in fast gas absorption without leakage. The **micro test plate (well plate)** in the kit (made with fibre-glass) is designed for qualitative analysis of organic compounds and radicals. **Aluminium heating blocks** are specially designed for detection of melting and boiling points of organic compounds. Other micro apparatus in the kit named **micro burner** (less fuel consumption), **micro burettes** (5 ml capacity and least count 0.2 ml), **micro titration flask** are very useful for performing the experiments.

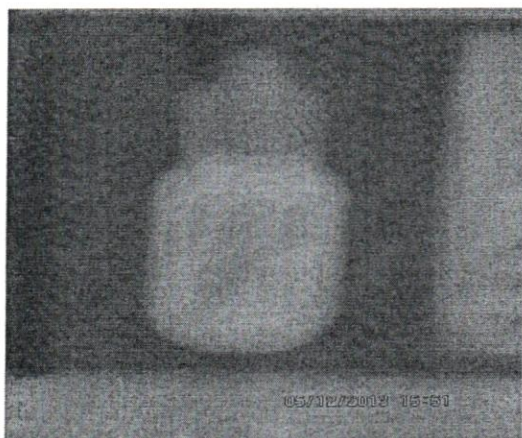


Fig.(i) Polyethylene dispensing bottles

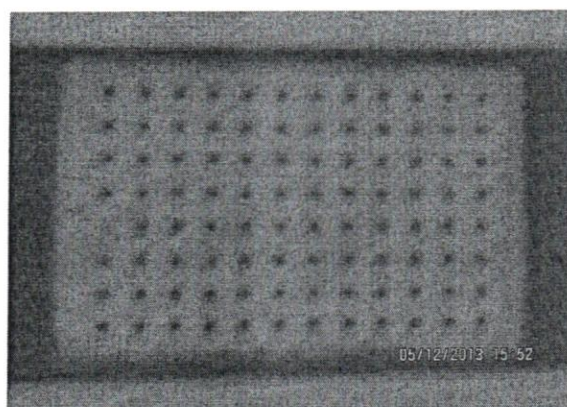


Fig.(ii) well – plate

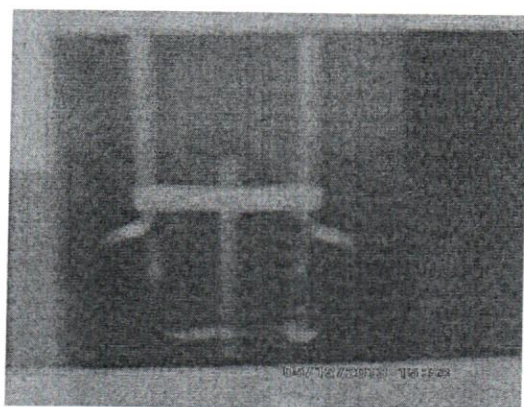


Fig.(iii) Micro Burrete

W-TUBE

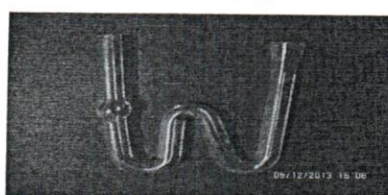


Fig.(iv) Micro glassware

List of kit items:

1.	Beaker (50 ml)	-	03 No.
2.	Boiling Tube	-	04 No.
3.	Capillary Tube	-	01 Box
4.	China Dish	-	04 No.
5.	Conical Flask	-	04 No.
6.	Dispensing Bottle	-	30 Nos.
7.	Pasteur Pipette	-	20 Nos.
8.	Glass Dropper with rubber bulb	-	04 Nos.
9.	Ignition Tube/Fusion tube	-	20 Nos.
10.	Glass Rod	-	04 Nos.
11.	Micro Funnel	-	04 Nos.
12.	Micro Filtration Unit	-	04 Nos.
13.	Micro Test Tube 2ml	-	24 Nos.
14.	Micro Beaker	-	12 Nos.
15.	Micro Measuring Cylinder	-	04 Nos.
16.	Micro Burettes	-	08 Nos.
17.	Micro Test Tube	-	04 Nos.
18.	Petri Dish	-	04 Nos.
19.	Platinum wire/Nichrome wire	-	04 Nos.
20.	Micro Spatula	-	04 Nos.
21.	Spirit Lamp/Bunsen burner	-	04 Nos.
22.	Circular Whatman Filter paper	-	20 Nos.
23.	Mercury Thermometer	-	02 Nos.
24.	Digital Thermometer with button cell	-	01 No.

25.	Tripod stand	-	04 Nos.
26.	Micro test tube stand	-	04 Nos.
27.	Two way burette clamp and stand	-	04 Nos.
28.	Micro test tube holder	-	04 Nos.
29.	Vials	-	20 Nos.
30.	Watch glass (small)	-	04 Nos.
31.	Micro test plate/well plate	-	04 Nos.
32.	W-tube	-	10 Nos.
33.	Wire gauge	-	04 Nos.
34.	Wash bottle	-	02 Nos.
35.	Calorimeter with 50 ml. capacity beaker -		01 No.
36.	Electrodes copper & Zinc	-	One each
37.	Emery paper	-	1 Sheet
38.	Multi-meter	-	1 Nos.
39.	Parchment/ cellophane	-	100 leaves one packet
40.	Glass pipette	-	04 Nos.
41.	Stirrer	-	04 Nos.
42.	Stopwatch	-	02 Nos.
43.	Thread roll	-	01 No.
44.	Volumetric flask	-	04 Nos.
45.	Universal indicator	-	02 Paper Box.
46.	Red and Blue litmus paper	-	05 Booklet each
47.	Forceps	-	04 Nos.
48.	Plastic box	-	One each
49.	Chromatography Jar	-	One each

The experiments which can be performed by MCL – All the chemistry experiments at school level from class VI – XII can be performed with the help of this kit. A few examples from senior secondary classes are mentioned below:

1. Potentiometric titrations
2. Estimation of solubility product
3. Verification of Nernst's equation
4. Determination of pK of an acid
5. Equilibrium, pH, melting point, boiling point detection and all other physical chemistry experiments
6. Organic qualitative analysis and small scale distillation and preparation
7. Test for functional groups

Need and Importance of Study:

Statement of the Problem:

Use of Senior Secondary Chemistry Laboratory Kit for the Promotion of Practical Skills amongst Higher Secondary Students of MP

Objectives of the Study:

1. To study the status of awareness and extent of use of Senior Secondary Chemistry Laboratory Kit in the schools of MP.
2. To observe the students practical skills while performing the experiments using Senior Secondary Chemistry Laboratory Kit.
3. To analyze the impact of Senior Secondary Chemistry Laboratory Kit on the students practical skills in chemistry at higher secondary level.

4. To compare the conceptual clarity of the students performing experiments with the help of Senior Secondary Chemistry Laboratory Kit and that of traditional laboratory.

Research Questions:

1. What is the status of awareness and extent of use of Senior Secondary Chemistry Laboratory Kit in the schools of MP
2. Is there any difference in the practical skills of the students performing experiments with Senior Secondary Chemistry Laboratory Kit and that of traditional laboratories in the schools of M.P.?
3. What is the impact of Senior Secondary Chemistry Laboratory Kit on the students practical skills at higher secondary level?
4. What is the difference between conceptual clarity of the students performing experiments with the help of Senior Secondary Chemistry Laboratory Kit and that of traditional laboratory?

Delimitation of the Study:

The study was conducted in the state of M.P. only for the senior secondary schools students performing experiments using Senior Secondary Chemistry Laboratory.

Chapter -2

Overview of Related Research Literature

There are multidimensional factors those are responsible for negligence of laboratory work in chemistry. The setting up a conventional chemistry laboratory demands lots of financial support. The number of students in the chemistry class (as its common for BCZ and PCM group) is always high comparative to other disciplines. Increasing cost of chemicals, breakages of glassware and equipments, problems in disposal of chemical waste, handling of toxic materials, shortage of time to maintain the equipments etc are another noticeable reasons those are responsible for dilution of laboratory work in chemistry. Problems may be overcome if we can have a laboratory programme with certain modifications. The change in overall laboratory setting is required which can provide a solution which would be cost effective, safe and technically more efficient. This should be able to ensure the optimum use of resources and promote the environmental values. The literature review reveals the fact that the use of MCL has been more effective in order to enhance student's practical skills in chemistry at higher secondary level. Another study puts emphasis on the use of W – tube (a w shaped tube, an apparatus in the kit) for conceptual clarity of the students at higher secondary stage.

Chapter -3

Methodology

3.1 In house meeting

An in-house planning meeting for the research programme entitled “**Impact of micro scale chemistry laboratory on the students practical skills in chemistry at higher secondary level in the state of Gujarat and MP: A competitive study**” was conducted on Oct. 9th 2017.

1. The following members were present in the meeting:
 - a. Prof. N. Pradhan, Principal RIE, Bhopal
 - b. Prof. I. B. Chugtai, Dean of Instructions, RIE, Bhopal
 - c. Prof. Ramesh Babu, Dean research, RIE, Bhopal
 - d. Prof. L. K. Tiwary, Head DEE & Prof of Chemistry
 - e. Dr. Rashmi Sharma, Assistant Professor & Principal investigator

2. In the meeting, the research proposal was discussed in detail and the following suggestions were made by the members:
 - The title of the research proposal may be changed as “**Use of Micro scale Chemistry Laboratory for the Promotion of Practical Skills amongst Higher Secondary Students of MP**”
 - The objectives, research questions and tools also may be changed accordingly.
 - To analyze the impact of MCL on the practical skills of the students, one school from each of the state may be studied thoroughly.
 - To study the impact of MCL on students’ conceptual clarity, the items may be restricted to content which is directly related to practical syllabus.
 - If possible, digital recording of the evidences (students’ practical skills) may be done.

3. At the end, the principal investigator conveyed a sincere vote of thanks to all the members for their suggestions and guidance.

3.2 Development of Tools for Data Collection

The following tools for data collection were developed by the investigator and were finalized in the workshop mode;

- i. Interview schedule for Practicing Teachers
- ii. Guidelines for Focus Group Discussion with Students
- iii. Observation Schedule for following experiments:
 - a. Salt Analysis
 - b. Volumetric Titration
 - c. Detection of elements in Organic Compounds
 - d. Preparation of an organic compound
 - e. Preparation of an inorganic compound
 - f. Chemical Kinetics

A copy of each of above mentioned tools is attached as annexure.

3.3 Collection of Data

Data was collected from 32 Post Graduate Chemistry Teachers belonging to 32 districts of Madhya Pradesh. Teachers were interviewed in person. A copy of Interview Schedule for Practicing Teachers is enclosed.

3.4 Analysis of Data

Qualitative and quantitative analysis of data collected from the practicing teachers was done.

3.5 Annexure

1. Name and Addresses of Participating teachers

2. Tools for Data Collection

- i. Interview schedule for Practicing Teachers
- ii. Guidelines for Focus Group Discussion with Students
- iii. Observation Schedule for following experiments:

- a. Salt Analysis
 - b. Volumetric Titration
 - c. Detection of elements in Organic Compounds
 - d. Preparation of an organic compound
 - e. Preparation of an inorganic compound
 - f. Chemical Kinetics
3. **Name and Addresses of the schools having Senior Secondary Chemistry Laboratory kits** in their schools (purchased during last three years i.e. 2015 onwards, As per DEK, NCERT Record)

Proceedings of In-house meeting

4. An in-house planning meeting for the research programme entitled "**Impact of micro scale chemistry laboratory on the students practical skills in chemistry at higher secondary level in the state of Gujarat and MP: A competitive study**" was conducted on Oct. 9th 2017.
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 - i. Prof. L. K. Tiwary, Head DEE & Prof of Chemistry
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6. In the meeting, the research proposal was discussed in detail and the following suggestions were made by the members:
 - The title of the research proposal may be changed as "**Use of Senior Secondary Chemistry Laboratory Kit for the Promotion of Practical Skills amongst Students of M.P.**"
 - The objectives, research questions and tools also may be changed accordingly.
 - To analyze the impact of MCL on the practical skills of the students, one school from each of the state may be studied thoroughly.
 - To study the impact of MCL on students' conceptual clarity, the items may be restricted to content which is directly related to practical syllabus.
 - If possible, digital recording of the evidences (students' practical skills) may be done.
7. At the end, the principal investigator conveyed a sincere vote of thanks to all the members for their suggestions and guidance.

Chapter - 5

Conclusions

- i. Chemistry Teachers of Madhya Pradesh have very limited awareness with respect to Senior Secondary Chemistry Laboratory kit.
- i. Majority of Post graduate Chemistry teachers of Madhya Pradesh are not aware of the Concept of Senior Secondary Chemistry Laboratory kit.
- ii. Most of the teachers have been exposed to Senior Secondary Chemistry Laboratory kit at Regional Institute of Education, Bhopal during some training programme.
- iii. Except one school, all the schools do not possess Senior Secondary Chemistry Laboratory kit with them.
- iv. Majority of the teachers have shown their interest to procure these kits in their schools.
- v. All the teachers have appreciation for these kits as they have seen the demonstrations using these kits during the training programmes.
- vi. Out of all the kit items, **W-tube** is found to be most useful apparatus of Senior Secondary Chemistry Laboratory kit.
- vii. As per the records of Division of Educational Kits, NCERT, New Delhi, a number of **four (04) kits** only have been purchased from NCERT by different schools of M.P. within the span of four years i.e. 2014 to March 2018.

Recommendations

- i. Some Strategies for dissemination of Senior Secondary Chemistry Laboratory kit should be evolved.
- ii. Systematic training on the use of Senior Secondary Chemistry Laboratory Kit should be organized for the Chemistry Teachers of Madhya Pradesh.
- iii. Senior Secondary Chemistry Laboratory Kit should be made available to the identified schools of M.P.

References

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5. Pareek R. M., Arya A. K., Vidyapati T. J., Impact of Microscale Laboratory Kit on Students Achievement in Chemistry Practical, School Science, 2012, 50 (2), 12
6. Sharma R., Sharma A., Environmental friendly way for enhancing chemistry practical skills: the micro scale chemistry laboratory, Education and Innovation, 2015, 2 (3), 62-63

Annexure

1. Interview schedule for teacher (1)
2. Observation Schedule (2-6)
3. Interview schedule for students (7)
4. Kit purchase record as per DEK, NIE, NCERT

Observation Schedule - 1

Experiment No. 1: Detection of elements in organic compounds (O. C.)

A. Preparation of Sodium Extract:

Check list:-

1. Taking **mustard seed size** of sodium metal with the help of the forceps.
2. **Drying** of sodium metal between folds of filter paper (**1/4th size**).
3. Dropping of dry sodium metal into ignition tube and **heating** on spirit lamp/ kerosene lamp by holding with the help of the tong.
4. **Cooling** of ignition tube to room temperature.
5. **Adding** a pinch (about 50gm) of **O.C.** into the ignition tube and heating with sodium metal on the flame slowly - slowly and later strongly till lower portion of the ignition tube becomes red hot.
6. Taking about 10 ml of distilled water in 20 ml beaker and plunge the red hot ignition tube into distilled water.
7. Ensure steps 1-6 to ensure complete fusion of O.C. with sodium metal.
8. Filtration of solution through the small funnel. The filtrate is sodium or Lassaigne's extract (L.E.) ready for test N, S and halogens.

B. Testing of Elements:

Check list:-

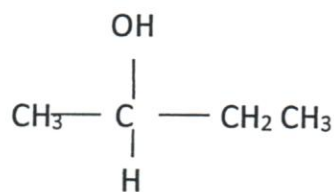
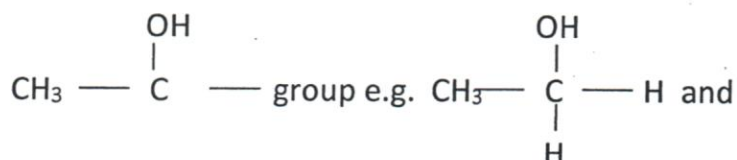
1. **Using distilled water** (rain water after two heavy showers).
2. Use of minimum quantities of chemicals ($\text{FeSO}_4 \cdot 7 \text{H}_2\text{O}$ etc)
3. Usage of NaOH solution before testing of elements.
4. Green ppt. Of $\text{Fe}(\text{OH})_2$ obtained after adding NaOH solution and heating not to be confused with N.
5. Observation of blood red colour on addition of FeCl_3 in case of N & S present together.
6. Cooling of solution after heating with NaOH and FeSO_4 .
7. Adding 3-4 drops of conc. H_2SO_4 carefully along the walls of test tube (t.t.) after cooling.
8. Boiling of L.E. with minimum amount of dil. HNO_3 to boil off N in the form of HCN and S in the form of H_2S before testing for halogens to avoid confusion with white ppt. of AgCN and black ppt. Of Ag_2S .
9. Usage of droppers for taking minimum volume of solutions.
10. Proper usage of well plate while testing with solutions after boiling and cooling.

Observation Schedule - 2

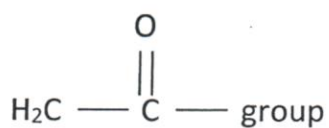
Experiment No. 2: Preparation of iodoform

Check list:-

1. Dissolving of about 1g of I₂ in 3 ml of ethanol(solution 'A')
2. Dissolving of about 1g of NaOH flakes in 1 ml of water (soln. 'B').
3. Adding solution 'B' in solution 'A' and warming in water bath with care.
(C₂H₅OH vapours catch fire)
4. Constant shaking contents of the test tube.
5. Cooling of test tube to get light yellow crystals.
6. Filtration and drying of crystals.
7. Weighing of dry iodoform with a chemical balance and calculating percentage yield.
8. Determination of m.p. of iodoform.
9. Appreciating formation of iodoform as a test for alcohols containing



ketones containing



Observation Schedule - 3

Experiment No. 3: Salt Analysis

Check list:

Inferring radicals by

1. Observing physical appearance like colour and smell of the salt.
2. Inferring radicals by heating about 0.5 g (a pinch) of the salt in the dry test tube (t.t.)
3. Performing NaOH test by heating the salt and inferring the basic radicals.
4. Performing flame test with the help of platinum wire if possible or iron spatula.
5. Performing dil. H_2SO_4 test and inferring for CO_3^{2-} , HCO_3^- , NO_2^- , CH_3COO^- & S^{2-} .
6. Performing conc. H_2SO_4 test and inferring for Cl^- , Br^- , I^- , NO_3^- and avoiding smell of poisonous gases (HCl gas released is never to be confused with Cl_2 gas as H_2SO_4 cannot oxidize the evolved HCl gas into Cl_2 gas).
7. In absence of copper chips, copious brown fumes can be obtained by adding a small piece of folded paper into mix solution with conc. & hot H_2SO_4 .
8. Testing SO_4^{2-} by adding BaCl_2 solution to the salt solution and inferring by the formation of white ppt. due to BaSO_4 .
9. Inferring basic radicals group wise by following the procedure given in the manual.
10. Ammonium salts on heating liberate NH_3 gas to be tested by HCl rod (dense white fumes) and acetate salts give vinegar like smell on rubbing with oxalic acid crystals.

Observation Schedule - 4

Experiment No. 4: Volumetric Titration

Title: Preparation of 1 litre M/40 oxalic acid Solution 'A' and find strength of the given oxalic acid Solution 'B' using NaOH Solution as the intermediate by two burette method.

Check list:

1. Rinsing micro burette No. 1 with Solution 'A' of M/40 oxalic acid and burette No. 2 with NaOH solution.
2. Filling of micro burette No. 1 (5 ml capacity) with M/40 oxalic acid Solution 'A' (by tilting the burette) up to the mark 0.0 (lower meniscus)
3. Filling micro burette No 2 (by tilting the burette) with intermediate solution of NaOH upto the mark of 0.0 (lower meniscus)
4. Fixing a white piece of paper with two holes on each burette to facilitate noting down the burette readings.
5. Observing the initial readings of burette No. 1 and 2 recorded by the student in the table.
6. Taking 2 ml of M/40 oxalic acid Solution 'A' in 25 ml conical flask by dropping oxalic acid drop by drop. This constitutes volume of oxalic acid solution taken for titration and observing addition of one drop of phenolphthalein solution as indicator.
7. Observing again the initial burette reading of burette 'B' which should be at 0.0 only to ensure no leakage.
8. Starting addition of unknown NaOH solution into 25 ml conical flask containing M/40 oxalic acid drop by drop with constant stirring till light pink color appears. To be confirmed by matching with the colorless solution. Burette 'B' reading is noted in the table. Volume of M/? NaOH solution used is written in the table.

9. Ensuring that the titration solution is not thrown away into the sink. 2 ml of M/40 oxalic acid solution is added to the titration solution and titration started again with unknown NaOH solution without adding indicator. Titration continued till light pink color is obtained again. Burette 'B' reading is noted again.
 10. Burette 'A' is filled again with M/40 oxalic acid solution 'A' upto the mark and 2 ml of M/40 oxalic acid is added again to the titration solution.
 11. Observing titration process till concordant readings are obtained.
 12. Verifying the recorded data and the necessary calculations to determine molarity of unknown NaOH solution.
 13. Observing the repetition steps 1-12 above for (concordant readings) for titration of intermediate NaOH solution of known molarity, now with unknown oxalic acid solution 'B'.
 14. Verifying the recorded data and checking calculations for determination of strength of the unknown oxalic acid solution.
1. Ensuring that distilled water is used for preparation of solutions. N.B./1 (for Feachess) for preparation of 1 litre of M/40 oxalic acid solution . 3.15 g of oxalic acid is to be dissolve din distilled water and the volume made up to the mark of 1 litre flask.
 2. For preparation of M/? NaOH solution, 2 g of NaOH is dissolved. Distilled water and the volume made up to the mark in 2 litre flask. NaOH (&) bottle is never to be left unstoppered.
 3. Solution 'B' of oxalic acid may be prepared by dissolving 3.5 g of oxalic acid in distilled water and the volume made up to the mark in 1 litre flask.

Observation Schedule - 5

Experiment No. 5: Preparation of an organic compound - Potassium Trioxalateferrate (III)

Check List:

1. Procuring a clean beaker of the capacity of 50/25 ml and dissolving 0.80 g of dehydrated sample of oxalic acid in 10 ml of hot water contained in the beaker.
2. Adding to the above solutions 2.0 g of pellets of solid potassium hydroxide gradually in installments with stirring so that it dissolves completely.
3. Transferring 1.30 g of ferric chloride solid into the reaction mixture obtained in step 2 listed above and dissolving this also completely with constant stirring.
4. Filtering the resultant solution obtained in step 3. (use watmann 40. 41 filter paper)
5. Concentrating the green filtrate in a porcelain dish using water bath.
6. Cooling the solution obtained in step 5
7. Washing the green colored crystals formed with cold water.
8. Drying the green colored crystals between the folds of filter paper of appropriate size.

(Note: masses as mentioned above of all solids i.e. oxalic acid. Potassium hydroxide and ferric chloride to the approximate only)

Observation Schedule - 6

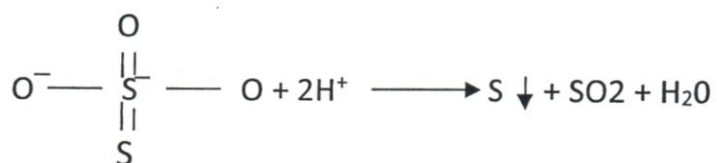
Experiment No. 6: Chemical Kinetics

Kinetic investigation of reaction between sodium thiosulphate and hydrochloric acid: A study of concentration dependence and temperature effect

Check List:

1. Checking the balanced chemical reaction written by students:
Whether students are able to write the ionic reaction between sodium thiosulphate and HCl ($\text{Na}_2\text{S}_2\text{O}_3 + 2\text{HCl} \longrightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{SO}_2 + \text{S}$)
2. Whether they understand the cause of appearance of turbidity. Comprehending observing the appearance of the turbidity meticulously.
3. Whether they are able to prepare 100 ml of 1M HCl by diluting the concentrated HCl having molarity of 11-6 M. (12 M)
4. Whether they are able to prepare 500 ml of 0.1 M $\text{Na}_2\text{S}_2\text{O}_3$ adopting mole concept.
5. Whether they are able to design the experiment to study the effect of concentration of HCl on reaction rate.
6. Whether they know that rate can be represented as the inverse time of appearance of turbidity due to sulphur colloid formation.
7. Whether they have taken equal amount of (10 ml) sodium thiosulphate in the X marked 50 ml beaker at the outer bottom.
8. Whether they have added 1 mL, 2 mL, 3 mL, 4 mL and 5 mL 1M HCl one by one and have noted time of invisible of mark in each beaker (time taken for mark to become invisible).
9. Whether they are able to plot a graph between volume of HCl added and inverse of time appearance of turbidity (x mark becoming invisible).
10. Whether they have analyzed the graph and drawn some conclusion.

11. Whether they are in position to repeat the same experiment at higher temperature like 40⁰c, 50⁰c and 60⁰c and compared the results of kinetics.
12. Whether they are in position to study the effect of concentration of Na₂S₂O₃ at a given concentration of HCl try taking varying amount of Na₂S₂O₃ in different beakers and adding equal amount of HCl in each beaker and noting the time of mark becoming invisible.



Regional Institute of Education, RIE, Bhopal - 13

Use of Micro scale Chemistry Laboratory for the Promotion of Practical Skills
amongst Higher Secondary Students of Gujarat and MP

(A research study)

Principal Investigator – Dr. Rashmi Sharma, Assistant Professor (Chemistry)

rashminerie666@gmail.com, 9893413900

Interview Schedule for Students

Name and Address of School _____

Name of the student _____

Class _____

1. Write list of experiments which can be performed:

a. With ease and effectively by MCL kit.

b. with difficulty by MCL kit.

2. Does MCLS kit motivate you to perform experiments? Yes/no

3. A. Is kit material long lasting? Yes/no

B. if not, give reasons _____

4.

A. Is itens of MCL kit enough to perform all experiments of class XI & XII? Yes/no

B. If not, list the requirements those can not be performed

5. Suggest ways to reduce cost of kit material

6. How is the kit material eco-friendly? Write at least three points.

7. Can you suggest any innovative procedure for performing any of the prescribed experiments. Give list of experiments with procedure?

8. How does performance of experiments by MCL kit helps you in strengthening of concepts? Illustrate by citing three concepts of class XI/XII.

9. How does the MCL kit help you in developing life skills after performance of chemistry experiments? Give any three examples.

10. Any suggestion(s) for improvement of MCL kit

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Interview Schedule for practicing teachers

Name and Address of School _____

Name of the Teacher _____

Qualifications _____

Teaching Experience _____

Experience of Handling MCL kit _____

1. What is micro scale chemistry laboratory?

2. What are the advantages of micro scale chemistry laboratory?

3. Do you have micro scale chemistry laboratory in your school? If yes, how many?

4. Who has provided this laboratory kit(s) to you school?

5. List the areas where you feel the kit is environmentally friendly?

6. List the glass wares / other materials of the kit which you have not used in traditional laboratory settings?

7. Which of the kit item(s) is/are most useful for you as a teacher in micro scale chemistry laboratory kit?

8. Which of the kit item(s) is/are most useful for students in micro scale chemistry laboratory kit?

9. Name the kit item(s) which is/are widely used?

10. Name the kit item(s) which is/are rarely used?

11. List the experiments you conduct using MCL kit?

12. List the experiments which are difficult to be performed using MCL kit?

11. (a) Do you feel all the kit items in MCL kit are useful for teaching of chemistry at higher secondary level? Yes/no

(b) If not, list the items which are not frequently used.

13. Do your students enjoy doing experiments with MCL?

(a) If yes, name the experiments

(b) If not, name the experiments

14. (a) Do you observe any difference in the practical skills of your students when they perform experiments with the help of MCLs? Yes/no

(b) List such skills

15. Name the practical skills those are prominently enhanced?

16. (a) Do you observe any difference in conceptual clarity of your students after using MCL kit for experiments? Yes/no

(b) If yes, list those content areas

17. (a) Do the kit items help you in classroom teaching?
(b) If yes, cite few examples -

Yes/no

18. Any suggestions for improvement in materials and their uses in MCL kit?

19. List out the limitations of MCL kit.

20. Suggestions about cost effectiveness of materials of MCL kit.

Name and Address of the Sr. Sec. Schools having Chemistry Lab kits
(As per DEK Records)

Sl No.	Date	Name & Address of School	Book No./ Receipt No.	No. of Kits
1	09.09.16	Phoolan Devi Charitable Trust S/O Karan Singh General Sales Agency, Opp. New Bus Stand, Palampur, Himachal-176081	35 / 1736	1 Kit
2	28.09.16	Aarambh, 33-B Gitanjali Sec. 17, Plot No. 52, Vashi, Navi Mumbai-400703	35 / 1743	1 Kit
3	21.10.15	KuwahBhan CPA 74, New Seelampur, Delhi	31 / 1509	1 Kit
4.	20.11.15	कार्यालय संचालनराज्य, विज्ञानशिक्षासंस्थान एवं अध्यापक शिक्षामहाविद्यालय, जबलपुर, म.प्र.	31 / 1518	1 Kit
5.	04.12.15	M.M. International School, Jabalpur, M.P.	31 / 1522	1 Kit
6.	04.12.15	Agartya International Foundation 101, Varrabh Plaza, 12 Jaya Mahal, Main Road, Bangalore	31 / 1523	1 Kit
7.	10.12.15	Principal GIC, Ufrankhaf, Uttarakhand	31 / 1525	1 Kit
8.	11.12.15	Nehru Museum of Service & Technology, Indian Institute of Science & Technology, Khanagpur, West Bangal - 721302	31 / 1527	1 Kit
9.	13.1.16	The Director, Science & Technology Dept., Book No. 35-38, Sector-2, Panchkula, Haryana	31 / 1536	21 Kits
10.	20.1.16	Head DESM	31 / 1543	03 Kits
11.	21.1.16	Principal, G/C Sukhwolongh, ChampallalUttarakhand, Chanchu Mohan, Nerha	33 / 1606	1 Kit
12.	22.1.16	Principal Govt. IC BohdaBaglshwar, Uttarakhand	33 / 1614	1 Kit
13.	22.1.16	Programme Coordinator, INSPIRE AN College, Patna	33 / 1616	1 Kit
14.	18.2.16	DAV Public School, JasalaVihar, Delhi	33 / 1640	1 Kit
15.	2.3.17	J.N.V. Waringkheda, Dist. Srimuktser Sahib, Punjab - 151211	37 / 1860	1 Kit
16.	29.3.17	Mr. Deepak 3/2 SarvPriyaVihar	37 / 1869	1 Kit

17.	30.3.17	Saehelvan Public School, Rohini See 13, New Delhi – 85	37 /1871	1 Kit
18.	4.5.17	Deepa Composite P.U. College, Roopnagar, Mysore – 570026	37 /1880	1 Kit
19.	18.5.17	DAV Public School, East Rohini Road, Delhi – 93	37 /1884	1 Kit
20.	20.5.17	KV Arnavankadu Cordiate Factory Arnyankady, The Neelgiries IN-643202	37 /1890	1 Kit
21.	3.5.17	Remal Public School, Sect 8 Rohini Delhi – 85	37 /1894	1 Kit
22.	27.12.16	Shyama Prasad Mukharji College, Delhi University, Punjabi Bagh, New Delhi – 110026	36 /1791	1 Kit
23.	29.12.16	Sandgyan Public School, Ramnagariya Jagatpura, Jaipur – 302017	36 /1793	1 Kit
24.	13.1.17	Regional Institute of Education, Bhopal	36 /1794	3 Kits
25.	7.2.17	Bal Bharti Public School, Sec-12, Dwarka, Nwe Delhi – 110078	36 /1800	1 Kit
26.	29.4.14	KV AFS, Yelhaaka Banglore – 560063	23 /1126	1 Kit
27.	1.9.14	KV No. 2, Near Police Line, FF Road, Ferozepur Cant, Punjab – 152001	23 /1130	1 Kit
28.	2.9.14	Dr. Archana Rani, Type V/52, Delhi Technological University, Banaras Road, Delhi – 42	23 /1132	1 Kit
29.	5.9.14	Army Public School, P.O. Khasa C/O 56APO	23 /1135	1 Kit
30.	11.9.14	West Academy Sr. Sec. School, Railway Road, Ratwadi, Haryana	23 /1137	1 Kit
31.	9.10.14	JNV, Bohani, Dist. Narsinghpur, M.P.	23 /1150	1 Kit
32.	6.6.14	The Principal KV, Miran Sahib J&K	22 / 1052	1 Kit
33.	12.6.14	Army Public School, (Maths) Jammu – 181205	22 / 1054	1 Kit
34.	17.6.14	KV Ernakulam, Karavatha PO Kochi – 20, Kerala	22 / 1057	1 Kit
35.	18.6.14	KV Ujjain, Dewas Road, Nagziree Ujjain – 456010	22 / 1060	1 Kit
36.	30.6.14	A.G. Padmanaleam School for Promotions, Innovation and Creativity in Education, (SPICE), 9/4 Arsriram Layout Saibaba Colony, Boimbatore - 641011	22 / 1069	1 Kit
37.	4.7.14	JNV Kolhapur, MS	22 / 1071	1 Kit
38.	8.7.14	KV N4 No. 11, Sululpura S. Har – Rajashthan – 332001	22 / 1077	1 Kit
39.	9.7.14	KV BSI, Baadpur, J&K – 193502	22 / 1078	1 Kit
40.	12.8.14	KV No. 1, Rajnagar, Hubli – 580032	22 / 1096	1 Kit

41.	13.8.14	KV Sarni Dist. Betul, MP 460447	22 / 1100	1 Kit
42.	24.4.14	Amity International School, Sec I VasandharaYojna, Gaziabad, UP – 201012	21 / 1003	1 Kit
43.	29.4.14	Army Public School, DighiAlahd Road, Near Dighi Post Office, Dighi Camp, Pune – 15	21 /1013	1 Kit
44.	8.5.14	KV No. 3, MorarCantt, Gwalior, M.P.	21 /1023	1 Kit
45.	22.5.14	KV Bhind, Lahor Road ,Near 171, Bhind – 477001	21 /1029	1 Kit
46.	27.5.14	KV ASC Center (r) Victoria Road, Bangalore – 560047, Karnataka	21 /1042	1 Kit
47.	27.5.14	KV No. 2, Airforce Chakeri, Kanpur - 208008, UP	21 /1043	1 Kit
48.	2.6.14	KV Satna, Air Force Station, Satna Dist. Parchi, Midrapur, West Bengal	21 /1049	1 Kit
49.	10.10.14	KV Susanussi, Jalandhar – 144027	24 /1151	1 Kit
50.	16.10.14	KV Mathura, Refinery Nagar, Mathura, UP	24 / 1054	1 Kit
51.	13.11.14	KV Bachel, BIOP Deposit – 5, Bachel – 494553 Dist. Dantewada, CG	24 /1178	1 Kit
52.	25.11.14	JNV At Chandnal, PO Natipal Via Baruderpur, Dist. Bhadrok (ODISHA) 756125	24 /1180	1 Kit
53.	25.11.14	JNV	24 /1080	1 Kit
54.	02.12.14	Kuldip Singh Sajwal, F/120 Bank Road, Sarav, New Delhi	24 /1187	1 Kit
55.	05.12.14	KV URPF, KharadeKalar, New Delhi – 72	24 /1192	1 Kit
56.	12.12.14	KV Naval Base, Kerwar – 581303	24 /1194	1 Kit
57.	31.03.15	State Council of Educational Research and Training, Varun Marg, Defense Colony, New Delhi – 110024	27 /1302	1 Kit
58.	20.05.15	Veda Vyara DAV Public School, D – block, Vikaspuri, New Delhi	27 /1326	1 Kit
59.	29.05.15	The Principal, SSB International School, 5/A, Hal II Stage Indira Nagar, Bangalore – 560028	27 /1328	1 Kit
60.	01.06.15	Divine Public School, BardhaBhinraDostpur Road, Akbarpur, Ambedkar Nagar, UP	27 /1332	1 Kit
61.	31.12.14	The Principal, Miranda House, DU, New Delhi	25 /1206	1 Kit
62.	02.01.15	KV No. 2, Ground Parade Road, Agra – 282007, UP	25 /1210	1 Kit

63.	06.01.15	KV Panagarh, Dist Bardwan, WB	25 /1211	1 Kit
64.	23.01.15	KV, Shahdol-484001, MP	25 /1242	1 Kit
65.	07.01.15	BR Crlobali School, GamenrKheri, Gujjar Road, Sonipat, Haryana	25 /1213	1 Kit
66.	13.01.15	KV, Near Guru Nanak Chowk, Bilaspur	25 /1216	1 Kit
67.	19.01.15	KV No. 1, Jhansi Cantt Rana Pratap Marg, Jhansi	25 /1223	1 Kit
68.	02.02.15	KV Govindpur, Dist. Dinajpur, PO Mirmal – 733130	25 /1240	1 Kit
69.	03.02.15	KV Balaghat, Post Barvali, Dist. Balaghat – 481102, M.P.	25 /1242	1 Kit
70.	05.02.15	Mrs. Janhnis J More, Sr. Project Assistant Indian Institute of technology, Dept. of Comp. Science and Engineering KarnealRakhi Building, Bombay	25 /1245	1 Kit
71.	13.02.15	KV, MorenaAmbah Road, PO JingiMorena – 476001	25 /1249	1 Kit
72.	17.03.15	Principal, National Public Sr. Sec. School, Sec. 3 Block & Rajendra Nagar, Sahibabad (A.B)	26 /1283	1 Kit
73.	26.03.15	SCERT, Varun Marg, Defense Colony, New Delhi – 110024	26 /1299	1 Kit
74.	21.09.15	St. Joseph's MSVM Nagar, Dalsim GM Sarai, Samastipur, Bihar	30 /1473	1 Kit
75.	06.10.15	Head DESM	30 /1483	1 Kit
76.	09.10.15	Principal, Govt. Hr. Sec. School, Shahganj, Sehore, M.P.	30 /1494	1 Kit
77.	22.02.16	SurajBhan, DAV Public School, F-10/15, VasasntVihar, New Delhi – 110057	34 / 1670	4 Kits
78.	17.05.16	Sardar Patel Vishwavidyalaya, Lodhi State, New Delhi	34 / 1692	1 Kit
79.	01/06/16	Principal, Hansraj Model School, Road No. 73, Punjabi Bagh, New Delhi – 110026	34 / 1698	4 Kits
80.	18/07/16	Head DESM, NCERT, New Delhi – 16	35 / 1716	3 Kits
81.	17/08/16	Arya Mahila PG College, Grade 'A" Accreditation NAAC, Chetganj, Varanasi - 221009	35 / 1727	1 Kit
82.	09/09/16	Dhyandeep Foundation, Centre Palthan Gate Road, Aurangabad	35 / 1734	1 Kit