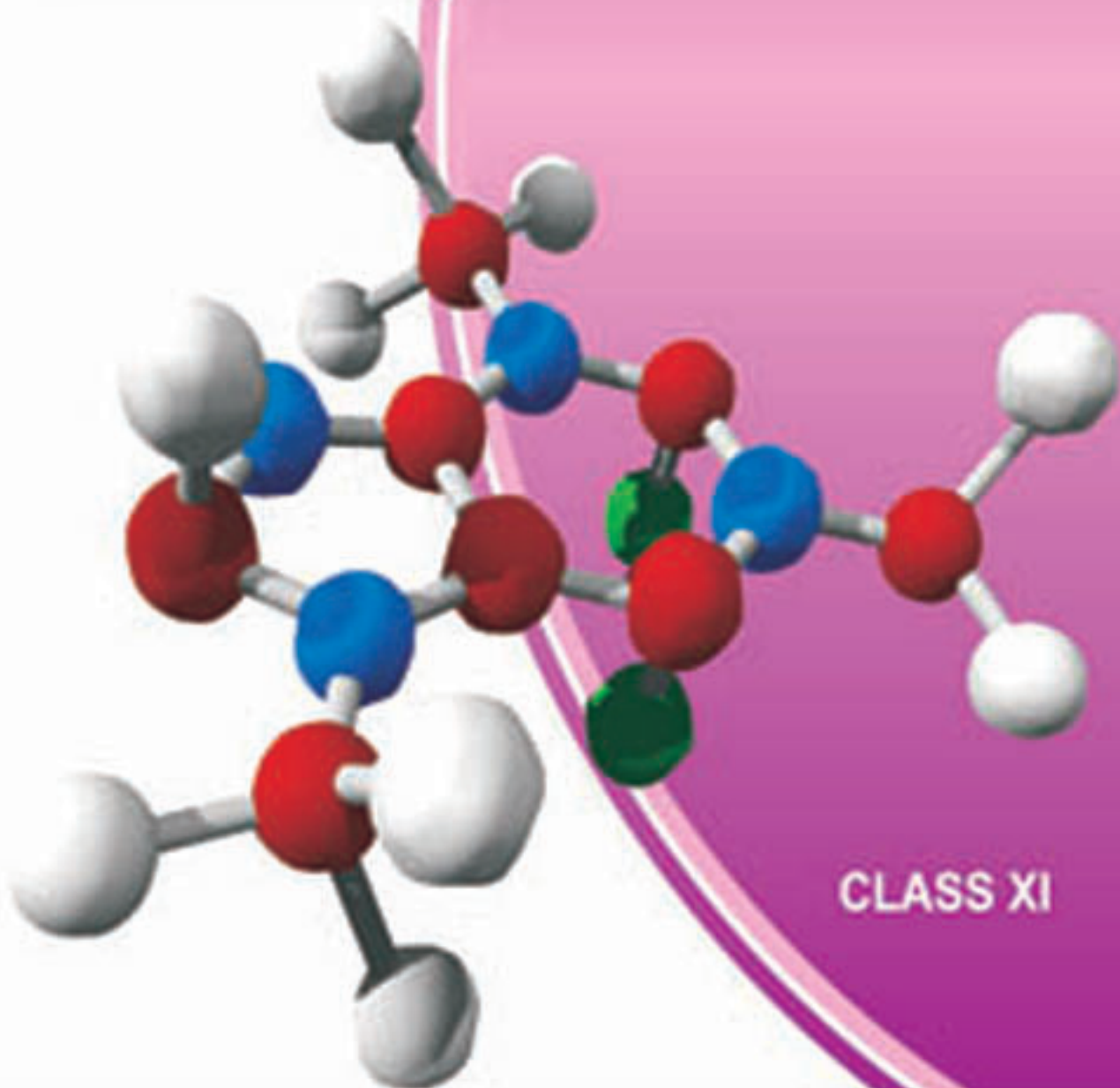


Comprehensive

PRACTICAL CHEMISTRY



CLASS XI

Comprehensive
PRACTICAL CHEMISTRY

FOR
CLASS XI

Strictly according to new curriculum prescribed by
Central Board of Secondary Education (CBSE)
and
State Boards of Chhattisgarh, Haryana, Bihar, Jharkhand, Kerala,
Mizoram, Meghalaya and other States following NCERT Curriculum

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CONTENTS

| <i>Chapters</i> | <i>Pages</i> |
|---|--------------|
| Syllabus | (xi)–(xii) |
| 1. INTRODUCTION | 1–6 |
| 2. BASIC LABORATORY TECHNIQUES | 7–15 |
| <i>Viva questions with answers</i> ... | 14 |
| 3. DETERMINATION OF MELTING POINT | 16–18 |
| <i>Exp-3.1</i> : To determine the melting point of the given solid substance ... | 16 |
| <i>Viva questions with answers</i> ... | 18 |
| 4. DETERMINATION OF BOILING POINT | 19–21 |
| <i>Exp-4.1</i> : To determine the boiling point of the liquid ... | 19 |
| <i>Viva questions with answers</i> ... | 21 |
| 5. PURIFICATION OF CHEMICAL SUBSTANCES BY CRYSTALLISATION | 22–30 |
| <i>Exp-5.1</i> : To prepare crystals of pure copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) from a given impure sample of the blue vitriol ... | 26 |
| <i>Exp-5.2</i> : To prepare the crystals of potash alum ($\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$) from the crude sample ... | 28 |
| <i>Exp-5.3</i> : To purify impure sample of benzoic acid by the process of crystallisation ... | 29 |
| <i>Viva questions with answers</i> ... | 29 |
| 6. EXPERIMENTS BASED ON pH CHANGE | 31–44 |
| <i>Exp-6.1</i> : Determine the pH values of hydrochloric acid at different strengths using; (i) pH papers and (ii) universal indicator solution ... | 34 |
| <i>Exp-6.2</i> : To determine the pH of various samples of NaOH solution using: (i) pH paper, and (ii) universal indicator solution ... | 35 |
| <i>Exp-6.3</i> : Determine the pH of solutions of some salts using pH paper or universal indicator ... | 36 |
| <i>Exp-6.4</i> : Determine the pH of vegetable and fruit juices using pH paper and universal indicator ... | 37 |

(vi)

| | | |
|---|-----|--------------|
| <i>Exp-6.5</i> : Compare the pH of solutions of hydrochloric acid and acetic acid having same concentration | ... | 38 |
| <i>Exp-6.6</i> : Study the pH change in the titration of $\frac{M}{10}$ HCl with $\frac{M}{10}$ NaOH using universal indicator | ... | 39 |
| <i>Exp-6.7</i> : (a) To study the change in pH of acetic acid (a weak acid) solution by addition of sodium acetate | ... | 40 |
| (b) To study the change in pH of ammonium hydroxide (a weak base) solution by the addition of ammonium chloride | ... | 40 |
| <i>Viva questions with answers</i> | ... | 42 |
| 7. EFFECT OF CHANGE OF CONCENTRATION ON CHEMICAL EQUILIBRIUM | | 45–49 |
| <i>Exp-7.1</i> : To study the shift of equilibrium between ferric ions and thiocyanate ions by increasing the concentration of either of them | ... | 45 |
| <i>Viva questions with answers</i> | ... | 48 |
| 8. QUANTITATIVE ESTIMATION (VOLUMETRIC ANALYSIS) | | 50–81 |
| <i>Exp-8.1</i> : Prepare $\frac{M}{10}$ sodium carbonate solution | ... | 56 |
| <i>Exp-8.2</i> : Prepare $\frac{M}{10}$ oxalic acid solution | ... | 59 |
| <i>Exp-8.3</i> : Prepare 250 ml of 5N HCl from the given 12N HCl | ... | 61 |
| <i>Exp-8.4</i> : Prepare 250 ml of 2M H ₂ SO ₄ from the given 18M H ₂ SO ₄ | ... | 62 |
| <i>Exp-8.5</i> : Determine the strength of the given sodium hydroxide solution. You are provided with $\frac{M}{20}$ oxalic acid solution | ... | 69 |
| <i>Exp-8.6</i> : Determine the strength and molarity of the given solution of hydrochloric acid. Given is 0.05 M Na ₂ CO ₃ solution | ... | 71 |
| <i>Exp-8.7</i> : Determine the percentage purity of the given sample of caustic soda, 5.0 g of which are dissolved per litre. Ask for your requirement | ... | 72 |
| <i>Exp-8.8</i> : Determine the percentage composition of a mixture of KOH and KCl, 8.0 gms of which are dissolved per litre of the given solution. Ask for what you require | ... | 74 |
| <i>Exp-8.9</i> : The given solution contains 6.3 g of hydrated oxalic acid, $\begin{matrix} \text{COOH} \\ \\ \text{COOH} \end{matrix} \cdot n\text{H}_2\text{O}$ crystals per litre. Determine the value of <i>n</i> (no. of molecules of water of crystallisation). Provided 0.1 M NaOH | ... | 75 |

(vii)

| | | |
|---|-----|----------------|
| <i>Exp-8.10</i> : Determine volumetrically, the value of 'n' i.e., the number of water molecules of crystallisation in washing soda, $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$, 7.0 g of which have been dissolved per litre of the given solution. Provided $\frac{M}{10}$ HCl | ... | 76 |
| <i>Exp-8.11</i> : You are provided with the solution of a hydrogen carbonate of a monovalent alkali metal (M) with strength equal to 10.0 gms per litre. Find out the atomic mass of the metal (M). Ask for your requirement | ... | 78 |
| <i>Viva questions with answers</i> | ... | 79 |
| 9. QUALITATIVE ANALYSIS | | 82–133 |
| <i>Exp-9.1</i> : To analyse the given salt for acidic and basic radicals | ... | 121 |
| <i>Exp-9.2</i> : To analyse the given salt for acidic and basic radicals | ... | 123 |
| <i>Viva questions with answers</i> | ... | 127 |
| 10. DETECTION OF ELEMENTS IN ORGANIC COMPOUNDS | | 134–140 |
| <i>Viva questions with answers</i> | ... | 139 |

INVESTIGATORY PROJECTS

(141–170)

| | | |
|--|-----|------------|
| 1. STUDY OF METHODS OF PURIFICATION OF WATER | | 142 |
| 2. ANALYSIS OF HARD WATER | | 145 |
| <i>Exp-1</i> : To determine the hardness of a water sample | ... | 146 |
| 3. TO STUDY THE FOAMING CAPACITY OF SOAPS | | 148 |
| <i>Exp-1</i> : Compare the foaming capacities of different samples of soaps | ... | 149 |
| <i>Exp-2</i> : Study the effect of addition of sodium carbonate (washing soda) on the foaming capacity of a soap | ... | 150 |
| 4. THE STUDY OF CONTENTS RESPONSIBLE FOR FLAVOUR OF TEA | | 151 |
| <i>Exp-1</i> : Compare the water soluble polyphenol (catechin) content in the various samples of tea leaves | ... | 151 |
| <i>Exp-2</i> : Compare the tannic acid content of various samples of tea | ... | 152 |
| <i>Exp-3</i> : Compare the caffeine content of the different samples of tea | ... | 153 |
| 5. TO STUDY THE RATE OF EVAPORATION OF DIFFERENT LIQUIDS | | 154 |
| <i>Exp-1</i> : To compare the rates of evaporation of water, acetone and diethyl ether. | ... | 155 |
| <i>Exp-2</i> : To study the effect of surface area on the rate of evaporation of diethyl ether | ... | 156 |

| | | | |
|--------------|--|-----|----------------|
| <i>Exp-3</i> | : To study the effect of temperature on rate of evaporation of acetone | ... | 157 |
| <i>Exp-4</i> | : To study the effect of air current on the rate of evaporation | ... | 158 |
| 6. | STUDY OF THE EFFECT OF ACIDS AND BASES ON THE TENSILE STRENGTH OF FIBRES | | 158 |
| <i>Exp-1</i> | : To compare tensile strength of cotton, silk and nylon fibres | ... | 159 |
| <i>Exp-2</i> | : To find the effect of acids and alkalies on tensile strength of cotton, wool and silk fibres | ... | 160 |
| 7. | ANALYSIS OF VEGETABLE AND FRUIT JUICES | | 161 |
| <i>Exp-1</i> | : To analyse some fruit and vegetable juices for the contents present in them | ... | 161 |
| 8. | PREPARATION OF RAYON THREAD FROM FILTER PAPER | | 162 |
| <i>Exp-1</i> | : To prepare rayon threads from filter papers using cuprammonium process | ... | 163 |
| 9. | COMPARATIVE STUDY OF COMMERCIAL ANTACIDS | | 164 |
| <i>Exp-1</i> | : To analyse the given samples of commercial antacids by determining the amount of hydrochloric acid they can neutralize | ... | 165 |
| 10. | STUDY OF ADULTERANTS IN FOOD-STUFFS | | 167 |
| <i>Exp-1</i> | : To detect the presence of adulterants in fat, oil and butter | ... | 167 |
| <i>Exp-2</i> | : To detect the presence of adulterants in sugar | ... | 168 |
| <i>Exp-3</i> | : To detect the presence of adulterants in samples of chilli powder, turmeric powder and pepper | ... | 168 |
| 11. | PREPARATION OF AN ALUM FROM SCRAP ALUMINIUM | | 169 |
| <i>Exp-1</i> | : To prepare potash alum from scrap aluminium | ... | 170 |
| | APPENDICES | | 171–176 |
| | Appendix-I : Atomic Masses of Some Common Elements | ... | 172 |
| | Appendix-II : Preparation of Common Reagents Used in the Chemical Laboratory | ... | 173 |

PREFACE

It gives us immense pleasure in presenting the new revised edition of **Comprehensive Practical Chemistry** for students of **Class XI** under 10 + 2 pattern. The book has been written strictly according to the new syllabus adopted by Central Board of Secondary Education and other state boards. We hope that the book will be quite helpful to young students in acquiring the skills of various laboratory techniques. Some of the outstanding features of the book are :

- Simple language and lucid style.
- Wherever required, a large number of illustrations have been given to clarify the use of various apparatuses used in laboratory.
- The theoretical aspects of each experiment have been discussed briefly along with the experiment.
- In volumetric analysis calculations based on molarity have been given.
- In qualitative inorganic analysis, the various tests have been given in a systematic way in tabular form.
- In order to guide the students about recording the experiment in the notebook, a specimen record of analysis of a salt has been given in the chapter on qualitative analysis.
- A large number of solved viva questions have been included in each chapter.
- A number of investigatory projects have been given at the end.

We sincerely hope that the book will be appreciated by our learned colleagues and students. We shall be glad to receive constructive suggestions for the further improvement of the book.

—AUTHORS

SYLLABUS

CLASS XI (PRACTICALS)

| Evaluation Scheme for Examination | Marks |
|--|--------------|
| Volumetric Analysis | 10 |
| Salt Analysis | 8 |
| Content Based Experiment | 6 |
| Class Record, Project and Viva | 6 |
| Total | 30 |

Practicals Syllabus

Micro-chemical methods are available for several of the practical experiments. Wherever possible such techniques should be used:

A. Basic Laboratory Techniques (Periods 2)

1. Cutting glass tube and glass rod
2. Bending a glass tube
3. Drawing out a glass jet
4. Boring a cork

B. Characterization and Purification of Chemical Substances (Periods 6)

1. Determination of melting point of an organic compound.
2. Determination of boiling point of an organic compound.
3. Crystallization of impure sample of anyone of the following: Alum, Copper sulphate, Benzoic acid.

C. Experiments based on pH (Periods 6)

- (a) Anyone of the following experiments:
- Determination of pH of some solutions obtained from fruit juices, solution of known and varied concentrations of acids, bases and salts using pH paper or universal indicator.
 - Comparing the pH of solutions of strong and weak acid of same concentration.
 - Study the pH change in the titration of a strong base using universal indicator.
- (b) Study the pH change by common-ion in case of weak acids and weak bases.

D. Chemical Equilibrium

(Periods 4)

One of the following experiments:

- (a) Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either ions.
- (b) Study the shift in equilibrium between $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and chloride ions by changing the concentration of either of the ions.

E. Quantitative Estimation

(Periods 12)

- (i) Using a chemical balance.
- (ii) Preparation of standard solution of oxalic acid.
- (iii) Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.
- (iv) Preparation of standard solution of sodium carbonate.
- (v) Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

F. Qualitative Analysis

(Periods 16)

- (a) Determination of one anion and one cation in a given salt

Cations: Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+ .

Anions: CO_3^{2-} , S^{2-} , SO_3^{2-} , SO_4^{2-} , NO_2^- , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^- .

(Note: Insoluble salts excluded).

- (b) Detection of nitrogen, sulphur, chlorine in organic compounds.

PROJECTS

(Periods 10)

Scientific investigations involving laboratory testing and collecting information from other sources.

A Few Suggested Projects

- Checking the bacterial contamination in drinking water by testing sulphide ion.
- Study of the methods of purification of water.
- Testing the hardness, presence of iron, fluoride, chloride, etc., depending upon the regional variation in drinking water and study of causes of presence of these ions above permissible limit (if any).
- Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on it.
- Study of the acidity of different samples of the tea leaves.
- Determination of the rate of evaporation of different liquids.
- Study of the effect of acids and bases on the tensile strength of fibers.
- Study of acidity of fruit and vegetable juices.

Note: Any other investigatory project, which involves about 10 periods of work, can be chosen with the approval of the teacher.

INTRODUCTION

Hypothesis become theories and theories attain rank of laws after withstanding rigorous experimental tests. Feasibility of a process is confirmed in the laboratory. Qualitative and quantitative analyses give complete chemical picture of the substance. It is with these considerations in mind we proceed to learn what is there in a chemistry laboratory.

1.1. CHEMISTRY LABORATORY

A chemistry laboratory is a workshop for chemists. Here students learn the techniques of the preparation, identification and estimation of chemical substances. Before starting experiment, a student must know from where to get the apparatus required for the given experiment and the placement of the chemicals to be used. A student must know the proper use of each equipment and the precautions to be observed while working in the laboratory. A chemistry laboratory is provided with the following fittings with which the student must become familiar.

1. Demonstration Table

Before starting experiment, the teacher gives instructions and demonstrates the concerned experiment on demonstration table. In chemistry laboratory, no seats are made available to the students, so students stand around demonstration table and note the instructions from teacher.

2. Students' Working Table

A number of wooden or concrete tables are provided for working. Each seat is provided with :

(a) **Reagent shelves.** Reagents or chemicals to be used are placed on the reagent shelf. These are the reagents which are commonly used. For example, all dilute and concentrated acids such as H_2SO_4 , HCl , HNO_3 , etc. and bases like NaOH , NH_4OH , etc.

(b) **Sinks and water taps.** A sink and a water tap is fitted between every two reagent shelves. On either side of the sink, usually two taps are fitted for supply of water.

(c) **Gas taps.** These taps are fitted on the seats for supply of petrol gas to the burners. Sometimes kerosene is used for producing gas in place of petrol.

3. Side Shelves

Mostly there are two big shelves fitted on the walls of the laboratory. Reagents and chemicals, which are less frequently used, are placed in these shelves. Sometimes solid chemicals are placed in a separate shelf.

4. Fume Cup-board

There is at least one fume cup-board in the corner of the laboratory. All experiments giving out poisonous gases or vapours are performed in this cup-board.

5. Balance Room

It is a small room attached to each laboratory. Here, a number of balances are kept for weighing the substances.

6. Exhaust Fans

Two exhaust fans are provided at the two corners of the laboratory for the removal of the poisonous gases and vapours from the laboratory.

1.2. COMMON LABORATORY APPARATUS

The apparatus which is commonly used by XIth class student is described below :

1. Beakers. Beakers of different sizes such as 150 ml, 200 ml made of soft glass or corning glass. Beakers are used for taking various liquids.

2. Test Tubes. Test tubes of different sizes are available. Small test tubes used for salt analysis known as centrifuging tubes and boiling tubes are also available.

3. Conical Flask. It is used in volumetric analysis for carrying out titration.

4. Funnel. It is used for filtration or for pouring solutions.

5. Measuring Flask. It is used in quantitative analysis when we have to prepare a solution with a particular volume. There are flasks of 50 ml, 100 ml and 250 ml capacity. There is a mark on the stem of the flask upto which the liquid is taken to complete the volume.

6. Glass-Rod. It is used for stirring purposes. It is also used as an aid for transferring the liquid into the funnel.

7. China Dish. It is a small vessel made of porcelain. It is used in crystallisation, for concentrating a solution.

8. Wire Gauze. It is placed above the flame of the burner so that the glass vessel being heated does not touch the flame directly and hence is prevented from breaking.

9. Tripod Stand. It is used for supporting a china dish or a beaker so that it can be heated from below.

Other apparatus with which a student must familiarize are *test tube holder, test tube brush, crucible tongs, spatula, watch glass, clamp stand, burette, pipette, water bath, sand bath and centrifugal machine.*

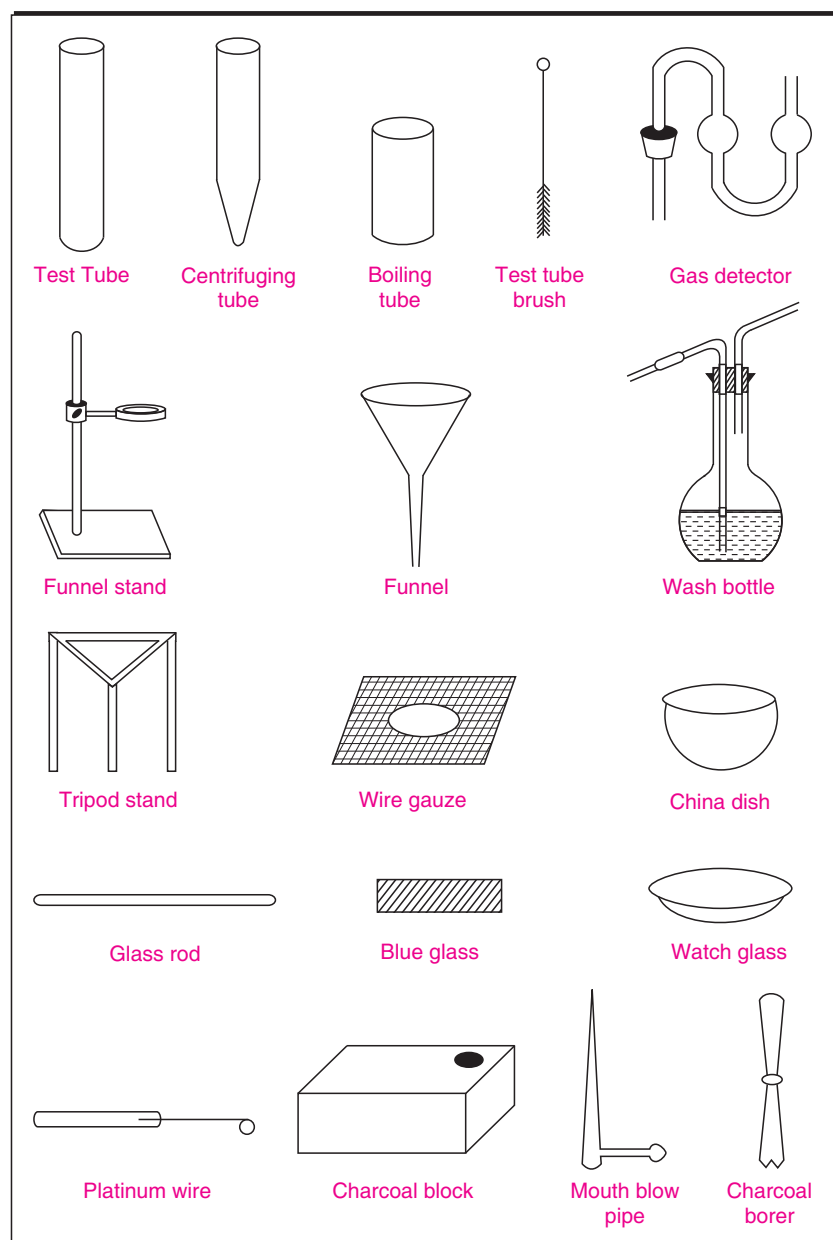


Fig. 1.1. Apparatus used in chemistry laboratory.

1.3. INSTRUCTIONS TO WORK IN LABORATORY

To work in the laboratory, a student must follow the following rules :

1. A student must have a practical note-book, rough note-book for instructions, a pen or pencil, a laboratory coat and other equipment such as a platinum wire, fractional weights as required.

2. Always come prepared for the experiment. This will help in understanding the experiment better.
3. Always listen to the teacher's instructions carefully and note down the important points and precautions to be followed.
4. After the instructions, collect the apparatus from the laboratory assistant in queue.
5. Thoroughly clean the apparatus to be used.
6. Do only the experiments assigned, unallotted experiments should not be done.
7. Do your experiment honestly without caring for the final result. Record the observations on a rough note-book instead of writing on the pieces of paper.
8. Plan your work so that it is finished in the stipulated time.
9. Be economical with the reagents. Only small quantities of the reagents are to be used.
10. Handle the glass apparatus very carefully. In case of any breakage, report it to your teacher at once.
11. Dispose of all waste liquids in the sink and allow water to run for sometime by opening the water tap.
12. Keep your seat clean. If an acid or other corrosive chemical is spilled, wash it off with water.
13. Clean your apparatus after the experiment and return it to the laboratory assistant.
14. In case of any injury or accident or breakage of the apparatus, report it to the teacher immediately.
15. Wash your hands with soap after the experiment.

1.4. SOME IMPORTANT PRECAUTIONS

To avoid unnecessary risk or injury during laboratory work, the students are advised to observe the following precautions :

1. Do not touch any chemical with hand as some of them may be corrosive.
2. Never taste a chemical. It may be poisonous.
3. Do not place the chemical on the palm of your hand.
4. Do not keep the reagent bottles open.
5. Do not roam here and there in the laboratory without work.
6. Do not put any object into the reagent bottle.
7. Do not bring inflammable liquids such as alcohol, ether near the flame.
8. Do not take the reagent from the shelf to your seat.
9. Do not disturb the arrangement of reagents placed on the shelf.
10. Do not use cracked glass apparatus such as beakers for heating purposes.
11. Do not keep water tap running when not required.
12. Do not throw solid waste materials like filter paper pieces, test-tube pieces, etc. in the sink. Throw them in the waste box only.
13. Do not heat beakers or china dish directly on flame. Always make use of wire gauge.

14. Never add water to the acid. Always pour acid slowly into the water with stirring.
15. Do not play with the chemicals.

1.5. PRACTICAL NOTE-BOOK

All the experiments that are conducted in the laboratory are recorded in a practical note-book. It is compilation of whole work done by the student, so it must be well maintained, protected from mechanical and chemical damage. For keeping up-to-date record of experiments following points should be kept in mind :

1. The name of the experiment should be entered along with the date of carrying out that experiment.
2. Requirements should be mentioned next to the title given.
3. Theory and principle of the experiment should be given in precise manner.
4. This should be followed by procedure in which experiment is to be conducted. Then a summary of precautions to be taken care are mentioned. Finally mention the general calculations for the experiment.

If we make a table of the points to be written on left hand and right hand side of the note-book, it will look somewhat like the one given below :

| <i>Left hand side</i> | <i>Right hand side</i> |
|-----------------------|------------------------|
| Date | Date |
| Diagram | Name of experiment |
| Chemical equation | Theory |
| Observations | Procedure |
| Calculations | General calculations |
| | Precautions |

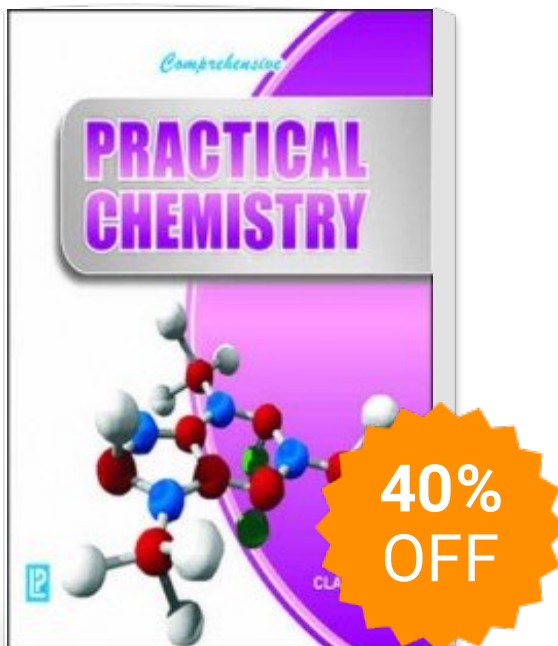
Keep following points in consideration regarding your practical note-book :

1. Do not tear pages from note-book.
2. Do not over write if a mistake has been committed in recording, put a line over it and write the correct word or figure again.
3. Number the pages of your note-book.
4. Complete the index, indicating the experiment, its serial number, page number on which it is written.
5. Keep your note-book neat and tidy and covered with brown paper.

1.6. FIRST AID EMERGENCY TREATMENT IN THE LABORATORY

A chemistry laboratory encompasses different types of chemicals, apparatus. Any lack of attention on the part of student may cause accident. Accidents may occur by chance also. In any case prompt action should be taken to give first aid to the victim and then should be

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