MODERN'S abc OF

Practical CHEMISTRY

CLASS XI

S. Kiran
Kavya

MODERN'S abc OF Practical CHEMISTRY

For

CLASS–XI

According to New Syllabus Prescribed by Central Board of Secondary Education (CBSE), New Delhi and State Boards of Uttarakhand, Chhattisgarh, Jharkhand, Punjab, Haryana, Himachal, Kerala, Mizoram, Meghalaya, Nagaland, Manipur and Other States following CBSE Curriculum.

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We are committed to serve students with best of our knowledge and resources. We have taken utmost care and attention while editing and printing this book but we would beg to state that Authors and Publishers should not be held responsible for unintentional mistakes that might have crept in. However, errors brought to our notice, shall be gratefully acknowledged and attended to.

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Preface

A chemist bases his thinking on experiments. The task of analytical chemistry is to develop and provide experimental methods of determining the chemical composition of substances. The book in your hands describes various procedures for qualitative and quantitative analysis.

This book is intended for class XI students. The text has been written strictly according to the new syllabus prescribed by **Central Board of Secondary Education.** It presents the theoretical principles and practical procedures of analytical chemistry in an easy and comprehensive way. Some salient features of the book are :

- The content is given in a simple language.
- A large number of illustrations have been given to make the experiments easily understandable.
- A brief theoretical background has been given in each experiment.
- In volumetric analysis, the calculations have been done in molarity.
- The salt analysis has been given in a simplified manner along with the tables.
- To guide the students to write the salt analysis, two specimen records have been given at the end of the chapter of qualitative analysis of inorganic compounds.

We hope that the book will help students in learning the skills of various laboratory techniques and handling the laboratory apparatus more properly.

We express our heartfelt gratitude to our **Supreme Guide** who lighted our path during the journey of writing this book. Our inexpressible thanks are due to **Sh. B.R. Sharma** (National Sales Head) and **Sh. Ravinder Pathania** (General Manager Publication) whose words of encouragement have imbibed an untiring zeal in us. Our thanks are due to **Sh. S.K. Sikka** (General Manager Publication) for giving us unstinting support. Our words are insufficient to express our thanks to **MBD staff** who have flawlessly helped us in bringing out this work on paper.

Our heart bows to the contribution of ***Likyana*** who have constantly supported us in the compilation of this work.

We shall be glad to receive constructive suggestions from the readers.

– S. Kiran
–Kavya

Syllabus

CHEMISTRY PRACTICALS (CLASS – XI)

PRACTICALS (Total Periods 60)

Evaluation Scheme for Examination	**Marks**
Volumetric Analysis	08
Salt Analysis	08
Content Based Experiment	06
Project work	04
Class Record and Viva	04
Total	**30**

A. Basic Laboratory Techniques

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 substance

1. Determination of melting point of organic compound.
2. Determination of boiling point of organic compound.
3. Crystallization of an impure sample of any one of the following :

Alum, copper sulphate, Benzoic acid.

C. Experiments related to pH change

(*a*) Any one 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 of pH change in the titration of a strong base using universal indicator.

(*b*) Study of pH change by common-ion effect in case of weak acids and weak bases.

D. Chemical equilibrium

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 $[Co(H_2O)_6]^{2+}$ and chloride ions by changing the concentration of either of the ions.

E. Quantitative estimation

- Using a chemical balance.
- Preparation of standard solution of oxalic acid.
- Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.
- Preparation of standard solution of sodium carbonate.
- Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

F. Qualitative Analysis

(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+}, Zn^{2+}, Ni^{2+}, Co^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}

Anions—CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}, $C_2O_4^{2-}$, CH_3COO^-

(Note : Insoluble salts excluded)

(b) **Detection of Nitrogen, Sulphur, Chlorine in an organic compounds.**

PROJECTS

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 the 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 them.
- 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 fibres.
- 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.

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CHAPTER 1

THE CHEMIST AND HIS TOOLS

A chemist bases his thinking on experiments. While performing the experiments, the students must learn the habit of neat and tidy work, of keeping the bench clean and handling the apparatus properly. It is also necessary that the student should learn to record the results and the conclusions drawn from the experiments.

In doing his experiments, the scientist uses many special tools.

APPARATUS USED FOR VOLUMETRIC ANALYSIS

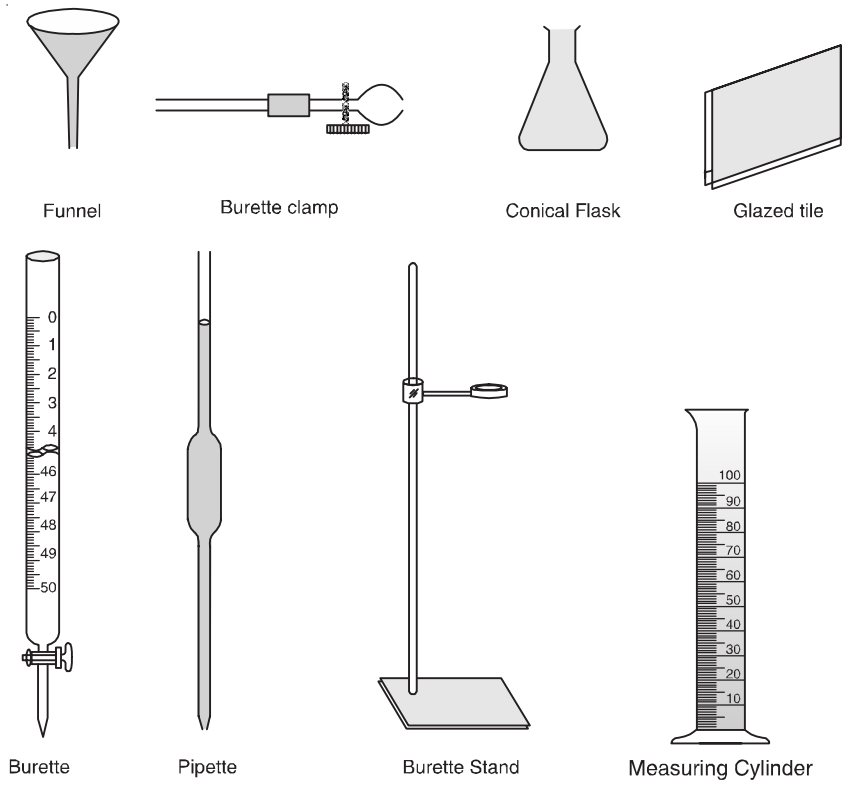

Figure 1

APPARATUS USED FOR QUALITATIVE ANALYSIS AND OTHER EXPERIMENTS

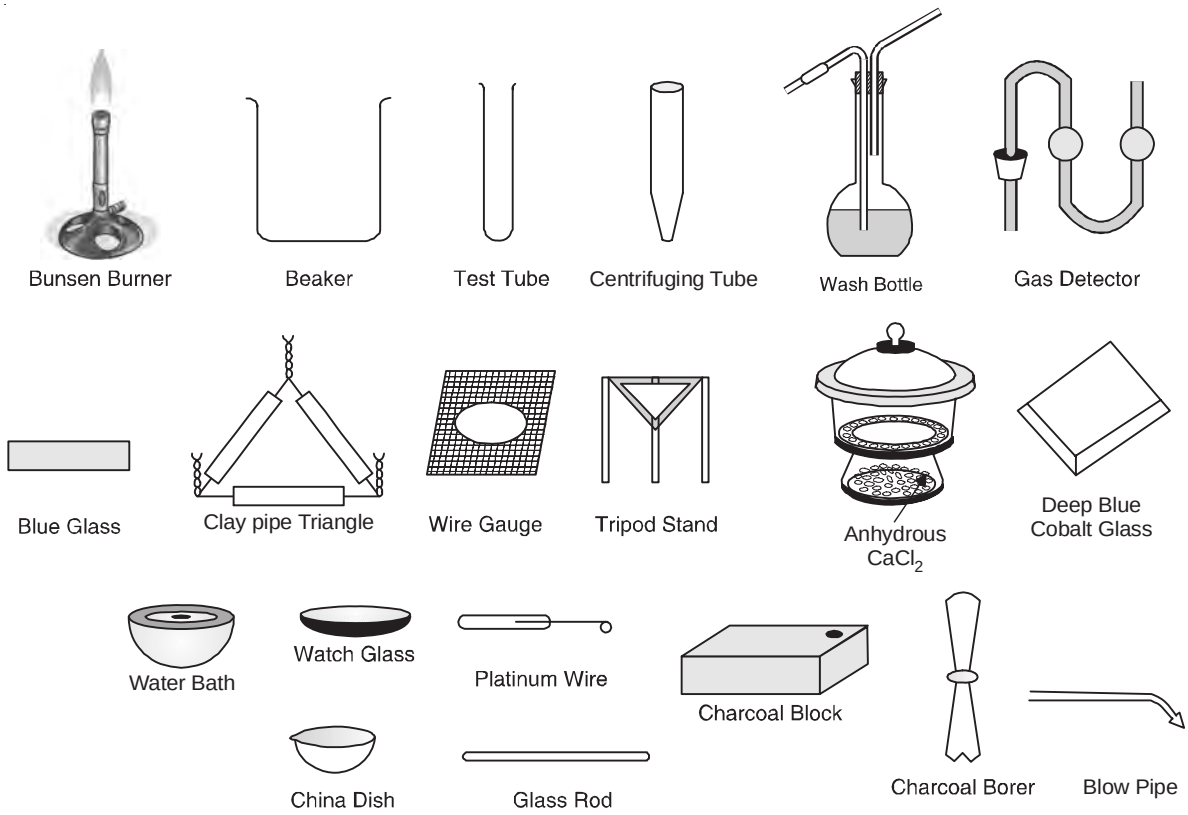

Figure 2

1.1. Common Apparatus Used in the Laboratory

1. **Test Tubes** — Test tubes of different sizes and shapes are used in the laboratory. Centrifuging tubes and boiling tubes are used in salt analysis.
2. **Beakers** — Beakers of different capacities such as 100 ml, 150 ml, 200 ml are used for preparing solutions, carrying out precipitation reactions and for evaporating solvents. These are made of soft glass or corning glass.
3. **Conical Flask** — It is used for carrying out titration in volumetric analysis.
4. **Separating Funnel** — Separating funnel is used for separating immiscible liquids.
5. **Condensors** — Condensors are used to condense the vapours to the liquid state. Two types of condensors are used; (*a*) air condensor and (*b*) water condensor. In air condensor, the vapours transfer the heat to surroundings and get converted to liquid whereas in water condensors water is circulated around the inner tube. The vapours transfer heat to the surrounding water and get condensed to liquid form. Air condensors are used for refluxing and distillation of liquids having high boiling point whereas water condensors are used for low boiling liquids.
6. **Gas Detector** — It is used for testing various gases in salt analysis.
7. **Funnel** — It is used for filtration and transferring solutions from one container to another.
8. **Measuring Cylinder** — It is used in quantitative analysis for measuring liquids of a particular volume.

9. **Glass Rod** — It is used for stirring purposes.
10. **China Dish** — It is made of porcelain material. It is used for concentrating solutions in the process of crystallisation.
11. **Wire Gauze** — It is kept on the tripod stand above the flame of burner. It is used to prevent breaking of glass apparatus due to direct heating on the flame.
12. **Tripod stand** — It is used for various apparatus like china dish or beaker to be heated.

Various other apparatus like test-tube holder, tongs, burette, pipette, watch-glass, centrifugal machine, weighing balance etc. are used in the laboratory

1.2. Bunsen Burner

The Bunsen burner is a gas burner especially designed for use in the laboratory; it is named after its inventor, the German Chemist Bunsen. It burns liquid petroleum gas (LPG).

Fig. 3 shows a typical gas-burning Bunsen burner. The brass tube has a circular air hole near its lower end which has a ring allowing it to be completely or partially closed.

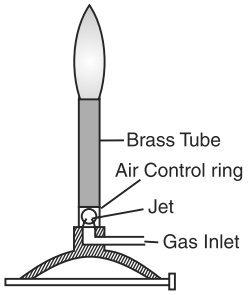

Figure 3

When this **hole is closed**, the burner burns pure gas and gives a large luminous yellow flame which is smoky and not very hot. This flame will deposit soot on anything

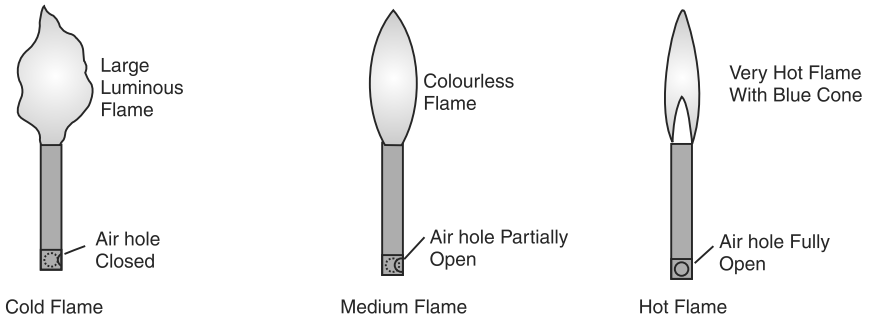

Figure 4

that is placed in it. When the **air hole is partially open**, the jet of gas flowing up the tube draws in air with which it mixes. This mixture gives a very much hotter flame. When the **air hole is fully open**, the roaring flame obtained is the hottest and its hottest part is just above the tip of the blue cone (Fig. 4).

1.3. Instructions for Laboratory Work

Some general instructions for conducting the work in laboratory are as follows :

1. A student must have a practical notebook, pencil, eraser, scale, rough notebook, a laboratory coat, a platinum wire and fractional weights.
2. Pay attention to teacher's instructions, note down important points and precautions regarding the experiment in the rough notebook.
3. Use thoroughly clean apparatus and wash it after the experiment.
4. Wear safety glasses when they are required.
5. Laboratory coat must be worn all the time during the practical.
6. Read the label of the reagent bottle carefully before using it.
7. Stopper the reagent bottle and keep it back on the shelf immediately after using the reagent.
8. Be economical with the reagents.
9. Wash your hands after finishing the experiments.

1.4. Some Don'ts in the Laboratory

The laboratory work involves certain hazards. To avoid the risk of any accident, following points must be kept in mind.

1. Do not touch chemicals and reagents with hand as they may be corrosive.
2. Do not taste a chemical, it may be poisonous.
3. Do not bring inflammable liquids such as ether, alcohol near the naked flames.
4. Do not keep the reagent bottles open.
5. Do not return unused chemicals back into the reagent bottles.
6. Do not heat beakers or flasks directly on the flame. Always use a wire gauze.
7. Do not throw solid waste materials like filter papers or broken test tubes into the sink or on the floor. Dispose these in the dustbin
8. Do not use cracked glass apparatus such as beakers for heating purposes.
9. Do not waste gas or water in the laboratory. Close the taps immediately when not in use.

1.5. Recording the Laboratory Work

All work done in the laboratory is recorded carefully and systematically in the practical notebook. While entering your observations in the practical notebook, always remember the following points :

1. Do not tear off pages from the notebook.
2. Do not erase anything in the notebook. Cross the wrong entries with a single line and write the correct statement in its place.
3. Record all laboratory data directly into the notebook.
4. Be honest in your record. Never cook the readings.

1.6. Safety Precautions

Observe the following precautions while working in the laboratory.

1. Never work alone in the laboratory.
2. Avoid loose dress and tie back the long hair to keep away from the flame.
3. Do not throw a burning match stick into the waste box.
4. Do not heat the inflammable liquids directly on the flame.
5. Never heat the bottom of the test tube containing the solution to avoid splashing out. Heat it from a point at the highest level of the solution as shown in Fig. 5.
6. Use a test tube holder for heating a test tube.
7. Never smell the vapours or gas directly. Do it by keeping the test tube at least six inches away from your nose and fan the vapours towards the nose with your hand.
8. Never perform an unauthorised experiment.
9. Never dilute an acid by adding water to the concentrated acid because it is an exothermic reaction and the liquid may bump out. Always dilute acid by adding acid slowly to water with stirring.
10. Never mix the chemicals that are not mentioned in the experiment this may lead to serious accidents in the laboratory.
11. Use fume cupboards for carrying out experiments involving poisonous or irritating vapours.
12. Keep the laboratory well ventilated by keeping the doors and windows open and by switching on the exhaust fans.

1.7. First Aid in Laboratory

An accident may occur in the laboratory due to carelessness or by chance. Common possible accidents and their First aid treatment are summarised herewith.

S.No.	*Types of Accident*	*First Aid Treatment*
1.	**Cuts**	
	(*i*) Minor cuts	Remove the glass piece if any, apply a little methylated spirit and cover with a piece of cotton.
	(*ii*) Serious cuts	Apply pressure on the cut for about ten minutes to stop bleeding. Consult a doctor.
2.	**Eye Injuries**	
	(*i*) Acid in the eye	Wash thoroughly with water and then with 1% Na_2CO_3 solution.
	(*ii*) Alkali in the eye	Wash with water followed by 1% boric acid solution.
	(*iii*) Foreign particle in the eye	Do not rub the eye. Remove the particle carefully with a soft handkerchief. Wash with water.
3.	**Burns**	
	(*i*) Burns caused by dry heat (flame or hot object)	Apply Burnol or Sarson oil.
	(*ii*) Burns caused by acid	Wash with 10% $NaHCO_3$ solution followed by water. Apply Burnol.
	(*iii*) Burns caused by alkali	Wash with 1% acetic acid solution and then with water. Dry the wound and apply Burnol.
4.	**Poisons**	
	(*i*) Poison in the mouth and not swallowed	Spit out and wash thoroughly with water.
	(*ii*) Acid swallowed	Drink lots of lime water.
	(*iii*) Alkali swallowed	Drink lemon or orange juice and then excess of water.
	(*iv*) Salt of heavy metal swallowed.	Take milk or white of an egg.
	(*v*) Arsenic or mercury salt	Take one table spoon of common salt or zinc sulphate in a glass of water.
	(*vi*) Inhalation of poisonous gas like Cl_2, Br_2 or SO_2 gas	Move the affected person to open air. Inhale vapours of dilute ammonia and gargle with dilute solution of sodium bicarbonate ($NaHCO_3$)
5.	**Fires**	
	(*i*) Clothes on fire	Wrap with blanket and lie on the ground and roll. Do not run.
	(*ii*) Electrical fire	Switch off immediately and throw sand over the object. Do not throw water.
	(*iii*) Inflammable material in the flask, beaker catches fire.	Cover the container with a wet cloth.

VIVA-VOCE

Q. 1. Is it right to taste a chemical in the laboratory ?
Ans. No, because they may be poisonous.
Q. 2. Why is a beaker so called ?
Ans. Its one end is like the transpose beak of a bird.
Q. 3. What is a flame ?
Ans. It is a region of burning gases radiating heat and light.
Q. 4. What is the function of air regulator in a bunsen burner ?
Ans. It is used to control the quantity of air mixing with gas.
Q. 5. What happens when air holes are gradually opened ?
Ans. The flame becomes non-luminous.
Q. 6. What do you understand by striking back of a bunsen burner ?
Ans. When there is more air and less of gas, the flame travels down and starts burning near the base at the nozzles of the burner.
Q. 7. What action will you take if the burner strikes back ?
Ans. Put off the burner, cool it under the tap water and light it again, keeping the air holes partially open.
Q. 8. What type of flame is required for general heating ?
Ans. A non-luminous flame.
Q. 9. How will you reduce the height of the flame of a bunsen burner ?
Ans. By reducing the supply of the gas.
Q. 10. Which gas is used for burners in the laboratory ?
Ans. Liquefied Petroleum Gas.
Q. 11. Which chemical is used for cleaning the dirty apparatus in the laboratory ?
Ans. Chromic acid which is a mixture of potassium dichromate and conc. H_2SO_4.
Q. 12. What is the use of a wash bottle ?
Ans. It is a convenient arrangement for taking the required quantity of water in the form of a spray.
Q. 13. What type of first aid is given if the acid falls in the eye ?
Ans. Wash with water and then with excess of sodium bicarbonate solution.
Q. 14. What first aid is given if a salt of a heavy metal is swallowed ?
Ans. Give milk or white of an egg.
Q. 15. What treatment is given in case of burn by Bromine ?
Ans. Wash with 2% NH_4OH solution and apply glycerine.

NCERT Discussion Questions

Q. 1. How is an analytical balance different from a physical balance ?
Ans. The accuracy of analytical balance is more than that of a physical balance. It can weigh a substance upto 4 places of decimal.
Q. 2. On what principle, is weighing by using rider based ?
Ans. Principle of moment is applied for weighing by using rider *i.e.* weight is equal to the arm length from the centre of beam multiplied by the weight of the rider.
Q. 3. Which weights are called fractional weights ?
Ans. The weights for weighing 10 mg to 500 mg are called fractional weights.
Q. 4. Why are foreceps always used for handling the weights ?
Ans. Because handling the weights with hands might make the weights dirty and cause an error.
Q. 5. The rider rests at a reading of 3.4 on the left side of the beam. What contribution does this make to the weight of the material being weighed when weights are placed on the right pan ?
Ans. The weight indicated by rider : Each big division = 0.001 g, and each small division = 0.0002 g.
$\therefore$ At 3.4 mark it will weigh = $0.001 \times 3 + 0.0002 \times 4 = 0.0038$ g.
This weight is subtracted from the weights in the right pan.
Q. 6. Can you weigh 0.0023 g using chemical balance ? Give reason for your answer.
Ans. Because weight upto fourth decimal place can be calculated only by using rider and each small division corresponds to 0.0002 g weight so the last digit cannot be an odd number.

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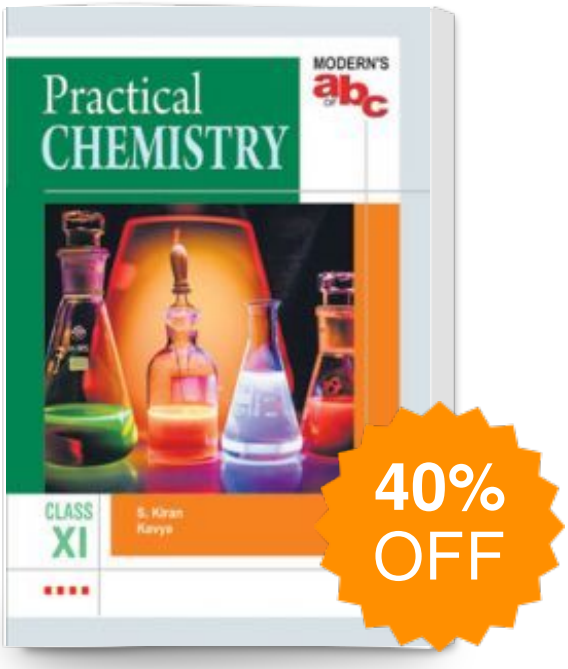

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