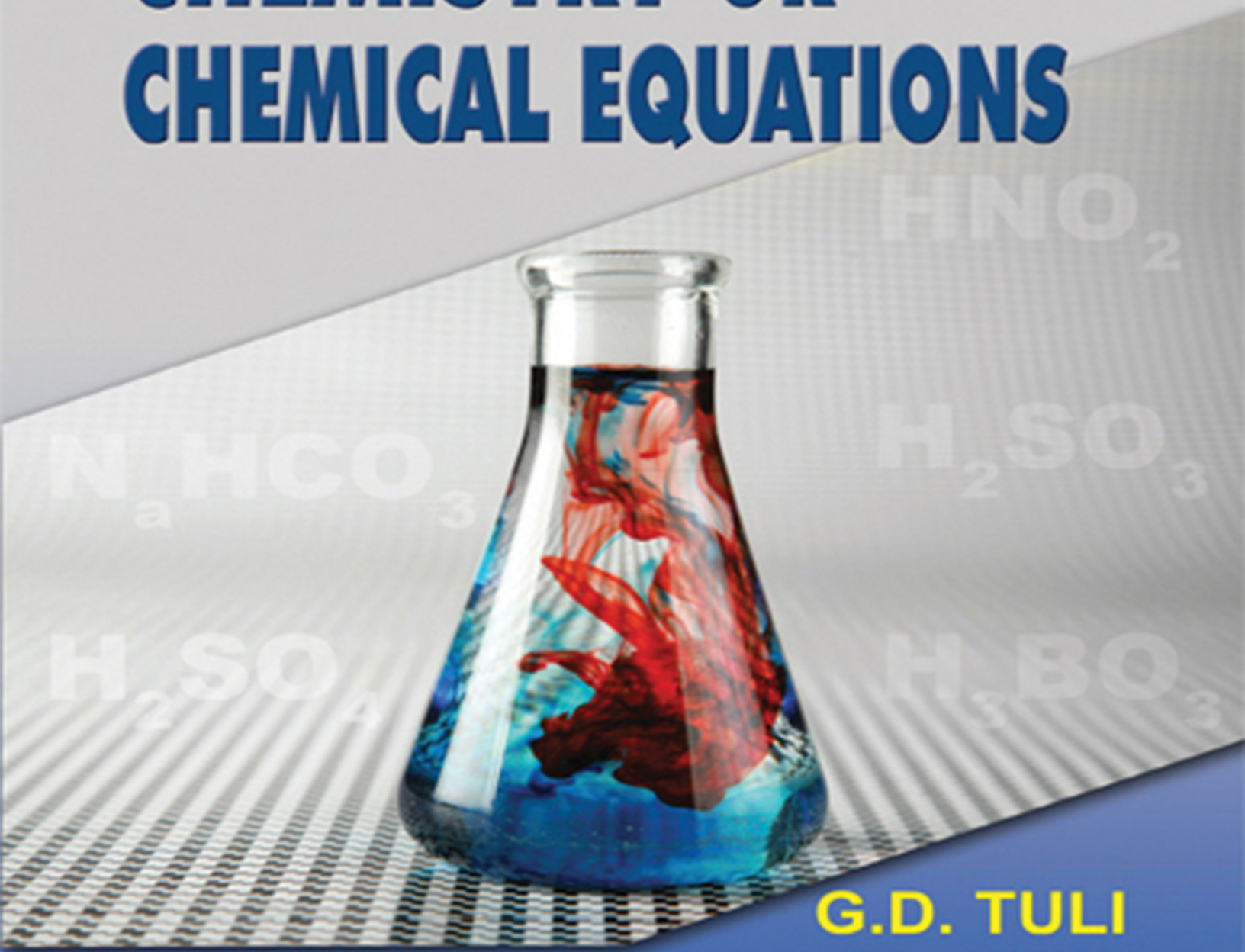
THE LANGUAGE OF CHEMISTRY OR CHEMICAL EQUATIONS



G.D. TULI
P.L. SONI

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FIRST MULTICOLOUR EDITION

The Language of Chemistry OR Chemical Equations

and how to master them

Including Balancing of Equations

- *By Ion-Electron Method*
- *By Oxidation Number Method*

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PREFACE TO THE TWENTY-FIRST EDITION

(First Multicolour Edition)

It gives us immense pleasure to bring out the twenty-first edition of the book in multicolour with attractive illustrations. Special attention has been paid to the following points :

- Errors of the previous editions pointed out by readers from time to time have been removed.
- Point size of the text has been increased so as to make its reading easier.
- The style of the book has been modified to suit the requirements of students.
- Now the book is in new attractive format.

We hope the readers of the book will find the book all the more useful. Suggestions for further improvement will be most welcome.

Our thanks are due to the Editorial Staff of S.Chand & Company, especially to Mr. Riyaz Baqar, for his help in conversion of the book into multicolour edition and Mr. Pradeep Kr. Joshi for Designing & Layouting of this book.

Authors

Preface to the Nineteenth Edition

A common idea prevails that when **"Language of Chemistry"** constitutes a part of Inorganic Chemistry textbooks, what is the justification of bringing out a seperate booklet? To those teachers and students of chemistry, who share this view we have to offer a word of apology.

No textbook provides a sufficient number of equations to the students for practice. Moreover, the equations given are always written in the language of chemistry. The student simply reads these equations from the textbook and copies them. He never gets any practice in writing equations, with the result that he cannot balance them in any test. He loses interest in the subject and regards it as something beyond his reach.

In this small booklet a large number of equations are written in words and the students is required to translate them into the language of chemistry. He has to write correct formulae and then balance the equations independently. For verification of the result, he can look up the answers given at the end. Just in a week or two he learns the method of writing correct balanced equations. He feels interested in the subject and finds it quite his own.

For writing and naming of formulae the chemists prefer the Stock system of nomenclature. So modern names are introduced along with the classifical and trivial (common) names. Thus ferrous chloride is also written as iron (II) chloride, and so on.

Modern chemists prefer balancing chemical equations by Ion-electron method and oxidation number method. These two methods have been added in the present edition as two separate chapters (Chapters V and VI). We hope these will inspire the students to learn these modern methods.

The booklet will be equally useful for the students in schools as well as B.Sc. Students of different universitities.

One of the Special Features of the present edition is the inclusion of **'Test your Understanding'** at the end of each chapter. These exercises will help the student to revise the chapter as well as test his/her understanding.

The last two chapters (Chapters VII and VIII) entitled 'Test yourself on these Typical Questions' have been added for the benefit of examinees. It will enable them to test their knowledge before the examination.

We are grateful to all those who sent their suggestions for improvement of the booklet. Any suggestion for its improvement will be thankfully received.

Authors

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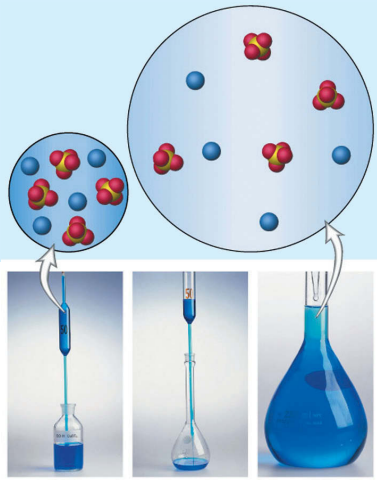
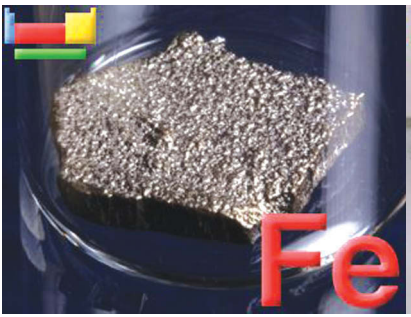


CHAPTER 1

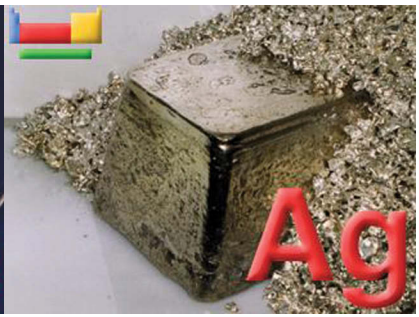
Introduction

1. Chemistry and its Language. Every science has its own technical terms and usually it requires considerable effort on the part of a beginner to master them. Chemistry is no exception. It is full not only of technical terms but also of certain expressions like H_2O, H_2SO_4 etc., which in the language of chemistry stand for the names of certain definite chemical substances. Before we take up the study of this language, it is absolutely essential to understand some of the important technical terms which we shall come across.

2. Element. The various substances around us are of two kinds. One kind is very simple and cannot be broken up into anything simpler by any chemical method at our disposal. Substances of this kind, *e.g.*, hydrogen,



Iron (Fe) is a natural element.

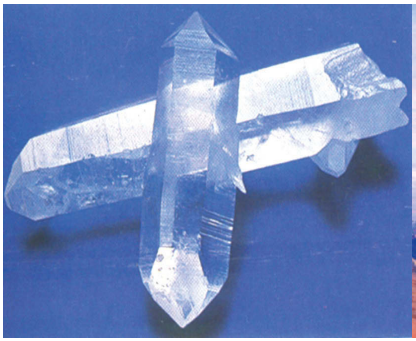


Pure silver has a brilliant white metallic lustre. It is a bit harder than gold and is very ductile and malleable.

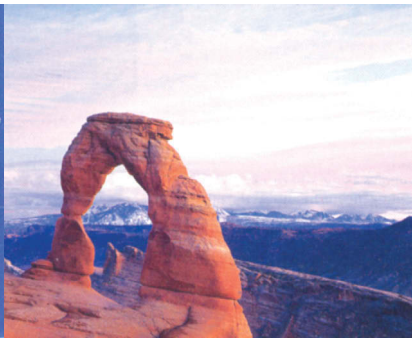
oxygen, iron, silver, etc., consist of one and the same type of matter and are called elements.

Simple forms of matter which cannot be decomposed into simpler substances are called **elements.**

3. Compound. A compound is a substance of the other kind. When two or more elements combine chemically, *i.e.*, in such a way that the properties of the resulting substance are entirely different from those of the combining elements, *a chemical compound* is obtained. It can be decomposed into simple substances by suitable chemical methods at our disposal. Water and carbon dioxide are examples of compounds.



(a) Crystalline quartz is a pure compound (SiO_2).

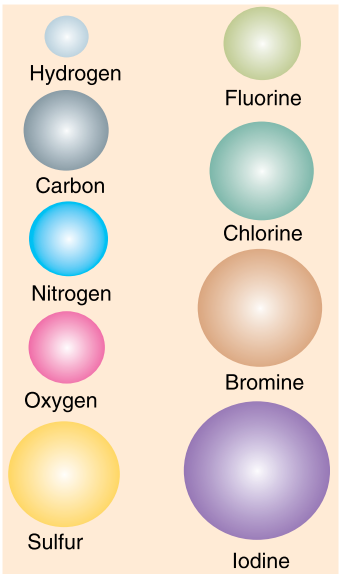


(b) The red sandstone in Delicate Arch is a solid mixture of many compounds.

A compound is a substance produced by union of two or more elements in a definite proportion. It can be decomposed into two or more simple substances.

4. Atom. *The smallest particle of an element which can take part in chemical change is called an* **atom**. It may or may not be capable of independent existence.

5. Atomic Weight. Atoms are so small particles that their weights are inconveniently small in terms of grams, *i.e.*, gram is too big a unit to weigh an atom or a molecule. For example, the weight of a carbon atom is 0.000,000,000,000,000,000,000, 0195 g (1.95×10^{-23} g). To overcome this difficulty, one-twelfth of the weight of a carbon atom (^{12}C isotope) is selected as a unit of weight for the purpose and is termed 1 atomic mass unit (1 amu).



Some common atoms. The easiest way to identify, atoms in pictures of models is by colour.

Atoms of the same element may have different masses. These are called isotopes. For example, chlorine has two isotopes of weights 35 amu and 37 amu. These are mixed in such a proportion that their average weight is 35.5 amu. Such an average is called atomic weight of the element.

Atomic weight *is defined as the average mass of the atoms of an element expressed in atomic mass units, carbon-12 being taken as the standard with an atomic mass of 12 amu*. By saying that atomic weight of magnesium is 24, we only mean that an atom of magnesium is twice as heavy as an atom of carbon.

6. Molecule. *The smallest particle of matter which is capable of independent existence is called a* **molecule.**

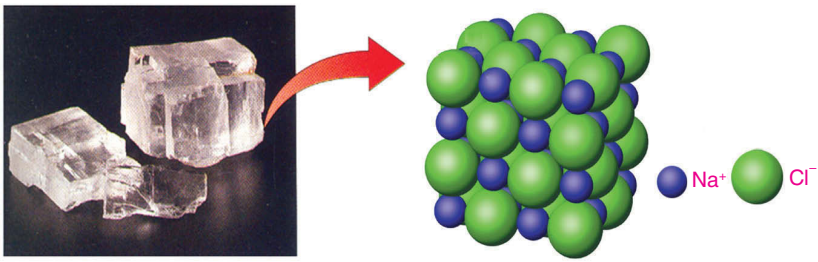
It is the smallest particle of a substance which possesses the properties of that substance. It cannot be subdivided without destroying its characteristic properties.

The molecule of an element is made up of one or more atoms of only one and the same type, while the molecule of a compound is made up of dissimilar atoms.

7. Molecular Weight. *The molecular weight of an element or a compound is defined as the relative weight of its molecule as compared with that of carbon atom* (^{12}C *isotope*) *taken as 12 amu.*

It is only a number and gives only a relative weight of the molecule. It does not give us the actual weight of the molecule at all. Molecular weight of magnesium carbonate is equal to 84 times that a molecule of magnesium carbonate is 7 times heavy as an atom of carbon or 84 times as heavy as one-twelfth of an atom of carbon.

8. Radical. The molecule of a compound is usually made up of two parts which are separately known as **radicals**. For example, the radicals present in *sodium chloride* molecule are *sodium* and *chloride* while those in potassium *nitrate are potassium and nitrate*.

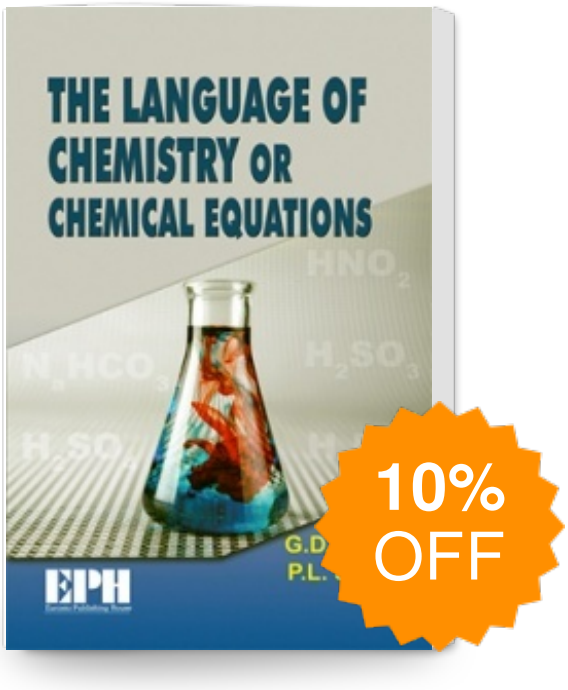


The arrangement of Na^+ ions and Cl^- ions in a crystal of sodium chloride.

Radicals are groups of atoms that react as single atoms and keep their identity in many reactions.

A radical is called a **simple radical** when it in as atom only, *e.g.,* sodium, potassium etc. It is known as a **compound radical** when it is made up of a

The Language of Chemistry or Chemical Equations



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