Romain Elsair

Fundamentals of Chemistry

bookboon.com
The eBook company

Romain Elsair

Fundamentals of Chemistry

Fundamentals of Chemistry

ISBN 978-87-403-0105-2

Contents

Fundamentals of Chemistry

Aim of this Book

This book addresses first year students and aims at:

- Developing further knowledge and understanding of some core scientific concepts and principles
- Improving ability to understand and express scientific knowledge,
- Preparing for further study of specialist modules in physics, engineering, chemistry or biology, and
- Preparing for future undergraduate studies in Science or Engineering.

Scope of this Book

This book is mainly about Physical Chemistry and explains the basic concepts of gases, liquids and solids, the relation of properties to structure, the chemical changes, the trends and patterns in the Periodic Table.

Strong emphasis will be placed on chemical energy changes to finally provide an introduction to solutions and pH.

The fundamental properties of matter underlie all of Science and Engineering subjects, and will be needed, even if the student is not going to study more Chemistry.

General principles, methods of calculation and scientific thinking skills will be useful to all Science & Engineering subjects.

1 Substances and Reactions

1.1 Classifying Substances

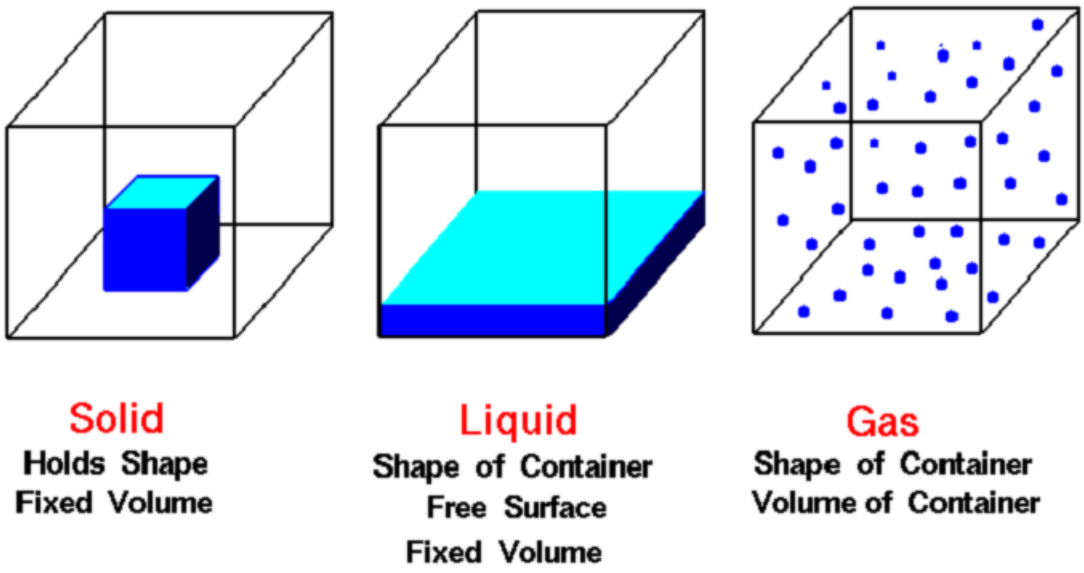
A substance is a pure form of matter. Substances can be classified or put into groups with similar substances.

Chemists have elaborated common ways of classifying:

- Solids, liquids and gases,
- Elements, mixtures, compounds, and
- Metals, non-metals, semi-metals.

1.2 Solids, Liquids and Gases

Solids have shape and volume. Liquids have volume but adopt the shape of their container. Gases occupy the shape and volume of their container.



1.2.1 Solids, Liquids and Gases. Changes of State

The three states of matter, solid, liquid and gas exist because each one has a different balance of kinetic and potential energy. If energy is added or removed from the substance, it changes its state.

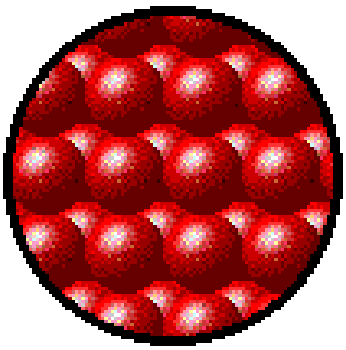
1.2.2 Kinetic Theory of matter

All matter is composed of particles (atoms, molecules, ions). The particles attract each other via interatomic forces. All the particles have kinetic energy (K.E.) which varies with temperature. The state of matter depends on balance between:

- K.E. of particles (tending to separate), and
- Attraction between particles (tending to pull together).

1.2.3 Solids

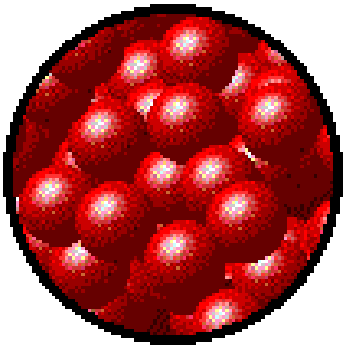
In a solid the atoms are close together, held in position by the strong interatomic electrostatic forces. They have some K.E., which makes them vibrate about an equilibrium position, but they cannot change places. This means that solids have a fixed shape and a fixed volume i.e. they are rigid.



Microscopic view of a Solid

1.2.4 Liquids

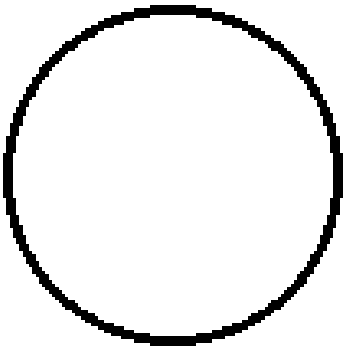
In a liquid the atoms are not much farther apart than in a solid. There are still quite strong interatomic bonds between the atoms. The atoms have more kinetic energy and are able to move randomly, changing places with their neighbours. There is less order than in a solid. Thus a liquid has no fixed shape but does occupy a fixed volume.



Microscopic view of a Liquid

1.2.5 Gases

In a gas the atoms move randomly at high speeds. They are much further apart than in solids or liquids. There are no interatomic forces between the atoms. Interaction only occurs when the atoms (or molecules) collide. The internal energy of a gas is entirely kinetic.



Microscopic view of a Gas

1.3 Changing state

When a substance changes state, it does not change into a new substance. Ice is still water – it is water in the solid state. Steam is still water – it is water in the gaseous state. The heat has not broken down the water into hydrogen and oxygen gases. Any substance can exist in any state, if it is cooled or heated enough.

E.g. If nitrogen gas is cooled to -195.79°C, it will change to a liquid. If this is cooled further to -210°C, the liquid nitrogen will solidify

E.g. Iron will melt to a liquid above 1538°C. This liquid iron will change to a gas above 2862°C.

The temperature at which a solid changes to a liquid is called the melting point. The temperature at which a liquid changes to a gas is called the boiling point.

1.4 Element

An element is a pure substance. It cannot be decomposed into simpler substances by chemical means. It contains only one type of atom. Over 100 known elements are listed in the Periodic Table. Sometimes found free but more often occur combined with other elements as compounds. Elements can be classified as metals, non-metals & semi- metals (metalloids). Recommended browsing at http://www.webelements.com

1.5 Metals & Non-metals

Metals

Metals have a shiny appearance, are good conductors of electricity and heat. They can be drawn into wires (ductile) and can be hammered into different shapes (malleable).

Non-metals

Non-metals have a dull appearance. They are poor conductors of electricity and heat. They cannot be drawn into wires or hammered into different shapes (brittle).