Genius Nepal

A First Course on Matter
&
Atomic Structure

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A First Course on Matter

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About the Book

This chapter has been extracted from book by geniusnepal. This book is targeted for the students of class 8, 9, 10 for helping them in understanding matter. We believe this book to be different than those you have encountered so far. Different in a sense that, it does not include exercises and does not follow any specific language; although most of the text is written in English, to make you understand we have also included *Devanagari* script at some instances. We are more focused to make students understand the concepts and ideas, so priorities have been given in writing *simple- spoken type* English which sometimes have even violated the rules of Grammar.

Making students understand is the greatest challenge that stands before every teacher and every writer. Our experiences till date that we have achieved while pursuing our goal, teach us that, it is next to impossible to visualize the concepts of force via text alone. So, interactive images and animation/videos are essential. We the members of geniusnepal are trying to provide you with those resources at our best. Geniusnepal is dedicated to help students achieve the best qualities, which the country at present needs the most. (Details at: *http*://geniusnepal.com).

This book doesnot substitute the *mainstream syllabus based* books used by different schools. But can be used as a good reference book. It is recommended that every student has a copy of this book as we believe it to be good in helping you grab the ideas. In this book, we have reflected what we have learnt in our course of educational voyage. This book is not an extract or copies of any other books though we may have acquired knowledge from them. So, it is solely an intellectual property of the writers.

Despite repeated proof-reading and rechecking, there may still exist mistakes in the book as it is the 1st edition and first of this kind ever written by the writers. Help us rectify it and bring out better volumes in the coming future. Help us grow.

Authors

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1.1 Matter and Atomic Structure

- Observe the world. You see different things as like books, pen, house, people and many more around you. They have different properties. Some of them are strong solid; some are liquid and so on. Have you ever thought what makes them so different?

- Whatever you see around you are matter. The book that you read, the pen that you write with, the house where you live in, the food that you eat, the mountain that you see or the water that you drink in are all matter.

- Those things that you touch are matter. Matters are anything that occupy space and has weight. Matters are physical quantities and hence they can be measured.

- Your thinking, understanding, feeling and so forth are not matter since you can't touch them. (i.e. they are intangible). Furthermore, they can't be measured.

- Why do so many different types of matter exist in the world and what makes them so different?

- Well, people all around the world have been thinking about it since a long time and are still trying to understand everything about it.

- After a long research, people have found out that matters are made up of extremely minute particles known as molecule. A molecule is the smallest particle of a matter into which a given matter may be divided without changing its identity.

- These molecules are further made up of extremely minute particles called atom. These atoms are further made up of minute particles called electrons, protons, and neutrons. These electrons, protons, and neutrons are considered to be made up of by the combination of quarks. "Atom and atomic structure" is discussed later on this chapter.

- As already stated, a molecule is made up of atoms. There are only 118 unique atoms known to us till now. Then why are there so many different types of substances around us?

- Let's take an example from nature;
- When you mix **red** color with **blue**, the resultant color is **purple**.
- When you mix **red** color with **yellow**, the resultant color is **orange**.
- When you mix **red** color with **blue** and **yellow**, the resultant color is **brown**.

  i.e.

- When you mix different colors you produce a unique color which is completely different from its source. Different varieties of colors can be produced by differing the proportion of the colors in the mixture. Similarly, atoms combine in different proportion to produce wide variety of new products, i.e. molecules. These molecules widely vary from each other in accordance with the variation of combining atoms. These molecules have completely different properties than that of the combining atoms. Thus variety of molecules with different properties is formed by the combination of same or in different atoms in various proportions.

E.g.:

- When 2 atoms of H and 1 atom of O combine together, H_2O molecule (water molecule) is formed.
- When 2 atom of H and 2 atom of O combine together, H_2O_2 molecule (hydrogen peroxide) is formed.

  In the above examples, in both cases H atom and O atom are combined in different proportion and the product is different (i.e. different molecule).

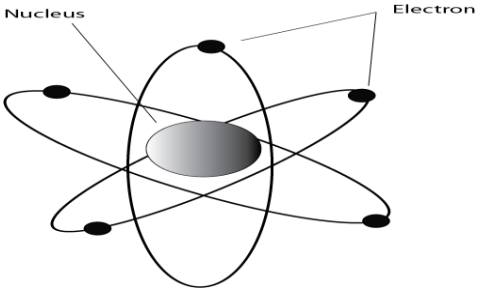
  Hence, different molecules are produced by the combination of same or different atoms in various proportions and hence different substances that you can see are formed.

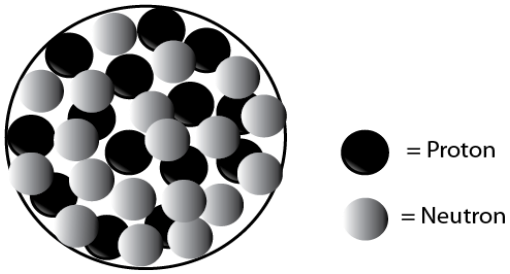
➢ Atoms are further made up of by minute sub-atomic particles called electrons, protons, neutrons. By the series of experiment, these sub atomic particles are found to be identical for all the atoms. i.e. the electron of H is identical to the electron of 'C'.

➢ If so, then why do different atoms exist with different properties?

- To understand this, you need to have knowledge about four fundamental forces (explained in chapter one). These four fundamental forces govern every phenomenon in the nature. Be it the revolution of earth around the sun or the formation of rainbow, these things are governed by these four forces.
- The existence of different atom is due to the various combinations of these sub-atomic particles. As like when 1 electron and 1 proton combine, H atom is formed. When 2 electrons, 2 protons, 2 neutrons combine He atom is formed.
- The difference in properties of these atoms is due to the variation of the four fundamental forces. As the no. of sub-atomic particles differ for different atoms, the four fundamental forces differ with a difference in no. of sub-atomic particle resulting in the difference in properties of different atoms.

1.2 Atomic Structures





➢ Atom of all elements is composed of two parts. The centre is nucleus and the surrounding electrons.

- The nucleus of an atom is composed of two types of sub-atomic particle namely proton and neutron.

- Each electrons have a negative charge of 1.6×10^{-19} coulomb and each proton have a positive charge of 1.6×10^{-19} coulomb. Neutron is chargeless particle. Thus a nucleus as a whole is positively charged. (This charge in the sub-atomic particle is due to the combination of quark).

- For an atom, the no. of proton in the nucleus is exactly equal to the no. of orbiting electrons. Thus an atom is electrically neutral.

- Any substance that contains unequal number of electrons and protons are said to be electrically charged. If a body loses an electron, it loses negative charge and hence it becomes positively charged body and vice versa.

Experimentally found data:

	Mass	Charge
Electron	$m_e = 9.1 \times 10^{-31}$ Kg	1.6×10^{-19} C (negative)
Proton	$m_p = 1.672 \times 10^{-27}$ Kg	1.6×10^{-19} C (positive)
Neutron	$m_n = 1.674 \times 10^{-27}$ Kg	

Note:

1. The electrical charge of electron and proton is equal in magnitude but opposite in nature.
2. Mass of proton and neutron are nearly equal and roughly 2000 times the mass of the electron.
3. Over 99.9% of the mass of atom is concentrated in its nucleus.

- We all know that opposite charge attracts each other. So, a force of attraction exists between positively charged nucleus and negatively charged electrons. This force of attraction is responsible for the revolution of electrons around the nucleus. [Similar to Earth revolving around the Sun].

- The protons and neutrons are held within the stable atomic nucleus by an attractive interaction, called the strong nuclear force [chapter 1] that overcomes the electric repulsion of the proton. This strong nuclear force has a short range, and its effect. Do not extend beyond the nucleus.