CHAPTER 4

METHODOLOGY

4.1 METHOD ADOPTED

4.1.1 TOOLS & TECHNIQUES EMPLOYED FOR THE STUDY

4.1.2 SAMPLE SELECTED FOR THE STUDY

4.1.3 EXPERIMENTAL DESIGN & PROCEDURE

4.1.4 STATISTICAL TECHNIQUES APPLIED
METHODOLOGY

The details regarding the tools and techniques employed, method or procedure adopted for collecting data and the statistical techniques employed for the analysis of data are given below:

4.1 METHOD ADOPTED

The Investigator adopted Experimental cum Survey Method for the present investigation.

The details regarding the method/procedure adopted for collecting the data are given below under appropriate heads.

4.1.1 TOOLS AND TECHNIQUES EMPLOYED FOR THE STUDY

The following tools were employed for collecting necessary data.

(1) A Two-tier Diagnostic test in Chemistry for Educationally Backward Students studying in standard IX

(2) Remedial Teaching Materials in Chemistry for Educationally Backward Students on the following topics:

(i) Periodic Table
Methodology

(ii) Atomic Structure

(iii) Oxidation & Reduction

(3) Achievement test in Chemistry for students studying in Standard IX (used as pre and post tests)

(4) Rating Scale for experts and Secondary School Chemistry Teachers

(5) Questionnaire for Experts and Secondary School Chemistry teachers

(6) General Data Sheet.

All the above mentioned tools were prepared by the Investigator for the present study. The details regarding the tools used for the present study are given below:

1. TWO-TIER DIAGNOSTIC TEST IN CHEMISTRY (for Educationally Backward Students in Chemistry studying in Standard IX)

To construct a Diagnostic test, the Chemistry text books prescribed for Standards VIII, IX and X were thoroughly analysed and 63 learning points under different topics were listed. The list of learning points was given to experienced teachers and experts in Chemistry to get their opinion. According to their suggestions
some of the learning points were deleted, some were added and some were modified. Thus 50 learning points from seven different topics (Acids and Bases, Atomic Structure, Chemical Bonding, Language of Chemistry, Oxidation & Reduction, Periodic Table, and Physical and Chemical Changes) were selected for the preparation of Diagnostic Test. (Table 5.1).

On the basis of the teaching points (n = 50), Investigator prepared a Diagnostic Test having 50 multiple choice items, to collect details regarding the errors committed by the Educationally Backward students in Chemistry studying in Standard IX. The items for the Diagnostic Test were based on the Two-tier multiple choice format described by Tamir¹ (1971), Tobin and Capie² (1981) and Trigust³ (1986-1987). Each item has two tiers. The first tier of each item consists of a content question having 4 choices. The student has to choose the most suitable answer from the given 4 choices and make a tick mark in the answer sheet. The second tier of each item contains 4 possible reasons for the answer given in the first tier of the item. The student has to choose the most suitable reason for their answers for the first tier and make a tick mark in the answer sheet provided. The answer to an item was considered correct if the student selected
both the correct content choice and the correct reason. Each correct answer was given a score of one. (Appendix -1)

The Investigator administered the Diagnostic Test in Chemistry to a sample of 620 Educationally Backward students studying in Standard IX. Out of 620, the scores of 370 students were taken for item analysis. Difficulty indices for the items ranged from 0.09 to 0.7 showing a wide range of difficulty in the items. Discriminating powers ranged from 0.32 to 0.65 and all of them were considered acceptable according to Lien⁴ (1971). According to Gilbert⁵ (1977), work using multiple choice items with four or five choices, student understanding of the conceptual area was considered satisfactory if more than 75% of the students correctly answered the item. The items for which more than 75% of the students answered incorrectly were chosen as difficult items and the corresponding learning points were used for the preparation of the Remedial Teaching Materials in Chemistry.

The details regarding the learning points (included in the Remedial Teaching Materials in Chemistry) are given below:
## LEARNING POINTS

### I Periodic Table

1. History of classification of elements
2. Mendeleev's Periodic Table
3. Mendeleev's Periodic Law
4. Merits and Demerits of Mendeleev's Periodic Table
5. Periodic Table-hemists Map
6. The Periodic Law
7. The Periodic Table as we have Today
8. Groups-vertical Columns
9. Periods-Horizontal Rows
10. Alkali Metals
11. Halogens
12. Transitions Elements
13. Group number and Valence Electrons
14. Period number and Number of Shells
15. Atomic size down a Group
16. Atomic size across a period

### II Atomic Structure

1. Atom-Concept
2. Parts of an atom
3. Nucleus the central part
4. Electric charges of Electrons, Protons and Neutrons
5. Contributions towards the discovery of atomic particles
6. Shell or Orbit
7. Characteristics of Electron cloud
8. Relative Mass of Fundamental particles
9. Atomic Number
10. Mass Number
11. Representation of an atom

### III Oxidation And Reduction

1. Early concept of Oxidation
2. Early Concept of Reduction
3. Oxidation based on Oxidation Number
4. Reduction based on Oxidation Number
5. Electronic concept of Oxidation
6. Electronic concept of Reduction
7. Redox reaction
8. Oxidising agent
9. Reducing agent
II. REMEDIAL TEACHING MATERIALS IN CHEMISTRY

The Investigator prepared Remedial Teaching Materials for the following topics in Chemistry for Educationally Backward students studying in Standard IX

(i) *Periodic Table*

(ii) *Atomic Structure*

(iii) *Oxidation & Reduction*

For the preparation of Remedial Teaching Materials, the Investigator made a detailed analysis of the content and literature related to the selected areas and identified learning points (*LP*) - *Periodic Table* (*LP=16*), *Atomic Structure* (*LP=11*) and *Oxidation & Reduction* (*LP=9*).

Each Learning point is explained with suitable learning situations, Charts, Pictures, Models, Experiments, Discussion, Projects, Concrete situations, Problems and Outdoor activities. Provision for developing scientific skills and social skills were given due importance while preparing the Remedial Teaching Materials.
The Remedial Teaching Materials (prepared by the Investigator) on the topics Periodic Table and Atomic Structure are given below:

[Note: The Investigator prepared 3 Remedial Teaching Materials on the topics, Periodic Table, Atomic Structure and Oxidation & Reduction. But Remedial Teaching Materials on two topics viz., Periodic Table and Atomic Structure, are given below. (pp 108-334)]
SCHOOL OF PEDAGOGICAL SCIENCES
MAHATMA GANDHI UNIVERSITY
KOTTAYAM

REMEDIAL TEACHING MATERIALS
ON
PERIODIC TABLE
(STANDARD IX)

Prepared by : RAJESWARI. K

Supervised by : Dr. EXEMMAL. J
(Supervising Teacher)
Reader
Department of Education
University of Kerala

2004
REMEDIAL TEACHING MATERIALS

Remedial Teaching Materials on the topic PERIODIC TABLE is subdivided into 16 Units. Details are given in pages 108-254. In each Unit, students are provided chances for observation, classification, identification, discussion, analysis and concept formation.

Suitable charts, models, examples, illustrations, life situations are also used for developing new concepts/teaching points. Practice session is given at the end of each unit to test the level of attainment of the students. Extended Activities and Reference Section are given. An Achievement Test on Periodic Table is given at the end of the material.
<table>
<thead>
<tr>
<th>UNIT 1</th>
<th>HISTORY OF CLASSIFICATION OF ELEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT 2</td>
<td>MENDELEEV'S PERIODIC TABLE</td>
</tr>
<tr>
<td>UNIT 3</td>
<td>MENDELEEV'S PERIODIC LAW</td>
</tr>
<tr>
<td>UNIT 4</td>
<td>MERITS AND DEMERITS OF MENDELEEV’S PERIODIC TABLE</td>
</tr>
<tr>
<td>UNIT 5</td>
<td>MODERN PERIODIC TABLE</td>
</tr>
<tr>
<td>UNIT 6</td>
<td>THE MODERN PERIODIC LAW</td>
</tr>
<tr>
<td>UNIT 7</td>
<td>PERIODIC TABLE - CHEMIST’S MAP</td>
</tr>
<tr>
<td>UNIT 8</td>
<td>GROUPS - VERTICAL COLUMNS</td>
</tr>
<tr>
<td>UNIT 9</td>
<td>PERIODS - HORIZONTAL ROWS</td>
</tr>
<tr>
<td>UNIT 10</td>
<td>THE ALKALI METALS</td>
</tr>
<tr>
<td>UNIT 11</td>
<td>HALOGENS</td>
</tr>
<tr>
<td>UNIT 12</td>
<td>TRANSITION ELEMENTS</td>
</tr>
<tr>
<td>UNIT 13</td>
<td>GROUP NUMBER AND VALENCE ELECTRONS</td>
</tr>
<tr>
<td>UNIT 14</td>
<td>PERIOD NUMBER AND NUMBER OF SHELLS</td>
</tr>
<tr>
<td>UNIT 15</td>
<td>ATOMIC SIZE DOWN A GROUP</td>
</tr>
<tr>
<td>UNIT 16</td>
<td>ATOMIC SIZE ACROSS A PERIOD</td>
</tr>
</tbody>
</table>
The Periodic Table is a product of the contributions of chemists from many countries. It has taken centuries of work to arrive at this arrangement of elements. Dmitri Mendeleev (1834-1907) was a Russian chemist who drew up the first Periodic table. He did this by charting the known chemical elements in order of increasing atomic weight, although we know that it is the order of atomic number that is significant.

The Modern Periodic Table is an encyclopedia of all the known elements. It also provides space to accommodate elements yet to be discovered. The periodic table is useful because there is regularity in the chemical properties of the elements.
The arrangement of elements in the periodic table is useful as it is possible to predict the properties of an individual element from its position. The Modern Periodic table is a table of all the chemical elements, in order of their atomic numbers so that elements with similar properties are close to each other. *The Modern Periodic Table was designed by Henry Moseley.*
## LEARNING POINTS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Learning Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Antoine Lavoisier, Dobereiner, Newland and Dmitri Ivanovich Mendeleev and Henry Moseley made several attempts to classify elements.</td>
</tr>
<tr>
<td>2</td>
<td>Mendeleev arranged elements in the periodic table in the increasing order of atomic masses.</td>
</tr>
<tr>
<td>3</td>
<td>Mendeleev's periodic law states that physical and chemical properties of elements are periodic functions of their atomic weight.</td>
</tr>
</tbody>
</table>
| 4     | i. Mendeleev exhaustively classified the elements for the first time in the history.  
ii. Mendeleev's periodic table does not precisely follow the order of atomic mass and some dissimilar elements were arranged in the same group. |
| 5     | The Modern periodic law states that the properties of elements are periodic functions of their atomic number. |
| 6     | i. The Modern Periodic Table was designed by Henry Moseley.  
ii. The elements are arranged in the increasing order of their atomic number.  
iii. There are 18 groups and 7 periods. |
| 7     | Periodic table may be defined as the arrangement of various elements according to their properties, in a tabular form. |
| 8 | i  The vertical columns in the Periodic Table are called groups  
   ii There are 18 groups in the Modern Periodic Table |
| 9 | i  The horizontal rows in the Periodic Table are called periods  
   ii There are 7 periods |
| 10 | i The Group 1 elements in the periodic table are called alkali metals  
   ii The Group 1 elements are Sodium, Potassium, Rubidium, Caesium and Francium |
| 11 | i The Group 17 elements in the periodic table are called halogens  
   ii The Group 17 elements are Fluorine, Chlorine, Bromine, Iodine and Astatine |
| 12 | The elements in groups 3-12 in the periodic table are called transition elements |
| 13 | Period Number represents the number of shells in an atom |
| 14 | i In Group 1 and 2, the number of valence electrons is equal to group number  
   ii From the group 13 to 18, number of valence electrons is equal to group number minus 10 |
| 15 | Atomic size increases from top to bottom in a group due to increase in number of shells |
| 16 | Atomic size decreases from left to right in a period due to increase in the nuclear charge without increasing the number of shells |
Students are encouraged to recall the following concepts:

- Elements are pure substances made of the same kind of atoms.
- Elements exist in solids, liquids and gaseous states.
- Compounds are pure substances made of different kind of atoms.
- In an atom there are equal number of protons and electrons.
- Atomic number is equal to the number of protons in an atom.
- Electrons in an atom are present outside the shell and are arranged in shells.
- In an atom the outermost shell is called the valence shell.
- The electrons present in the outermost shell are called valence electrons.
Look around you and name:

**Phase II**

Students are encouraged to write the answers for the following questions in the space provided.(recalls different elements present in the nature)

1. Two lighter elements
   (i) ______
   (ii) ______

2. Two elements in the gaseous states
   (i) ______
   (ii) ______

3. Two elements in the solid state
   (i) ______
   (ii) ______

4. Two elements in the liquid state
   (i) ______
   (ii) ______

5. Two elements present in the atmospheric air
   (i) ______
   (ii) ______

6. The elements in water
   (i) ______
   (ii) ______

7. The elements in Carbon dioxide
   (i) ______
   (ii) ______
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>(i)</th>
<th>(ii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(8)</td>
<td>Two metallic elements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9)</td>
<td>Two nonmetallic elements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>Two elements having isotopes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11)</td>
<td>Two elements used for making ornaments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td>Two elements commonly used for making household utensils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>Two elements used for making weapons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(14)</td>
<td>The most abundant element in the atmospheric air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(15)</td>
<td>The most abundant element in the earth’s crust</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16)</td>
<td>An element used as thermometric liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(17)</td>
<td>The elements present in Common Salt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(18)</td>
<td>Two coinage metals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Now think

Make a list of other known elements (other than question numbers 1 to 10 pp. 115-116) to you

Example

Box [1]

Nitrogen, Phosphorus, Sodium, Potassium, Magnesium

Students are encouraged to identify that there are about 116 elements
Students are encouraged to familiarize the two illustrations given below:

ILLUSTRATION (I)

Consider a music shop. Suppose CDs and tapes are placed in groups such as chart music, dance, melody, top hitz etc. This makes it easier to find the kind of music looking for:

![Arrangement of Cassettes](image)

Fig. 4.1 Arrangement of Cassettes

Let the students compare such a music shop with an unclassified one.
ILLUSTRATION (II)

Let the students consider the arrangement of books in a library:

In certain libraries books are placed in groups such as novels, short stories, journals, dramas' scientific books, biographies, autobiographies, etc.

In certain other big libraries books are placed in groups such as Arithmetic, Botany, Chemistry, English Literature, General Knowledge, Engineering, electronics, periodicals, etc. Makes the students aware of the advantage of such an arrangement of books. Putting books into groups in this way is called classifying.

Fig. 4.2 Arrangement of books in a library
Through the above illustrations students find out the convenience of classification and also encourages to think about the advantage of classification in Chemistry.

Box [2]

Advantage of classification of elements

Made the study of elements easy

THINK AND DISCUSS

Provide opportunity for classifying the substances given in Box [3], in different ways.

Box [3]

Providing opportunity to classify the above list of substances into the following categories:

1. Solid, liquid and gas
2. Elements and compounds
3. Metals and nonmetals
4. Acids and bases

**Example**

Classifying elements (Box 3) into solid, liquid and gas.

<table>
<thead>
<tr>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur</td>
<td>Water</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Nitric Acid</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td></td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td>Nitrogen</td>
</tr>
<tr>
<td>Gold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students are encouraged to expand each group by adding more substances to it.

Providing opportunity to recall the different modes of classification made by the pupils:

**Substances can be classified in different ways**
Students are encouraged to record the action of Sodium, Potassium, Iron and Copper with water (in the space provided).

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Experiment</th>
<th>Observation</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Putting sodium in water</td>
<td>Vigorous reaction</td>
<td>ACTIVE METAL</td>
</tr>
<tr>
<td>2</td>
<td>Putting potassium in water</td>
<td>Vigorous reaction</td>
<td>ACTIVE METAL</td>
</tr>
<tr>
<td>3</td>
<td>Putting Iron in water</td>
<td>No change</td>
<td>INACTIVE METAL</td>
</tr>
<tr>
<td>4</td>
<td>Putting copper in water</td>
<td>No change</td>
<td>INACTIVE METAL</td>
</tr>
</tbody>
</table>
Encouraging students to classify elements (Sodium, Potassium, Iron and Copper) on the basis of their hardness.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Experiment</th>
<th>Observation</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cutting sodium metal with a knife</td>
<td>can be cut easily</td>
<td>SOFT METAL</td>
</tr>
<tr>
<td>2</td>
<td>Cutting a piece of potassium with a knife</td>
<td>can be cut easily</td>
<td>SOFT METAL</td>
</tr>
<tr>
<td>3</td>
<td>Cutting a piece of copper</td>
<td>Cannot be cut easily</td>
<td>HARD METAL</td>
</tr>
<tr>
<td>4</td>
<td>Cutting a piece of Iron</td>
<td>Cannot be cut easily</td>
<td>HARD METAL</td>
</tr>
</tbody>
</table>

Identifies the advantages of **classification of elements:**

**Classification of elements made the study of elements easy and more convenient**
Methodology

LET US THINK AND DISCUSS

UNIT 1 HISTORY OF CLASSIFICATION OF ELEMENTS

Learning Point

Antoine Lavoisier, Dobereiner, Newlands, Dmitri Ivanovich Mendeleev and Henry Moseley made several attempts to classify elements.

PREVIOUS KNOWLEDGE

Providing opportunity to acquire information of scientists in the field of classifying elements.

Familiarising the important chemists and their contributions in classifying elements.
The work done by Lavosier (1789)

Lavosier marked the beginning of classification in 1789. He classified the then known elements into METALS and NON METALS

Fig. 4.3 Lavosier
Students are encouraged to go through the contributions of Dobereiner (1817)

Dobereiner:

1. **Identified the triads** (*group of three similar elements*).
   
   **Example**
   
   (i) Lithium, Sodium, Potassium.

   (ii) Chlorine, Bromine, Iodine.

2. **Used atomic mass as the basis for grouping elements.**
Discussing the contributions of **Newlands** (1864)

The English scientist Newlands arranged the elements in the order of their increasing atomic mass. He argued that the properties of eighth element was repeated as the eighth note in musical notes (sa, ri, ga, ma, pa, dha, ni, sa). Based on this observation Newland postulated the **Law of Octaves** (similarity between every eighth element like the eighth note of an octave in music). Newlands was the first to use numbers in a serial order and to predict periodicity.

**Newlands** ↔ **Law of Octaves**
DESCRIPTING THE MAJOR CONTRIBUTIONS OF MENDELEEV (1834-1907)

The classification of Mendeleev that made history in the world of Chemistry !!!

PROCEDURE ADOPTED BY MENDELEEV FOR CLASSIFYING ELEMENTS

More than 60 elements known at the time was selected.

He wrote the atomic mass and properties of elements on separate cards.

He made a comparative study,

Published a table,

And Classified the known elements.
Classification of elements by Mendeleev

Mendeleev's periodic table

<table>
<thead>
<tr>
<th>PERIODIC SYSTEM OF THE ELEMENTS IN GROUPS AND SERIES.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUPS OF ELEMENTS</td>
</tr>
<tr>
<td>O</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
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<td>5</td>
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<td>6</td>
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<td>7</td>
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<td>8</td>
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<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

LOWER ALKALI OXIDES

HIGHER VANADOUS OXIDES
- RH, RH, RH, RH, RH, RH

PT-I

* PT - Periodic Table
Students are encouraged to develop concept about Mendeleev’s Periodic Table (through observation, discussion and questioning)

(1) What is the basis of classification of Mendeleev’s periodic table?

(2) Whether the elements are arranged in the ascending or descending order of mass numbers?

(3) How many rows are there in the table?

(4) How many columns are there in the table?

(5) How many elements are included in the table?

CONCEPTS OF MENDELEEV

(1) Numbered the elements according to the atomic mass (mass number)

(2) Arranged in the ascending order (increasing order) of atomic mass

(3) There are Six rows

(4) There are Eight columns

(5) Sixty elements are included in the table
Henry Moseley, an English scientist proved that it is the number of protons, i.e., the atomic number, that can be called the identity card of an element. Moseley designed the Modern Periodic Table.
Develop Charts representing the summary of HISTORY OF CLASSIFICATION

CLASSIFICATION OF ELEMENTS

- LAVOSIER
- DOBEREINER
- NEWLANDS

PERIODIC TABLE

- MENDELEEV
- MOSELEY

- METALS & NON METALS
- TRIADS
- LAW OF OCTAVES
- PERIODIC TABLE ELEMENTS-ASCENDING ORDER OF MASS NUMBER
- MODERN PERIODIC TABLE-ATOMIC NUMBER
Attention

- Dobereiner was the first to identify the triads
- Dobereiner was the first to use the atomic mass as the basis for grouping.
- Law of octaves was formulated by Newlands
- Mendeleev first listed the known elements in an ascending order of their atomic mass
- Moseley developed the Modern Periodic Table

Scientific Terms / Concepts
- LAW OF OCTAVES
- TRIADS
CONCLUSION

Lavosier, Dobereiner, Newlands, Mendeleev and Henry Moseley made several attempts to classify elements.

EVALUATION

Fill in the blanks. Choose the correct answer from the brackets

(1) Law of octaves was formulated by -------
(Mendeleev, Newlands, Dobereiner)

(2) The triads were first identified by -------
(Mendeleev, Newlands, Dobereiner)

(3) -------first listed the known elements in the order of their atomic mass
(Mendeleev, Newlands, Dobereiner)

(4) Modern Periodic Table was developed by ----- 
(Mendeleev, Moseley, Dobereiner)

(5) What is the basis of classification of Mendeleev's Periodic Table?

(6) Give an example for a Triad?
UNIT 2 MENDELEYEV'S PERIODIC TABLE

Learning Point

Mendeleev arranged elements in the periodic table in the increasing order of atomic masses.

PREVIOUS KNOWLEDGE

Pupils have learnt that different elements show different properties. They have also learnt that Elements are classified on the basis of atomic masses.

DEVELOPING THE CONCEPT OF PERIODIC TABLE

Encourage pupils to go through the Mendeleev's Periodic Table (PT-1) and provide opportunity to find out what is a period and what is a group.
Let the students go through the Mendeleev's Periodic Table:

(PT - 1)

Encourage the students to answer the following questions observing the Mendeleev's Periodic Table.

1. How many columns are there in the table?  
2. How many rows are there in the table?  
3. What is the basis of classification?

Encourages to identify Group and Period

Provide opportunity to locate and find out the periods and groups

Periods are Horizontal Rows

Groups are Vertical Columns
Attention

- In the Mendeleev's Periodic Table elements are arranged in the increasing order of atomic masses
- The horizontal rows in the periodic table are called groups
- The vertical columns in the periodic table are called periods

Scientific Terms / Concepts
- MENDELEEV'S PERIODIC TABLE
Mendeleev arranged elements in the periodic table in the increasing order of atomic masses.

CONCLUSION

EVALUATION

Answer the following questions:

1. Fill in the blanks:
   a. Horizontal rows in the periodic table are called 
   b. Vertical columns in the periodic table are called 

2. What is the basis of classification of Mendeleev's Periodic table?
UNIT 3 MENDELEYEV'S PERIODIC LAW

Learning Point

Mendeleev's periodic law states that the properties of elements are periodic functions of their atomic masses.

PREVIOUS KNOWLEDGE

Let the children discuss the special features of Mendeleev's Periodic Table.

ACTIVITY

Discussing the characteristics of Mendeleev's periodic table: Students are encouraged to answer the following questions with the help of Mendeleev's Periodic Table (PT - 1).
1. How many elements are there in the table? ..............................................

2. How many groups are there in the table? ..............................................

3. How many periods are there in the table? ..............................................

4. What is the basis of classification? ....................................................... 

5. What is the order of arrangement of elements? ..................................... 

6. As you proceed from left to right in a period, what changes do you notice in the atomic mass of elements? .................................................. 

7. When Mendeleev arranged the elements in the order of increasing atomic mass, did the elements with similar properties fall on a group or in a period? .................................................. 

Provide opportunity to recall the seasons of India and their occurrence in a periodic manner (understanding the meaning of periodicity)

Students identify the periodic properties of elements by observation and discussion.
Providing opportunities to arrive at the Mendeleev’s Periodic Law (through discussion and observation of Periodic Table)

Mendeleev’s Periodic Law

THE PROPERTIES OF ELEMENTS ARE PERIODIC FUNCTIONS OF THEIR ATOMIC MASSES

Attention

- In the Mendeleev’s Periodic Table, the properties of elements are arranged the properties of elements are periodic functions of their atomic masses.
CONCLUSION

The Mendeleev's periodic law states that the Properties of elements are periodic functions of their atomic masses

EVALUATION

Answer the following questions:

(1) State Mendeleev's periodic law

(2) What is the significance of Mendeleev's periodic table in the classification?

(3) How many periods are there in the Mendeleev's periodic table?

(4) How many groups are there in the Mendeleev's periodic table?

(5) What are the characteristics of Mendeleev's periodic table?
UNIT 4 MERITS AND DEMERITS OF MENDELEEV'S PERIODIC TABLE

Learning Points

(i) Mendeleev exhaustively classified the elements for the first time in the history.

(ii) Mendeleev's periodic table does not precisely follow the order of atomic mass.

(iii) Some dissimilar elements were arranged in the same group.

Students have learnt about Mendeleev's Periodic Table and Periodic Law (Units 1 to 3)
Discussing the characteristic features of the Mendeleev's Periodic Table (Students are encouraged to find the answer for the following questions based on tables: pp........)

(1) Is the increasing order of atomic masses of elements strictly adhered to?
(2) Are elements with different properties included in the same group?
(3) What is the action of Potassium with water?
(4) What is the action of Copper with water?
(5) What about the hardness of Potassium and Copper?
(6) Can Potassium and Copper be included in the same group?

ANSWER KEY

(1) Does not precisely follow the order of atomic mass
(2) Elements with different properties are included in the same group (eg:- Potassium and Copper)
(3) Potassium reacts vigorously with water
(4) Copper is passive towards water
(5) Potassium is soft while Copper is hard
(6) Potassium and Copper cannot be included in the same group
Methodology

Students are encouraged to develop concepts about the merits and demerits of Mendeleev’s Periodic Table (through observation, discussion and questioning).

Identifying the major merits and defects of Mendeleev’s Periodic Table

<table>
<thead>
<tr>
<th>MERITS</th>
<th>DEFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaustively classified the elements for the first time</td>
<td>Does not precisely follow the order of atomic mass</td>
</tr>
<tr>
<td></td>
<td>Some dissimilar elements are arranged in the same group</td>
</tr>
</tbody>
</table>

\textbf{Attention}

- Mendeleev arranged the non elements in a tabular form
- Mendeleev exhaustively classified the elements for the first time in the history.
- Mendeleev’s periodic table does not precisely follow the order of atomic mass.
- Some dissimilar elements were arranged in the same group (e.g., K, Cu)
CONCLUSION

(1) Mendeleev exhaustively classified the elements for the first time in the history.
(2) Mendeleev’s periodic table does not precisely follow then order of atomic mass.
(3) Some dissimilar elements were arranged in the same group.

EVALUATION

Answer the following questions:

(1) Write the merits of Mendeleev’s periodic table

(2) What are the major demerits of Mendeleev’s periodic table?
UNIT 5  MODERN PERIODIC TABLE

Learning points

(i) The Modern Periodic Table was designed by Henry Moseley.

(ii) The elements are arranged in the increasing order of their atomic number.

(iii) There are 18 groups and 7 periods in the Modern Periodic Table.

Previous Knowledge

Providing opportunity to recall the concept of Period and Group.

- Horizontal rows are called periods.
- Vertical columns are called groups.
Let the students discuss the special features of the Modern Periodic Table.

Discussing the characteristic properties of the Modern Periodic Table (with the help of Periodic Table).

Modern Periodic Table

PT - 2
Methodology

*Students are encouraged to write the answers for the questions given below.* *(Observing PT-2)*

1. How many groups are there in the table?

2. How many periods are there in the table?

3. Name the smallest period.

4. Name the members of the first period.

5. Give the atomic numbers of the first period elements.

6. Name the members of the second period.

7. Whether the elements are arranged in the increasing or decreasing order of the atomic number?
Developing diagrammatic representation of 8 MAIN groups (1, 2, 13, 14, 15, 16, 17 and 18).

1 2 GROUPS 13 14 15 16 17 18

| 1 H | 3 Li 4 Be | 5 B 6 C 7 N 8 O 9 F 10 Ne 11 Na 12 Mg 13 Al 14 Si 15 P 16 S 17 Cl 18 Ar | 2 He |
|-----|---------|-----------------|-----------------|-------|
| 19 K 20 Ca | 31 Ga 32 Ge 33 As | 34 Se 35 Br 36 Kr | 37 Rb 38 Sr 39 In 40 Sn 41 Sb 42 Te 43 I 44 Xe |
| 55 Cs 56 Ba 57 | 49 Tl 50 Sn 51 Sb 52 Te 53 I 54 Xe | 55 Cs 56 Ba 57 | 58 Rf 59 Db 60 Sb 61 Bi 62 Po 63 At 64 Rn |

* Lanthanides (14 elements)

** Actinides (14 elements)

Identifying 7 periods in the Modern Periodic Table (Observing PT – 2)
Methodology

Providing opportunity for the pupils to locate groups 3 to 12

```
GROUP
```

<table>
<thead>
<tr>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>44</td>
<td>45</td>
<td>46</td>
<td>47</td>
<td>48</td>
</tr>
<tr>
<td>*57</td>
<td>72</td>
<td>73</td>
<td>74</td>
<td>75</td>
<td>76</td>
<td>77</td>
<td>78</td>
<td>79</td>
<td>80</td>
</tr>
<tr>
<td>**89</td>
<td>104</td>
<td>105</td>
<td>106</td>
<td>107</td>
<td>108</td>
<td>109</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Lanthanides (14 elements)
** Actinides (14 elements)

Encourage the students to develop the concept about the arrangement of elements in the Periodic Table - C₁ (through observation and discussion)

```
C₁
```

Elements are arranged in the increasing order of atomic numbers.
Students are encouraged to answer the following questions (based on the Modern Periodic Table.)

(1) What is the basis of classification?
(2) How many horizontal rows are there?
(3) How many vertical columns are there?
(4) Where is the place of transition elements?
(5) How many rows are there below the main block?
(6) Name the incomplete period?
(7) Name the shortest period?
(8) How many elements are there in the shortest period?
(9) How many elements are there in the second period?
(10) How many elements are there in the third period?
(11) How many elements are there in the fourth period?
(12) How many elements are there in the fifth period?
(13) How many elements are there in the sixth period?
(14) Name the elements in the first period?
(15) Name the first element in the second group?
(16) Name the first element in the fifteenth group?
(17) Name the first element in the seventeenth group?
(18) How many members are there in the eighteenth group?
(19) Name the first element in the last period?
# Methodology

## ANSWER KEY

<table>
<thead>
<tr>
<th></th>
<th>Increasing order of atomic number</th>
<th>14</th>
<th>Hydrogen and Helium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7 horizontal rows</td>
<td>15</td>
<td>Beryllium</td>
</tr>
<tr>
<td>3</td>
<td>18 vertical columns</td>
<td>16</td>
<td>Boron</td>
</tr>
<tr>
<td>4</td>
<td>Between groups 2 and 13</td>
<td>17</td>
<td>Lead</td>
</tr>
<tr>
<td>5</td>
<td>Two rows</td>
<td>18</td>
<td>Five</td>
</tr>
<tr>
<td>6</td>
<td>Seventh</td>
<td>19</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>7</td>
<td>First</td>
<td>20</td>
<td>Oxygen</td>
</tr>
<tr>
<td>8</td>
<td>Two</td>
<td>21</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>9</td>
<td>Eight</td>
<td>22</td>
<td>Fluorine</td>
</tr>
<tr>
<td>10</td>
<td>Eight</td>
<td>23</td>
<td>Six</td>
</tr>
<tr>
<td>11</td>
<td>Eighteen</td>
<td>24</td>
<td>Francium</td>
</tr>
<tr>
<td>12</td>
<td>Eighteen</td>
<td>25</td>
<td>Argon</td>
</tr>
<tr>
<td>13</td>
<td>Thirty two</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Providing opportunity to Identify the Number of Groups and Periods in The Modern Periodic Table*

GROUPS = 18  
PERIODS = 7
Encouraging students to recall the name of the scientist who developed the *Modern Periodic Table*

Henry Moseley (Figure 4.7), an English scientist proved that it is the number of protons, i.e., the atomic number, that can be called the identity card of an element.

**Attention**

- In the Modern Periodic Table, there are 18 groups
- There are 7 periods in the Modern Periodic Table
- Henry Moseley designed the Modern Periodic Table
- Elements are arranged in the increasing order of atomic number in the Modern Periodic Table
CONCLUSION

(1) The Modern Periodic Table was designed by Henry Moseley
(2) The elements are arranged in the increasing order of their atomic number in the modern Periodic Table
(3) There are 18 groups and 7 periods.

EVALUATION

Answer the following questions:

1. How many periods are there in the Modern Periodic Table?
2. How many groups are there in the Modern Periodic Table?
3. Who designed the Modern Periodic Table?
4. What is the basis of classification of Modern Periodic Table?
UNIT 6  THE MODERN PERIODIC LAW

Learning Point

The Modern periodic law states that the properties of elements are periodic functions of their atomic number.

PREVIOUS KNOWLEDGE

Students have learnt about MENDELEEV'S PERIODIC TABLE (Unit 2 and 3)

Providing opportunity to recall the following concepts

- Groups are vertical columns in the periodic table
- Periods are horizontal rows in the periodic table
Students are encouraged to develop the following concepts through observation, discussion and questioning: (Providing opportunity to observe the Modern Periodic Table - PT - 2)

(Giving answers to the following questions)

1. How many groups are there in the Modern Periodic table?
2. How many periods are there in the Modern periodic table?
3. Which is the incomplete period?
4. Which is the shortest period?

<table>
<thead>
<tr>
<th>Concept</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>There are 18 groups in the periodic table</td>
</tr>
<tr>
<td>2</td>
<td>There are 8 periods in the Periodic table</td>
</tr>
<tr>
<td>3</td>
<td>The eighth period is an incomplete period</td>
</tr>
<tr>
<td>4</td>
<td>First period is the shortest period</td>
</tr>
</tbody>
</table>

Identifying the basis of classification of Modern Periodic Table through observation, discussion and based on the structural representation of the Modern Periodic Table (PT-2 & PT-3).
<table>
<thead>
<tr>
<th>1</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Li</td>
</tr>
<tr>
<td>11</td>
<td>Na</td>
</tr>
<tr>
<td>19</td>
<td>K</td>
</tr>
<tr>
<td>37</td>
<td>Rb</td>
</tr>
<tr>
<td>55</td>
<td>Cs</td>
</tr>
<tr>
<td>87</td>
<td>Fr</td>
</tr>
</tbody>
</table>

**Methodology**

**Periodic Table**

* Lanthanides (14 elements)

** Actinides  (14 elements)

PT - 3
Providing opportunities to go through the periodic tables:

(PT - 2 & 3). Identifying the symbol and atomic numbers

The first element in the periodic table and its atomic number?

**HYDROGEN**

ATOMIC NUMBER = 1

The second element in the periodic table and its atomic number?

**HELIUM**

ATOMIC NUMBER = 2

The third element in the periodic table and its atomic number?

**LITHIUM**

ATOMIC NUMBER = 3

The fourth element in the periodic table and its atomic number?

**BERYLLIUM**

ATOMIC NUMBER = 4
Name the third element and what is its atomic number?

Students are encouraged to find out the number of periods in the Periodic Table.

\[
\begin{align*}
7 \text{ PERIODS} & \quad \text{Reason} \\
7 \text{ HORIZONTAL ROWS}
\end{align*}
\]

Students are encouraged to find out the number of groups in the Periodic Table.

\[
\begin{align*}
18 \text{ GROUPS} & \quad \text{Reason} \\
18 \text{ VERTICAL COLUMNS}
\end{align*}
\]

Encourage students to identify the order of arrangement of elements in the Periodic Table (increasing order of atomic number).

Phase I

Let the students represent the elements in:

FIRST PERIOD

Atomic Number \[1\] \rightarrow 2 elements \[2\]

\[
\begin{align*}
1^1\text{H} & \quad \text{ Reason} \\
2^2\text{He}
\end{align*}
\]
**Phase II**

**SECOND PERIOD**

<table>
<thead>
<tr>
<th>Number</th>
<th>Atomic Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

8 elements

**Phase III**

**THIRD PERIOD**

<table>
<thead>
<tr>
<th>Number</th>
<th>Atomic Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>18</td>
</tr>
</tbody>
</table>

8 elements

**KEY POINT**

The elements in the Modern Periodic Table are arranged in the increasing order of atomic numbers.
Provide opportunity to compare the Modern Periodic table with Mendeleev's Periodic Table:

Students are encouraged to answer the following questions:

1. **WHAT IS THE BASIS OF CLASSIFICATION OF ELEMENTS IN THE MENDELEEV'S PERIODIC TABLE?**

2. **WHAT IS THE BASIS OF CLASSIFICATION OF ELEMENTS IN THE MODERN PERIODIC TABLE?**

Students identify the periodic properties of elements by observation and discussion.

Arriving at the Modern Periodic Law by observation and discussion.

**Modern Periodic Law** states that the properties of elements are periodic functions of their atomic number.
Attention

- The elements are arranged in the increasing order of their atomic number
- There are 18 groups in the modern periodic table
- There are 7 periods in the modern periodic table

Scientific Terms / Concepts
- MODERN PERIODIC LAW

CONCLUSION
Modern Periodic Law states that the properties of elements are periodic functions of their atomic number
Answer the following question:

(1) How many periods are there in the modern periodic table?

(2) How many groups are there in the modern periodic table?

(3) Who designed the modern periodic table?

(4) What is the basis of classification in the modern periodic table?
UNIT 7 PERIODIC TABLE - CHEMIST’S MAP

Learning Point

Periodic table may be defined as the arrangement of various elements according to their properties, in a tabular form.

PREVIOUS KNOWLEDGE

Providing opportunity to recall the following facts:

- Mendeleev arranged elements in a table.
- The horizontal rows in the periodic table are called periods.
- The vertical columns in the periodic table are called groups.
- In Mendeleev’s Periodic Table, elements are arranged in the increasing order of atomic mass.
- In Modern Periodic Table, elements are arranged in the increasing order of atomic number.
Students are encouraged to recall the concepts ($C_2$ and $C_3$).

$C_2$ Classification of elements in to groups made the study of elements easy.

$C_3$ Arrangement of elements in rows and columns are based on the properties of elements.

Encourage the students to answer the following questions with the help of Mendeleev's Periodic Table (PT-1).

1. How many groups are there? 

2. How many periods are there? 

3. What is the basis of classification? 

4. As you proceed from left to right in a period, what changes do you notice in the atomic mass of elements?
Students are encouraged to answer the following questions with the help of Modern Periodic Table.

1. How many groups are there? 

2. How many periods are there? 

3. What is the basis of classification? 

4. As you proceed from left to right in a period, what changes do you notice in the atomic mass of elements?
Discussing the position of Sodium, Potassium, Iron, Magnesium, Oxygen, Nitrogen, Gold, Silver, Aluminium, Chlorine and Copper in the periodic table

**In the Periodic table, the elements are arranged according to their properties**

**CONCLUSION**

Periodic table is the arrangement of various elements according to their properties in a tabular form

**EVALUATION**

*Answer the following questions:*

1. What do you mean by periodic table?
2. What is the use of periodic table?
UNIT 8 GROUPS VERTICAL COLUMNS

Learning Points

(i) The vertical columns in the periodic table are called groups.

(ii) There are 18 groups in the Modern periodic table

PREVIOUS KNOWLEDGE

Discussing the characteristics of MODERN PERIODIC TABLE.

(Providing opportunity to recall that there are vertical columns in the periodic table)

Students are encouraged to go through the Modern periodic table (PT-2) and to find out the number of groups in the periodic table
Identifying the name of each group

<table>
<thead>
<tr>
<th>GROUP</th>
<th>NAME OF THE GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alkali metal</td>
</tr>
<tr>
<td>2</td>
<td>Alkaline earth metal</td>
</tr>
<tr>
<td>3-12</td>
<td>Transition elements</td>
</tr>
<tr>
<td>13</td>
<td>Boron Family</td>
</tr>
<tr>
<td>14</td>
<td>Carbon Family</td>
</tr>
<tr>
<td>15</td>
<td>Nitrogen Family</td>
</tr>
<tr>
<td>16</td>
<td>Oxygen Family</td>
</tr>
<tr>
<td>17</td>
<td>Halogens</td>
</tr>
<tr>
<td>18</td>
<td>Noble gases</td>
</tr>
</tbody>
</table>

Develops the fact that Groups are also termed as families

**Scientific Terms / Concepts**
- GROUP
Attention

- Vertical columns in the periodic table are called GROUPS
- There are 18 groups in the Modern periodic table
- Groups are also termed as FAMILIES

CONCLUSION

(1) The vertical columns in the periodic table are called groups
(2) There are 18 groups in the modern Periodic Table

EVALUATION

*Answer the following questions:

1. Define group
2. How many groups are there in the Modern Periodic table?
3. Name the following groups:
   a. Group 1
   b. Group 2
UNIT 9 PERIODS - HORIZONTAL ROWS

Learning Points

(i) The horizontal rows in the periodic table are called periods

(ii) There are 7 such periods

PREVIOUS KNOWLEDGE

- Recalling the characteristics of MODERN PERIODIC TABLE (PT - 2) (Refer Unit 5)
- Providing opportunity to recall that there are 7 horizontal rows in the Periodic table

Students are encouraged to go through the MODERN PERIODIC TABLE and to find out the number of PERIODS in the Periodic Table (PT-2)
Encourage students to prepare a table representing the number of elements in each period with the help of Modern Periodic Table (PT-2)

<table>
<thead>
<tr>
<th>Period</th>
<th>No. of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>7</td>
<td>INCOMPLETE</td>
</tr>
</tbody>
</table>

Developing the concept ($C_4$) about the number of periods in the Modern Periodic Table

There are seven periods in the Modern Periodic Table
DO YOU REMEMBER

- How many periods are there in the modern periodic table?
- Name the shortest period?
- How many members are there in the shortest period?
- How many members are there in the second period?
- Name the incomplete period
- Which is the longest period?
- How is Group 6 and Group 7 differ from other periods?
- Name the first element in the third group?
- Name the last element in the fourth group?
- Name the group to which the first member of each period belongs to
- Name the group to which the last member of each group belongs to?
Lanthanides and Actinides

Students are provided opportunity to find out the position of *lanthanides* and *actinides* in the periodic table.

Developing the layout of Modern Periodic Table and helps to identify the position of Lanthanides and Actinides.

![Periodic Table](image)

**Fig. 4.8 Lay out of Modern Periodic Table**

*Locating the position of Lanthanides and Actinides in the Periodic Table (with the help of PT-2 & Figure-23)*

- **Lanthanides** → **PERIOD 6**
- **Actinides** → **PERIOD 7**
Developing the concept \((C_5)\) about Lanthanides and Actinides

**Lanthanides and Actinides are placed as separate rows under the periodic table**

**Attention**

- The horizontal rows in the Periodic table are called Period
- There are 7 periods in the Modern Periodic table
- Lanthanides belong to sixth period
- Actinides belong to seventh period
- Lanthanides and Actinides are placed at the bottom of the main block in the periodic table

**Scientific Terms / Concepts**
- PERIOD
- LANTHANIDES
- ACTINIDES
Methodology

CONCLUSION
(1) The horizontal rows in the Periodic table are called Period
(2) There are 7 periods in the Modern Periodic Table

EVALUATION

Answer the following questions
(1) Define a period?
(2) How many periods are there in the Modern Periodic Table?
(3) Say whether the Lanthanides and Actinides constitute discrete periods? Why?
UNIT 10 THE ALKALI METALS

Learning Points

(i) The Group I elements in the periodic table are called alkali metals

(ii) They are Sodium, Potassium, Rubidium, Caesium and Francium and are active metals

DISCUSSING THE CHARACTERS OF A GROUP

Provide opportunity to go through the first group in the Modern Periodic Table

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td></td>
</tr>
<tr>
<td>Lithium</td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
</tr>
<tr>
<td>Rb</td>
<td></td>
</tr>
<tr>
<td>Rubidium</td>
<td></td>
</tr>
<tr>
<td>Cs</td>
<td></td>
</tr>
<tr>
<td>Caesium</td>
<td></td>
</tr>
<tr>
<td>Fr</td>
<td></td>
</tr>
<tr>
<td>Francium</td>
<td></td>
</tr>
</tbody>
</table>

GROUP I:
THE ALKALI METALS
Students are asked to make display cards showing the atomic number and symbols of alkali metals. Students carrying the display cards showing the atomic number and symbols of Alkali Metals are asked to face the whole class. Students in the class write down the members of Alkali Metal.
Providing opportunity to compare properties of elements of First Group.

Encouraging students to conduct the following experiments.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Experiment</th>
<th>Observation</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cutting Sodium with a knife</td>
<td>Can be cut easily</td>
<td>Soft</td>
</tr>
<tr>
<td>a</td>
<td>Cutting Potassium with a knife</td>
<td>Can be cut easily</td>
<td>Soft</td>
</tr>
<tr>
<td>2</td>
<td>Treating Sodium with water</td>
<td>Vigorous reaction</td>
<td>Reactive</td>
</tr>
<tr>
<td>a</td>
<td>Treating Potassium with water</td>
<td>Vigorous reaction</td>
<td>Reactive</td>
</tr>
<tr>
<td>3</td>
<td>Burning Lithium in air</td>
<td>Burns vigorously</td>
<td>Reactive</td>
</tr>
<tr>
<td>a</td>
<td>Burning Sodium in air</td>
<td>Burns vigorously</td>
<td>Reactive</td>
</tr>
<tr>
<td>4</td>
<td>Reacting Sodium with Chlorine gas</td>
<td>Produces White powder</td>
<td>React violently</td>
</tr>
<tr>
<td>a</td>
<td>Reacting Potassium with Chlorine gas</td>
<td>Produces White powder</td>
<td>React violently</td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Developing the concepts $C_6$ and $C_7$ about Alkali metals (with the help of experiment, observation and inference)

- **$C_6$**  *Alkali Metals are soft*  
- **$C_7$**  *Alkali Metals are reactive*

Provide opportunity to recall the formulae of some compounds of Sodium and Potassium and identify the similarities between the formula of the compounds of Sodium and Potassium

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Compounds of sodium</th>
<th>Formula</th>
<th>Compounds of potassium</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium Chloride</td>
<td>NaCl</td>
<td>Potassium Chloride</td>
<td>KCl</td>
</tr>
<tr>
<td>2</td>
<td>Sodium Oxide</td>
<td>Na$_2$O</td>
<td>Potassium Oxide</td>
<td>K$_2$O</td>
</tr>
<tr>
<td>3</td>
<td>Sodium Carbonate</td>
<td>Na$_2$CO$_3$</td>
<td>Potassium Carbonate</td>
<td>K$_2$CO$_3$</td>
</tr>
<tr>
<td>4</td>
<td>Sodium Nitrate</td>
<td>NaNO$_3$</td>
<td>Potassium Nitrate</td>
<td>KNO$_3$</td>
</tr>
</tbody>
</table>
Methodology

ACTIVITY (3)

Students are provided with pieces of Sodium, Potassium, Sodium Chloride, Potassium Chloride, Sodium Sulphate and Lithium Chloride. They are asked to place the above substances one by one in a Bunsen’s Flame.

OBSERVATION

Alkali Metals and their compounds give bright colours when placed in a Bunsen’s Flame

Developing the Concept ($C_8$) about the similarities in properties of Alkali metals

$C_8$ Alkali Metals show similar properties
Provide opportunity to identify the mode of storing Sodium and Potassium

Identifies the reactivity of Sodium and Potassium

Encourage students to find out the reason for the Group I elements showing similar properties

Recalling the concept of valence electrons and their role in a chemical reaction
Provide opportunity to find out the electronic configuration of alkali metals.

<table>
<thead>
<tr>
<th>Atomic Number</th>
<th>Name Of The Element</th>
<th>Symbol</th>
<th>Electronic Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lithium</td>
<td>Li</td>
<td>2, 1</td>
</tr>
<tr>
<td>11</td>
<td>Sodium</td>
<td>Na</td>
<td>2, 8, 1</td>
</tr>
<tr>
<td>19</td>
<td>Potassium</td>
<td>K</td>
<td>2, 8, 8, 1</td>
</tr>
<tr>
<td>37</td>
<td>Rubidium</td>
<td>Rb</td>
<td>2, 8, 18, 8, 1</td>
</tr>
<tr>
<td>55</td>
<td>Caesium</td>
<td>Cs</td>
<td>2, 8, 18, 18, 8, 1</td>
</tr>
<tr>
<td>87</td>
<td>Francium</td>
<td>Fr</td>
<td>2, 8, 18, 32, 18, 8, 1</td>
</tr>
</tbody>
</table>

Identifying the number of valance electrons

All Group I elements have one valence electron and that is why they show similar properties

Developing the Concept (C₉) about the nature of valance electrons in elements in the same group

Atoms of elements in the same group of the periodic table have the same number of valence electrons
Alkali Metals are Lithium, Sodium, Potassium, Rubidium, Caesium and Francium.

- They are soft and reactive metals
- They have only one valence electron.
- They all show similar properties.

Scientific Terms / Concepts

- ALKALI METALS
- LITHIUM
- SODIUM
- POTASSIUM
- RUBEDIIUM
- CAESIUM
- FRANCIUM
CONCLUSION

(1) The Group I elements in the periodic table are called alkali metals.
(2) Alkali metals are Sodium, Potassium, Rubidium, Caesium and Francium and are active metals.

EVALUATION

I Fill in the blanks:

(1) First Group elements in the Periodic Table are called -----
(2) Alkali Metals contain ---- valence electrons.
(3) First element among the Alkali Metals is ----.

II Answer the following:

(1) Name the Alkali Metals.
(2) Alkali Metals show similar properties. Why?
(3) Sodium and Potassium are kept under Kerosine. Why?
UNIT 11 HALOGENS

Learning Points

(i) The Group 17 elements in the periodic table are called halogens

(ii) They are Fluorine, Chlorine, Bromine, Iodine and Astatine and are reactive non-metals.

PREVIOUS KNOWLEDGE

Provide opportunity to recall

- Fluorine, Chlorine, Bromine and Iodine are non-metals.
- They are diatomic molecules

Discussing the Characters of a Group
Methodology

Provide opportunity to go through the seventeenth group in the Modern Periodic Table

GROUP 17 → HALOGENS

<table>
<thead>
<tr>
<th>9</th>
<th>F</th>
<th>Fluorine</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Cl</td>
<td>Chlorine</td>
</tr>
<tr>
<td>35</td>
<td>Br</td>
<td>Bromine</td>
</tr>
<tr>
<td>53</td>
<td>I</td>
<td>Iodine</td>
</tr>
<tr>
<td>85</td>
<td>At</td>
<td>Astatine</td>
</tr>
</tbody>
</table>

**ACTIVITY I**

Students are asked to make display cards showing the symbol and atomic number of halogens (F, Cl, Br, I and At). Students carrying the display cards showing the symbols and atomic numbers of halogens are asked to face the whole class. All students in the class write down the members of halogens.

Comparing the properties of elements of Seventeenth group
Methodology

Encourages to identify the physical state of existence of halogens

<table>
<thead>
<tr>
<th>Halogens</th>
<th>Diagramatic representation of halogen atom</th>
<th>State of existence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorine</td>
<td><img src="image" alt="Fluorine Diagram" /></td>
<td>GAS</td>
</tr>
<tr>
<td>$\text{F}_2$</td>
<td><img src="image" alt="Fluorine Molecule" /></td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td><img src="image" alt="Chlorine Diagram" /></td>
<td>GAS</td>
</tr>
<tr>
<td>$\text{Cl}_2$</td>
<td><img src="image" alt="Chlorine Molecule" /></td>
<td></td>
</tr>
<tr>
<td>Bromine</td>
<td><img src="image" alt="Bromine Diagram" /></td>
<td>LIQUID</td>
</tr>
<tr>
<td>$\text{Br}_2$</td>
<td><img src="image" alt="Bromine Molecule" /></td>
<td></td>
</tr>
<tr>
<td>Iodine</td>
<td><img src="image" alt="Iodine Diagram" /></td>
<td>SOLID</td>
</tr>
<tr>
<td>$\text{I}_2$</td>
<td><img src="image" alt="Iodine Molecule" /></td>
<td></td>
</tr>
</tbody>
</table>

Identifying the common properties of halogens (Questioning and discussion and references)

1. How many atoms are present in one molecule of Fluorine?

2. Chlorine is a diatomic molecule. Why?

3. Name the liquid Halogen

4. What is the state of existence of Fluorine and Chlorine?
Identifying the similarities between the formula of the compounds of Fluorine and Chlorine

<table>
<thead>
<tr>
<th>Compounds of sodium</th>
<th>Formula</th>
<th>Compounds of potassium</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride</td>
<td>NaCl</td>
<td>Sodium Fluoride</td>
<td>NaF</td>
</tr>
<tr>
<td>Potassium Chloride</td>
<td>KCl</td>
<td>Potassium Fluoride</td>
<td>KF</td>
</tr>
<tr>
<td>Hydrogen Chloride</td>
<td>HCl</td>
<td>Hydrogen Fluoride</td>
<td>HF</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>CaCl₂</td>
<td>Calcium Fluoride</td>
<td>CaF₂</td>
</tr>
</tbody>
</table>

Comparing the properties of Fluorine and Chlorine

Develops the following facts (F₁, F₂, F₃)

1. Fluorine and Chlorine are non-metals
2. Fluorine and Chlorine are gases
3. Fluorine and Chlorine react with metals
Explaining the reaction between Sodium and Fluorine

REACTION (1)

\[ \text{Sodium + Fluorine } \rightarrow \text{ Sodium Fluoride} \]

\[ 2\text{Na} + \text{F}_2 \rightarrow 2\text{NaF} \]

Explaining the reaction between Sodium and Chlorine

REACTION (2)

\[ \text{Sodium + Chloride } \rightarrow \text{ Sodium Chloride} \]

\[ 2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl} \]

Developing the concept \( (C_{10}) \) about the nature of properties of Fluorine and Chlorine based on \( F_1, F_2, F_3 \) and Reactions (1) and (2)

\[ C_{10} \]

Fluorine and Chlorine show similar properties
Encouraging to find out the **reason for Group 17 elements showing similar properties**

![Phase I](image)

Recalling the concept of **valence electrons and their role in chemical reaction**

![Phase II](image)

Provide opportunity to find out the electronic configuration of halogens

<table>
<thead>
<tr>
<th>Atomic number</th>
<th>Name of the element</th>
<th>Symbol</th>
<th>Electronic configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Fluorine</td>
<td>F</td>
<td>2, 7</td>
</tr>
<tr>
<td>17</td>
<td>Chlorine</td>
<td>Cl</td>
<td>2, 8, 7</td>
</tr>
<tr>
<td>35</td>
<td>Bromine</td>
<td>Br</td>
<td>2, 8, 18, 7</td>
</tr>
<tr>
<td>53</td>
<td>Iodine</td>
<td>I</td>
<td>2, 8, 18, 18, 7</td>
</tr>
<tr>
<td>85</td>
<td>Astatine</td>
<td>At</td>
<td>2, 8, 18, 32, 18, 7</td>
</tr>
</tbody>
</table>

Identifying the reason for showing similar properties by halogens

*All halogens have same number of valence electrons (7). So they show similar properties*
Developing the Concept (C11) about the nature of valence electrons in the atoms of elements in the same group.

Atoms of elements in the same group of the periodic table have the same number of valence electrons

Encouraging students to go through the table given below, showing the reactivity of halogens as we go down the group.

<table>
<thead>
<tr>
<th>Halogen</th>
<th>Conditions needed for reactions to occur</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorine</td>
<td>DARK, Very Very Low Temperature</td>
<td>explode</td>
</tr>
<tr>
<td>Chlorine</td>
<td>SUN, Normal Temperature</td>
<td>explode</td>
</tr>
<tr>
<td>Bromine</td>
<td>Heating</td>
<td>Reaction Occurs</td>
</tr>
<tr>
<td>Iodine</td>
<td>Strong Heating</td>
<td>React very slowly</td>
</tr>
</tbody>
</table>
Developing the concept ($C_{12}$) about the reactivity of halogens down the group

**The reactivity of halogens decreases as we go down the group** (Example: Fluorine is the first element and Iodine is the last element)

Identifying the most reactive halogen

**Fluorine is the most reactive halogen**

**KEY POINTS**

- Atoms of the same group contain the same number of valence electrons
- Elements in the same group show similar chemical properties
Attention

- 17th group elements are halogens.
- Halogens are reactive non-metals
- Halogens have seven valence electrons.
- Halogens show similar properties.

Scientific Terms / Concepts

- HALOGENS
- FLUORINE
- CHLORINE
- BROMINE
- IODINE
- ASTATINE
CONCLUSION
The Group 17 elements in the periodic table are called halogens and they are Fluorine, Chlorine, Bromine, Iodine and Astatine.

EVALUATION

I Fill in the blanks:
(1) Seventeenth Group elements in the Periodic Table are called -----
(2) Halogens contain ---- valence electrons.
(3) First element among the Halogen group is ----.

II Answer the following:
(1) Name the Halogens.
(2) Halogens show similar properties. Why?
(3) Name the most reactive non-metal.
UNIT 12 TRANSITION ELEMENTS

Learning Point

The elements in groups 3-12 in the periodic table are called transition elements.

Previous Knowledge

Provide opportunity to go through the figure 4.9 representing the arrangement of elements in group 3-12 based on atomic number.

Fig. 4.9 Arrangement of elements in group 3-12 based on atomic number

(A atomic numbers from 21 are given in the columns)
TRANSITION ELEMENTS

Periodic Table (PT-5)

OBSERVATION

Students are encouraged to answer the following questions with the help of Figure-24 and PT-5.

1. How many groups are there in the Transition series?
2. Name the groups belonging to Transition series
3. Where is the position of Transition elements?
4. How many Transition series are there in the Modern Periodic Table?
5. Name some Transition elements
Developing the facts $F_4$, $F_5$, $F_6$ and $F_7$

Students are encouraged to identify common transition elements with the help of periodic table (PT-5) and suggest the important uses of familiar metals.

- Iron (making weapons), Mercury (thermometer),
- Gold (ornaments), Silver (ornaments), Tungsten
Encouraging to answer the following questions

1. Name five metals.

2. How many complete series are there in the transition series?

3. How many members are there in the first transition series?

4. How many members are there in the second transition series?

5. How many members are there in the third transition series?

6. Name the elements present in the tenth group.

7. Locate the position of Iron in the transition series.

8. Name the familiar elements from the first transition series

9. Name the liquid metal.

Developing the Concept $C_{13}$ about Transition elements

Transition elements are metals
Transition elements are metals
Elements belonging to groups 3-12 are called transition metals

**Scientific Terms / Concepts**
- TRANSITION ELEMENT

**CONCLUSION**
The elements in groups 3-12 in the periodic table are called transition elements

**EVALUATION**

1. Answer the following:
   1. What are transition elements?
   2. Name the liquid metal.
   3. Name two metals used for making ornaments.
   4. Name two transition metals used for making electrical cables.
   5. Name the transition metal used for making filament of lamps.
UNIT 13 GROUP NUMBER AND VALENCE ELECTRONS

Learning Points

(i) In Group 1 and 2, the number of valence electrons is equal to group number

(ii) From the groups 13 to 18, number of valence electrons is equal to group number minus 10

PREVIOUS KNOWLEDGE

Students have learnt the electronic configuration.

ACTIVITY (1)

Writing the electronic configuration of Group 1.
Electronic Configuration of Group I

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lithium</td>
<td>3</td>
<td>2, 1</td>
<td>1</td>
</tr>
<tr>
<td>Sodium</td>
<td>11</td>
<td>2,8, 1</td>
<td>1</td>
</tr>
<tr>
<td>Potassium</td>
<td>19</td>
<td>2,8,8, 1</td>
<td>1</td>
</tr>
<tr>
<td>Rubidium</td>
<td>37</td>
<td>2,8,18,8, 1</td>
<td>1</td>
</tr>
<tr>
<td>Caesium</td>
<td>55</td>
<td>2,8,18,18,8, 1</td>
<td>1</td>
</tr>
<tr>
<td>Francium</td>
<td>87</td>
<td>2,8,18,32,18,8, 1</td>
<td>1</td>
</tr>
</tbody>
</table>

Developing the concept $C_{14}$ about number of valence electrons in Group 1 elements

All Group 1 elements contain one valence electron.
Writing the electronic configuration of Group 2

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beryllium</td>
<td>4</td>
<td>2, 2</td>
<td>2</td>
</tr>
<tr>
<td>Magnesium</td>
<td>12</td>
<td>2,8, 2</td>
<td>2</td>
</tr>
<tr>
<td>Calcium</td>
<td>20</td>
<td>2,8,8, 2</td>
<td>2</td>
</tr>
<tr>
<td>Strontium</td>
<td>38</td>
<td>2,8,18,8, 2</td>
<td>2</td>
</tr>
<tr>
<td>Barium</td>
<td>56</td>
<td>2,8,18,18,8, 2</td>
<td>2</td>
</tr>
<tr>
<td>Radium</td>
<td>88</td>
<td>2,8,18,32,18,8, 2</td>
<td>2</td>
</tr>
</tbody>
</table>

Develop the concept $C_{15}$ about number of valence electrons in Group 2 elements

All Group 2 elements contain two valence electrons
Writing the electronic configuration of Group 13

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boron</td>
<td>5</td>
<td>2, 3</td>
<td>3</td>
</tr>
<tr>
<td>Aluminum</td>
<td>13</td>
<td>2,8, 3</td>
<td>3</td>
</tr>
<tr>
<td>Gallium</td>
<td>31</td>
<td>2,8,18, 3</td>
<td>3</td>
</tr>
<tr>
<td>Indium</td>
<td>49</td>
<td>2,8,18,18, 3</td>
<td>3</td>
</tr>
<tr>
<td>Thallium</td>
<td>81</td>
<td>2,8,18,32,18, 3</td>
<td>3</td>
</tr>
</tbody>
</table>

Developing the concept $C_{16}$ about the number of valence electrons in Group 13 elements

$C_{16}$ Group Number(13) - 10 = Number of Valence electrons(3)
Encourages to write the electronic configuration of Group 14

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>6</td>
<td>2, 4</td>
<td>4</td>
</tr>
<tr>
<td>Silicon</td>
<td>14</td>
<td>2, 8, 4</td>
<td>4</td>
</tr>
<tr>
<td>Germanium</td>
<td>32</td>
<td>2, 8, 18, 4</td>
<td>4</td>
</tr>
<tr>
<td>Tin</td>
<td>50</td>
<td>2, 8, 18, 18, 4</td>
<td>4</td>
</tr>
<tr>
<td>Lead</td>
<td>82</td>
<td>2, 8, 18, 32, 18, 4</td>
<td>4</td>
</tr>
</tbody>
</table>

Developing the concept $C_{17}$ about the number of valence electrons in Group 14 elements

$$C_{17} = \text{Group Number}(14) - 10 = \text{Number of Valence electrons}(4)$$
Encourages to write the electronic configuration of Group 15

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>7</td>
<td>2, 5</td>
<td>5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>15</td>
<td>2, 8, 5</td>
<td>5</td>
</tr>
<tr>
<td>Arsenic</td>
<td>33</td>
<td>2, 8, 18, 5</td>
<td>5</td>
</tr>
<tr>
<td>Antimony</td>
<td>51</td>
<td>2, 8, 18, 18, 5</td>
<td>5</td>
</tr>
<tr>
<td>Bismuth</td>
<td>83</td>
<td>2, 8, 18, 32, 18, 5</td>
<td>5</td>
</tr>
</tbody>
</table>

Developing the concept $C_{18}$ about the number of valence electrons in Group 15 elements

$C_{18}$ Group Number(15) $- 10 = \text{Number of Valence electrons}(5)$
Encourages to write the **electronic configuration of Group 16**

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>8</td>
<td>2, 6</td>
<td>6</td>
</tr>
<tr>
<td>Sulphur</td>
<td>16</td>
<td>2, 8, 6</td>
<td>6</td>
</tr>
<tr>
<td>Selenium</td>
<td>34</td>
<td>2,8,18, 6</td>
<td>6</td>
</tr>
<tr>
<td>Tellurium</td>
<td>52</td>
<td>2,8,18,18, 6</td>
<td>6</td>
</tr>
<tr>
<td>Polonium</td>
<td>84</td>
<td>2,8,18,32,18, 6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Developing the concept $C_{19}$ about the number of valence electrons in Group 16 elements*

$$C_{19} \quad \text{Group Number(16) - 10 = Number of Valence electrons(6)}$$
Encourages to write the electronic configuration of Group 17

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorine</td>
<td>9</td>
<td>2, 7</td>
<td>7</td>
</tr>
<tr>
<td>Chlorine</td>
<td>17</td>
<td>2,8, 7</td>
<td>7</td>
</tr>
<tr>
<td>Bromine</td>
<td>35</td>
<td>2,8,18, 7</td>
<td>7</td>
</tr>
<tr>
<td>Iodine</td>
<td>53</td>
<td>2,8,18,18, 7</td>
<td>7</td>
</tr>
<tr>
<td>Astatine</td>
<td>85</td>
<td>2,8,18,32,18, 7</td>
<td>7</td>
</tr>
</tbody>
</table>

Developing the concept $C_{20}$ about the number of valence electrons in Group 17 elements

$C_{20} \quad \text{Group Number (17) – 10 = Number of Valence electrons(7)}$
Encourages to write the electronic configuration of Group 18

<table>
<thead>
<tr>
<th>Element</th>
<th>No. of electrons</th>
<th>Electronic Configuration</th>
<th>No. of Valence electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helium</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Neon</td>
<td>10</td>
<td>2, 8</td>
<td>8</td>
</tr>
<tr>
<td>Argon</td>
<td>18</td>
<td>2, 8, 8</td>
<td>8</td>
</tr>
<tr>
<td>Krypton</td>
<td>36</td>
<td>2, 8, 18, 8</td>
<td>8</td>
</tr>
<tr>
<td>Xenon</td>
<td>54</td>
<td>2, 8, 18, 18, 8</td>
<td>8</td>
</tr>
<tr>
<td>Radon</td>
<td>86</td>
<td>2, 8, 18, 32, 18, 8</td>
<td>8</td>
</tr>
</tbody>
</table>

Developing the concept $C_{21}$ about the number of valence electrons in Group 18 elements

$C_{21}$

Group Number(18) − 10 = Number of Valence electrons(8) except for Helium ($F_{11}$)

Identifying the relation between Group number and number of valence electrons (based on concepts $C_{14}$ to $C_{21}$)

Group Number = Number of Valence electrons
OR
Group Number − 10 = Number of valence electrons
Attention

- All elements in group 1 contain only 1 valence electron.
- All elements in group 2 contain only 2 valence electrons.
- All elements in group 13 contain only 3 valence electrons.
- All elements in group 14 contain only 4 valence electrons.
- All elements in group 15 contain only 5 valence electrons.
- All elements in group 16 contain only 6 valence electrons.
- All elements in group 17 contain only 7 valence electrons.
- All elements in group 18 contain only 8 valence electrons except Helium (Helium has 2 valence electrons)
CONCLUSION

(1) In Group 1 and 2, the number of valence electrons is equal to group number.

(2) From the group 13 to 18, number of valence electrons is equal to group number minus 10

EVALUATION

Answer the following:

(1) How many valence electrons are there in group 1 elements?

(2) An element X belongs to 13th group. How many valence electrons are there in it?

(3) An element contains 6 valence electrons. To which group it belongs?

(4) How many valence electrons are there in group 18 elements?

(5) Name the element having only 2 electrons in the group 18.
UNIT 14 PERIOD NUMBER AND NUMBER OF SHELLS

Learning Point

Period Number represents the number of shells in an atom

Previous Knowledge

Students have learned the electronic configuration of elements and provide opportunity to recall the concept of period.

Activity (1)

Encourage students to write the electronic configuration of period 1

Writing the electronic configuration of Period 1

<table>
<thead>
<tr>
<th>Element</th>
<th>Hydrogen</th>
<th>Helium</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Methodology

Developing the concept $C_{22}$ about the number of shells in the first period elements

First Period elements contain only one shell

ACTIVITY (2)

Encourages to write the electronic configuration of Period 2

<table>
<thead>
<tr>
<th>Element</th>
<th>Lithium</th>
<th>Beryllium</th>
<th>Boron</th>
<th>Carbon</th>
<th>Nitrogen</th>
<th>Oxygen</th>
<th>Fluorine</th>
<th>Neon</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2,1</td>
<td>2,2</td>
<td>2,3</td>
<td>2,4</td>
<td>2,5</td>
<td>2,6</td>
<td>2,7</td>
<td>2,8</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Developing the concept $C_{23}$ about the number of shells in the second period elements

Second Period elements contain two shells

**ACTIVITY (3)**

Encourages to write the electronic configuration of main group elements in Period 3

<table>
<thead>
<tr>
<th>Element</th>
<th>Sodium</th>
<th>Magnesium</th>
<th>Aluminum</th>
<th>Silicon</th>
<th>Phosphorus</th>
<th>Sulphur</th>
<th>Chlorine</th>
<th>Argon</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2,8,1</td>
<td>2,8,2</td>
<td>2,8,3</td>
<td>2,8,4</td>
<td>2,8,5</td>
<td>2,8,6</td>
<td>2,8,7</td>
<td>2,8,8</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Developing the concept $C_{24}$ about the number of shells in the third period elements

$C_{24}$ Third Period elements contain three shells

Encourages to write the electronic configuration of main group elements in Period 4

<table>
<thead>
<tr>
<th>Element</th>
<th>Potassium</th>
<th>Calcium</th>
<th>Gallium</th>
<th>Germanium</th>
<th>Arsenic</th>
<th>Selenium</th>
<th>Bromine</th>
<th>Krypton</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>19</td>
<td>20</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2,8,8,1</td>
<td>2,8,8,2</td>
<td>2,8,18,3</td>
<td>2,8,18,4</td>
<td>2,8,18,5</td>
<td>2,8,18,6</td>
<td>2,8,18,7</td>
<td>2,8,18,8</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Developing the concept $C_{25}$ about the number of shells in the Fourth period elements

$C_{25}$ Fourth Period elements contain four shells
Encourages to write the **electronic configuration of main group elements in Period 5**

<table>
<thead>
<tr>
<th>Element</th>
<th>Rubidium</th>
<th>Strontium</th>
<th>Indium</th>
<th>Tin</th>
<th>Antimony</th>
<th>Tellurium</th>
<th>Iodine</th>
<th>Xenon</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>37</td>
<td>38</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>52</td>
<td>53</td>
<td>54</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2.8,18,8.1</td>
<td>2.8,18,8.2</td>
<td>2.8,18,8.3</td>
<td>2.8,18,8.4</td>
<td>2.8,18,8.5</td>
<td>2.8,18,8.6</td>
<td>2.8,18,8.7</td>
<td>2.8,18,8.8</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

*Developing the concept $C_{26}$ about the number of shells in the fifth period elements*

$C_{26}$  
**Fifth Period elements contain five shells**
Encourages to write the electronic configuration of main group elements in Period 6

<table>
<thead>
<tr>
<th>Element</th>
<th>Caesium</th>
<th>Barium</th>
<th>Thallium</th>
<th>Lead</th>
<th>Bismuth</th>
<th>Polonium</th>
<th>Astatine</th>
<th>Radon</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of electrons</td>
<td>55</td>
<td>56</td>
<td>81</td>
<td>82</td>
<td>83</td>
<td>84</td>
<td>85</td>
<td>86</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2.8.18.18.8.1</td>
<td>2.8.18.18.8.2</td>
<td>2.8.18.32.18.3</td>
<td>2.8.18.32.18.4</td>
<td>2.8.18.32.18.5</td>
<td>2.8.18.32.18.6</td>
<td>2.8.18.32.18.7</td>
<td>2.8.18.32.18.8</td>
</tr>
<tr>
<td>No. of Shells</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Developing the concept $C_{27}$ about the number of shells in the sixth period elements

$C_{27}$ Sixth Period elements contain six shells
Identifying the relation between period number and number of shells. (Based on the concepts $C_{22}$-$C_{27}$).

<table>
<thead>
<tr>
<th>Period Number</th>
<th>Represents the number of shells preset in an element</th>
</tr>
</thead>
</table>

**Attention**

- First Period elements contain only 1 shell.
- Second Period elements contain 2 shells.
- Third Period elements contain 3 shells.
- Fourth Period elements contain 4 shells.
- Fifth Period elements contain 5 shells.
- Sixth Period elements contain 6 shells.
- Seventh Period elements contain 7 shells.
CONCLUSION

Period Number represents the number of shells in an atom

EVALUATION

Answer the following questions:

(1) How many shells are there in the elements of Group 1?

(2) How many shells are there in the elements of Group 2?

(3) Name the group to which the element belong:
   (i) Having 2 shells
   (ii) Having 5 shells
   (iii) Having 3 shells

(4) What is the relation between the No. of shells and the Number of the Period?
UNIT 15 ATOMIC SIZE DOWN A GROUP

Learning Point

Atomic size increases from top to bottom in a group due to increase in number of shells

Previous Knowledge

Students are encouraged to recall the following concepts

- Atomic size is related to atomic radius
- The elements in a group contain same valence electrons
- K-Shell can accommodate 2 electrons
- L-Shell can accommodate maximum of 8 electrons
- M-Shell can accommodate maximum of 18 electrons and so on.
DISCUSSING THE CHARACTERISTICS OF A GROUP

Students are encouraged to write down the electronic configuration of Lithium to Francium. (with the help of Periodic Table)

<table>
<thead>
<tr>
<th>ATOMIC NUMBER</th>
<th>NAME OF THE ELEMENT</th>
<th>SYMBOL</th>
<th>ELECTRONIC CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lithium</td>
<td>Li</td>
<td>2, 1</td>
</tr>
<tr>
<td>11</td>
<td>Sodium</td>
<td>Na</td>
<td>2, 8, 1</td>
</tr>
<tr>
<td>19</td>
<td>Potassium</td>
<td>K</td>
<td>2, 8, 8, 1</td>
</tr>
<tr>
<td>37</td>
<td>Rubidium</td>
<td>Rb</td>
<td>2, 8, 18, 8, 1</td>
</tr>
<tr>
<td>55</td>
<td>Caesium</td>
<td>Cs</td>
<td>2, 8, 18, 18, 8, 1</td>
</tr>
<tr>
<td>87</td>
<td>Francium</td>
<td>Fr</td>
<td>2, 8, 18, 32, 18, 8, 1</td>
</tr>
</tbody>
</table>
Seven students of Standard IX are encouraged to prepare display cards showing letter N

(N represents nucleus of an atom) and the rest of the students to prepare display cards showing

(- represents electron). Students carrying display card N and that of e are asked to form two separate lines.
The first student carrying display card N and the first one carrying display card 'e' were selected and encouraged to form the structure of *Hydrogen* atom.
The second student carrying display card N and the next three carrying display card 'e' were selected and encouraged to form the structure of Lithium atom.
The third student carrying display card $N$ and the next eleven carrying display card 'e' were selected and encouraged to form the structure of *Sodium* atom.
The fourth student carrying display card N and the next nineteen carrying display card ‘e’ were selected and encouraged to form the structure of Potassium atom.

Develop the concept $C_{28}$ about the relation between the size of the atom and number of shells (based on activity 1 to 4)

Size of the atom increases with increase in number of shells
Students are encouraged to draw the Bohr model of Hydrogen, Lithium, Sodium, Potassium, Rubidium, and Caesium.
Methodology

(3)

Sodium

(4)

Potassium
(5)

Rubidium
Methodology

Caesium

(6)

55 p
78 n

Caesium
Develop the concepts $C_{29}$ to $C_{33}$ about change in atomic size down the group

- $C_{29}$: The Number of shells in an atom increases as we move down the group
- $C_{30}$: The size of the atom increases as we move down the group
- $C_{31}$: The size of the atom increases due to increase in number of shells
- $C_{32}$: The first element is the smallest atom
- $C_{33}$: The last element is the biggest atom in the group
Attention

- Atomic size increases from top to bottom
- Number of shells increases from top to bottom
- In a group, atomic size increases due to increase in number of shells
- In a group, first element is the smallest
- In a group, last element is the biggest

Scientific Terms / Concepts
- ATOMIC SIZE
CONCLUSION

Atomic size increases from top to bottom in a group due to increase in number of shells

EVALUATION

Answer the following:

(1) How many shells are there for elements in the first period?
(2) How many shells are there for elements in the second period?
(3) How many shells are there for elements in the n\textsuperscript{th} period?
(4) Name the smallest atom in the first period
(5) Name the biggest atom in the second period
(6) What happens to the size of an atom as we move down a group? Why?
UNIT 16  ATOMIC SIZE ACROSS A PERIOD

Learning Point

Atomic size decreases from left to right in a period due to increase in the nuclear charge without increasing the number of shells.

Previous Knowledge

Provide opportunity to recall the following concepts

- Atomic size is related to atomic radius
- The elements in a group contain same valence electrons
- K-Shell can accommodate 2 electrons
- L-Shell can accommodate maximum of 8 electrons
- M-Shell can accommodate maximum of 18 electrons and so on.
DISCUSSING THE CHARACTERISTICS OF A PERIOD

Students are encouraged to write down the electronic configuration of Lithium to Neon with the help of Periodic Table

<table>
<thead>
<tr>
<th>Element</th>
<th>Lithium</th>
<th>Beryllium</th>
<th>Boron</th>
<th>Carbon</th>
<th>Nitrogen</th>
<th>Oxygen</th>
<th>Fluorine</th>
<th>Neon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic No.</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Electronic Configuration</td>
<td>2,1</td>
<td>2,2</td>
<td>2,3</td>
<td>2,4</td>
<td>2,5</td>
<td>2,6</td>
<td>2,7</td>
<td>2,8</td>
</tr>
</tbody>
</table>
Twenty five students of Standard IX are encouraged to prepare display cards showing the sign $+ \text{(represents proton of an atom)}$ and another 25 students to make display cards showing the sign $- \text{(represents electron)}$. Students carrying display card $+$ and that of $-$ are asked to form two separate lines.
The first three students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Lithium atom and three students carrying negative cards are asked to take their positions outside the circle in the order 2, 1 respectively in the 2\textsuperscript{nd} and 3\textsuperscript{rd} circles which represent the first and second shells respectively. Three pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.

\textit{Lithium (2,1)}
The next four students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Beryllium atom and next four students carrying negative cards are asked to take their positions outside the circle in the order 2, 2 respectively in the 2nd and 3rd circles which represent the first and second shells respectively. Four pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.

Beryllium (2, 2)
The next five students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Boron atom and next five students carrying negative cards are asked to take their positions outside the circle in the order 2, 3 respectively in the 2\textsuperscript{nd} and 3\textsuperscript{rd} circles which represent the first and second shells respectively. Five pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.
The next six students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Carbon atom and next six students carrying negative cards are asked to take their positions outside the circle in the order 2, 4 respectively in the 2\textsuperscript{nd} and 3\textsuperscript{rd} circles which represent the first and second shells respectively. Six pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.
The next seven students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Nitrogen atom and next seven students carrying negative cards are asked to take their positions outside the circle in the order 2, 5 respectively in the 2nd and 3rd circles which represent the first and second shells respectively. Seven pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.

Nitrogen (2,5)
The next seven students carrying positive cards are asked to keep their positions inside the first circle which represents the nucleus of Oxygen atom and next seven students carrying negative cards are asked to take their positions outside the circle in the order 2, 6 respectively in the 2\textsuperscript{nd} and 3\textsuperscript{rd} circles which represent the first and second shells respectively. Eight pieces of rope are taken and one end of each rope is tied to the students carrying negative cards. The free end of each rope is given to students carrying positive cards and are asked to pull the string with slight force towards the centre.
Developing the concept $C_{34}$ to $C_{36}$ about the change in atomic size across a period (from Activities 1 to 6)

- $C_{34}$: Nuclear attraction increases along a period
- $C_{35}$: Number of shells remains the same along a period
- $C_{36}$: Size of the atom decreases from left to right along a period
Students are encouraged to draw the Bohr model of Lithium, Beryllium, Boron, Carbon, Nitrogen, Oxygen, Fluorine and Neon.
Developing the concepts about the reason for decrease in size of atom across a period (C₁₇ to C₄₀)

- **C₃₇** Nuclear attraction increases along a period
- **C₃₈** Number of shells remains the same along a period
- **C₃₉** Size of the atom decreases from left to right along a period
- **C₄₀** Number of protons increases with number of electrons along a period
Attention

- Number of shells remains the same in a period
- Nuclear attraction on outer electrons increases
- Atomic size decreases from left to right in a period.
- First element in the group is the biggest atom.
- Last element in the group is the smallest atom.

CONCLUSION

Atomic size decreases from left to right in a period due to the increase in nuclear charge without increasing the number of shells.

EVALUATION

Answer the following:
1. Name the smallest atom in the second period. Why is it so?
2. What happens to the size of the atom as we move from left to right in a period?
3. Potassium is the biggest in the third period. Why?
(I) Name the following:

(1) The scientist who designed the Modern periodic table

(2) The scientist who first made a successful attempt in classifying the known elements

(3) The smallest atom

(4) The biggest atom

(5) The shortest period

(6) The longest period

(7) The incomplete period

(8) Number of periods

(9) Number of groups

(10) Another name of First group elements

(11) The first element in the Group 1

(12) The last element in the Group 1

(13) The first element in the Group 17

(14) The first element in the Group 18

(15) A group of metals

(16) A group non metals
(II) Define the following:
(1) Group
(2) Period
(3) Modern periodic Law
(4) Mendeleev’s Periodic law
(5) Transition elements

(III) Answer the following questions:
(1) What happens to the atomic size as we move down the group? Why?
(2) What happens to the atomic size as we move from left to right in a period? Why?
(3) Where is the position of transition elements in the periodic table?
(4) Where is the position of actinides and lanthanides in the Periodic table?
(5) Where on the periodic table would you find
   (i) Metals
   (ii) Non metals
   (iii) The alkali metals
   (iv) Halogens
EXTENDED ACTIVITY

1. Why was Mendeleev more successful with his Periodic Table than Newlands?

2. Compare Modern Periodic Table with Mendeleev's Periodic Table

3. What are the main characteristic features of Modern Periodic Table?

4. Prepare chart of MODERN PERIODIC TABLE.

5. Prepare an album including the contributions of Lavoisier, Johns Newlands, Dobereiner, Dmitri Mendeleev and Moseley.

6. Draw the main groups (1, 2, and 13 to 18) in the Modern periodic table.
REFERENCES


ACHIEVEMENT TEST IN CHEMISTRY

Std IX

Time: 1 Hour
Max mark: 25

Instructions: Answer all questions

(1) Choose the correct answer from the bracket (Each question carries 1 mark)

(1) The biggest atom is
   (a) Oxygen    (b) Nitrogen
   (c) Fluorine  (d) Helium

(2) Halogens belong to
   (a) Group1    (b) Group 2
   (c) Group17   (d) Group 18

(3) Which of the following is a transition metal?
   (a) Mercury   (b) Magnesium
   (c) Copper    (d) Iron

(4) The incomplete period in the Modern periodic Table is
   (a) 1     (b) 2
   (c) 7     (d) 8

(5) The number of valence electrons in the 16th Group elements is
   (a) 2     (b) 8
   (c) 1     (d) 6
(6) The electronic configuration of an element is 2, 8, 7. How many shells are there in it?
   (a) 1   (b) 2   (c) 3   (d) 7
   (1 x 6 = 6 marks)

(II) Find the odd one
   (1) Lithium, Strontium, Sodium, Potassium
   (2) Potassium, Calcium, Aluminium, Copper
   (3) Chlorine, Oxygen, Nitrogen, Magnesium
   (4) Oxygen, Helium, Nitrogen, Fluorine
   (1 x 4 = 4 marks)

(III) Define the following:
   (1) Group
   (2) Period
   (1 x 2 = 2 marks)

(IV) State the Modern Periodic law
   (2 x 1 = 2 marks)

(V) Name 3 transition elements and write their uses
   (3 x 1 = 3 marks)

(VI) Compare the merits and demerits of Mendeleev’s Periodic table
    (3 x 1 = 3 marks)
(VII) Look at the table and answer the questions given below:

<table>
<thead>
<tr>
<th>A</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) The biggest atom
(2) The smallest atom
(3) Atom with highest electro negativity
(4) Atom with lowest electro negativity
(5) Halogen
(6) Alkaline Earth Metal
(7) Transition element
(8) Number of electrons in the outermost shell of B

\[ \frac{1}{2} \times 8 = 4 \text{ marks } \]
SCHOOL OF PEDAGOGICAL SCIENCES
MAHATMA GANDHI UNIVERSITY
KOTTAYAM

REMEDIAL TEACHING MATERIALS
ON
ATOMIC STRUCTURE
(STANDARD IX)

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Reader
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2004
**REMEDIAL TEACHING MATERIALS**

Remedial Teaching Materials on the topic **ATOMIC STRUCTURE** is subdivided into 11 Units. Details are given in pages 255-334. In each Unit, students are provided chances for observation, classification, identification, discussion, analysis and concept formation.

Suitable charts, models, examples, illustrations, life situations are also used for developing new concepts/teaching points. **Practice session** is given at the end of each unit to test the level of attainment of the students. **Extended Activities and Reference Section** are given. An **Achievement Test** on Atomic Structure is given at the end of the material.
<table>
<thead>
<tr>
<th>UNIT 1</th>
<th>CONCEPT OF ATOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT 2</td>
<td>PARTS OF AN ATOM</td>
</tr>
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<td>UNIT 3</td>
<td>NUCLEUS OF AN ATOM</td>
</tr>
<tr>
<td>UNIT 4</td>
<td>ELECTRIC CHARGE OF PROTON, NEUTRON &amp; ELECTRON</td>
</tr>
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<td>UNIT 5</td>
<td>CONTRIBUTIONS TOWARDS THE DISCOVERY OF ATOMIC PARTICLES</td>
</tr>
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<td>UNIT 6</td>
<td>SHELL OR ORBIT</td>
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<td>UNIT 7</td>
<td>CHARACTERISTICS OF ELECTRON CLOUD</td>
</tr>
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<td>UNIT 8</td>
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</tr>
<tr>
<td>UNIT 9</td>
<td>ATOMIC NUMBER</td>
</tr>
<tr>
<td>UNIT 10</td>
<td>MASS NUMBER</td>
</tr>
<tr>
<td>UNIT 11</td>
<td>REPRESENTATION OF AN ATOM</td>
</tr>
</tbody>
</table>
The first definite theory about the structure of matter was put forward by English Scientist and School Teacher, John Dalton (1808). According to Dalton's atomic theory matter consists of small indivisible particles called atoms, which can neither be created nor be destroyed. Atoms of the same elements are alike in all respects & combine with other atoms in simple whole number ratios forming compounds or molecules. Dalton’s atomic theory remains undisputed up to the end of 19th century & early 20th century showed that the atom has a complex structure and is divisible. These studies further revealed that the atoms are divisible into smaller particles called protons, neutrons and electrons. These particles are regarded as fundamental particles because these are the main constituents of all atoms.
### Learning Points

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Learning Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atoms are the building blocks from which all the materials in the world are made up of.</td>
</tr>
<tr>
<td>2</td>
<td>Every atom has a nucleus at the centre and electrons outside the nucleus.</td>
</tr>
<tr>
<td>3</td>
<td>Nucleus is the central part of every atom which consists of protons and neutrons.</td>
</tr>
<tr>
<td>4</td>
<td>Protons have positive charge and electrons have negative charge. Neutrons are electrically neutral.</td>
</tr>
<tr>
<td>5</td>
<td>The fundamental particles of an atom are discovered by scientists such as J.J. Thomson, Earnest Rutherford and James Chadwick.</td>
</tr>
<tr>
<td>6</td>
<td>The path of an electron around the nucleus is called shell or orbit.</td>
</tr>
<tr>
<td>7</td>
<td>Electron cloud is the part of an atom in which there is possibility of finding electrons.</td>
</tr>
<tr>
<td>8</td>
<td>Relative mass of neutron, proton and electron.</td>
</tr>
<tr>
<td>9</td>
<td>Atomic number is the number of protons in an atom or number of electrons in a neutral atom.</td>
</tr>
<tr>
<td>10</td>
<td>Mass number is the total number of protons and neutrons.</td>
</tr>
<tr>
<td>11</td>
<td>Atoms can be symbolically shown using atomic number and mass number.</td>
</tr>
</tbody>
</table>
LET US THINK AND DISCUSS

UNIT 1 CONCEPT OF ATOM

Learning Point
Atoms are the building blocks from which all the materials in the world are made up of.

PREVIOUS KNOWLEDGE

Students at Secondary level might have learnt that all materials are made up of matter and the fundamental unit of matter is the atom. Molecules are formed by the combination of atoms. Students are also aware that substances differ in their properties due to the different type of atoms present in them.
Students are encouraged to think of twenty six letters in the English Alphabet and the number of words that can be developed by different combinations of the twenty six letters.

Each type of arrangement of letters make different types of words.

Encourage students to compare the letters in words with tiny particles in substances.

Words are composed of letters. Similarly substances are composed of simpler particles called atoms.
Students are given a set of match sticks and are encouraged to develop different Geometrical patterns using match sticks.

Fig. 4.12 Different Geometrical patterns from match sticks
Students are encouraged to compare match sticks with tiny particles in a substance.

Geometrical Patterns are made up of match sticks. Similarly substances are made up of simpler particles called atoms.

ACTIVITY (3)

Students are encouraged to crush a chalk piece into chalk powder and are provided with an opportunity to compare chalk particles with tiny particles in a substance.

Chalk is made up of chalk particles (chalk powder). Similarly substances are made up of tiny particles called atoms.
Encourages students to make the following comparisons:

(1) **Letters-Word**

(2) **Match Sticks Geometrical Pattern**

(3) **Chalk Particles-Piece of Chalk**

with

**Atoms-Substance.**

---

**Developing the concept about constituent of matter**

**Atoms are constituents of all matter**
Discussing details about the discovery of atom by Sir. John Dalton (1766-1844)

John Dalton, the son of a poor weaver, was born in Cumberland, England. He began his lifelong career as a teacher at a village school when he was only twelve. Seven years later he became a school principal. From his early years to his death, Dalton carefully recorded the meteoric data each day temperature, pressure, time, amount of rainfall and so forth. Dalton suffered from protanopia, an inability to distinguish colours at all. Much to his amusement his sight defect became known as ‘Daltonism’.

Dalton put forward the atomic theory in 1803.

According to John Dalton all matter is made up of tiny particles called atoms and atoms can neither be created nor be destroyed. Atoms combine to form molecules.
Atoms are the building blocks from which all the materials in the world are made up of.
UNIT 2 PARTS OF AN ATOM

Learning Point

Every atom has a nucleus at the centre and electrons outside the nucleus.

Previous Knowledge

Provide opportunity to recall that atoms are the constituents of all matter.

Illustration

Students are provided opportunity to recall that the sun is the centre of the solar system and the planets and satellites are moving/revolving the sun through some fixed path.
Comparing **atom**, **nucleus** and **electron cloud** with **solar system**, **sun** and **planets and satellites** respectively.
Students are encouraged to represent the parts of an atom.

![Diagram of an atom showing the nucleus and electron cloud]

**Fig. 4.15 Parts of an Atom**

\[
\text{Atom} = \text{Nucleus} + \text{Electrons}
\]

**Attention**

- Nucleus is at the centre of the atom
- Electrons are present outside the nucleus.
CONCLUSION
Every atom has a nucleus at the centre and electrons outside the nucleus

EVALUATION

Answer the following:-

(1) Name the central part of the atom
(2) Name the outer part of the atom
(3) Define the following:
   (i) Nucleus
   (ii) Atom
UNIT 3  NUCLEUS OF AN ATOM

Learning Point
Nucleus is the central part of every atom which consists of Protons and Neutrons

PREVIOUS KNOWLEDGE

Recalling the position of nucleus and electrons in an atom

Discussing the characteristics of Nucleus of an atom
**ACTIVITY**

*Students are asked to draw a Circle using a compass and then Mark the centre.*


diagram

- **(1)** Nucleus is the central part of every atom

- **(2)** Etymologically nucleus means the central part

  NUCLEUS = CENTRAL PART
Students are encouraged to identify the characteristics of nucleus

(1)

Protons and Neutrons are Present inside the nucleus

(2)

Nucleus is the heavy part of an atom

Electron

Nucleus
Neutrons and Protons are together termed as **Nucleons**

**Nucleus** is electrically **positive**

Mass of the Nucleus is the total mass of the protons and the neutrons.
Attention

- Nucleus is the central part.
- Neutrons and protons are present inside the nucleus.
- Particles in the nucleus are called nucleons.
- Nucleus is electrically positive.
- Electrons are present outside the nucleus.

**Scientific Terms / Concepts**

- NUCLEUS
- PROTONS
- NEUTRONS
- ELECTRONS
- NUCLEONS
CONCLUSION

Nucleus is the central part of every atom which consists of Protons and Neutrons

EVALUATION

(1) Which is the centre of the atom?
(2) Where do you see the electrons?
(3) Where are the neutrons and protons seen?
(4) Develop models of nucleus for the following atoms:

   (i) Hydrogen (No. of protons = 1, No. of neutrons = 0)
   (ii) Helium (No. of protons = 2, No of neutrons = 2)
   (iii) Argon (No of protons = 18, No of neutrons = 18)
UNIT 4  ELECTRIC CHARGE OF PROTONS, NEUTRONS AND ELECTRONS

Learning Point

**Protons** have **positive** charge and **electrons** have **negative** charge. **Neutrons** are electrically **neutral**

**PREVIOUS KNOWLEDGE**

*Students are encouraged to recall the following concepts:*

- Atoms are electrically neutral
- Flow of electrons causes electricity
Students are encouraged to compare the charges of protons, neutrons and electrons from the Table (4.1) given below.

### Table 4.1 Charges of protons, neutrons and electrons

<table>
<thead>
<tr>
<th>Particle in the atom</th>
<th>Charge</th>
<th>Relative charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>Positive charge</td>
<td>+1</td>
</tr>
<tr>
<td>Neutron</td>
<td>Neutral charge</td>
<td>0</td>
</tr>
<tr>
<td>Electron</td>
<td>Negative charge</td>
<td>-1</td>
</tr>
</tbody>
</table>

**Attention**

- Protons have positive charge
- Electrons have negative charge
- Neutrons are electrically neutral
**CONCLUSION**

(1) Protons are positively charged
(2) Electrons are negatively charged
(3) Neutrons are electrically neutral

**EVALUATION**

*Answer the following questions:*

(1) Name the positively charged particle in an atom
(2) What is the charge of an electron?
(3) Name the neutral particle in an atom
(4) Complete the table given below:

<table>
<thead>
<tr>
<th>Particles</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protons</td>
<td>-----</td>
</tr>
<tr>
<td>Electrons</td>
<td>-----</td>
</tr>
<tr>
<td>Neutrons</td>
<td>-----</td>
</tr>
</tbody>
</table>
UNIT 5 CONTRIBUTIONS TOWARDS THE DISCOVERY OF ATOMIC PARTICLES

Learning Points

(i) J.J Thomson discovered electrons
(ii) Earnest Rutherford discovered protons
(iii) James Chadwick discovered neutrons.

Previous Knowledge

Providing opportunity to recall the contributions of J.J. Thomson, Rutherford and James Chadwick

The existence of electron was first demonstrated by J.J. Thomson in 1897. In 1897 he discovered that in the atom there are negatively charged particles of low mass. He called these particles Electrons.

Fig. 4.16
J.J. Thomson
Earnest Rutherford was born in New Zealand in 1871. He was working on radioactivity. In 1911 Rutherford’s experiments proved that atoms contain positively charged particles equal in magnitude to the charge of electrons and mass greater than that of electrons. He named these particles as protons.

In 1911 Rutherford’s experiments showed the existence of a dense, positively charged centre, extremely small when compared to the total size of the atom. He named this part as the nucleus.

In 1932 Chadwick discovered that atoms contain charge less particles also. He called these particles as Neutrons. Its mass was found to be nearly the same mass as that of a proton.
Electron was discovered by J.J. Thomson.

Proton was discovered by Rutherford.

Chadwick discovered Neutron

Scientific Terms / Concepts

- J.J. THOMSON
- RUTHERFORD
- JAMES CHADWICK
CONCLUSION

(1) J.J Thomson discovered electrons.
(2) Rutherford discovered protons.
(3) James Chadwick discovered neutrons.

EVALUATION

Fill in the blanks

(1) Electron was discovered by--------
(2) Proton was discovered by--------
(3) ----was discovered by James Chadwick
(4) The massive particles in an atom are----- and----
UNIT 6 SHELL OR ORBIT

Learning Point
The path of the electron around the nucleus is called shell or orbit.

PREVIOUS KNOWLEDGE

Students might have learnt that electron cloud is a region where electrons are found.

ACTIVITY (1)

Encourage the students to draw the Diagrammatic representations of the structure of atoms of Hydrogen (H), Helium (He), Lithium (Li) and Sodium (Na).
(1) Hydrogen
   - Electron
   - Proton

(2) Helium
   - Electron
   - Proton
   - Neutron

(3) Lithium
   - Electron
   - Neutron
   - Proton
Students are encouraged to compare the diagrammatic representations of \textbf{Hydrogen, Helium, Lithium} and \textbf{Sodium} and are encouraged to write their observations.
Observations

1. The nucleus is at the centre of the atom
2. The nucleus consists of protons and neutrons
3. The electrons are present outside the nucleus
4. Electrons are present in the circular paths called orbits or shells
5. Hydrogen has only one electron
6. The only one electron in the Hydrogen is arranged in the first circular path
7. There are two electrons in a Helium atom
8. The two electrons in the Helium are arranged in the same circular path
9. There are three electrons in Lithium atom
10. The third electron in the Lithium atom is arranged in the second circular path.
11. There are 11 electrons in the Sodium atom
12. The first two electrons in the Sodium are arranged in the first circular path, the next eight are arranged in the second circular path and the eleventh electron is arranged in the third circular path
Encourage students to answer the following questions based on the observations.

1. Why is the second electron enter in the first path itself?
   The First Shell can accommodate maximum of two electrons.

2. Why is the third electron enter the second path?

3. Why is the eleventh electron not occupied in the second path itself?

Developing the concept of electron shells

Electron shells are Circular path of the electron outside the nucleus.

Encourage to name different electron shells.

Electron Shells may be named either
1, 2, 3, 4, -------
or
K, L, M, N, -------
Developing the concept of structure of atoms through classroom activity (Phase 1 to 3)

A leader was selected from Std. IX and was provided with a card representing nucleus. The other students were provided with one card each, representing an electron.

The teacher writes the name of an element (Hydrogen, Helium, Neon, etc.) on the blackboard. The leader of the team carrying the card of nucleus takes his position at the centre. The members holding the cards with electron has to form a circle representing an electron in a shell and finally the students make the structure of the element written on the blackboard.
Diagrammatic representation of the classroom activity showing the structure of atoms

**Phase 1**

**Hydrogen**

**Phase 2**

**Helium**
Neon

Phase 3

Provide opportunity to find out the capacity of electron shells

K Shell $\rightarrow$ 2 electrons
L Shell $\rightarrow$ 8 electrons
M Shell $\rightarrow$ 18 electrons
N Shell $\rightarrow$ 32 electrons
Encourage students to **draw the structure of Hydrogen, Helium, Lithium and Chlorine and Argon**

**Fig. 4.19 Hydrogen atom**
Structure of Helium atom

Fig. 4.20 Helium atom

K Shell is the lowest level which can accommodate up to 2 electrons

Structure of Lithium atom

Fig. 4.21 Lithium Atom

e = electron
Structure of Chlorine atom

Chlorine - 17 protons
- 17 electrons
- 18 neutron

17 p
18 n

K Shell (2 e)
L Shell (8 e)
M Shell (7 e)

Fig. 4.22 Chlorine atom

**L Shell** is the second shell which can accommodate upto a maximum of 8 electrons.
Structure of Argon atom

Argon atom
- 18 protons
- 18 electrons
- 20 neutrons

Fig. 4.23 Argon atom

M Shell is the third shell which can accommodate up to a maximum of 18 electrons

Similarly

N Shell can hold up to a maximum of 32 electrons
Structuring model for representing the main constituents of atom

- Protons at the atomic centre
- Neutrons at the atomic centre

Cluster together to form

The Nucleus

Together becomes

Electrons moving round very fast around the nucleus at different levels

To form ELECTRON SHELLS

K SHELL
L SHELL
M SHELL
N SHELL

Fig. 4.24 Structural representation of atom
Students are encouraged to calculate the maximum number of electrons that can be accommodated in each shell given in (Table 4.2)

Table 4.2 Maximum number of electrons that can be accommodated in the shell

<table>
<thead>
<tr>
<th>No. of Shells</th>
<th>Shell</th>
<th>Maximum Number of Electrons That can be accommodated In the shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K</td>
<td>$2 \times 1 \times 1$ i.e., $2 \times 1^2 = 2$</td>
</tr>
<tr>
<td>2</td>
<td>L</td>
<td>$2 \times 2 \times 2$ i.e., $2 \times 2^2 = 8$</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>$2 \times 3 \times 3$ i.e., $2 \times 3^2 = 18$</td>
</tr>
<tr>
<td>4</td>
<td>N</td>
<td>$2 \times 4 \times 4$ i.e., $2 \times 4^2 = 32$</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>n</td>
<td>n</td>
<td>$2 \times n \times n$ i.e., $2 \times n^2 = 2n^2$</td>
</tr>
</tbody>
</table>

Attention

- Electron shells are imaginary circular paths of the electron.
- K Shell can hold a maximum of 2 electrons.
- L Shell can hold a maximum of 8 electrons.
- M Shell can hold a maximum of 18 electrons.
- N Shell can hold a maximum of 32 electrons.
- n\textsuperscript{th} Shell can hold a maximum of $2n^2$ electrons.
CONCLUSION

The path of the electron around the nucleus is called shell or orbit

EVALUATION

Answer the following questions:

(1) Define an electron shell

(2) Fill in the blanks.
   (i) K shell can hold a maximum of _____ electrons.
   (ii) L shell can hold a maximum of _____ electrons
   (iii) n^th shell can hold a maximum of _____ electrons

(3) Match the following:

<table>
<thead>
<tr>
<th>Number of Electrons</th>
<th>Shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>K</td>
</tr>
<tr>
<td>32</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
</tr>
<tr>
<td>18</td>
<td>N</td>
</tr>
</tbody>
</table>

(4) Draw the atomic structure of the following atoms
   (i) Hydrogen (atomic number = 1)
   (ii) Carbon (atomic number = 6)
   (iii) Sodium (atomic number = 11)
UNIT 7 CHARACTERISTICS OF ELECTRON CLOUD

**Learning Point**
Electron cloud is the part of an atom in which there is possibility of finding electrons.

**Previous Knowledge**
Let the students discuss the special features of the electron cloud of an atom.

**Activity**
Students are encouraged to represent pictorially the characteristics of electron cloud.

<table>
<thead>
<tr>
<th>(1)</th>
<th>Nucleus is surrounded by electron cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Diagram showing Nucleus and Electron Cloud" /></td>
</tr>
</tbody>
</table>
Electron cloud is a region in which electrons are found.

Electrons in the electron cloud circle very fast around the nucleus.

Electron cloud is the electrically negative part of an atom.

Electrons circle at different levels in the electron cloud called electron shells or orbits.
**Methodology**

<table>
<thead>
<tr>
<th>(5)</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Orbit-2 Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each orbit can hold a definite number of electrons</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Orbit-8 Electrons</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Orbit-18 Electrons and so on</td>
</tr>
</tbody>
</table>

Electron Cloud is the lighter part of the atom

![Diagram](image)
Developing the basic structure of an atom
Attention

- Atoms are built up of protons, neutrons and electrons
- Protons and neutrons are present in the nucleus
- The electrons revolve in orbits around the nucleus

**Scientific Terms / Concepts**

- ELECTRON CLOUD

**CONCLUSION**

Electron cloud is the part of an atom in which there is possibility of finding electrons
EVALUATION

Answer the following questions:

(1) What do you mean by an electron cloud?

(2) Define an electron shell

(3) Give one word answer:

(i) Imaginary path through which electrons revolve

(ii) Where do you see the electrons?

(iii) What is the charge of an electron?
UNIT 8 RELATIVE MASS OF FUNDAMENTAL PARTICLES

Learning Points

(i) Protons and Neutrons have a mass approximately one

(ii) Electrons have a mass $1/1840$ relative to the mass of a Hydrogen atom

PREVIOUS KNOWLEDGE

Recalling the following concepts

- Nucleus contains protons and neutrons
- Electrons are present outside the nucleus
- Nucleus is the heavy part of an atom
- Mass of nucleus is the total mass of protons and neutrons
Students are encouraged to draw the structure of hydrogen atom.

Provide opportunity to identify the relation between the mass of Hydrogen atom and the mass of a proton (discussion and questioning)

Example

(i) No. of electrons in a Hydrogen atom. (1)
(ii) No. of protons in a Hydrogen atom. (1)
(iii) No. of neutrons in a Hydrogen atom (0)
(iv) The massive particle in a Hydrogen atom (1 Proton)

Mass of Hydrogen atom is due to the mass of one proton
Students are encouraged to prepare Table showing the mass of fundamental particles with respect to the mass of hydrogen atom.

Table 4.3 Mass of fundamental particles with respect to mass of Hydrogen atom

<table>
<thead>
<tr>
<th>Particle</th>
<th>Mass</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>Nearly equals to the mass of hydrogen atom</td>
<td>Nucleus</td>
</tr>
<tr>
<td>Neutron</td>
<td>Nearly equals to the mass of hydrogen atom</td>
<td>Nucleus</td>
</tr>
<tr>
<td>Electron</td>
<td>Very low mass as compared to protons and neutrons</td>
<td>Outside Nucleus</td>
</tr>
</tbody>
</table>

Students are encouraged to prepare Table showing the approximate relative mass of fundamental particles.

Table 4.4 Approximate relative mass of fundamental particles

<table>
<thead>
<tr>
<th>PARTICLE</th>
<th>COMPARING THE MASS WITH RESPECT TO HYDROGEN</th>
<th>APPROXIMATE RELATIVE MASS (MASS RELATIVE TO HYDROGEN ATOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>Equal to Hydrogen Atom</td>
<td>1</td>
</tr>
<tr>
<td>Neutron</td>
<td>Equal to Hydrogen Atom</td>
<td>1</td>
</tr>
<tr>
<td>Electron</td>
<td>Very Low compared to Hydrogen Atom</td>
<td>1/1840 (Mass of electron is considered as Zero)</td>
</tr>
</tbody>
</table>
Provide opportunity to compare the Diagrammatic representations of masses of proton, neutron and electron.

- Equal Mass for Proton and Neutron
- Equal Mass for Proton and Hydrogen
- Mass of electron is very small when compared to mass of proton in an atom
Attention

- Protons and neutrons in atom have almost equal mass.
- The mass of an electron is approximately zero.

Scientific Terms / Concepts

- MASS OF ELECTRON
- MASS OF PROTON
- MASS OF NEUTRON
CONCLUSION

(1) Proton and Neutron have mass approximately one
(2) Electron has zero mass

EVALUATION

(1) What is the relative mass of proton?
(2) What is the relative mass of neutron?
(3) What is the relative mass of electron?
(4) Name 2 fundamental particles having almost equal mass
UNIT 9 ATOMIC NUMBER

Learning Point

Atomic number of an element is the number of protons in each atom or the number of electrons in a neutral atom.

PREVIOUS KNOWLEDGE

Providing opportunity to recall the following concepts:

- Different atoms have different number of protons
- An atom has equal number of protons and electrons
- An atom possesses mass which is due to the presence of nucleus.
DEVELOPING THE CONCEPT OF ATOMIC NUMBER

(1) Encourage students to draw the structure of Oxygen atom

(Atomic number of Oxygen $\rightarrow 8$)

Fig. 4.25 Structure of Oxygen atom
(2) Identifying the number of protons and electrons in an oxygen atom (if atomic number is given)

Students are encouraged to calculate the number of protons and electrons in an Oxygen atom to identify the relation between the number of protons, number of electrons and atomic number.

\[
\begin{align*}
\text{Number of Protons} &= 8 \\
\text{Number of electrons} &= 8 \\
\text{Atomic number} &= 8 \text{ (Given)} \\
\text{Number of Protons} &= \text{Atomic Number} \\
\text{Number of Electrons} &= \text{Number of Protons} \\
\text{Atomic Number} &= \text{Number of Electrons} \\
(\text{Atomic Number} &= \text{Number of Electrons in a Neutral Atom})
\end{align*}
\]
Students are directed to establish the relationship between atomic number, number of protons and number of electrons from Table 4.5

Table 4.5 Atomic number, number of protons and number of electrons of elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Protons</th>
<th>Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Helium</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Carbon</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Oxygen</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Sodium</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Chlorine</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

Atomic Number = Number of Protons = Number of Electrons

(Atomic number is equal to number of electrons in a neutral atom)
Attention

- In an atom electrons and protons are equal in number.
- The number of electrons or protons are referred to as atomic number

Scientific Terms / Concepts

- ATOMIC NUMBER

CONCLUSION

Atomic number is the number of protons in an atom or number of electrons in a neutral atom

EVALUATION

(1) Define atomic number

(2) What is the relation between the atomic number and number of electrons?

(3) What is the number of protons and electrons in an atom with atomic number 17?

(4) What is the atomic number of an atom containing 10 protons?
UNIT 10 MASS NUMBER

Learning Point

Mass number of an element is the total number of protons and neutrons present in an atom.

Previous Knowledge

Providing opportunity to recall the following concepts

- Nucleus is the massive part of the atom
- Protons and neutrons are the massive particles and are present inside the nucleus
- Every atom has mass.
DEVELOPING THE CONCEPT OF MASS NUMBER

Encourage students to represent the structure of CARBON, OXYGEN AND SODIUM ATOMS

Number of protons = 6
Number of Neutrons = 6
Total Number of massive particles = 6 + 6 = 12
Therefore MASS NUMBER = 12
Provide opportunity to calculate the mass number of Oxygen atom

\[
\begin{align*}
\text{Number of protons} & = 8 \\
\text{Number of Neutrons} & = 8 \\
\text{Total Number of massive particles} & = 8 + 8 = 16 \\
\text{Therefore MASS NUMBER} & = 16
\end{align*}
\]
(3)

Figure 4.28 Structure of Sodium atom

Provide opportunity to calculate the mass number of Sodium atom

| Number of protons | = 11 |
| Number of Neutrons | = 12 |
| Total Number of massive particles | = 11 + 12 = 23 |
| Therefore MASS NUMBER | = 23 |

Identifying the relation between mass number, number of protons and number of neutrons.

\[
\text{Mass Number of Sodium atom} = \text{Number of Protons} + \text{Number of Neutrons}
\]
**ACTIVITY (2)**

Students are encouraged to recall the number of protons and neutrons in the Hydrogen atom and calculate the mass number.

| Number of Protons | = | 1 |
| Number of Neutrons | = | 0 |
| Mass Number | = | Number of Protons + Number of Neutrons |
| | | = 1 + 0 = 1 |

**Mass Number of an atom** = **Number of Protons** + **Number of Neutrons**
Methodology

Providing opportunity to find out the atomic number, Mass number, No. of electrons, no. of protons, and no. of neutrons using the Table

Table 4.6 Number of electrons, protons, atomic number and mass number of elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Electrons</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Atomic Number</th>
<th>Mass Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Helium</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Carbon</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Oxygen</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Sodium</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Chlorine</td>
<td>17</td>
<td>17</td>
<td>18</td>
<td>17</td>
<td>35</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Neon</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Magnesium</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Sulphur</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>32</td>
</tr>
</tbody>
</table>

Using Table 4.6 students write the number of electrons, protons, neutrons, atomic number and mass number of Hydrogen, Helium, Carbon, Oxygen, Sodium, Chlorine, Nitrogen, Neon, Magnesium and Sulphur
Developing the equation showing the relation between number of neutrons, mass number and atomic number

\[
\text{Number of neutrons} = \text{Mass number} - \text{Atomic number}
\]

Attention

- Mass Number is equal to the total number of protons and neutrons

Scientific Terms / Concepts

- MASS NUMBER

Conclusion

Mass number of an element is the total number of protons and neutrons present in an atom
**EVALUATION**

I. Answer the following

(1) Define mass number?
(2) The mass number of Al is 27 and atomic number is 13. Find out the number of protons, electrons and neutrons present in it?

II. Examine the table given below and find out the missing numbers (proton /electron/neutron/atomic number/mass number)

<table>
<thead>
<tr>
<th>Element</th>
<th>Number of</th>
<th>Atomic Number</th>
<th>Mass Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protons</td>
<td>Electrons</td>
<td>Neutrons</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Beryllium</td>
<td>4</td>
<td>4</td>
<td>---</td>
</tr>
<tr>
<td>Magnesium</td>
<td>---</td>
<td>---</td>
<td>12</td>
</tr>
<tr>
<td>Sodium</td>
<td>11</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sulphur</td>
<td>16</td>
<td>16</td>
<td>---</td>
</tr>
</tbody>
</table>
UNIT 11 REPRESENTATION OF AN ATOM

Learning Point

All atoms can be represented by using mass numbers and atomic numbers.

PREVIOUS KNOWLEDGE

Providing opportunities to recall the following concepts

- Symbols are short hand representations of atoms
- Symbol represents an atom of the element

Familiarizing the symbolic representation of atoms

Example 1

Symbol for Hydrogen atom → H
Atomic number of Hydrogen → 1
Mass number of Hydrogen → 1
Provide opportunity to represent the short hand notation of \textit{Hydrogen} atom

\begin{center}
\begin{itemize}
\item[(1)] \begin{tikzpicture}
    \node[above] at (0,0) {H};
    \node[below left] at (-0.5,-0.5) {1};
\end{tikzpicture}
\item[(2)] \begin{tikzpicture}
    \node[above] at (0,0) {H};
    \node[below left] at (-0.5,-0.5) {1};
\end{tikzpicture}
\end{itemize}
\end{center}

\textit{Activity (1)}

Providing opportunity to complete the Table 4.7 showing the relation between atomic number, mass number, no. of electrons, no. of protons and no. of neutrons.

\begin{table}[h]
\centering
\caption{Relation between atomic number, mass number, no. of electrons, no. of protons and no. of neutrons}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
Short Hand Form of Atom & Name of Element & Atomic Number & Mass Number & Number of Electrons & Protons & Neutrons \\
\hline
\( ^{6}\text{C}^{12} \) & Carbon & 6 & 12 & 6 & 6 & 6 \
\hline
\( ^{12}\text{Mg}^{24} \) & Magnesium & 12 & 24 & 12 & 12 & 12 \
\hline
\( ^{11}\text{Na}^{23} \) & Sodium & 11 & 23 & 11 & 11 & 12 \
\hline
\( ^{16}\text{S}^{32} \) & Sulphur & 16 & 32 & 16 & 16 & 16 \\
\hline
\end{tabular}
\end{table}
Students are encouraged to represent short hand notation of Neon, Carbon and Oxygen atoms

(1)

Symbol for Neon $\rightarrow$ Ne

Atomic Number $\rightarrow$ 10

Mass Number $\rightarrow$ 20

Short hand notation for Neon

\[
\begin{align*}
\text{20} & \quad \text{Ne} \\
\text{10} & \quad \text{or} \\
\text{20} & \quad \text{Ne} \\
\text{10} &
\end{align*}
\]
(2) Symbol for Neon $\rightarrow$ C  
Atomic Number $\rightarrow$ 6  
Mass Number $\rightarrow$ 12  

$\downarrow$  

Short hand notation for Carbon  

12  
6  
C  

Or  

12  
6  
C  

(3) Symbol for Neon $\rightarrow$ O  
Atomic Number $\rightarrow$ 8  
Mass Number $\rightarrow$ 16  

$\downarrow$  

Short hand notation for Oxygen  

16  
8  
O  

Or  

16  
8  
O
Representing the short hand notation of an element

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Number</td>
<td>Mass Number</td>
</tr>
<tr>
<td>SYMBOL</td>
<td>SYMBOL</td>
</tr>
<tr>
<td>Atomic Number</td>
<td>Atomic Number</td>
</tr>
</tbody>
</table>

**CONCLUSION**

Atoms are represented symbolically using symbol, atomic number and mass number

**EVALUATION**

*Answer the following:*

1. Find out the number of protons, neutrons and electrons present in the atoms given below.
   - Carbon, Nitrogen, Sodium
2. Draw the models of the above atoms.
3. Write down the short hand form of the following atoms.
   - (a) Oxygen  (b) Calcium
   - (c) Boron   (d) Copper
EXTENDED ACTIVITY

(1) Draw the structure of the following atoms showing the nucleus containing protons and neutrons and the orbits with the respective electrons.

(i) Lithium
(ii) Aluminium
(iii) Silicon
(iv) Calcium

(2) Prepare an album including the major contributions of J.J. Thomson, Rutherford and James Chadwick.

(3) Prepare a radio talk on the discovery and properties of electrons, protons and neutrons.
TEST YOUR KNOWLEDGE

(1) Name the following:

(i) the basic unit of matter
(ii) the sub-atomic particle with positive charge and unit mass
(iii) sub-atomic particle with no charge and unit mass
(iv) the shell that can hold a maximum of 18 electrons
(v) the scientist who discovered electrons
(v) the particles present inside the nucleus

(2) Define the following:

(i) nucleus
(ii) Nucleons
(iii) Atomic number
(iv) Mass number
(v) electron shell

(3) Name the scientists behind the discovery of electrons, protons and neutrons.

(4) Why is sodium atom electrically neutral?
(5) Explain the parts of an atom

(6) Draw the atomic structure of the following atoms:
   (a) Lithium  (b) Neon  (c) Sodium

(7) What is the relationship between atomic number and mass number?

(8) Write down the number of protons, neutrons and electrons present in:
   (i) Chlorine atom (Atomic number = 17, Mass number = 35) and
   (ii) Calcium atom (Atomic number = 20, Mass number = 40)

(9) Develop models of the nucleus for the following atoms:
   (a) Helium  (b) Chlorine

(10) Explain the charge and mass of fundamental particles in an atom.
REFERENCES


ACHIEVEMENT TEST IN CHEMISTRY
(SECONDARY LEVEL)

Time: 1 hour
Max. Marks: 25

Instructions: Answer all the questions

(A) Choose the correct answer from the bracket.

(1) Electron was discovered by ____
   (a) J.J. Thomson (b) Chadwick
   (c) Rutherford (d) John Dalton

(2) The central part of the atom is called ____
   (a) Electron (b) proton
   (c) Neutron (d) nucleus

(3) The maximum number of electrons that can be accommodated in the second shell is ____
   (a) 2 (b) 8
   (c) 18 (d) 32

(4) The sub-atomic particle with a positive charge and unit mass is ____
   (a) electron (b) proton
   (c) neutron (d) positron
(5) The shell nearest to the nucleus is ____
   (a) K               (b) L
   (c) M               (d) N

(6) Atomic number of Phosphorous is 15; its number of electrons in the atom will be ____
   (a) 2               (b) 8
   (c) 10              (d) 15

(7) The particles which are equal in number in an atom are ____
   (a) proton & neutron (b) neutron & electron
   (c) proton & electron (d) nucleus & proton

(8) The neutral particle in an atom is ____
   (a) electron         (b) proton
   (c) neutron          (d) nucleus

(9) The mass number of magnesium is 24 and has 12 electrons.
    The number of neutrons will be ____
   (a) 11               (b) 12
   (c) 21               (d) 23

(10) Basic fundamental unit of matter is ____
    (a) molecule         (b) element
    (c) atom             (d) ion

(1 x 10 = 10 marks)
Methodology

(B) Define the following:

(a) Electron shell
(b) Mass number
(c) Nucleons

\(2 \times 3 = 6 \text{ marks}\)

(C) Explain why atom as a whole is neutral with a suitable example.

\(4 \times 1 = 4 \text{ marks}\)

(D) Draw the structure of the following atoms showing the nucleus containing protons and neutrons and the orbits with the respective electrons.

(a) Nitrogen (Atomic number = 7, Mass number = 14)
(b) Silicon (Atomic number = 14, Mass number = 28)

\(2 \frac{1}{2} \times 2 = 5 \text{ marks}\)
(III) ACHIEVEMENT TEST IN CHEMISTRY

The Investigator prepared an Achievement test in Chemistry for Educationally Backward students studying in Standard IX based on the topics selected for the preparation of Remedial Teaching Materials.

74 test items were included in the draft test. Twenty multiple choice questions are included in Section A (one mark allotted for each item). In Section B there are ten questions and students have to answer in a word or in a sentence; one mark allotted for each question. Section C consisted of six short answer and one short essay type questions. Separate answer sheets were provided to students.

Item Analysis

Item analysis is concerned primarily with two characteristics of items namely item difficulty and item discriminating power. Item analysis is done to find out the suitability of the test item. Any test can be improved through selection, substitution or revision of items. The total scores obtained for each candidate was calculated by summating the scores of the individual items. The 300 response sheets were arranged in the descending order of the total scores. The top 27 per cent and bottom 27 per cent were used for item analysis.
Methodology

The scores for each item in both groups were used for calculating the Discriminating Power (DP) and Difficulty Index (DI) of each item. Items with Difficulty Index (DI) between 0.37 to 0.6 and Discriminating Power (DP) above 0.4 were selected for the final test. The selected items were printed in booklet form with all necessary instructions. A sample of the final test is given in Appendix II. (The Achievement test was prepared on the basis of the Blue print)

Validity & Reliability of the Tests

The procedure adopted for the construction of the final test provides complete evidence for the validity of the test. Face validity of the test was ascertained by subjecting the test to assessment by experts, for their comments.

The content validity of the test has been ensured through the choice of items and the test construction procedures. The reliability of the test was found out using Split-half Method. The Correlation test scores for the two halves was found out using the Pearson's Product Moment Coefficient of Correlation. The reliability of the half test was 0.72. It was corrected by Spearman-Brown Prophecy Formula. The coefficient obtained was 0.84, which shows that the test is highly reliable for the purpose.
SCORING KEY OF ACHIEVEMENT TEST

Scoring key is given in *Appendix III*

VALIDATION OF REMEDIAL PROGRAMME DEVELOPED

The suitability of Remedial Teaching Materials in Chemistry prepared for Educationally Backward students studying in Standard IX was assessed by submitting the Remedial Materials to experts in the field of Chemistry. In the light of the valid suggestions made by them, appropriate modifications and corrections were made in the Remedial Materials prepared. The responses in the schedule were then subjected to statistical analysis. The details of the Evaluation Schedule are presented in the Analysis Part (Chapter V). The list of experts are given as *Appendix IV*.

(IV) RATING SCALE FOR EXPERTS AND SECONDARY SCHOOL CHEMISTRY TEACHERS

A rating scale was prepared by the investigator to collect details regarding Remedial Instructional Materials on the following aspects:

(i) Suitability of the Remedial Instructional Materials

(ii) Availability of the resources

(iii) Practicability
The respondents were asked to go through the concepts given in the rating scale and indicate their opinion by putting a Cross mark (X) in any one of the three columns, viz., Great Extent (GE), Some Extent (SE) and Not at All (NA) [Appendix-V]

(V) **QUESTIONNAIRE FOR EXPERTS AND TEACHERS (AT SECONDARY SCHOOL LEVEL)**

(1) Questionnaire for Experts

A questionnaire covering three major aspects was prepared to collect the responses of Experts regarding the following dimensions:

(i) Necessity of Remedial teaching

(ii) Need for special training for Secondary school Chemistry teachers in Diagnostic testing

(iii) Need for special training for Secondary school Chemistry teachers in Remedial Teaching [Appendix V]

(2) Questionnaire for Teachers

A questionnaire covering six major aspects was prepared to collect the responses of the Secondary school Chemistry Teachers regarding the following dimensions:
Methodology

(i) Necessity of Diagnostic testing and Remedial Teaching

(ii) Need for special training for Secondary school Chemistry teachers in Diagnostic testing and Remedial Teaching

(iii) Extent of Practice (Diagnostic testing and Remedial teaching)

(iv) Procedures adopted in Diagnostic testing and Remedial teaching

(v) Practical difficulties likely to be encountered by teachers while practicing Diagnostic testing and Remedial teaching

(vi) The suggestions of Secondary School teachers for the effective use of Diagnostic testing and Remedial teaching in Chemistry at Secondary School Level

(Appendix VII).

(VI) GENERAL DATA SHEET

A general data sheet was prepared and administered along with the other schedules to collect personal details about the students like sex, locality of school, medium of instruction, management of school, income and educational status of parents (Appendix VIII).
4.1.2 SAMPLE SELECTED FOR THE STUDY

The details regarding the sample selected for the study are given below:

(i) The investigator selected 620 Educationally Backward students [based on the annual examination achievement test scores of all school subjects in Standard VIII, First unit test and first terminal (Examination) achievement test scores of the same students in Standard IX] studying in standard IX of different schools in Kollam district. (On the basis of Achievement tests students scoring less than 30% for all school subjects selected as Educationally Backward students).

(ii) From the 620 Educationally Backward students 300 students scoring less than 30% in Chemistry were selected for experimental study (The details are given in Table 4.8). While selecting the sample, care was taken to give due representation to variables like sex, locality, management, community, income and educational status.
Table 4.8  The Sample selected for Experimental Teaching

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of Schools</th>
<th>Sex</th>
<th>Locality</th>
<th>Management</th>
<th>Medium of Instruction</th>
<th>Educational Status</th>
<th>Type of Teaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Urban</td>
<td>Rural</td>
<td>Govt.</td>
<td>Pvt.</td>
<td>Eng</td>
</tr>
<tr>
<td>1</td>
<td>Govt. HSS, Panmanamanayil</td>
<td>7</td>
<td>13</td>
<td>20</td>
<td>20</td>
<td>20</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Govt. HSS, Chavara</td>
<td>21</td>
<td>10</td>
<td>21</td>
<td>21</td>
<td>11</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>10</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Govt. Girls H.S. Chavara</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>St. Joseph G.H.S. Neendakara</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Govt. Girls H.S, Vallikkeezhu</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Vimala Hridaya GHSS, Kollam</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>St. Aloysius HSS, Kollam</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
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<td></td>
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<td>15</td>
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<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: RT = Remedial Teaching  LM = Lecture Method
SL = Self Learning
Methodology

(iii) The Rating Scale was administered to 16 experts and 54 Secondary School Chemistry Teachers.

(iv) A questionnaire was administered to 16 Experts and 54 teachers in Chemistry at Secondary School level

(v) The general data sheet was administered to the 300 students selected for experimental study

4.1.3 EXPERIMENTAL DESIGN AND PROCEDURE

The basic experimental design adopted in the present investigation was Pre-test Post-test parallel group design.

The investigator selected 300 IX\textsuperscript{th} Standard Students from seven Secondary Schools for the Experimental study. The topics selected for experimental study were Periodic Table, Atomic Structure and Oxidation and Reduction. Care was taken to give due representation to Sex, Locality, Management of Schools, Medium of instruction and Educational status of parents.

After selecting schools for the experimental study, the investigator made necessary arrangements with the heads if the schools selected for conducting experiments.
The investigator adopted three methods for teaching the topics. The details are given below:

**Method I**

Remedial Teaching using Remedial Teaching Materials

**Method II**

Self learning Method using Remedial Teaching Materials prepared

**Method III**

Lecture Method using textual materials

The details regarding the experimental procedure are given below:

**4.1.3.1 PRE-TEST**

After selecting the schools for experimental study, the investigator made necessary arrangements with the heads of schools for conducting experiments. The investigator administered the Achievement test in Chemistry (Pre-test) to the Treatment Groups: Remedial Teaching Group-RT (N=100), Self Learning Group-SL (N=100), and Lecture Method Group-LM (N=100) to assess the entry behaviour of the Educationally Backward Students in Chemistry.
4.1.3.2 EXPOSURE TO REMEDIAL TEACHING

The Group I (Remedial Teaching Group - RT) was exposed to Remedial teaching by the investigator, using the Remedial Teaching Materials in Chemistry prepared by the investigator. Facilities were provided to students to follow the procedures and learning situations given in Remedial Teaching Materials. The previous knowledge of the students was assessed by suitable activities and learning situations. Students were encouraged to develop terms, concepts and principles through discussion, observations, experiments, activities and projects.

4.1.3.3 EXPOSURE TO SELF-LEARNING

The Group II (Self Learning Group - SL) was exposed to self learning materials after assessing the entry behaviour (Remedial Teaching Materials, prepared by the investigator for Remedial teaching Group, with necessary direction and modification was used as self learning material).

4.1.3.4 EXPOSURE TO LECTURE METHOD

The Group III (Lecture Method Group - LM) was exposed to Lecture Method using the textual material. The experimental topics were taught by the investigator systematically with the help of illustrations and audio visual aids such as charts, models and
experiments. At the end of each class, follow up activities were also given.

4.1.3.5 POST-TEST

4.1.3.5.1 Immediate Post-test

The investigator administered the Achievement test in Chemistry to the students in the Treatment Groups (RT, SL and LM) immediately after the experimental teaching to assess the terminal behaviour. (Same Achievement Test was used as Pre-test and Immediate Post-test)

4.1.3.5.2 Delayed Memory Achievement

The Achievement test in Chemistry was administered to the students of the Experimental Groups after three months to assess the Delayed memory achievement. (The same Achievement test in Chemistry was used as pre-test and delayed Memory Achievement test)

General Data sheet were also administered to the experimental Group along with Immediate Post-test.
4.1.4 STATISTICAL TECHNIQUES

The statistical techniques employed / adopted in the present study are listed below:

(1) Analysis of variance and analysis of co variance were used to study whether there is any significant difference among the Treatment Groups (RT, SL and LM) with regard to achievement in Chemistry.

(2) Test of significance of difference between percentages.
REFERENCES


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