

CHAPTER – 5

PERIODIC CLASSIFICATION OF ELEMENTS

Elements : Substances containing atoms of only one type. eg. Na, Au, Mg etc.

– There are around 118 elements known to us.

Elements are classified to make the study easy.

Dobereiner's Triads : When the elements were written in order of increasing atomic masses the atomic mass of the middle was the average of the atomic mass of the other two elements.

| eg. Elements | Atomic Mass |
|--------------|-------------|
| Ca | 40.1 |
| Sr | 87.6 |
| Ba | 136.3 |

Limitations : Only three triads were recognised from the elements known at that time.

Atomic mass of an element is the relative mass of its atom as compared with the mass of a Carbon-12 atom taken as 12 units

Newland's law of octaves :

- Based on increasing atomic mass of elements.
- When elements are arranged it was found that every eighth element had properties similar to that of the first. eg properties of sodium and Lithium are the same.

Limitations :

- Applicable only upto Calcium
- Properties of new elements couldn't fit in it

- In some cases properties of the elements were not same as defined by octave.
- Worked well only with lighter elements.

Mendeleev's periodic law :- The properties of elements are the periodic function of their atomic mass.

Mendeleev's periodic table based on the chemical properties of elements.

Contain eight vertical columns called groups and seven horizontal rows called periods form Mendeleev's periodic table.

Achievements of Mendeleev's Periodic table

- Elements with similar properties could be grouped together
- Some gaps were left for the undiscovered elements.
- Noble gases could be placed without disturbing the existing order.

Limitations:

- No fixed position for hydrogen
- No place for isotopes
- No regular trend in atomic mass.

Modern Periodic Table

Modern Periodic Law : Properties of elements are a periodic function of their atomic number.

- Atomic Number – denoted by Z and equals to the no. of protons in the nucleus of an atom.
- Modern periodic table contains 18 vertical columns known as groups and 7 horizontal rows known as periods.
- Elements in a group have valence electrons
- No. of the shells increases as we go down the group.
- Elements in a period have same number of shells.
- Each period marks a new electronic shell getting filled.
- No. of elements placed in a particular period depends upon the fact that how electrons are filled into various shells.

- Maximum no. of electrons that can be accommodated in a shell depend on the formula $2n^2$ where n is the no. of the given shell.
eg. k shell – $2 \times (1)^2 = 2$ elements in the first period L shell – $2 \times (2)^2 = 8$ elements in the second period.
- Position of the element in the periodic table tells about its reactivity.

Trends in the Modern Periodic Table

- Valency : No. of valence electrons present in the outermost shells.
- Atomic Size : Atomic size refers to radius of an atom.
- Atomic size or radius decreases in moving from left to right along a period due to increase in nuclear charge
- Atomic size increases down the group because new shells are being added as we go down the group.

Metallic Character : Metallic character means the tendency of an atom to lose electrons.

- Metallic character decreases across a period because the effective nuclear charge increases that means the tendency to lose electrons decreases.
- Metals are electropositive as they tend to lose electrons while forming bonds.
- Metallic character increases as we go down a group as the effective nuclear charge is decreasing. Non metals are electronegative. They tend to form bonds by gaining electrons.
- Metals are found on the left side of the periodic table while non-metals are towards the right hand side of the periodic table.
- In the middle we have semi-metals or metalloid because they exhibit some properties of both metals and non metals.
- Oxides of metals are basic in nature while oxides of non-metals are acidic in nature.

(Refer the table given on side page)

Gradation in Periodic Properties

| S. No. | Property | Variation across period | Reason | Variation along group | Reason |
|--------|------------------------|-------------------------|-------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------|
| 1. | Atomic size | Decreases | Due to increase in nuclear charge | Increases | due to addition of new shells. due to increase in distance between outer most electron and nucleus. |
| 2. | Metallic Character | Decreases | due to increase in effective nuclear charge tendency to lose valence electrons decreases. | Increases | due to decrease in effective nuclear charge tendency to lose valence electrons increases. |
| 3. | Non-Metallic Character | Increases | due to increase in effective nuclear charge tendency to gain electrons increases | Decreases | due to decrease in effective nuclear charge tendency to gain electron decreases |

EXERCISE

(Question Bank)

Very Short Answer type Questions.

(1 mark)

1. Write down three elements which represent Dobereiner's triad.
2. Write down two drawbacks of Newland's law of octaves.
3. Which important property did Mendeleev use to classify the elements in his periodic table.
4. Explain why the number of elements in the third period is 8?
5. Name the most metallic and most non-metallic element in the periodic table.
6. Define Isotopes.
7. What was the need for classification of elements?
8. Name two elements that have two electrons in their outermost shell.
9. How many vertical columns and horizontal rows are there in modern periodic table. What is the special name assigned to them?
10. Name the element having electronic configuration 2, 8, 2.

Short Answer type Questions

(2 Marks)

1. Why He, Ne and Ar are called inert gases?
2. Which one has greater atomic size – Cl or Br?
3. What were the drawbacks of Mendeleev's periodic table? Write any two.
4. How does the tendency to lose electrons will change in a group and why?
5. Justify the statement – Atomic size of an element decreases along a period whereas increasing down the group.
6. Why metallic oxides are basic in nature whereas Non-metallic oxides are acidic in nature.

Long Answer Type**(3 Marks)**

- How do we calculate the valency of an element from its electronic configuration?
 - How does the valency vary in a period?
 - How does the valency vary in going down a group?
- Study the variation in the atomic radii of elements given below and arrange them in an increasing order

| | | | | |
|-----|-----|-----|-----|-----|
| Na | Li | Rb | Cs | K |
| 186 | 152 | 246 | 262 | 231 |

- Name the element which has the smallest and the largest atoms.
 - How does the atomic size vary as we go down a group.
- Four elements ABCD along with their electronic configurations are given below

| | | | | | |
|--------------------------|---|------|------|---------|---------|
| Elements | – | A | B | C | D |
| Electronic Configuration | – | 2, 1 | 2, 8 | 2, 8, 1 | 2, 8, 8 |

- Now answer the following questions
 - Which two elements belong to the same period,
 - Which two elements belong to the same group
 - Which element out of A and C is more reactive and why?

Long Answer Type Question**(5 Marks)**

- Write down five major differences between Mendeleev periodic table and modern periodic table.
- Examine elements of the third period and classify them as metals and non metals.
 - On which side of the table do you find metals and why.