

## 4.PERIODIC TABLE

### Classification of Lavoisier.

It was Lavoisier who first made an attempt to classify the elements. He tried to classify the known elements into metals and non metals. But he could not classify metalloids. It was the major limitation of his classification.

### Triads of Dobereiner

Dobereiner, classified the elements into small groups of three elements having similar properties. He named the groups as 'triads'.

(Li,Na,K), (Ca,Sr,Ba), (Cl,Br,I) are a few examples for triads. In each triads, the mass number of the second element was approximately equal to the average mass numbers of first and third element.

Example: Triads (Li,Na,K)

Atomic mass of Li = 7

Atomic mass of K = 39

Average of these two =  $(7+39)/2 = 23$

The mass number of sodium which is the second element is 23.

He was not able to classify all the elements into triads. It was one of the major limitations of his classification.

**Law of Octaves:** It was the scientist Newlands who proposed the Law of Octaves. He arranged the elements in the increasing order of atomic mass. He noticed that the properties of the every 8<sup>th</sup> element is the repetition of the those of the first and he compared this to seven notes of music.

But the elements with higher atomic mass did not obey this rule. This was the one of the limitations of the law.

### Mendeleev's Periodic Table

It was the Russian scientist Mendeleev who framed a table for the first time for the classification of elements. He arranged the elements in the increasing order of their atomic masses. He named the horizontal rows of the table as period and the vertical columns as groups.

**Mendeleev's Periodic Law:** The physical and chemical properties of elements are periodic functions of their atomic masses. It was the periodic law of Mendeleev.

### Advantages of Mendeleev's periodic table.

\* Elements having similar properties were included in the same group.

\* He could correct the wrongly determined atomic masses of some elements.

Example:- Atomic mass of Beryllium was redetermined from 14 to 9.

\* The existence and properties of some elements that were not discovered then was predicted.

### Limitations of Mendeleev's periodic table.

\* Elements with entirely different physical properties were included in the same group.

Example: Hard metals like copper and silver were included in the group where soft metals Lithium, Sodium and potassium etc. are present. (Group.1).

\* Hydrogen which is a non metal was included along with the metals in first group.

\* Increasing order of atomic mass was not strictly followed.

Example: Cobalt having comparatively larger mass number is placed before Nickel.

### Modern Periodic Table.

Mosley understood that the atomic number is the basis of physical and chemical properties of element and he modified the periodic law.

According to this, *the chemical and physical properties of elements are periodic functions of their atomic numbers.*

Moseley framed modern periodic table by arranging the elements in the ascending order of their atomic number. There are 18 groups and seven periods in modern periodic Table.

### Electronic configuration and position of element in Periodic Table.

There is relation between the number of electrons present in the outermost shell of an atom and its position in the periodic table. In the case of 1<sup>st</sup> and 2<sup>nd</sup> group elements, the number of electrons in the outermost shell indicates their group number.

Example.1.  ${}_{11}\text{Na} - 2,8,1$ . There is one electron in the outermost shell of sodium atom. Sodium belongs to 1<sup>st</sup> group.

Example.2.  ${}_{20}\text{Ca}$ : 2,8,8,2 There are two electrons in the outer most shell of Calcium. It belongs to 2<sup>nd</sup> group. In the case of atoms in the groups from 13 to 18, when 10 is added to the number of outermost electrons give their group number.

Example.  ${}_{13}\text{Al}$  – 2,8,3  $10+3 = 13$  is the group of Aluminium.  
The number of shells in an element is the period it belongs.

Examples. There are three shells in Sodium atom. Sodium belongs to third period. Similarly Calcium has four shells and it belongs to 4<sup>th</sup> period.

### **Family of Elements.**

As the elements belonged to the same group exhibits similar properties, elements in each group is considered as a family. The names of the families are given below.

Group.1: Alkali metals. Group.2: Alkaline earth metals.

Groups from 3 to 12: Transition elements.

Group.13: Boron family. Group.14: Carbon family. Group.15: Nitrogen family Group.16: Oxygen family.

Group.17: Halogens Group.18: Noble gases.

### **Representative Elements.**

The elements present in the groups 1&2 and the groups from 13 to 18 are called representative elements. All kinds of elements; metals, non metals and metalloids & the elements in all the states (gas, liquid and solid) are present in these groups. That is why they are called representative elements.

### **Noble gases.**

The elements belonged to 18<sup>th</sup> group of modern periodic table is called noble gases. As there are 8 electrons in their outermost shell, noble gases do not take part in chemical reaction with other substance or element.

Example.  ${}_{10}\text{Ne}$ : 2,8  ${}_{36}\text{Kr}$ : 2,8,18,8

### **Transition Elements.**

The elements included the periodic table from 3 to 12<sup>th</sup> groups are called transition elements. All these elements are metals. They form coloured compounds. Transition elements exhibit similarity in periods as well as in groups.

### **Inner transition Elements.**

The elements in the 6<sup>th</sup> period carrying atomic numbers from 58 to 71 are called Lanthanide. And the elements in the 7<sup>th</sup> period having atomic numbers from 90 to 103 are called Actinide.

These 28 elements are collectively known as Inner Transition Elements.

Inner transition elements are arranged in two separate rows below the periodic table.

### **Size of atoms in periods and Groups.**

When it is moved down along the group, the number of shells in the atoms of the elements increases and hence its size. For example, the first element Hydrogen in the first group has one shell and the second element Lithium has two shells and third atom Sodium has three shells and so on. Therefore size of Hydrogen, Lithium, Sodium etc.. increases respectively.

In periods, when we move from left to right the positive charge of the nucleus gradually increases. So the electrons in the shells are strongly attracted towards the nucleus and hence the size of atoms decreases.

### **Ionisation Energy**

The amount of energy required to liberate an electron from the outermost shell of an isolated atom is called ionisation energy. Ionisation energy of an atom depends on its size and the charge of the nucleus. Ionisation energy of atoms decreases with increase of their size. So ionisation energy of elements decreases when it is moved from top to bottom along a group. Similarly ionisation energy increases from left to right along a period.

### **Electronegativity.**

Electronegativity is the ability of an atom to attract the bonded electrons towards it. Electronegativity of elements decreases from top to bottom in groups and increases from left to right in periods.

### **Metalloids.**

Elements showing the properties of both metals as well as non metals are called metalloids. Silicon (Si), Germanium (Ge) Arsenic (As) etc. are examples for metalloids.

**Periodic Trends in the periodic Table.**

Trends	Down the group	Across the period from left to right
Size of atom	increases	decreases
Metallic character	increases	decreases
Non metallic character	decreases	increases
Ionisation Energy	decreases	increases
Electronegativity	decreases	increases

**PRACTICE QUESTIONS**

1. Name the scientist who first made an attempt to classify the elements?
2. How did Lavoisier classify the elements?
3. Who did classify the elements as Triads?
4. Give one example for Triads of Dobereiner.
5. What is the relation between the mass numbers of the Elements in a Triads.
6. What are Triads?
7. What was the major drawback of the classification of Dobereiner?
8. Name the scientist who noticed the repetition of the properties of element as seven notes of music?
9. Who did propose the law of octaves?
10. Name the scientist who framed a table for the first for the classification of elements?
11. State the periodic Law of Mendeleev.
12. It was in columns and rows Mendeleev arranged the elements. What the columns and periods were called?
13. How many groups and periods were there in Mendeleev's periodic table?
14. Write down three advantages of Mendeleev's periodic table.
15. The classification of Mendeleev led to the correction of the mass number of a few elements. Give one example for the same.
16. On what basis did Mendeleev classify the elements?
17. What were the major disadvantages of Mendeleev's periodic table?
18. State modern periodic Law.
19. Who did frame the modern periodic table?
20. How the elements are arranged in modern periodic table?
21. How many groups and periods are there in modern periodic table?
22. In modern periodic table, where the elements having similar properties are included?
23. Which is the shortest period in the modern periodic table? How many elements are there in it?
24. Write down the electronic configuration of Oxygen ( ${}_{8}\text{O}$ ) and Potassium ( ${}_{19}\text{K}$ ) and find out its period and group.
25. Which elements are called Alkaline earth metals?
26. What is called the elements in the first group?
27. Which are transition elements? Give three features of these elements.
28. The elements in which groups are called representative elements?
29. How many families are there in modern periodic table? Elements of which group is called halogens?
30. What is known as 18<sup>th</sup> group elements? What is their the main feature?
31. What is called the elements which are arranged in two separate rows below the periodic table?
32. In which period do Actinide belong?
33. Lanthanide in the ..... period and Actinide in the ..... are collectively called as inner transition elements.
34. Which elements are called rear earths?

35. How does the size of atom vary when we move downward along a group?
36. Why the size of atoms increase while moving downward along a group?
37. In which side of the periodic table is the largest atom located?
38. "As the shell number decreases when we move from left to right along the period, the size of the atoms decreases". Correct this statement.
39. Energy required to ionise an atom is called ionisation Energy. How does it vary along the period and group?
40. How does size of an atom relate with ionisation energy?
41. What is the relation between ionisation energy and metallic property?
42. How does the non metallic property of elements change from left to right along a period?
43. In which side of the periodic table the elements having higher metallic properties are arranged?
44. The ability of atoms to attract the electrons that take part in chemical bonding is known as Electronegativity. How does it vary along a group?
45. Sodium is the left most element and Argon is the right most element in the third period. Which is possessed highest ionisation energy?
46. What are metalloids. Give two examples.
47. A part of periodic table is given. The symbols are not real.

	1																	18	
1	A	2																	
2	B	E												I		K	L	M	
3	C	F	3	4	5	6	7	8	9	10	11	12	J					N	
4	D					G		H											

- a. How many electrons are there in the outermost shell of the elements I & J?
- b. Find the halogens from the table.
- c. Which is the larger atom E or F?
- d. Which are the transition elements?
- e. How many representative elements are there in this table?
- f. Which is the most electronegative element in the period 2?
- g. Find the element in the third period having highest metallic property.

## PRACTICE QUESTIONS AND ANSWERS

1. Name the scientist who first made an attempted to classify the elements?

**Ans.** Lavoisier.

2. How did Lavoisier classify the elements?

**Ans.** He classified the elements as metals and non metals.

3. Who did classify the elements as Triads?

**Ans.** Dobereiner.

4. Give one example for Triads of Dobereiner.

**Ans.** Lithium, Sodium and Potassium.

5. What is the relation between the mass numbers of the Elements in a Triads.

**Ans.** The average of the mass numbers of first and third element of a triad is almost equal to the mass number of second element.

6. What are Triads?

**Ans.** It is the small groups of three elements having similar properties. It was the Scientist Dobereiner who classified the elements as Triads.

7. What was the major drawback of the classification of Dobereiner?

**Ans.** He couldn't group all the elements into Triads.

8. Name the scientist who noticed the repetition of the properties of element as seven notes of music?

**Ans.** Newlands.

9. Who did propose the law of octaves?

**Ans.** Newlands.

10. Name the scientist who framed a table for the first for the classification of elements?

**Ans.** Mendeleev.

11. State the periodic Law of Mendeleev.

**Ans.** The physical and chemical properties of elements are the periodic functions of their atomic masses.

12. It was in columns and rows Mendeleev arranged the elements. What the columns and periods were called?

**Ans.** Columns were called groups and rows were called periods.

13. How many groups and periods were there in Mendeleev's periodic table?

**Ans.** Group - 8. Period - 6

14. Write down three advantages of Mendeleev's periodic table.

**Ans.** i. Elements of similar properties were included in the same group.

ii. He could correct the wrongly determined atomic masses of some elements.

iii. The existence and properties of some elements that were not discovered then was predicted.

15. The classification of Mendeleev led to the correction of the mass number of a few elements. Give one example for the same.

**Ans.** The mass number of Beryllium was redetermined to 9 that had been wrongly determined as 14.

16. On what basis did Mendeleev classify the elements?

**Ans.** On the basis of the atomic masses of the elements.

17. What were the major disadvantages of Mendeleev's periodic table?

**Ans.** i. Elements having entirely different properties were included in the same group.

Example. In the first group, hard metals like copper and silver were grouped with soft metals like Lithium, Sodium and Potassium.

ii. The ascending order of atomic masses was not strictly followed.

Example: Cobalt, the comparatively massive element was placed before Nickel.

18. State modern periodic Law.

**Ans.** The physical and chemical properties of elements are periodic functions of their atomic numbers.

19. Who did frame the modern periodic table?

**Ans.** Moseley.

20. How the elements are arranged in modern periodic table?

**Ans.** In modern periodic table, the elements are arranged in the ascending order of their atomic number.

21. How many groups and periods are there in modern periodic table?

**Ans.** Groups: 18, Periods: 7

22. In modern periodic table, where the elements having similar properties are included?

**Ans.** In groups.

23. Which is the shortest period in the modern periodic table? How many elements are there in it?

**Ans.** Period.1. It consists only two elements. (Hydrogen and Helium)

24. Write down the electronic configuration of Oxygen ( ${}_{8}\text{O}$ ) and Potassium ( ${}_{19}\text{K}$ ) and find out its period and group.

**Ans.**  ${}_{8}\text{O} - 2,6$  Group :  $6+10 = 16$

Period: As there are two shells, it belongs to the period 2.

${}_{19}\text{K} - 2,8,8,1$  Group : 1 Period: 4

25. Which elements are called Alkaline earth metals?

**Ans.** Elements in the second group.

26. What is called the elements in the first group?

**Ans.** Alkali metals.

27. Which are transition elements? Give three features of these elements.

**Ans.** The elements included in the groups from 3 to 12 are called transition elements.

Features: i. All these elements are metals. ii. Their compounds are coloured.

iii. They show similarity in periods as well as in groups.

28. The elements in which groups are called representative elements?

**Ans.** The elements in the groups 1&2 and from 13 to 18 groups are known as representative elements.

29. How many families are there in modern periodic table? Elements of which group is called halogens?

**Ans.** Nine. 17<sup>th</sup> group.

30. What is known as 18<sup>th</sup> group elements? What is their main feature?

**Ans.** Noble gases. They do not react with other substances.

31. What is called the elements which are arranged in two separate rows below the periodic table?

**Ans.** Inner transition elements.

32. In which period do Actinide belong?

**Ans.** Period.7

33. Lanthanide in the ..... period and Actinide in the ..... are collectively called as inner transition elements.

**Ans.** Six and seven.

34. Which elements are called rare earths?

**Ans.** Lanthanide.

35. How does the size of atom vary when we move downward along a group?

**Ans.** Size increases.

36. Why the size of atoms increase while moving downward along a group?

**Ans.** Due to the increase of the number of shells.

37. In which side of the periodic table is the largest atom located?

**Ans.** Left side.

38. "As the shell number decreases when we move from left to right along the period, the size of the atoms decreases". Correct this statement.

**Ans.** When it is moved from left to right along a period, its size decreases due to the increase of positive charge of the nucleus.

39. Energy required to ionise an atom is called ionisation Energy. How does it vary along the period and group?

**Ans.** Ionisation energy decreases along the group as we move from top to bottom and it increases along the period from left to right.

40. How does size of an atom relate with ionisation energy?

**Ans.** Ionisation Energy decreases with size of the atom.

41. What is the relation between ionisation energy and metallic property?

**Ans.** Metallic property decreases with increase of ionisation energy.

42. How does the non metallic property of elements change from left to right along a period?

**Ans.** Non metallic property increases.

43. In which side of the periodic table the elements having higher metallic properties are arranged?

**Ans.** On the left side.

44. The ability of atoms to attract the electrons that take part in chemical bonding is known as Electronegativity. How does it vary along a group?

**Ans.** Electronegativity decreases from top to bottom along a group.

45. Sodium is the left most element and Argon is the right most element in the third period. Which is possessed highest ionisation energy?

**Ans.** Argon.

46. What are metalloids. Give two examples.

**Ans.** Elements that exhibits metallic property as well as non metallic property are called metalloids.

Examples. Germanium (Ge) and Silicon (Si)

47. A part of periodic table is given. The symbols are not real.

	1																	18	
1	A	2																	
2	B	E												I		K	L	M	
3	C	F	3	4	5	6	7	8	9	10	11	12	J					N	
4	D					G		H											

a. How many electrons are there in the outermost shell of the elements I & J?

b. Find the halogens from the table.

c. Which is the larger atom E or F?

d. Which are the transition elements?

e. How many representative elements are there in this table?

f. Which is the most electronegative element in the period 2?

g. Find the element in the third period having highest metallic property.

**Ans.**a. 3

b. M & N

c. F

d. G & H

e. A, B, C, D, E, F, I, J, K, L, M, N (12 numbers)

f. M

g. C