PERIODIC CLASSIFICATION OF ELEMENTS

LEARNING OBJECTIVES:

- Early Attempts for classification
- Dobereiner classifications
- Newlands classifications
- Mendeleeves classifications
- Moseleys classification of modern periodic table

REAL LIFE APPLICATIONS:

Periodic table has several real time applications as each element has its own identity & each element form various bonds with various elements

For example :-

for example, Iridium is used to develop cancer treatment, hypodermic needles, helicopter spark plugs and fountain pen nibs brings the element alive with meaning.

Periodic trends have several applications which includes production of Polymer Electrolytes in the manufacture of Lithium-Ion Batteries,

Similarly In medicinal field, it is used to prevent various deficiency diseases

For Example, you can prevent iodine deficiency by using iodised salt (most off-the-shelf table salt is iodised). This is done by substituting some of the chlorine you would normally eat in table salt with iodine.

Lithium salts are used to treat bipolar disorder by substituting lithium for sodium in the central nervous system.Introduction:

You must have visited a library. There are thousands of books in a large library. In spite of this if you ask for a particular book, the library staff can locate it easily.

ILLUSTRATION-1

Where is the daily life use of milk of megnisia

a) agriculture b) pharmacitical industries c) factories d) All of the above

SOLUTION-1

pharmacitical industries

How is it possible?

In library, the books are classified into various categories and sub-categories. They are arranged on shelves accordingly. Therefore location of books becomes easy. Let us come back to chemistry. Most of the matter that we see, touch and feel is made up of compounds. There are millions of such compounds existing presently. You will be surprised to know that compounds are formed as a result of various permutations and combination of only about 110 odd elements. To study properties of these elements and their compounds is a tough task.

How then was this task simplified?

This task was simplified by simple classification of elements into few groups. Instead of studying each and every element or compounds, we just learn the properties of groups.The attempts were made by different scientists to classify elements based on their properties.

Necessity for classification of elements

Following are the reasons for the classification of elements.

(a) The classification may help to study them better.

(b) The classification may lead to correlate the properties of the elements with some fundamental property that is characteristic of all the elements.

(c) The classification may further reveal relationship between the different elements.

Early attempts for classification

i) Greeks classification:

The ancient Greeks erroneously suggested that all matter consisted of four elements only - Earth, air fire and water. But, their idea could not be supported by the experiments.

ii) Classification on the Basis of Valency

Realising the importance of valency in chemistry, an attempt was made to classify elements on this basis.

However, such classification suffers from the following drawbacks.

1. Several elements have variable valency, e.g., iron has a valency of 2 and 3, copper 1 and 2, tin 2 and 4, lead 2 and 4, etc. This makes the position of such elements uncertain.
2. Such classification does not explain the diverse nature of elements having the same valency. For example, both sodium and chlorine are monovalent, but they are quite different from each other in chemical behaviour. Sodium is a strongly ***electropositive** metal whereas chlorine is a strongly ***electronegative** nonmetal.

ILLUSTRATION:-II

Define elctopositivity and electro negativity

SOLUTION:-II

Any element lose of electrons its call electropositivity and any element gain of electron its call electro negativity

ILLUSTRATION:-III

In the modern periodic table, magnesium is surrounded by elements with atomic numbers 4, 11, 13 and 20. Identify the elements. Which of these have chemical properties resembing magnesium?

SOLUTION:-III

The element $_{12}Mg$ is present in the centre of elements having atomic numbers 4, 11, 13 a 20.The atomic number 4 and 20 resemble m nesium because they belong to same group ing same. Number of valence electro

	Be=4 (2, 2)	
Na=11 2, 8,11	Mg=12 (2, 8,2)	A1=13 (2, 8, 3)
	Ca=20 (2, 8, 8, 2)	

iii) Major contributions leading to the development of modern periodic table

i) Dobernier's classification:

In the year 1829, Johnn Woifgang Dobereiner,a German scientist, was the first to classify elements. He grouped the elements that showed similar chemical properties in to groups of three called Triads.The distinctive feature of a triad was the atomic mass of the middle element.When elements were arranged in order of their increasing atomic mass,the atomic mass of the middle element was approximately the arithmetic mean of the other two elements of the triad.

Examples of Dobereiner's Triads

Significance of Dobereiner Triads:

This classification of elements in triads had greater significance in predicting the atomic mass and properties of the middle element. However, only a few elements could be arranged in such triads.

Ex : Li - 7 , Na - 23, K -39 .....> $\frac{7+39}{2}=23$

ILLUSTRATION-4

a) Name two elements you would expect to show chemical reaction similar to sodium. What is the basis of your choice?

b) Arrange the elements present in that group in the increasing order of reactivity. Give reason.

SOLUTION-

a) Lithium and and potassium show same chemical properties as sodium because all the three elements poses same number of valence electron and belong to same group, that is, IA group.

b) Increasing order of reactivity Li<Na<K<Rb<Cs. This is due to decrease in ionisation potential values from top to bottom in a group.

Defects of Triad Classification:

(i) Quite a large number of similar elements could not be grouped into triads.
Example: Iron, manganese, nickel, cobalt, zinc and copper are similar elements but cannot be placed in the triads.

(ii) It was possible that quite dissimilar elements could be grouped into triads. As Dobereiner failed to arrange the then known elements in the form of triads, his classification was not very successful.
Example: For example, carbon (12), nitrogen (14) and oxygen (16) can form a triad but their properties are entirely different from each other.

TEACHING TASK

I. Single Correct Choice Type:

1. Which of the following is an achievement of the triads classification?
   1) Relation between all properties of an element.
   2) Relation between only atomic weights of an element.
   3) Relation between the properties of same elements.
   4) Relation between the atomic mass of all elements.

2. Atomic weights of three elements in a dobereiner triad are x, 81, 127.Find the missing atomic weight
   1) 104 2) 35 3) 23 4)46

3. The atomic weight of Lithium is : 1)
   4 2) 7 3) 5 4) 10

4. (i) Elements with both metallic and non-metallic characters are called_____.
   (ii) Arrangement of elements into groups of three is called _____.

	(i)	(ii)
1)	Active metals	Octaves
2)	Metallic elements	Metals
3)	Triads	Metals
4)	Metalloids	Triads

II Multi Correct Choice Type:

5. The _____ was the basis of the classification proposed by Dobereiner.
   1) Atomic number 2) Atomic weights 3) Atomic mass 4) None

III. Reasoning Type:

6. ***Statement I:*** Iron exhibits a variable valency.
   Statement II: Chlorine is a mono-valent element.
   1.Both Statements are true, Statement II is the correct explanation of Statement I.
   2.Both Statements are true, Statement II is not correct explanation of Statement I.
   3.Statement I is true, Statement II is false.
   4.Statement I is false, Statement II is true

IV. match the following

	Column-I	**Column-II**
7.	a) Dalton	1) C,N,O
	b) Dobereiner traid	2) periodicity
	c) Cylyndrical table of elements	3) de-chancourtois
	d) Reccurance of characterstics properties of elements	4) Newland
		5)qualitative to a quantitative basis

V. True or False

8. The element in between lithium and potassim in Doberener's classification is sodium
9. In newland's classification elements are arranged in an increasing order of their atomic weight

LEARNER'S TASK

BEGINNERS (Level - I)

I. Single Correct Choice Type:

1. The law of triads was proposed by :
   1) Dobereiner 2) Newlands 3) Lother Meyer 4) Chancourtois
2. The law of triads is applicable to :
   1) Lithium, beryllium, boron 2) Fluorine, chlorine, bromine
   3) Chlorine, bromine, iodine 4) Sodium, potassium, rubidium
3. Select the following pair of elements in which their arithmetic mean of atomic weights is equal to the atomic weight of strontium.
   1) Lithium, Barium 2) Sodium, Calcium
   3) Calcium, Barium 4) Sodium, Barium
4. Arithmetic meaning of atomic weights of Li, Na and K is _____
   1) 23 2) 11 3) 22 4) 19

ACHIEVERS (Level - II)

II. Multi Correct Choice Type:

5. Which of the following is / are correct statement (s) :
   1) Sodium is a strongly electropositive metal
   2) Chlorine is a strongly electronegative metal
   3) Chlorine is a strongly electronegative non-metal
   4) Sodium is a strongly electropositive non-metal

6. Which of the following elements not placed in Dobereiner triad classification
1) Iron 2) Nickel 3) Zinc 4)Copper
7. Which of the following three elements can form triad ,but their properties are entirel different from each other
1) Carbon 2) Nitrogen 3)Oxygen 4) Hydrogen.

III. Reasoning Type:

8. **Statement I:** Classification of elements is not useful to reveal the relationship between the different elements.
Statement II: Classification of elements may lead to correlate the properties of the elements with some fundamental property that is characteristic of all the elements.
1.Both Statements are true, Statement II is the correct explanation of Statement I.
2.Both Statements are true, Statement II is not correct explanation of Statement I.
3.Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

IV. Comprehension Type:

Necessity for classification of elements Following are the reasons for the classification of elements.
(1) The classification may help to study them better.
(2) The classification may lead to correlate the properties of the elements with some fundamental property that is characteristic of all the elements.
(3) The classification may further reveal relationship between the different elements

9. The elements which are malleable, ductile and good conductors of heat and electricity are named as:
1) Non-metals 2) Metals 3) Metalloids 4) None
10. The elements which are brittle, bad conductors of heat and electricity are named as:
1) Non-metals 2) Metals 3) Metalloids 4) None
11. The elements posses both metallic and non metallic characteristics are named as: 1)
Non-metals 2) Metals 3) Metalloids 4) None

V. Matrix Match Type:

12.

Column-I	**Column-II**
a) Lavoisier classified ultimate	1) Table of the relative weights particles of the of gaseous and other bodies
b) Dobernier classified	2) 81.25
c) Dalton classified	3) Metals and non-metals
d) Mean atomic mass of Ca, Sr & Ba	4) Triads
	5) 88.1

Vi. True or False

13. In Dobereiner's classification the atomic weight and the properties of the first element are almost equal to the average of those of the 2^{nd} and 3^{rd} elements of a triad

EXPLORERS (Level - III)

I. Descriptive type questions:

1. Explain how Dobereiner elements are grouped as triads?
2. What is the necessity to classify the elements?
3. Give some examples of Dobereneir triads?
5. Give the limitations of Dobereiner 's classification?

RESEARCHERS (Level - IV)

1. The element in between lithium and potassium in Dobereiners calssification is
   1)Sodium 2) magnesium 3) chlorine 4)none
2 If three elements X,Y,Z form a triad and atomic weights of x,z are 9&40respectively,then the atomic weight of an element y is--------
   1)18 2)24.5 3)20 4)36.1
3. Traid classification of elements had greater signifivance in predicting the ------ and---------- of the middle element

Newland's classification:

JOHN ALEXANDER REIN NEWLAND.

In 1864 , English chemist John Newland arranged the known 56 elements in an increasing order of their atomic weights.

He was a chemist as well as alover of music.

When elements are arranged in increasing order of their atomic mass the eighth element resembles the first in physical and chemical properties just like eighth note on a musical scale resembles the first note.

The eighth element after lithium is sodium. It is similar to lithium in many of its hemical properties. Similarly, the eighth element after sodium is potassium, whose properties are similar to sodium. The eighth element from fluorine is chlorine both of which are similar in their properties. The eighth element from nitrogen is phos phorus and both these elements are similar in properties.Based on this observa tion, Newland stated his law of octaves thus However, a very important conclusion was made that there is some systematic relationship between the order of atomic masses and the repetition of properties of elements. This gave rise to a new term called **Periodicity**. It is the recur rence of characteristic properties of elements arranged in a table, at regular intervals of a period.

H	F	Cl	Co/Ni	Br	Pd	I	Pt/Ir
Li	Na	K	Cu	Rb	Ag	Cs	Tl
Ga	Mg	Ca	Zn	Sr	Cd	Ba, V	Pb
B	Al	Cr	Y	Ce, La	U	Ta	Th
C	Si	Ti	In	Zr	Sn	W	Hg
N	P	Mn	As	Di, Mo	Sb	Nb	Bi
O	S	Fe	Se	Ro, Ru	Te	Au	Th

ILLUSTRATION:

What is periodicity

SOLUTION:

Particular property repeated in a system by the regular intervels. These intervels are 2, 8, 8, 18, 18, 32.

Achievements of the Law of octaves

(i) The law of octaves was the first logical attempt to classify elements on the basis of atomic weights.

(ii) Periodicity of elements was recognised for the first time.

Defects of Law of Octaves

(i) This law could be best applied, only up to the element calcium.

(ii) Newly discovered elements could not fit into the octave structure.

TEACHING TASK

I. Single Correct Choice Type:

1. Newland's arranged in elements:
   1) Increasing order of atomic number 2)Decreasing order of atomic number
   3) Increasing order of atomic mass 4) Decreasing order of atomic mass
2. In Newland's law of octaves the eighth element after lithium is:
   1) Beryllium 2) Boron 3) Carbon 4) Sodium
3. In Newland's law of octaves the eighth element after flourine is:
   1) Chlorine 2) Bromine 3) Oxygen 4) Sulphur
4. Name the scientist, who noticed that the eighth element was similar properties of the first element is:
   1) Newland 2) Dalton 3) Doberiener 4) Lother mayer

II. Multi Correct Choice Type:

5 Which of the following is correct statement?
   i) Law of octaves could be best applied only upto the element calcium.
   ii) Newly discovered elements could not fit into the octave structure.
   iii) Periodicity of element was recognised for the first time by Newland.
   iv) Law of octaves was based on atomic weights.
6. According to Newland's, which of the following elements having similar properties.
   1) Lithium, Sodium and Potassium 2) Sodium, Chlorine, Bromine
   3) Chlorine, Flourine 4) Potassium, Flourine

III. Comprehension Type:

John A. R. Newlands arranged the elements increasing order of the atomic weights, the eighth element properties are similar to first element properties, similar to the octave of music.

7. The law of octaves was proposed by J.A.R. Newlands is based on:
   1) Atomic volume 2) Atomic number
   3) Atomic weight 4) None
8. Identify the correct achievement in Newlands classification of elements.
   1) The law of octaves was the first logical attempt to classify elements on the basis of atomic weights.
   2) Periodicity of elements was recognised for the first time.
   3) This law could not be best applied, up to the element calcium.
   4) Newly discovered elements could fit into the octave structure.
9. Identify the correct failures in Newlands classification of elements.
   1) The law of octaves was the first logical attempt to classify elements on the basis of atomic weights.

2) Periodicity of elements was recognised for the first time.
3) This law could be best applied, only up to the element calcium.
4) Newly discovered elements could not fit into the octave structure.

IV. True or False

10. In newland's classification elements are arranged in an increasing order of their atomic weight
11. The law of octaves was the first logical attempt to classify elements on the basis of atomic weights.

LEARNER'S TASK

BEGINNERS (Level - I)

I. Single correct option

1. According to newland 's classification , the properties of 3rd element will find similarity with those of the ..... element
   1)11 2)12 3)8 4)1
2. Periodicity of elements was recognised for the first time in
   1)Lother meyer 2)newlands classification
   3)Dechancourtois 4)none

ACHIEVERS (Level - II)

II. Matrix Match Type:

3. **Column-I** (Based on law of octaves) **Column-II**

Column-I	Column-II
a) The eighth element after Flourine is	1) Phosphorus
b) The eighth element after Oxygen is	2) Chlorine
c) The eighth element after Boron is	3) Sulphur
d) The eighth element after Nitrogen is	4) Aluminium
	5) Calcium

III. True (or) false

4. Periodicity of the element was recognised for the first time by new land

EXPLORERS (Level - III)

1. What are the achivements and the limitations of new land classification
2. What is newlands classification of elements

RESEARCHERS (Level - IV

1. The systamatic relationship between the order of the atomic masses and repitation of properties of elements are called
   1) Periodicity 2) Atomicity 3) both 4) None
2. The elements known at the time of Newlands
   1) 56 2) 63 3)50 4)none
3. Li,Na,K,Rb elements are known as ----------

1) electropositive alkali metals 2) electropositive alkaline earth metals
3) Halogens 4)None

4 The eighth after lithium is ------- and the eighth afer sodium is-------
1)Sodium ,potassium 2)potassium ,calcium
3)phosphorous, magnesium 4)none

Mendeleev's Periodic Table :

With the failures of many attempts, there was a choatic mess in the arrangement of elements. An end to this chaotic mess of elements was put by Mendeleev.

Dmitri Ivanovich Mendeleev, a Russian chemist was the first for successful arrangement of elements. In 1869, he published a periodic table of elements .

Mendeleev's Periodic Law:

He studied the chemical properties of all 63 elements known at that time. On the basis of their properties, he proposed that when elements are arranged in the increasing order of their atomic masses, the elements with similar properties appear at regular intervals or periods, i.e., chemical properties of the elements are a periodic function of their atomic masses (atomic weights).

Later on when Mendeleev came to know about the work of Lother Meyer, he integrated the two statements (Lother Meyer's and his own statement) in the form of a law called Mendeleev Lother Meyer periodic law or simply Mendeleev's periodic law. This law states that:

What is Mendeleev's periodic table?

Mendeleev (1871) arranged all the then known 63 elements in the increasing order of their atomic masses. The arrangement of elements was made in horizontal rows (called periods) and vertical columns (called groups). This arrangement showed that the elements having similar chemical properties came directly under one another in the same group. This arrangement of elements was called Mendeleev's periodic table. Thus Mendeleev's periodic table can be defined as an arrangement of elements in the increasing order of their atomic masses in different groups and periods.

ILLUSTARTION:

How was the problem of placement of isotpes in mendelevee's periodic table overcome in modern periodic table?

SOLUTION:

Modern periodic table was based on the atomic numbers. Since isotopes have similar atomic numbers, the problem of placement of isotopes was solved.

Main features of Mendeleev's periodic table

(i) In Mendeleev's table, the elements were arranged in **vertical columns, called groups.**
(ii) There were in all eight groups: Group I to VIII. The group numbers were indicated be *Roman numerals*. i.e., I, II, III, IV, V, VI, VII & VIII.
(iii) Except VIII, every group is further divided into subgroups i.e., A and B. Groups VIII occupy three triads of three elements each, *i.e.*, in all nine elements
(iv) The properties of the elements in same group or subgroup are similar.
(v) There is no resemblance in the elements of subgroups A and B of same group except valency.
(vi) The **horizontal rows** of the periodic table are known as **periods.**

(vii) There were seven **periods**, represented by Arabic numerals 1 to 7. To accommodate more elements, the periods 4, 5, 6 and 7 were divided into two halves. The first half of the elements are placed in the upper left corner and second half in the lower right corner. For example, the elements occupying the box corresponding to group I and period are potassium (K) and copper (Cu), K is written in the top left corner, while Cu iswritten in the lower right corner.

(viii) A period comprises the entire range of elements after which the properties repeat themselves.

(ix) In a period, the properties of the elements gradually change from metallic to nonm metallic while moving from left to right.

(x) There were gaps left in the periodic table. Mendeleev left these gaps knowingly, as these elements were not discovered at that time.

Contributions of Mendeleev's Periodic Table:

Systematic study of elements:

Mendeleev's Periodic table simplified the study of elements. It became useful in studying and remembering the properties of a large number of elements, in a simpler way. This is because the elements showing similar properties belonged to the same group.

Prediction of new elements:

While arranging the elements, in increasing order of atomic mass, Mendeleev left three blanks for elements that were not discovered at that time. He was able to predict the properties of these unknown elements more or less accurately. He named them eka-boron, eka-aluminium and eka-silicon. He named them so, as they were just below boron, aluminium and silicon in the respective sub-groups. Eka-boron was later named as scandium, eka-aluminium as gallium and eka-silicon as germanium.

Correction of atomic masses:

Mendeleev's periodic table helped in correcting the atomic masses of some of the elements, based on their positions in the periodic table. For e.g., atomic mass of beryllium was corrected from 13.5 to 9. Atomic masses of indium, gold, platinum were also corrected.

Moseley's modification and the Modern periodic table

Basis for Moseley's classification : Discovery of radioactivity, isotopes, isobars and atomic nuclei led Moseley (in 1913) to change the periodic law as given by Mendeleev. He observed regularities in the characteristic X-ray spectra of the elements and found that plot $\sqrt{\nu}$ vs. Z (atomic number) is straight line while $\sqrt{\nu}$ vs. A (atomic weight) is not, and $\sqrt{\nu} = a(Z - b)$, where a and b are constants that arc same for all elements. Thus he concluded that atomic number is more fundamental property than atomic weight.

LONG FORM OF PERIODIC TABLE

Mosely proposed the modern periodic law which states that "the physical and chemical properties of elements are the periodic functions of their atomic numbers" Thus according to the modern periodic law , if the elements are arranged in th order of their increasing atomic numbers,, the elements with similar properties are repeated after certain regular intervals

Description of moden or the long form of the periodic table:

The long form of the periodic table (also called Bohr's table) consists of horizontal rows called periodic and vertical columns called group or families. There are 7 periods and 16 groups in the periodic table. The groups from I to VII are divided into sub group as 'A' and 'B' VIII group consists of 3 vertical columns. All noble gasses are kept in zero.

First Period: This period has only two elements, hydrogen and helium which have only one energy level or shell. This period is called very short period.

Second Period: Elements have two shells. It has 8 elements Li 3 to Ne 10. The elements of this period are called bridge elements.Short periods.

Third Period:This period also had 8 elements -Na11 to Ar 18. The second and third period are called short periods. These elements have 3 shells. The elements of this period are called typical elements.

Fourth Period: This period has 18 elements (K 19 to Kr 36). They have 4 energy levels or 4 shells. These are long periods.

Fifth Period: This period has 18 elements (Rb 37 to Xe 54). They have 5 energy levels or 5 shells. long periods.

Sixth Period: This periodic has 32 elements (Cs 55 to Rn 86). They have six enery levels or 6 shells. The fourth, fifth and sixth periods are called very long periods.

Seventh Periods:

This in an incomplete period which at present has 19 elements which starts with Fr 87. All these elements are radioactive. Out of these, the naturally accuring radioactive. elements are Fr 87, Ra 88, Ac 89, Th 90,Pa 91, and U 92 while the remaining elements after uranium,i.e, Np 93 to Db 105 are artificially prepared radioactive elements and these are clled transuranic elements. Atoms of these elements have 7 energy level or 7 shells.

Groups:

i. Groups IA (Akhili metals), II A (alkaline earth metals) IIIA (boron family) IVA (Carbon family) VA (Pnicogens), VIA (Chalocogens), VIIA (Halogens) contain metals, non-metals and metalloids, These elements are called representative elements because their valence electrons represent their group numbers.

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ILLUSTARTION:

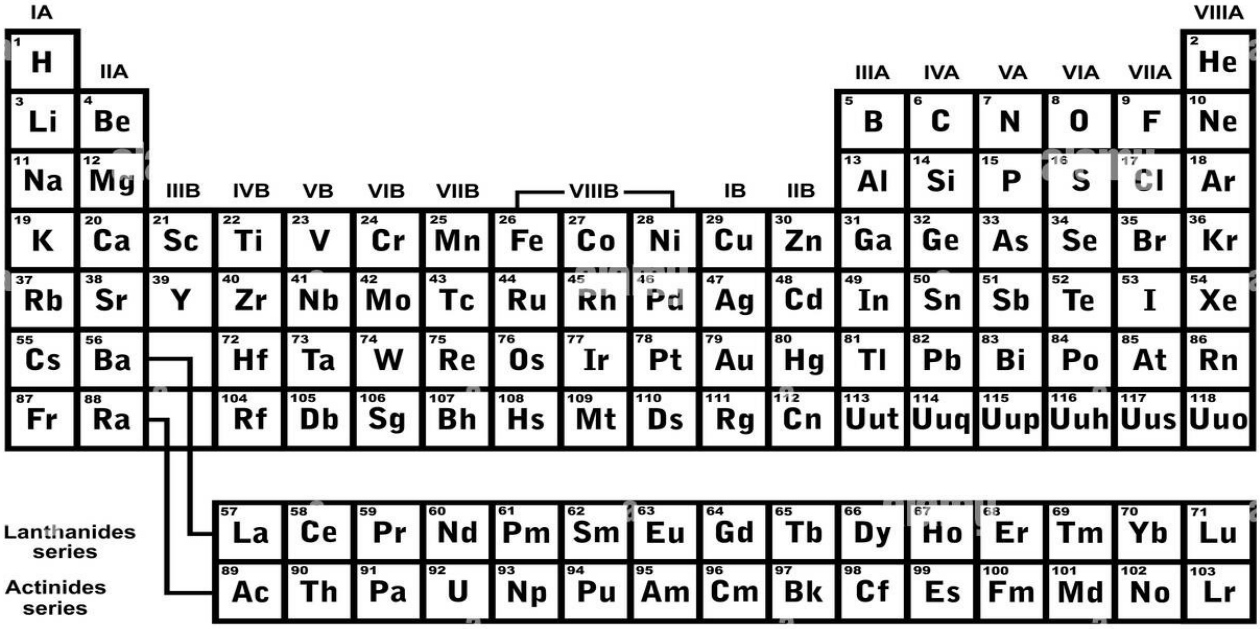
What are the basic difference between Mendeleev's periodic table and modern periodic table?

SOLUTION:

i) Mendeleev's periodic table was based on atomic weght whereas modern periodic table was based on atomimc number.

ii) Mendeleev's periodic table consis of eight group and seven periods whereas modern periodic table consis of eighteen group and seven periods.

PERIODIC TABLE OF THE ELEMENTS



CLASSIFICATION OF ELEMENTS ON THE BASIS OF THEIR ELECTRONIC CONFIGURATION

Elements are classified in to four blocks on the basis of differentiating electron enters in to which subshell of the main shell.

a) s-Block Elements b) p-Block Elements

c) d-Block Elements d) f-Block Elements

S - BLOCK ELEMENTS :

Differentiating electrons enter into s-subshell.

S-sublevel can accomadate 2-electrons, hence S-block elements are arranged in two groups, IA, IIA.

General electronic configuration is **ns^{1-2}.**

H, Li, Na, K, Rb, Cs, Fr elements (alkali metals) have 1 electron in their outer shell with **"ns^1"** general outer shell configuration, they belongs to IA.

Be, Mg, Ca, Sr, Ba and Ra (Alkaline Earth elements) have 2-electrons in their outer shell, with **"ns^2"** general outer shell configuration, they belongs to IIA.

Most of these are active metals.

Most of these compounds are ionic.

These are powerful reducing agents.

p- BLOCK ELEMENTS :

Differentiating electrons enter into p-subshell.

The general outer shell configuration of P-block elements. $ns^{1-2}np^{1-6}$

p-block elements are arranged in 6-groups they are from IIIA to VII A and O-group.

g) p-block contains metals, non-metals and metalloids.

d-BLOCK ELEMENTS:

If differentiating electrons enter the'd' subshell of (n-1) shell (i.e, d-orbitals of penultimate shell), the elements of this class are called **"d-block elements"**.

The general electronic configuration of d-block elements is **$(n-1)d^{1-10}\ ns^{1\text{ or }2}$**

(n = outer shell).

d-Block elements are placed between s-block and p-block and they are also called transition elements.

d-Block elements are further classified into following transition series on the basis of which **(n-1)d** is being filled.

f-BLOCK ELEMENTS:

If differentiating electrons enter into f-subshell of Anti penultimate i.e., (n-2) shell, the elements of this class are called **f-block** elements.

The general electronic configuration **$(n-2)f^{1-14}\ (n-1)d^{0\text{ or }1}\ ns^2$ (n = outer shell).**

These f-block elements are placed at the bottom of the periodic table in two rows, they are 4f series and 5f series. The properties of 4f-series elements are similar to Lanthanum they are known as Lanthanides (or) Lanthanons or rare earths.

ILLUSTRATION:

What are the general electronic configuration of S- block elements and P-block elements.

SOLUTION:

The general electronic configuration of s- block elements is ns^{1-2}

The general electronic configuration of p- block elements is ns^2np^{1-6}

ILLUSTARTION:

The electronic configutration of element is 2, 8, 8,1 these electron configuration belongs to which period and group.Whats is the element name?

SOLUTION:

The element group is 1A and period is 3rd period the element name is sodium.

TEACHING TASK

I. Single Correct Choice Type:

1. What are the indefinite positions of hydrogen element in Mendaleev's periodic table?
   1) IB, IIIB, 2) IA, IIB 3) IA, VII A 4) VII A, III B
2. The number of elements in period 1 of the periodic table is:
   1) 2 2) 8 3) 18 4) 32
3. Mendeleev's periodic table could not predict the following:
   1) Isobars 2) Isotopes 3) Isotones 4) None
4. According to Mendeleev's periodic table transition elements are placed in:
   1) VIII group 2) VII group 3) VI group 4) None of these

5. The two places left empty by Mendeleev in the periodic table were for:
   1) Aluminium and Silicon 2) Gallium and Germanium
   3) Arsenic and Antimony 4) Antimony and Bismuth
6. The long form periodic table is also known as
   1) Bohr's periodic table 2) Lother meyer's table
   3) Mendeleef's table 4) Sommerfield table
7. Number of short period in mendeleeve table is
   1) 2 2) 3 3) 4 4)1
8. In mendeleeve table triad of VIII group is
   1) Ru, Rh Pd 2) Cu, Ag, Au 3) N,O,F 4) Tl, Pb, Bi
9. Which of the following is not an anamalous pair
   1) S, Cl 2) Te,I 3) Co, Ni 4) Ar, K
10. Which of the following electronic configurations in the outermost shell is characteristic of alkali metals?
    1) $(n-1)s^2p^6,ns^2p^1$ 2) $(n-1)s^2p^6,d^{10},ns^1$ 3) $(n-1)s^2(n-1)p^6,ns^1$ 4) $ns^2\ p^6d^1$
11. Lanthanum belongs to ------ block
    1) s-block 2) p-block 3) d-block 4) f-block

II. Multi Correct Choice Type:

12. Pickout the liquid elements from the follwing at room temperature
    1) Hg 2) Cs 3) Br 4) I
13. Which of the following elements position cannot be justify on the bases of atomic weights
    1) rare earth elements 2) alkali metals
    3) transition elements 4) actinides
14. The atomic numbers of few elements are given below: Which of them can be considered as trans fermium elements?
    1) 101 2) 105 3) 93 4) 96
15. Which of the following is correct about s-block elements?
    1) The elements in which the electron enters the s-subshell of their outermost energy level are called s-block elements.
    2) This block is situated at the extreme left of the periodic table.
    3) This block contains elements of groups IA and IIA.
    4) None of the above.

III. Reasoning Type:

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

16. ***Statement I:*** Atomic weight of eka-boron is 44
    Statement-II: Atomic weight of scandium is 43.79
17. **Statement-I:** According to mendeleev periodic properties of elements is a fuction of their atomic masses
    Statement-II: Atomic number is equal to the number of protons
18. **Statement-I:** Second period consist of 8 elements
    Statement-II: Number of elements in each period four time the number of atomic orbitals available in energy level that is being filled.

IV. True or False

19. The horizontal rows of the period table are knowns as periods
20. There where seven periods represented by arabic numericals 1 to 7
21. He named this missing elements as eka boran, eka aluminum and eka silicon later on this elements where discover and named as scanidum, gallium, germinum respectivily

V. COMPREHENSION TYPE

Mendeleev left some gaps in his periodic table for some of the then unknown elements based on the properties of the other elements present in the same group. He named these missing elements as Eka boron , Eka aluminium and Eka silicon. Later on , these elements were discovered and named as scandium , gallium and germanium respectively.

22. Gallium was named by Mendeleev as
    1) Eka - aluminium 2) Eka -silicon 3) Eka -germanium 4)Eka-zinc
23. Which element was named eka -silicon in mendellev's classification of elements?
    1) Germanium 2) Gallium 3)Indium 4) Thalium
24. The element cited as an example to prove the validity of mendeleev's periodic table is:
    1) Ge 2)Sc 3) Ga 4) All of these

LEARNER'S TASK

BEGINNERS (Level - I)

I. Single Correct Choice Type:

1. The number of elements known at that time when Mendeleev arranged that in the periodic table was:
   1) 63 2) 60 3) 71 4) 65
2. The horizontal rows and vertical columns of a periodic table are called _____ and _____ respectively.
   1) Groups, periods 2) Periods, groups
   3) Blocks, partitions 4)Sections,segments
3. Which of the following pair is against to Mendeleev's periodic laws.
   1) Chromium, manganese 2) Sodium, magnesium
   3) Copper, zinc 4) Tellurium, iodine
4. Mendeleev's periodic table is based on:
   1) Atomic weight 2) Atomic number 3) Atomic volume 4) All the above
5. In the modern periodic table, the elements are arranged in.
   1) Increasing mass 2) Increasing volume
   3) Increasing atomic number 4) Alphabetically
6. Elements of I B and II B are called
   1) Normal elements 2) Transition elements
   3) Alkaline earth metals 4) Alkali metals.
7. The elements which are characterised by the outer shell electronic configuration from ns^1 to $ns^2\ np^5$ are collectively called as:
   1) Transition elements 2) Inner transition elements
   3) Representative elements 4) Actinides
8. The outer most orbit of an element "X" is partially filled with electrons in 's' and 'p' subshells.

Then that element is

1) an Inert gas 2) a Representative element
3) a Transition element 4) an Inner transition element

ACHIEVERS (Level - II)

II. Multi Correct Choice Type:

9. Which of the following is correct regarding Mendeleev's periodic classification?
   1) Similarities in the chemical properties of the elements.
   2) Decreasing order of atomic weight of the elements.
   3) Variation in the chemical properties of the elements.
   4) Increasing order of atomic weights of the elements.
10. Group 18 (or zero group) elements are also called as:
    1) Inert gases 2) Rare gases 3) Noble gases 4) Inactive gases

III. Reasoning Type:

1. Both Statements are true, Statement II is the correct explanation of Statement I.
2. Both Statements are true, Statement II is not correct explanation of Statement I.
3. Statement I is true, Statement II is false.
4. Statement I is false, Statement II is true.

11. *Statement I:* Lithium belongs IA group elements.
    Statement-II: In Mendeleev's periodic table except VIII group, every group is further divided into sub-group.
12. *Statement I:* In Mendeleev's periodic table, the elements were arranged in vertical columns, called groups.
    Statement-II: The properties of element in same group and sub-group are different.
13. *Statement I* : VI A group elements are called chalcogens.
    Statement II : Pnicogens belongs to VA group.

IV. True or False

14. Groups: IA,IIA,IIIA,IVA,VA,VIA,VIIA, contain metals, non-metals in metalliods
15. 6 th period has 32 elements
16. 7th period is an incomplete period which its present has 19 elements which starts with Fr 87

V. Comprehension Type:

Mendeleev's periodic table simplified the study of elements. It become useful in studying and remembering the properties of a large number of elements, in a simpler properties belonged to the same group. The physical and chemical properties of the elements are the periodic functions of their atomic weight.

17. Which one of the following is the defect in Mendeleev's periodic table:
    1) The position of hydrogen is not correctly defined.
    2) In certain pairs of elements like Ar (40) and K (39), Co (58.9) and Ni (58.6); Te (127.6) and I (126.9) and arrangement was not justified.
    3) Mendeleev's table was unable to explain the cause of periodicity among elements.
    4) All the above.
18. Which of the following element(s) atomic mass is corrected in Mendeleev's periodic classification of elements:

1) Indium 2) Gold 3) Platinum 4) All the above

19. According to Mendeleev's periodic classification of elements
1) Eka-boron was named as scandium. 2) Eka-aluminium was named as gallium
3) Eka-silicon was named as germanium 4) All the above.

VI. Matrix Match Type:

20.

Column-I	**Column-II**
a) Hydrogen	1) 2nd period
b) Lithium	2) 4th period
c) Sodium	3) 1st period
d) Potassium	4) 3rd period
	5) 5th period

21.

Column-I	**Column-II**
a) Sc	1) Eka silicon
b) Ga	2) Eka boron
c) Ge	3) Eka aluminium
d) Fe	4) 56

EXPLORERS (Level - III)

1. Write about the merits of mendeleev periodic table?
2. What is the mendeleevs periodic law?
3. What is the modern periodic law?
4. what is meant by representative elements? give examples
5. which periods are called the short periods and which periods are called long periods? why?

RESEARCHERS (Level - IV)

1. The elements of groups, IA, IIA, IIIA, IVA, VA, VIA and VIIA are collectively called.
1) Noble gases 2) Representative or normal elements
3) Transition elements 4) Inner transition elements
2. The most significant contribution towards the development of periodic table was made by:
1) Mendeleev 2) Avagadro 3) Dalton 4) Cavendish
3 The first elements of rare earth metals is
1) cerium 2) actinium 3) uranium 4) lanthanum
4. A pair of atomic numbers which belong to s - block are
1) 7, 15 2) 6, 12 3) 9, 17 4) 3, 12
5. Lanthanides are group of elements in which the differentiating electron enters into
1) s-sub level 2) d-sub level 3) p-sub level 4) f-sub level
6. According to ---- law, the sqare root of the freequency (v) of a spectral line of the charcteristic relation of an element is a linear function of its atomic number (z)
7. The law of triads is applicable to
1) lithium,beryllium applicable to 2) flourine, chlorine bromine
3) chlorine,bromine,iodine 4) sodium,bromine, rubidium
8. The number of elements in each of the long period of periodic table is
1) 32 2) 18 3) 8 4) 36
9. Which of the following is a typical element
1) Li 2) Na 3) F 4) N
10. Which of the following is a bridge element
1) Be 2) Cl 3) K 4) P

11. The propertice of the elements are the periodic function of their atomic number. The statements is giving by
1) N.Bohr 2) J.W.Dobbereine 3) D.I. Mendelvee 4)H.H.J. Moseley

12. Which one of the following groups contains metals, non metalsas well as metalloids
1) IA 2) IIA 3) IVA 4) VIIA

13. The electron configuration of the lement is $Is^2\ 2s^2\ sp^6\ 3s^2\ 3p^3$. What is the atomic number of the element which is just below the above element in the periodic table
1) 33 2) 34 3) 31 4) 49

14. which among the following is the reason for the periodicity in the properties of elements
1)similarity in atomic mass 2)similarity in atomic number 3) similarity in atomic radius 4)none

KEY

LECTURE TASK-I

I I-1 2-2 3-2 4-metalloids,triads 5-2,3.6-2 7)a-5,b-1,c-3,d-2 8-True 9-True

STUDENT TASK-I

LEVEL-I

I. 1-1 2-3 3-3 4-1

LEVEL-II.

5-1,3 6-3,4 7-1,2,3 8-4 9-2 10-1

. 11-3 12-3,4,1,5 13-false

LEVEL-IV

1-1 2-2, 3- atomic mass & proprties

LECTURE TASK-II

I. 1-3 2-4 3-1 4-1

II. 5-1,2,3,4 6-1,3

III. 7-3 8-2 9-4

IV. 10-T 11-T

STUDENT TASK-II

LEVEL-I

I. 1-3 2-2

LEVEL-II

3-2,3,4,1 4-true

LEVEL-IV

1-3 2-1 3-1 4-1

LECTURE TASK-III

1-3 2-1 3-2 4-1 5-2 6-1 7-1 8-1 9-1 10-3 11-3

12-1,3, 13-1,3,4 14-1,2, 15-1,2,3 16-B

. 17-2 18-2 19-T 20-T 21-T 22-1 23-1 24-4

STUDENT TASK-III

LEVEL-I

I 1-1 2-2 3-4 4-1 5-3 6-2 7-3 8-2

LEVEL-II.

II 9-1 ,4 10-1,2,3,4 11-2 12-3 13-2 14-T 15-T 16-T 17-4 18-4 19-4

VI 20-3,1,4,2 21- 2,3,1,4

LEVEL-IV

1-2 2-1 3-1 4-4 5-4 6- MOSELEY