

Periodic Classification of Elements

Q1) What is the need for classification of elements?

Ans) a) Classification helps to study elements better

b) It correlates the properties of elements with some fundamental properties of all elements

c) It reveals relationship between one and another element.

Q2) Describe the early attempts of classification.

Ans a) Classification into metals and nonmetals—Elements were broadly divided into metals and nonmetals on the basis of a set of physical and chemical properties

Reason for rejecting this classification---Only two major groups were formed elements which exhibited intermediate properties (metalloids) were not taken care of. There was no justification for more reactive and less reactive elements.

b) Classification on the basis of Dobereiner's Triads—J W Dobereiner attempted to classify elements in the form of triads

A triad is a group of three elements with similar physical and chemical properties arranged in increasing order of their atomic masses.

The law of triad states that atomic mass of the middle element of a triad is the arithmetic mean of the other two elements.

Eg--- Triad 1

Elements	Li	Na	K
At mass	7	23	39
Average	$7 + 39 = 46 / 2 = 23$		

Other examples are

Chlorine (35.5) Bromine (80) Iodine (127)

Achievements of classification into triads---It highlighted the relationship between atomic masses and the properties of elements.

Drawbacks of this classification—Quite a large number of elements could not be grouped into triads and there was also a chance of grouping together dissimilar elements.

c) Classification on basis of Newlands law of octaves---New land arranged the elements in increasing order of atomic masses and found that elements with similar properties reoccurred each time after every seven elements like the repetition in musical notes.

1 H	2 Li	3 Be	4 B	5 C	6 N	7 O
8 F	9 Na	10 Mg	11 Al	12 Si	13 p	14 S
15 Cl	16 K	17 Ca				

Acheivements of law of octaves -The periodicity as a property of an element was first time recognized(repition of properties)

Drawbacks --It coluld not include all elements and it did not extend beyond calcium. Transition elements were not recognized. Hydrogen was placed with fluorine and chlorine and this positioning was not justified. Coppers position along with alkali metals was not justified as they are completely different in properties .Also some slots had two elements placed together, for example cobalt and nickel are in the same slot and they are placed along with halogens (F, and Cl)

Q3) Define Mendeleev's Periodic Law— "The physical and chemical properties of all elements are the periodic functions of their atomic masses.

Q4) Give a short description of mendeleev's Periodic Table

1) There are eight vertical columns called groups. Groups from one to seven are subdivided into subgroups A and B

2) The horizontal rows are called periods , the properties of elements in a period change from a metal to a nonmetal.

3) There are few gaps ,which were left by mendeleev knowingly as he predicted the properties of those elements which he said would be discovered.

4) He named the unknown elements

Eka -aluminium-----which is gallium

Eka- silicon ----which is germanium

Eka -boron---which is scandium

Q5) State the merits of Mendeleev's classification over earlier or previous classifications

Ans) It was first time that the elements were placed in groups and periods

It is based on fundamental property of atomic mass.

Some gaps were left, which accelerated the progress of discovering these elements as their properties were predicted by him

Also some errors in the atomic masses of some elements were corrected.

When noble gases were discovered they were placed in a new column without disturbing the existing order.

Q6) State modern periodic law

"The physical and chemical properties of elements are periodic functions of their atomic number"

Q7) State the defects in Mendeleev's periodic table.

1) Anomalous pairs---Some elements with higher atomic mass were kept before those with lesser atomic mass

Eg- Argon(39.9) and potassium(39.1)

Eg- Cobalt(58.9) and Nickel (58.6)

2) Position of hydrogen -Hydrogen is not provided a definite place.

3) Isotopes---Since the table was designed on basis of atomic masses, there was no place assigned to isotopes.

4) There was hardly any relation between the properties of alkali metals copper, silver and gold or between halogens and magnesium yet they were placed together.

5) The concept of transition elements was defective therefore elements of VIII group were regarded transition elements.

6) No attempt was made to keep metals separate from nonmetals.

Q8) Describe the long form of periodic table.

1) Elements are arranged in groups and periods based on their atomic numbers(electronic configuration)

2) The rare earths (lanthanides and actinides) are placed separately outside the table.

3) There are 7 periods. The number of periods to which the element belongs is given by the number of its outermost shell. eg if outermost shell is M -shell then the element belongs to third period

4) There are 18 vertical columns.

Group I -alkali metals

Group 2-alkaline earth metals

Group 17 -halogens

Group 18-noble gases.

5) Metals are placed on the left side and the nonmetals are placed on the right .

Q9) Discuss the position of hydrogen in the periodic table

OR -how does hydrogen resemble alkali metals and halogens in its properties

Ans 9) Hydrogen has single electron in its valence shell and forms a positively charged this is similar to alkali metals such as sodium .There fore hydrogen resembles alkali metals. However its chemical properties are not similar to alkali metals. Hydrogen is gaseous and forms covalent compounds similar to those of halogens such as CCl_4 and CH_4 Now due to these reasons hydrogens place is not decided .It is placed separately above alkali metals as a special element just because of same electronic configuration.

Q10) Discuss the trends in properties in periods and groups.

(this qts will be asked in the form of application qts but the basic concepts will be same)

a) Valence electrons---As we move from left to right in a period the number of valence electrons increases from 1 to 8.(the number of period corresponds to the number of shells occupied by the electrons around the nucleus)

elements-	Li	Na
EC-	2, 1	2, 8, 1
Period	2	3

b) Valency -With respect to hydrogen the valency increases from 1 to 4 and then decreases to 1

Period 3	Na	Mg	Al	Si	P	S	Cl	Ar
hydride	NaH	MgH_2	AlH_3	SiH_4	PH_3	H_2S	HCl	--
valency	1	2	3	4	3	2	1	

With respect to oxygen valency increases from 1 to 7

Period 3	Na	Mg	Al	Si	P	S	Cl	Ar
oxides	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7	--

valency	1	2	3	4	5	6	7	0
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c) Size of the atom—The atomic radius decreases as we move from left to right in a periodic table this is due to increase in nuclear attraction.

There is an increase in one proton in the nucleus and one electron in the valence shell. This increase in positive charge increases the nuclear attraction and pulls the extra nuclear electrons inwards. Thus the size of the atom decreases.

d) Metallic and nonmetallic character---As we go from left to right metallic character decreases and non metallic character increases.

e) Reactivity ---As we move from left to right in a period the reactivity first decreases and then increases.

This is because the size of the atom decreases and therefore for metals losing electrons become difficult but for nonmetals gaining electrons becomes easy.

Eg -In third period

Na has one electron in its outermost shell . it loses this electron easily but Mg has 2 electrons in its outermost shell -it also loses 2 electrons but not as easily as sodium (this is because size of Na atom is larger than Mg atom therefore nuclear attraction in Na is lesser than Mg)

Metals which lose electrons easily are said to be more metallic and more reactive.

Eg In third period

Size of P atom is larger than size of Cl atom .Both are electron acceptors .The incoming electron is attracted easily by chlorine because its size of atom is smaller and hence more attraction from the nucleus .On the other hand Phosphorous also accepts electrons but not as easily as chlorine .

Non metals which gain electrons easily are said to be more reactive and more non metallic

SUMMARY

Periods---left to right ----->

Size of atom-----decreases---->

Metallic nature-----decreases->

Non metallic nature ---increases->

Reactivity ----Decrease (in case of metals and increases in case of nonmetals)----->

Q10) Discuss the trends in properties in Groups .

Ans)10-a) Valence electrons-The number of valence electrons remain the same as we go from top to bottom in a group.

elements in group 2 have-- -2 electrons in valence shell
group 13 has ---3 electrons in valence shell
group 14 has ---4 electrons in the valence shell
group 15 has----5 electrons in the valence shell
group 16 has ---6 electrons in the valence shell
group 17 has ---7 electrons in the valence shell
group 18 has ---8 electrons in the valence shell
(except helium)

b)Valency ---Valency remains same as we move down the group.

c)Size of the atom-As we move from top to bottom in a group the size of the atom increases.The increase in size of atom is due to increase in number of shells .As we move down in a group the atomic number increases this results in an increase in number of electrons and thus a new shell is added to accommodate them.

d)Metallic and Non metallic nature ---As we go down the group the metallic nature increases this is due to increase in the atomic size (losing electrons is easier when the size of the atom is larger)
The Nonmetallic nature decreases as we go down the group due to increase in size(accepting electrons becomes difficult)

Similarly as we go down the group the chemical reactivity of metals increases and that of nonmetals decreases.

- Note -the melting n boiling points of metals decreases down the group and that of nonmetals increases down the group

Q10) State the merits of long form of periodic table

Ans 10) 1)The classification is based on the atomic number which is the most fundamental property of the elements

2)It relates the position of an element and its electronic configuration

3)It explains similarities and variations in properties of elements

4) It clearly separates active metals nonmetals, inert gases, metalloids and transition metals

5)Inert gases are kept separately at the end of each period.

Q11) State the defects in long form of periodic table

Ans 1)Position of hydrogen still remains undecided.

2)Lanthanides and actinides are not included in the main body of the periodic table.

Q12. How does the electronic configuration of an atom relate to its position in the modern periodic table?

Ans -The group number of the elements having upto 2 valence electrons is equal to the number of valence electron.

The group number of elements having more than 2 valence electrons is equal to the number of valence electron plus 10.

The number of electrons shells in an atom of an element is equal to the period to which it belongs.

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