<u>Chemistry : Class X</u> Ch 5: Periodic Classification of Elements

Classification: Categorization of element on the basis of common properties is known as classification.

Need for Classification: There are around 118 elements existing on earth. To study each and every element it is required to reduce the study to certain number of categories, hence classification is required.

Periodicity of properties: Repetition of properties after regular intervals is known as Periodicity of Properties.

Dobereiner's Law of triads:

Dobereiner grouped elements into groups of three known as triads. The importance of these triads was that when these three elements were arranged in the increasing order of their atomic masses, then the atomic mass of the middle element was almost equal to the average of the atomic masses of the first and the third element. Example: Li, Na & K Cl, Br & I Ca, Ba & Sr Limitations:

- Only 3 triads were formed out of the elements discovered by that time.
- No scope for new elements which could be discovered later.

Newland's law of octaves:

Newland arranged the elements according to the increasing order of their atomic masses. He found that properties of every eight element were similar to that of the first element. According to his law the properties of the elements get repeated after every eight element like the notes of music. Limitations:

- This law was found to be applicable only up to Calcium.
- Only 56 elements were discovered by that time and Newland assumed that no more elements would be discovered in future.
- To fit the elements according to his law he placed more than one element in same cell.

Mendeleev's periodic table

Introduction: Mendeleev studied the chemical properties of various elements and grouped them on the basis of the similarity of these properties like types of oxides, hydroxides, chlorides etc... He found that all the elements got arranged according to increasing order of the atomic masses automatically. On the basis of this he formulated a law:

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

Table: The Mendeleev's Periodic table or the Classical form of the Periodic table is based on the Mendeleev's Periodic law and had the elements arranged according to the increasing order of the atomic masses.

Acheivements: Mendeleev left some gaps in his table and predicted the properties of the elements which could be discovered later. Limitations:

- Position of Hydrogen was not finalized as it showed the properties of both Alkali Metals as well as Halogens.
- Position of Isotopes was not confirmed.
- No place for Noble gases was suggested which were discovered later.
- There were Gaps in the Table.
- To match the properties, some elements with higher Atomic mass were kept before the elements of lower Atomic Mass.

Modern periodic table

Introduction: To overcome the limitations of Mendeleev's Periodic table, Henry Moseley found that Atomic Number was the more fundamental property to arrange the elements as compared to Atomic mass and so formulated the following Law on the basis of which Modern Periodic Table was formed.

Modern's Periodic law: The properties of the elements are the periodic function of their atomic numbers.

Features:

- Groups: The vertical columns in the Periodic Table are known as Groups. There are 18 groups in the Periodic Table.
- Elements in each group have same number of Valence electrons. As we move down along a group, a new shell is added at every step.

Eg. Group I – Alkali Metals					Group II – Alkaline Earth Metals							
	Κ	L	М	Ν		K	L	М	Ν			
Hydrogen:	1				Beryllium:	2	2					
Lithium:	2	1			Magnesium:	2	8	2				
Sodium:	2	8	1		Calcium:	2	8	8	2			
Potassium:	2	8	8	1								
Group XIII – Bo	ron Family				Group XVIII – Noble gases							
	Κ	L	М	Ν		K	L	М	Ν			
Boron:	2	3			Helium:	2						
Aluminium:	2	8	3		Neon:	2	8					
					Argon:	2	8	8				

- Periods: The horizontal rows in the Periodic Table are known as Periods. There are 7 periods in the Periodic Table.
- Every element in a period has same valence shell and as we move from left to right in a period, an electron is added in the same shell at each step. Eg. First Period: 2 elements: Valence Shell K

	K		Κ				
Hydrogen	1	Helium	2				
Second Period: 8	elements: Valence	e Shell - L					
K L	K L	K L	K L	K L	K L	K L	K L
Li 2 1	Be 2 2	B 2 3	C 2 4	N 2 5	O 2 6	F 2 7	Ne 2 8
Third Period: 18	elements: Valence	Shell - M					
K L M	KLM	[10] K L M	KLM	KLM	KLM	KLM	KLM
Na 2 8 1	Mg 2 8 2	[10] Al 2 8 3	Si 2 8 4	P 2 8 5	S 2 8 6	Cl 2 8 7	Ar 2 8 8

• Man made elements: The elements upto Z=92 are naturally occurring elements and the elements above this are synthetic or manmade elements.

• The elements Technicium (Tc) and Promethium (Pm) are formed form radioactive elements.

Periodicity of properties

1) Atomic Size: The radius of the atom from the centre of the nucleus to the valence shell.

- Along the Group: Atomic Size increases down the group due to increase in a shell at every step.
- Along the Period: Atomic size decreases as we move left to right in a period due to increase in effective nuclear charge at every step. This increase is a result
 of regular increase in number of electrons and protons which leads to increase in the net attractive force between the valence electrons and the nucleus.

2) Valency: Combining capacity of the atom

- Along the Group: The valency remains the same down the group as the number of valence electrons are same.
- Along the Period: The valency follows a pattern as we move left to right in a period. It first increases form 1 4 and then decrease to 0.

3) Metallic and Non metallic Character: The ability to lose electrons is known as the metallic character and the ability to gain electrons

- is known as the Non Metallic Character.
 - Along the Group: Metallic Character increases down the group due to increase in size of the atom at every step. So removal of Valence electrons becomes easy as they are far away from the nucleus. On the other hand the non metallic character decreases down the group.
 - Along the Period: Metallic Character decreases as we move left to right along a period due to decrease in size at every step. The valence electrons come closer to the nucleus and so they are bound tightly under the influence of the nucleus and cannot be lost easily. In case of non metallic Character, since the valence shell is near to the nucleus hence gaining electrons are quite easy which results into increase in the non metallic character.
 - Metalloids: These are the elements present diagonally in the periodic table and separate the metals and the non metals. Eg: Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb), Pollonium (Po), Tellurium (Te).

4) Ionization energy: Amount of energy required to take the electron out from the valence shell of an atom.

- Along the Group: Ionization energy decreases down the group as the losing of electrons becomes easy due to increase in size and hence not much energy is required to take out the electron.
- Along the Period: Ionization energy increases along the period as the electrons are tightly bound due to decrease in the size of the atoms. Hence more energy is required to remove the electrons out of the atom.

5) Type of oxides, Hydrides and Chlorides

• Along the Group: For the elements of a particular group the type of hyrides, chlorides, oxides are the same.

• Along the Period: Following patterns are followed.

	r nong the r errour r ono ning	patterno are ton	o n e a				
Group	Ι	II	XIII	XIV	XV	XVI	XVII
Hydrides	RH	RH_2	RH ₃	\mathbf{RH}_4	RH ₃	H_2R	HR
Chlorides	RCl	RCl_2	RCl ₃	RCl_4	RCl ₃ /RCl ₅	-	CIR
Oxides	R ₂ O	RO	R_2O_3	RO_2	R_2O_5/R_2O_3	RO_3	R_2O_7

Н	MODERN PERIODIC TABLE														He		
Li	Be	Transition Elements								В	С	Ν	0	F	Ne		
Na	Mg		I ransition Elements								Al	Si	Р	S	Cl	Ar	
К	Ca												Ge	As			
														Sb	Te		
															Ро		

ASSIGNMENT: Periodic Classification of elements

Very short answer type questions:

Q1. State the Modern Periodic Law.

- Q2. What is meant by groups in relation to the periodic table of elements?
- Q3. What is meant by periods in relation to the periodic table of elements?
- Q4. What is meant by classification of elements?
- Q5. Name the metals among the first ten elements present in the modern periodic table.

Q6. A metal M forms an oxide having the formula M_2O_3 . It belongs to the 3^{rd} period in the modern periodic table. Write the atomic number and the valency of the metal.

Q7. Name the two elements which would show chemical reactions as that of Magnesium. What is the basis of your answer?

- Q8. Find the valency of Silicon with the help of its electronic configuration.
- Q9. What is the trend followed by Atomic radii of elements as we move from left to right in a periodic table?
- Q10. What were the criteria used by Mendeleev in creating his periodic table?
- Q11. What are metalloids? Give two examples.
- Q12. Find the position of Sulphur in the modern periodic table using its electronic configuration.
- Q13. Name some elements which are formed by radioactivity.
- Q14. What is the basic difference between classical and modern periodic table?
- Q15. What type of hydrides is formed by group 2 elements?

Short answer type questions:

H, O, Cl, N

- Q2. Name some achievements of Mendeleev's Periodic table.
- Q3. How could the modern periodic table remove the anomalies of Medeleev's periodic table?
- Q4. Write a short note on Dobereiner's law of triads.

Q1. Out of the following which one is a halogen atom?

- Q5. Write a short note on Newlands Law of octaves.
- Q6. Name the elements which were left as gaps by Medeleev and were discovered later.
- Q7. What are alkali metals? Name some of them.
- Q8. Why do you think Noble gas are kept in a separate group?
- Q9. Why does atomic size vary as we move left to right in a periodic table.
- Q10. How does metallic character vary down the group in the periodic table and why?

Long answer type questions:

Q1. The position of three elements A, B, C in the periodic table is given below:

Group 16	Group 17
-	-
-	А
-	-
В	С

a) State whether A is a Metal or a Non Metal.

- b) State whether C is more reactive or less reactive than A
- c) Will C be smaller or larger in size than B?
- d) Which type of ion (anion/ cation) will be formed by element a? Give reason.

Q2. Name:

- a) 3 elements having a single electron in their outermost shell.
- b) 3 elements having two electrons in their outermost shell.
- c) 3 elements with filled outermost shell.
- d) Element present in the 14^{th} group and 3^{rd} period.
- e) Element present in the 16th group and 2nd period.

Q3. Using the part of the periodic table given below, answer the questions that follow:

Groups	Ι	II	III	IV	V	VI	VII	Zero
Periods								
1	Н							He
2	Li	Be	В	С	N	0	F	Ne
3	Na	Mg	Al	Si	Р	S	Cl	Ar
4	K	Ca						

a) Na has physical and chemical property similar to which element and why?

b) Write the electronic configuration of N and P. Which one of these will be more electronegative and why?

c) State the chemical property common to fluorine and chlorine.