CHAPTER – 5

PERIODIC CLASSIFICATION OF ELEMENTS

In the beginning of 18th century Joseph Louis Proust stated that hydrogen atom is the building material and atoms of all other elements are simply due to the combination of number of hydrogen atoms. (It is to be noted that at his time the atomic weight of all elements were given as whole numbers and the atomic weight of hydrogen was taken as one.)

DOBEREINER’S TRIADS

A German chemist Johann Wolfgang Dobereiner (1829) noted that there were groups of elements with three elements known as *triads.* Elements in each group or a triad possess with similar chemical properties. Dobereiner discovered that “the relative atomic mass of the middle element in each triad was close to the average of the relative atomic masses of the other two elements”. This statement is called the *Dobereiner’s law of Triads.*

Dobereiner’s Triads.

Group	Elements and their Atomic Mass			Arithmetic mean of Atomic mass
A	Lithium(Li)	Sodium(Na)	Potassium(K)	$\frac{7.0 + 39.0}{2} = 23.0$
	7.0	23.0	39.0	
B	Calcium (Ca)	Strontium(Sr)	Barium(Ba)	$\frac{40.0 + 137.0}{2} = 88.5$
	40.0	87.5	137.0	
C	Chlorine(Cl)	Bromine(Br)	Iodine(I)	$\frac{35.0 + 127.0}{2} = 81.0$
	35.0	80.0	127.0	
	55.8	58.9	58.6	

- ☞ In this table, atomic mass of sodium is equal to arithmetic mean of atomic masses of lihtium and potassium. Similarly, atomic mass of strontium is equal to arithmetic mean of atomic masses of calcium and barium.

LIMITATION OF DOBEREINER’S TRIADS:

- ☞ All the then known elements could not be arranged in the form of triads.
- ☞ The law failed for very low mass or for very high mass elements. In case of F, Cl, Br, the atomic mass of Cl is not an arithmetic mean of atomic masses of F and Br.
- ☞ As the techniques improved for measuring atomic masses accurately, the law was unable to remain strictly valid.

NEWLANDS’ LAW OF OCTAVES

Newlands law of octaves states that when elements are arranged in the ascending order of their atomic masses they fall into a pattern in which their properties repeat at regular intervals. Every eighth element starting from a given elements resembles in its properties to that of the starting element.

LIMITATION OF NEWLANDS’ OCTAVES:

- ☞ Newlands’ Octaves could be valid upto calcium only; as beyond calcium, elements do not obey the rules of Octaves.
- ☞ Newlands’ Octaves was valid for lighter elements only.
- ☞ It appears that Newlands did not expect the discovery of more elements than 56 which were discovered till his time.

- More than one element had to be placed in some of the groups; in order to place the elements having similar properties in one group. But in order to do so, he also put some dissimilar elements in same group.
- Iron; which has similar property as cobalt and nickel, was placed far from them.
- Cobalt and nickel were placed in the group with chlorine and fluorine in spite of having different properties.
- In spite of above limitations; Newlands was the first scientist who arranged the elements in order of their increasing relative atomic masses.

Newlands' Arranged Elements in Octaves:

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

INTEXT QUESTIONS PAGE NO. 81

Q1. Did Dobereiner's triads also exist in the columns of Newlands' Octaves? Compare and find out.
Ans:
Yes. Lithium, sodium and potassium; beryllium; magnesium and calcium are two triads that also exist in the columns of Newland's octaves.

Q2. What were the limitations of Döbereiner's classification?
Ans:
Please see above notes

Q3. What were the limitations of Newlands' Law of Octaves?
Ans:
Please see above notes

MENDELEEV'S PERIODIC TABLE

Mendeleef arranged the elements known at that time in a chart in a systematic order in the increasing order of their atomic weights. He divided the chart into 8 vertical columns known as *groups*. Each group is divided into A, B sub groups. Each column contained elements of similar chemical properties.

The elements in the first column, for example, react with oxygen to form compounds with the general formula R_2O. For example, Li, Na and K when react with oxygen form compounds like Li_2O, Na_2O and K_2O respectively.

Elements of the second column react with oxygen to form compounds with the general formula RO. For example, Be, Mg and Ca when react with oxygen form BeO, MgO and CaO.
Mendeleef tried to explain the similarities of elements in the same group in terms of their common valency.

THE PERIODIC LAW:

Based on Mendeleeff's observations regarding the properties of elements in the periodic table, a law known as the *periodic law* of the properties of elements was proposed.

"The law states that the physical and chemical properties of the elements are a periodic function of their atomic weights."

SALIENT FEATURES AND ACHIEVEMENTS OF THE MENDELEEFF'S PERIODIC TABLE:

1. Groups and sub-groups: There are eight vertical columns in Mendeleeff's periodic table called as *groups.* They are represented by Roman numerals I to VIII. Elements present in a given vertical column (group) have similar properties. Each group is divided into two sub-group 'A' and 'B'. The elements within any sub-group resemble each other to great extent. For example, sub-group IA elements called 'alkali metals' (Li, Na, K, Rb, Cs, Fr) resemble each other very much.
2. Periods: The horizontal rows in Mendeleeff's periodic table are called *periods*. There are seven periods in the table, which are denoted by Arabic numerals 1 to 7. A period comprises the entire range of elements after which properties repeat themselves.
3. Predicting the properties of missing elements: Based on the arrangement of the elements in the table he predicted that some elements were missing and left blank spaces at the appropriate places in the table.

   Mendeleef believed that some new elements would be discovered definitely. He predicted the properties of these new additional elements in advance purely depending on his table. His predicted properties were almost the same as the observed properties of those elements after their discovery.

   He named those elements tentatively by adding the prefix '***eka***' (*eka is a Sanskrit numeral means one*) to the name of the element immediately above each empty space. The predicted the properties of elements namely eka-aluminium, eka-boron, eka-aluminium and eka-silicon were close to the observed properties of Scandium, Gallium and Germanium respectively which were discovered later.

Properties of some elements as predicted and discovered latter				
Property	Eka-aluminium (Predicted)	Gallium (Actual)	Eka-silicon (Predicted)	Germanium (Actual)
Atomic Mass	68	69.7	72	72.61
Density	5.9 g/cm^3	5.94 g/cm^3	5.5 g/cm^3	5.35 g/cm^3
Melting point	Low	30.2^0C(Low)	High	947^0C(High)
Formula of chloride	$EaCl_3$	$GaCl_3$	$EsCl_4$	$GeCl_4$
Formula of oxide	Ea_2O_3	Ga_2O_3	EsO_2	GeO_2

4. Correction of atomic mass: the correct placement of elements in Mendeleeff's periodic table helped in correcting the atomic masses of some elements like, Beryllium, Indium, Gold.

   For example, At the time of Mendeleef, beryllium was given atomic weight 13.5.

   Atomic weight = equivalent weight × valency

The equivalent weight of Be was found experimentally as 4.5 and its valency was understood as 3. Therefore atomic weight of beryllium was given as 4.5 × 3 = 13.5. With this atomic weight it had to be placed in a wrong group in the table. He said that its valency should be only 2 and then its atomic weight then would be 4.5 × 2 = 9. If atomic weight of 'Be' is 9 it would fit in the second group and its properties practically are similar to Mg, Ca etc., of the second group elements. He also helped in the calculation of the correct atomic weights of 'Indium' and 'Gold' in this manner.

5. Some anomalous series of elements like 'Te' and 'I' were observed in the table. The anomalous series contained element with more atomic weight like 'Te' (127.6 u) placed before the element with less atomic weight like 'I' (126.9 u). Mendeleeff accepted minor inversions in the order of increasing atomic weight when these inversions resulted in elements being placed in the correct groups.

It was the extraordinary thinking of Mendeleeff that made the chemists to accept the periodic table and recognise Mendeleeff more than anyone else as the originator of the periodic law.

LIMITATIONS OF MENDELEEFF'S PERIODIC TABLE:

1. *Position of hydrogen:* The position of hydrogen in the table is not certain because it can be placed in group IA as well as in group VIIA as it resembles both with alkali metals of IA group and halogens of VIIA group.
2. ***Anomalous pair of elements:*** Certain elements of highest atomic mass precede those with lower atomic mass.
   For example, *tellurium* (atomic mass 127.6) precedes *iodine* (atomic mass 126.9).
   Cobalt and *nickel: argon* and *potassium* which were placed in table by deviating the basis of classification (placement in ascending order of atomic masses).
   For example, *potassium* (atomic mass 39) placed after *argon* (atomic mass 40).
   Similar situation was found in pairs of *cobalt* and *nickel* and *tellurium, iodine.*
3. *Dissimilar elements placed together:* elements with dissimilar properties were placed in same group as sub-group A and sub-group B. For example, alkali metal like Li, Na, K etc., of IA group have little resemblance with coinage metals like Cu, Ag, Au of IB group.
4. S*ome similar elements separated:* some similar elements like 'copper and mercury' and 'silicon and thalium' etc are placed in different groups of the periodic table.
5. ***Position of isotopes:*** isotopes of elements are placed in the same position in the table.

INTEXT QUESTIONS PAGE NO. 85

Q1. Use Mendeléev's Periodic Table to predict the formulae for the oxides of the following elements:

K, C, AI, Si, Ba.

Ans:

Oxygen is a member of group VIA in Mendeleef's Periodic Table. Its valency is 2. Similarly, the valencies of all the elements listed can be predicted from their respective groups. This can help in writing the formulae of their oxides.

(i) **Potassium (K)** is a member of group IA. Its valency is 1. Therefore , the formula of its oxide is K_2O .

(ii) **Carbon (C)** is a member of group IVA. Its valency is 4. Therefore, the formula of its oxide is C_2O_4 or CO_2.

(iii) **Aluminium (Al)** belongs to groups IIIA and its valency is 3. The formula of the oxide of the element is Al_2O_3.

(iv) **Silicon (Si)** is present in group IVA after carbon. Its valency is also 4. The formula of its oxide is Si_2O_4 or SiO_2.

(v) **Barium (Ba)** belongs to group IIA and the valency of the element is 2. The formula of the oxide of the element is Ba_2O_2 or BaO.

Q2. Besides gallium, which other elements have since been discovered that were left by Mendeléev in his Periodic Table? (any two)
Ans:
Scandium and germanium are the two elements that had been left by Mendeleef.

Q3. What were the criteria used by Mendeléev in creating his Periodic Table?
Ans:
The criteria used by Mendeleef were
(i) Physical and chemical properties of the elements.
(ii) Atomic masses in increasing order.

Q4. Why do you think the noble gases are placed in a separate group?
Ans:
Noble gases are also called inert gases because they have a complete octet and hence, are very stable. They do not react with other elements due to their stability. Since they all are unreactive, have complete octet and similar behaviour so they are placed in a separate group .

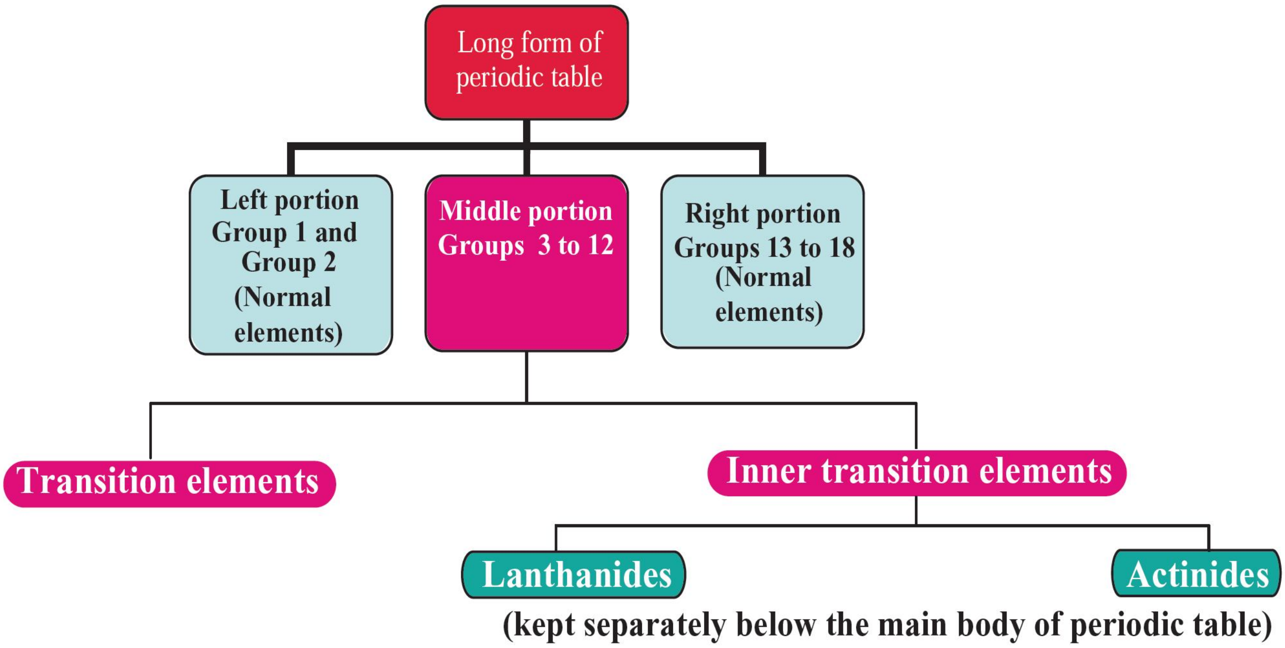
THE MODERN PERIODIC TABLE

Based on the modern periodic law, a number of forms of periodic table have been proposed from time to time but general plan of the table remained the same as proposed by Mendeleev. The table which is most commonly used and which is based upon the **electronic configuration of elements** is called the **long form of the periodic table**. This is called the **modern periodic table.**

Long form of the periodic table is a chart of elements in which the elements have been arranged in the increasing order of their atomic numbers. This table consists of **horizontal rows called periods and vertical columns called groups**.

- ☞ The modern periodic table has also been divided into four blocks known as s,p,d and f blocks.

Different portions of long form of periodic table



STUDY OF PERIODS

The **horizontal rows are called periods**. There are **seven** horizontal rows in the periodic table.

- **First period** (Atomic number 1 and 2): This is the shortest period. It contains only two elements (hydrogen and helium).
- **Second period** (Atomic number 3 to 10): This is a short period. It contains eight elements (lithium to neon).
- **Third period** (Atomic number 11 to 18): This is also a short period. It contains eight elements (sodium to argon).
- **Fourth period** (Atomic number 19 to 36): This is a long period. It contains eighteen elements (potassium to krypton). This includes 8 normal elements and 10 transition elements.
- **Fifth period** (Atomic number 37 to 54): This is also a long period. It contains 18 elements (rubidium to xenon). This includes 8 normal elements and 10 transition elements.
- **Sixth period** (Atomic number 55 to 86): This is the longest period. It contains 32 elements (ceasium to radon). This includes 8 normal elements, 10 transition elements and 14 inner transition elements (lanthanides).
- **Seventh period**(Atomic number 87 to 118): As like the sixth period, this period also can accomodate 32 elements. Till now only 26 elements have been authenticated by IUPAC.

STUDY OF GROUPS

- Vertical columns in the periodic table starting from top to bottom are called groups. There are 18 groups in the periodic table.
- First group elements are called alkali metals.
- Second group elements are called alkaline earth metals.
- Groups three to twelve are called transition elements .
- Group 1, 2 and 13 - 18 are called normal elements or main group elements or
- representative elements .
- Group 16 elements are called chalcogen family (except polonium).
- Group 17 elements are called halogen family.
- Group 18 elements are called noble gases or inert gases.

☞ The lanthanides and actinides which form part of the group 3 are called inner transition elements.

Modern Periodic Table

Metals | Metalloids | Non-metals

The zigzag line separates the metals from the non-metals.

PERIODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.0																	2 He Helium 4.0
2	3 Li Lithium 6.9	4 Be Beryllium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	10 Ne Neon 20.2
3	11 Na Sodium 23.0	12 Mg Magnesium 24.3											13 Al Aluminium 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9
4	19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.8	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.9	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8
5	37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (99)	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.3	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
6	55 Cs Caesium 132.9	56 Ba Barium 137.3	57 La* Lanthanum 138.9	72 Hf Hafnium 178.5	73 Ta Tantalum 181.0	74 W Tungsten 183.9	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192. 2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Ti Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (210)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 Ac** Actinium (227)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	–	114 Uuq	–	Uuh	–	–

* Lanthanoides	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.5
** Actinoides	90 Th Thorium 232.0	91 Pa Protactinium (231)	92 U Uranium 238.1	93 Np Neptunium (237)	94 Pu Plutonium (242)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (245)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Femium (253)	101 Md Mendelevium (256)	102 No Nobelium (254)	103 Lr Lawerncium (257)

CHARACTERISTICS OF MODERN PERIODIC TABLE

CHARACTERISTICS OF PERIODS

In a period, the electrons are filled in the same valence shell of all elements.
As the electronic configuration changes along the period, the chemical properties of the elements also change.
Atomic size of the elements in a period decreases from left to the right.
In a period, the metallic character of the element decreases while their non-metallic character increases.

CHARACTERISTICS OF GROUPS

- The elements present in 2 and 18 groups differ in atomic number by 8,8,18,18,32.
- The elements present in 13 – 17 groups differ in atomic number by 8,18,18,32.
- The elements present in 4 – 12 groups differ in atomic number by 18,32,32.
- The elements present in a group have the same number of electrons in the valence shell of their atoms.
- The elements present in a group have the same valency.
- The elements present in a group have identical chemical properties.
- The physical properties of the elements in group such as melting point, boiling point, density vary
- gradually.
- Atomic radii of the elements present in a group increases downwards.

ADVANTAGES OF THE MODERN PERIODIC TABLE

- The table is based on a more fundamental property ie., atomic number.
- It correlates the position of the element with its electronic configuration more clearly.
- The completion of each period is more logical. In a period as the atomic number increases, the energy shells are gradually filled up until an inert gas configuration is reached.
- It is easy to remember and reproduce.
- Each group is an independent group and the idea of sub-groups has been discarded.
- One position for all isotopes of an element is justified, since the isotopes have the same atomic number.
- The position of eighth group (in Mendeleev's table) is also justified in this table. All transition elements have been brought in the middle as the properties of transition elements are intermediate between left portion and right portion elements of the periodic table.
- The table completely separates metals from non-metals. The nonmetals are present in upper right corners of the periodic table.
- The positions of certain elements which were earlier misfit (interchanged) in the Mendeleev's periodic table are now justified because it is based on atomic number of the elements.
- Justification has been offered for placing lanthanides and actinides at the bottom of the periodic table.

DEFECTS IN THE MODERN PERIODIC TABLE

- ☞ Position of hydrogen is not fixed till now.
- ☞ Position of lanthanides and actinides has not been given inside the main body of periodic table.
- ☞ It does not reflect the exact distribution of electrons of some of transition and inner transition elements.

INTEXT QUESTIONS PAGE NO. 90

Q1. How could the Modern Periodic Table remove various anomalies of Mendeléev's Periodic Table?

Ans:

1. The fundamental basis for Modern Periodic Table is atomic number and not atomic mass and hence, it is more accurate.

2. Properties of elements could be well explained when they were arranged according to their increasing atomic number in the Modern Periodic Table.

3. A separate group for noble gases could be created when noble gases were discovered.

4. Hydrogen has been given a unique position in the Modern Periodic Table at the top left corner because of its unique properties.

Q2. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice?

Ans:

Magnesium (Mg) belongs to group 2 of Modern Periodic Table, known as alkaline earth metal family. The two other elements belonging to the same group are beryllium (Be) and calcium (Ca).

Calcium and magnesium; Beryllium and magnesium - This is because both of them have electronic configuration similar to Mg

Mg	*K*	*L*	*M*	
	2	8	**2**	
Ca	*K*	*L*	*M*	*N*
	2	8	8	**2**
Be	*K*	*L*		
	2	**2**		

These elements belong to the same group and hence, will show similar properties.

Q3. Name

(a) three elements that have a single electron in their outermost shells.

(b) two elements that have two electrons in their outermost shells.

(c) three elements with filled outermost shells.

Ans:

(a)	Li	Na	K
	2, 1	2, 8, 1	2, 8, 8,1
(b)	Mg	Ca	
	2, 8, 2	2, 8, 8, 2	
(c)	He	Ar	Ne
	2	2,8	2, 8, 8

Q4. (a) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?

(b) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common?

Ans:

(a) Li, Na, and K have one electron in their outermost shell.

Li	2, 1 (Atomic number 3)
Na	2, 8, 1 (Atomic number 11)
K	2, 8, 8, 1 (Atomic number 19)

(b) They both have completely filled outer shell.

	K	*L*	
He	**2**		(Atomic number 2)
Ne	2	**8**	(Atomic number 10)

Q5. In the Modern Periodic Table, which are the metals among the first ten elements?

Ans:

Metals among the first ten elements are lithium and beryllium.

Q6. By considering their position in the Periodic Table, which one of the following elements would you expect to have maximum metallic characteristic?

Ga Ge As Se Be

Ans:

The position of the given elements in the Periodic Table is as.

Ga		Ge	As	Se	Br
(Most metallic)	→	(Least metallic)			

On moving from left to right in a period, size decreases due to increase in effective nuclear charge and hence, tendency to lose electron, *i.e.*, metallic character decreases. Thus Ga has maximum metallic characteristic or metallic nature.

<u>EXERCISE QUESTIONS PAGE NO. 91 and 92</u>

Q1. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic Table.

(a) The elements become less metallic in nature.

(b) The number of valence electrons increases.

(c) The atoms lose their electrons more easily.

(d) The oxides become more acidic.

Ans:

(c) On moving from left to right, the atomic number increases and hence, the nuclear charge increases. With the increase of nuclear charge, the force binding the electron increases so the atom lose the electrons with more difficulty, not easily.

Q2. Element X forms a chloride with the formula XCl2, which is a solid with a high melting point. X would most likely be in the same group of the Periodic Table as

(a) Na (b) Mg (c) AI (d) Si

Ans:

(b) The formula of chloride is XCl_2 that means the valency of the element X is 2. The element having valency 2 will present in group 2. Out of given choices magnesium (Mg) belongs to group 2.

Q3. Which element has
(a) two shells, both of which are completely filled with electrons?
(b) the electronic configuration 2, 8, 2?
(c) a total of three shells, with four electrons in its valence shell?
(d) a total of two shells, with three electrons in its valence shell?
(e) twice as many electrons in its second shell as in its first shell?
Ans:
(a) Noble gases are the elements which have completely filled shells. The noble gas with two shells is Ne having atomic number 10 and electronic configuration 2, 8 both of which are completely filled.

(b) Electronic configuration 2, 8, 2 suggests that atomic number is 12 (2 + 8 + 2), magnesium (Mg) has atomic number 12.
(c) The element with three shells and form electrons in the valence shell will have electronic configuration 2, 8, 4. The atomic number of this element is 14 (2 + 8 + 4) so it will belong to group 14 hence, it is silicon (Si).

(d) Element with two shells with 3 electrons in the valence shell will exist in second period and will have the electronic configuration 2,3. The atomic number of this element will be 5 (2 + 3). So, it will be bron (B).

(e) The element has two shells. we know that first shell can have only 2 electrons, so according to the question there will be 4 electrons (double the number of electrons in first shell). The electronic configuration will be 2, 4 , so the atomic number is 6. Hence, the element is carbon (C).

Q4. (a) What property do all elements in the same column of the Periodic Table as boron have in common?
(b) What property do all elements in the same column of the Periodic Table as fluorine have in common?
Ans:
(a) All elements of 13th group, in which boron is present, have 3 electrons in their valence shell (2, 8, 3).
(b) Fluorine belongs to 17th group. All elements of this group have 7 electrons in their valence shell (2, 8, 7). They all show a valency of 1 in their compounds.

Q5. An atom has electronic configuration 2, 8, 7.
(a) What is the atomic number of this element?
(b) To which of the following elements would it be chemically similar? (Atomic numbers are given in parentheses.) N(7) F(9) P(15) Ar(18)
Ans:
(a) Atomic number of atom = 2 + 8 + 7 =17
(b) It will be similar to fluorine which is also having 7 electrons in its valence shell [F (2, 7)].

Q6. The position of three elements A, B and C in the Periodic Table are shown below –

Group 16	***Group 17***
---	**---**
---	**A**
---	**---**
B	**C**

(a) State whether A is a metal or non-metal.
(b) State whether C is more reactive or less reactive than A.
(c) Will C be larger or smaller in size than B?

(d) Which type of ion, cation or anion, will be formed by element A?
Ans:
(a) Since, *A* belongs to group 1 valence electrons so it is a non-metal because it will gain electron to complete its octet.

(b) *C* lies below *A* and in the same group. As we move down in a group, the size increases and electronegative character decreases. With the increase in electronegative character, the electron adapting tendency and hence the reactivities decrease so, *C* is less reactive than *A*.

(c) *C* is smaller than *B* in size because as we move left to right in a period atomic size decreases.

(d) As discussed in part (a) that element *A* has a tendency to gain electron to complete its octet. It needs to take up one electron, so it will form anion (A^-).

Q7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the Periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?
Ans:
(a) Electronic configuration of nitrogen and phosphorus:

	K	*L*	*M*
N	2,	5	
P	2,	8,	5

(b) N will be more electronegative than P as electronegativity decreases on going down a group in case of non-metals.

Q8. How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?
Ans:
The number of valence electrons in an atom of an element tells us the group number. *e.g.*, Na has atomic number 11

	K	*L*	*M*
Electronic configuration of Na (11) =	2	8	1

It has one electron in its last shell, thus it belongs to group I of the Periodic Table.
The number of shells in its electronic configuration tells the period number *e.g.*, Na shows 3 shells *K*, *L*, *M* so it belongs to 3rd period of the Periodic Table.

Q9. In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?
Ans:

At. no. of element	Electronic configuration
	K L M N O
12	2 8 **2**
19	2 8 8 1
21	2 8 8 3
38	2 8 18 8 **2**

From the electronic configuration written above we can see that element with atomic number 12 and 38 have 2 electrons in their last shell like calcium. So, they will resemble Ca in their physical and chemical properties.

Q10. Compare and contrast the arrangement of elements in Mendeléev's Periodic Table and the Modern Periodic Table.

Ans:

Mendeleev's periodic table	Modern periodic table
1. Elements are arranged in the increasing order of their atomic masses.	**1.** Elements are arranged in the increasing order of their atomic numbers.
2. There are a total of 7 groups (columns) and 6 periods (rows).	**2.** There are a total of 18 groups (columns) and 7 periods (rows).
3. Elements having similar properties were placed directly under one another.	**3.** Elements having the same valence shell are present in the same period while elements having the same number of valence electrons are present in the same group.
4. The position of hydrogen could not be explained.	**4.** Hydrogen is placed above alkali metals.
5. No distinguishing positions for metals and non-metals.	**5.** Metals are present at the left hand side of the periodic table whereas non-metals are present at the right hand side.