PERIODIC CLASSIFICATION

LEARNING OBJECTIVES :

- Mendeleef classification of elements
- Long form of periodic table
- classification of elements in to blocks and types
- periodic properties
- diagonal relation ship

REAL LIFE APPLICATIONS :

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

For example :

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

Φ 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.

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

§§ **Fundamentals**

At present around 110 elements are known. Among these 90 are natural, and the remaining are man made elements. Elements coming after 92 atomic number are known as “Trans Uranic Elements” or “Synthetic Elements” and they are “Radioactive”.

§§ **Mendeleeff’s Classification of Elements :**

¶¶ **Periodic Law :** The physical and chemical properties of the elements are periodic functions of their atomic weights.

Mendeleeff’s periodic table is also known as short form of periodic table.

Mendeleeff observed that elements with similar properties have

i) Almost have same atomic weight.

Eg: Fe(56), Rb(59), Ni(59)

ii) Atomic weights increasing constantly

Eg : K(39), Rb(85), Cs(133)

Elements are arranged in 11 horizontal rows known as series which are grouped into 7 periods.The first three periods are short periods and remaining are long periods. Each long period has 2 rows of elements or 2 series of elements. Vertical columns are called groups and there are nine groups (0 to 8^{th}). Leaving 0 and VIII, each group is subdivided into subgroups known as A and B group. Group VIII of the Mendeleeff table consists of three triads known as transition triads and they are

i) Iron, Cobalt and Nickel

ii) Ruthenium, Rhodium and Palladium

iii) Osmium, Iridium and Platinium

Zero group elements were later introduced by Ramsay and Rayleign.

Mendeleeff has a fore sight to leave some gaps in the periodic table for 3-elements. And these

elements are discovered latter and included in the table. Those three elements are

1) eka boron presently known as Scandium

2) eka silicon presently known as Germanium

3) eka aluminium presently known as Gallium

Mendeleeff corrected the atomic weights of Beryllium, Indium and Osmium by using corrected valency of elements

Atomic Wt. = Equivalent Wt. xvalency.

¶¶ **Demerits:**

i) some elements with higher atomic weight were placed before low atomic weight elements inorder to maintain similar chemical nature of elements and are called inverted pairs or anomalous pairs. Anomalous pairs of Mendeleeff's periodic table are

a) Ar-K b) Co-Ni c) Te-I and d) Th-Pa

ii) Position of hydrogen was not made clear

iii) Position of isotopes: Isotopes ar the atomsof same element having different atomic masses. Therefore, according to mendeleev's classification these should be placed at different places depending upon their atomic masses.

iv) Some similar elements are separated , in the periodic table.

EX: Cu, Hg, Ba ,Pb .

On the other hand some dissimilar elements have been placed together in the same group like a Halogens

¶¶ **Atomic Number:**

i) Moseley discovered the atomic numbers from X-ray spectra of elements by bombarding the elements with cathode rays and the elements emitted respective X-rays of characteristic frequency.

ii) Atomic number 'Z' can be related to frequency of the X-rays emitted by using $\sqrt{\nu} = a(Z - b)$ where a, b are constants for an element

iii) A plot of $\sqrt{\nu}$ against Z gives a straight line.

iv) Atomic number has provided a better basis for the periodic arrangement of the elements.

§§ **Modern periodic law :** Physical and chemical properties of the elements are periodic functions of their atomic numbers and electronic configuration.

§§ **Long Form of Periodic Table :**

1. Neils Bohr constructed the long form of periodic table.

2. Modern periodic table or the long form of periodic table is based on the electronic configurations of the elements.

3. There are 18 groups and 7 periods in the periodic table.

§§ **PERIODS : (Horizontal Rows)**

1.In periods elements are arranged in the incresing order of their atomic numbers. The electron by which an element differes from its previous element is called **"differentiating electron".**

2.In each period the differentiating electron enters the "s" orbital in the first element and "p" orbital in the last element.

3.In periods elements are arranged according to the "*(n+l)*" values order (Aufbau-Rule).

4.Long form of the periodic table is a ***Graphical Representation*** of the Aufbau-Rule.

5.Generally every period starts with an Alkali Metal and ends with Noble gas.

§§ **REMEMBER :**

1.3rd orbit contains **3s, 3p** and **3d** . But according to ***(n+l)*** **values order (energy order) 3d** comes after **4s**, hence accordingly elements with **3d configuration** are placed after **4s** only. i.e., **in 4th period. (3d** series - 1st transition period - **Sc(Z=21) to Zn (Z=30)).**

2.Elements with 4d configuration [from Y(Z=39) to Cd(Z=48)] placed in 5th period (2nd Transition series).

3.Elements with 5d configuration from La(Z=57) and Hf (Z=72) to Hg (Z=80) are placed in 6th period. (3rd transition series).

4.Fourteen 4f series elements belongs to 6th period III B group. Ce (Z=58) to Lu (Z=71).

5.Fourteen 5f series elements belongs to 7th period & III B group. Th (Z=90) to Lr (Z=103). 6d-series is incomplete series.

6.If 7th period is also completed, then the final element of this period would be with an atomic number 118.

§§ GROUPS : (VERTICAL COLUMNS) :

Long form of the periodic table comprises of 18-vertical columns which are divided into main groups and subgroups as - IA to VIIA, O groups and IIIB, IVB, VB, VIB, VIIB, VIII, IB and IIB groups.

VIII groups includes three vertical columns of Fe, Co, Ni. Total 9 elements are present in this group.

We adopt the 1-18 numbering scheme recomended by IUPAC in 1988.

Main group division is based on the number of electrons present in outer most orbit like H, Li, Na, K, Rb, Cs and Fr have 1 electron in their outer most orbit, so they are placed in IA group. Be, Mg, Ca, Sr, Ba and Ra have 2 electrons in their outer most orbit, so they are placed in IIA group.

§§ IUPAC NOMENCLATURE FOR SUPER HEAVY ELEMENTS

The elements after Fermium are called super heavy elements and at present these are called trans Fermium elements.

1.The names are derived by using root word's fo the three digits in the atomic number of the element and adding the suffix - ium.

2. In certain cases the names are shortended for examples

a) bi + ium is shortended to bium

b) tri + ium is shortended to trium

3. The IUPAC name of an element with atomic number 101 is unnilunium.

§§ 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 :

1.Differentiating electrons enter into s-subshell.

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

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

4.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.

5.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.

6.Most of these are active metals.

7.Most of these compounds are ionic.

Number	0	1	2	3	4	5	6	7	8	9
Root word	nil	un	bi	tri	quad	pent	hex	sept	oct	enn

8.These are powerful reducing agents.

¶¶ p - BLOCK ELEMENTS :

1.Differentiating electrons enter into p-subshell.

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

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

a) B, Al, Ga, In and *Tl* - Boron family - IIIA group, these elements have 3-electrons in outer shell, with **"ns^2np^1"** general outer shell configuration.

b) C, Si, Ge, Sn and Pb - Carbon Family - IVA group, these elements have 4-electrons in outershell, with **"ns^2np^2"** general outer shell configuration.

c) N, P, As, Sb and Bi - Nitrogen Family - VA group (Pnicogens). These elements have 5-electrons in outer shell, with **"ns^2np^3"** general outer shell configuration.

d) O, S, Se, Te, and Po- VIA group(Chalcogens), these elements have 6-electrons in outershell, with **"ns^2np^4",** general outer shell configuration.

e) F, Cl, Br, I and At- (Halogens) - VIIA group, these elements have 7-electrons in outer shell, with "ns^2np^5", general outer shell configuration.

f) He, Ne, Ar, Kr, Xe and Rn - Inert gases - O–group, Except He **($1s^2$)**, remaining inert gases have 8-electrons in outer shell with **"ns^2np^6"** general outer shell configuration.

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

e) Most of the p-block element compounds are covalent.

f) Most of these are oxidising agents

♣ REMEMBER:

i) Infact Helium belongs to s-block, but keeping its chemical inertness, Helium is placed along with other inert gases in O-group.

ii) Hence He is a p-block element with out p-electrons.

iii) The first p-block element is Boron [(He) $2S^2$ $2P^1$]

iv) The only group with all gaseous elements is **"O-group".**

¶¶ d-BLOCK ELEMENTS:

1.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"**.

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

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

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

a) 1st Transition series - 3d series - electronic configuration. **$3d^{1-10}$ $4s^{1-2}$ [Sc (Z=21) to Zn (Z=30)]**

b) 2nd Transition series - 4d - series - electronic configuration. **$4d^{1-10}$ $5s^{1-2}$ [Y(Z=39) to Cd (Z=48)].**

c) 3rd Transition series - 5d - series - electronic configuration. **$5d^{1-10}$ $6s^{1-2}$. [La (Z=57), Hf (Z=72) to Hg (Z=80)]**

d) 4th Transition series - 6d - series - is an incomlpete series.

e) Most of these are less active metals.

f) Most of these compounds are ionic and co-ordinate covalent.

♣ REMEMBER :

After completion of 6s, the differentiating electron suppose to enter into 4f, but in the case of Lanthanum the differentiating electron is entering into 5d, instead of 4f **(La - $6s^2$ $4f^0$ $5d^1$)**. Therefore "La" belongs to d-block.

Similarly in case of Actinium, the differentiating electron is entering into 6d, instead of 5f **(Ac-$7s^2$ $5f^0$ $6d^1$).** Therefore Ac also belongs to d-block.

¶¶ f-BLOCK ELEMENTS:

1.If differentiating electrons enter into f-subshell of Anti penultimate i.e., (n-2) shell, the ele-

ments of this class are called **f-block** elements.

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

3.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.

a) 4f-series - Lanthanide series - configuration **$4f^{1-14}$ $5d^{0-1}$ $6s^2$ from Ce(58) to Lu (71)**

b)) 4f- series elements belongs to 6th period and IIIB Group.

c) 5f - series elements - Actinide series - configuration **$5f^{1-14}$ $6d^{0-1}$ $7s^2$ from Th (90) to Lr (103).**

d) 5f - series elements belongs to 7th period and III B group.

e) Most of these elements are radioactive.

§§ CLASSIFICATION BASED ON CHEMICAL PROPERTIES.

All the elements are divided into four types on the basis of their chemical properties and electronic configuration.

TYPE - I : INERT GAS ELEMENTS:

1.He, Ne, Ar, Kr, Xe and Rn belongs to "0" group in the periodic table are called **Inert Gas Elements**.

2.Except He ($1s^2$), all the other elements have ns^2np^6 outer electronic configuration.

3.All are chemically inert due to the presence of stable ns^2np^6 (octet) configuration in their outer most shell.

4.He is inactive due to its completely filled 'K' shell. ($1s^2$)

5.It is known that heavier elements (Kr, Xe) forms compounds under special controlled conditions with Oxygen, Fluorine, $XeOF_2$, and $XeOF_4$. So they are now called **Noble gases**.

6.All are monoatomic gases.

7.They are also known as Rare gases (or) Aerogens.

TYPE -II : REPRESENTATIVE ELEMENTS OR NORMAL ELEMENTS

1.These are the elements whose outer shells are not completely filled.

2.Excluding "0" group, remaining s and p block elements (IA, IIA, IIIA, IVA, VA, VIA, VIIA) are called representative elements.

3.Most of these elements are abundent and active.

4.Their general outer electronic configuration os $ns^{1-2}np^{1-5}$.

5.Metals, nonmetals and metalloids are present in representative elements.

6.Atoms of these elements enter chemical combination by losing, gaining or sharing of electrons to attain stable nearest inert gas configuration.

7.In case of representative elements electrons of outer ns and np will take part in bonding.

TYPE-III : TRANSITION ELEMENTS:

1.These are the elements whose outer most and penultimate shells are incompletely filled.

2.Elements which have incompletely filled or partly filled d-orbitals either in elementary state or in any possible oxidation state are called as transition elements.

3.Their properties are intermediate to s - and p - block elements.

4.The general electronic configuration is **$(n-1)d^{1-10}$ ns^{1-2} .**

5.II B group elements Zn ($3d^{10}$ $4s^2$), Cd ($4d^{10}$ $5s^2$) Hg ($5d^{10}$ $6s^2$) are not transition elements (due to the absence of partly filled d-orbitals both in atomic and in ionic states) (Zn, Cd, Hg - are referred as Non-typical Transition Elements) or volatile metals.

6.In the case of Transition elements both (n-1)d and ns electrons participate in bonding.

7.The characteristic properties of transition elements are

a. They are hard and heavy metals
b. Variable Oxidation states
c. Formation of coloured ions due to d-d- transition
d. Formation of metal complexes
e. Paramagnetism
f. Catalytic activity.
g. High M.P., B.P and densities.
h. Good conductors of heat and electricity
i. Alloy formation.

These characteristic properties are due to

a. Small size b. High nuclear charge c. Unparied electrons in d-orbitals.

Note : Ni used as a catalyst in Hydrogenation of oils.
Fe used as a catalyst in Haber's process
Mo used as a promoter in Haber's process.

TYPE-IV : INNER TRANSITION ELEMENTS

1.These elements have three outermost shells incomplete i.e., n, (n-1) and (n-2)
2.The f-block elements are called inner transition elements.
3.General configuration **$(n-2)f^{1-14}$ $(n-1)d^{0 \text{ or } 1}$ ns^2.**
4.Since the last two shells have similar configuration these elements have similar physical and chemical properties (eg - these elements shows common oxidation state of +3).
5.There are two series of inner transition elements.
6.4f-series - Lanthanide series - $4f^{1-14}$ $5d^{0 \text{ or } 1}$ $6s^2$.
7.5f - series - Actinide series - **$5f^{1-14}$ $6d^{0 \text{ or } 1}$ $7s^2$.**
8.In periodic table, lanthanides are present between $_{57}$La & $_{72}$Hf and
9.Actinides are present between $_{89}$Ac & $_{104}$Rf.
10.Lanthanides are rare earths, and all most all Actinides are radioactive.

TEACHING TASK

Single answer type:

1. 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) $ns^2\ p^6d^1$

2. Lanthanum belongs to ------ block
1) s-block 2) p-block 3) d-block 4) f-block

3. Which pair of elements of atomic numbers given below will have similar chemical properties?
1) 13, 22 2) 3, 11 3) 4, 24 4) 2, 4

4. Which pair of atomic numbers represent element which are both s-block elements
1) 7, 15 2) 6, 12 3) 9, 17 4) 3, 12

5. Elements with atomic numbers 9, 17, 35, 53 are collectively known as
1) chalcogens 2) halogens 3) lanthanides 4) rare gases

6. First transitional series is present in
1) Third period 2) Fifth period 3) Fourth period 4) Sixth period

7. In iron atom (z=26), the differentiating electron enters……..sublevel
1) 4d 2) 3d 3) 4p 4) 5p

8. The atomic numbers of Lanthanides are from
1) 58 to 71 2) 90 to 103 3) 21 to 30 4) 39 to 48

9. The first lanthanide is
1) La 2) Ce 3) Th 4) Lu

10. The 4f level is successively filled up in
1) Alkali metals 2) Lanthanides 3) actinides 4) Halogens

11. 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

12. Most of the radio active elements are in
1) Lanthanides 2) Actinides
3) Representative elements 4) Second transitional series

13. The elements with atomic numbers 2, 10, 18, 36, 54, and 86 are collectively known as

1) Alkaline earth metals 2) Inert gases
3) Halogens 4) Rare earths

14. Which of the following represents the electronic configuration of d-block elements
1) $(n-1)s^2nd^{1-10}$ 2) $(n-1)d^{1-10}ns^{1-2}$ 3) $(n-1)s^2p^6$, ns^1 4) ns^2p^2 d^1

15. If the valency shell electronic structure for an element is ns^2np^5, this element will belong to the group of
1) Alkali metals 2) Inert metals 3) Noble gases 4) Halogens

16. Variable Oxidation states exhibited by
1. Normal elements 2. Metallic elements
3. Transitional elements 4.Non-metallic elements

17. Which one of the following belongs to representative group of elements in the periodic table
1) Lanthanum 2) Argon 3) Chromium 4) Aluminium

18. The element californium belongs to a family of
1) actinide series 2) alkali metal family
3) alkaline earth family 4) lanthanide series
4) their being less electropositive than the elements of groups IA and IIA

19. A member of Lanthadide
1. Cesium 2. Lanthanum 3. Niobium 4. Luticium

20. In which of the following period a maximum number of 32 elements are present
1. 4th 2. 6th 3. 3rd 4. 7th

21. The position of element with Z = 24 in the periodic table is
1) V A group & 4 period 2) VI B group & 4 period
3) IV A group & 3 period 4) III B group & 3 period

22. Transition metals exhibit variable oxidation states. It is because of
1) the smaller atomic radius 2) the higher nuclearcharge
3) high screening effect
4) the energy difference between (n-1)d & ns-subshell is very less

Multi Correct Choice Type:

*This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which **ONE or MORE** is correct. Choose the correct options*

23. 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

24. 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.

25. Which of the following is correct for d-block elements?
1) These elements is situated at the extreme right side of the periodic table.
2) General electronic configuration of these elements is ns^2,np^{1-6}
3) They show variable oxidation states.
4) This block elements form alloys.

Reasoning Type:

*This section contains certain number of questions. Each question contains Statement – 1(Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

1) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.
2) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

26. ***Statement I*:** Sodium is a strongly electropositive metal.
***Statement II* :** Chlorine is a strongly electronegative nonmetal.

27. ***Statement I*:** Grouping the elements having the same characteristics is known as classification of elements.
***Statement II* :** The classification of elements help the study of elements and their properties easier.

28. ***Statement I* :** In general, the outer electronic configuration of the elements of group 6 (or VI B) is $(n-1)d^4ns^1$.
***Statement II* :** 3 and 11^{th} group pair of the elements will have the same chemical properties.

29. ***Statement I* :** Atomic number is the number of protons in the nucleus of an atom.
***Statement II* :** Atomic number is also equal to the number of electrons in a neutral atom.

30. ***Statement I* :** The number of elements in 2^{nd} and 3^{rd} period is equal.
***Statement II* :** The number of elements in 4^{th} and 5^{th} period is equal.

Matrix Match Type:

♦ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

31.

Column-I	**Column-II**
a) Calcium	1) 127
b) Strontium	2) 137
c) Barium	3) 87.5
d) Iodine	4) 40
	5) 35.5

32.

Column-I	**Column-II**
Maximum number of eliments in the period	**Period number**
a) 1	1) 1
b) 2,3	2) 2
c) 4	3) 3
d) 5	4) 4
	5) 6

33.

Column-I	**Column-II**
Period number	**Nature of period**
a) 4	1) Very long period
b) 3	2) Long period
c) 2	3) Short period
d) 1	4) Very short period
	5) Incomplete period

34.

Column - I	**Column - II**
a) Fermium	1) 100
b) Lawrencium	2) 101
c) Mendelevium	3) 102
d) Nobelium	4) 103
	5) 104

Comprehension type

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

A. These are the elements whose outer most and penultimate shells are incompletely filled. Elements which have incompletely filled or partly filled d-orbitals either in elementary state or in any possible oxidation state are called as transition elements. Their properties are intermediate to s - and p - block elements.

35. Zn is not transitional metal. Because
1)outer most and penultimate shells are incompletely filled.
2)outer most and penultimate shells are completely filled.
3)penultimate shells are completely filled.
4)outer most shells are completely filled.

36. The metallic nature of transition metals are
1)intermediate to s - and p - block elements.
2)more than s block elements. 3)less than p block elements.
4)more t6han s - and p - block elements.

B. In the preceding unit we have learnt that an electron in an atom is characterised by a set of four quantum numbers, and the principal quantum number (n) defines the main energy level known as shell. We have also studied about the filling of electrons into different subshells, also referred to as orbitals (s, p, d, f) in an atom. The distribution of electrons into orbitals of an atom is called its electronic configuration. An element's location in the Periodic Table reflects the quantum numbers of the last orbital filled. In this section we will observe a direct connection between the electronic configurations of the elements and the long form of the Periodic Table.

37. The IUPAC symbol of the elements with atomic numbers 104, 105 and 106 respectively is :
1) Db, Rf, Hs 2) Rf, Db, Sg 3) Rf, Mt, Ds 4) Mt, Ds, Rg

38. The atomic number of the elements Hassnium, Meitnerium and Darmstadtium respectively is:
1) 106, 107, 108 2) 109, 110, 111
3) 102, 103, 104 4) 108, 109, 110

39. The elements with atomic numbers greater than 100 are :
1) Naturally occuring elements 2) Naturally occuring metals
3) Naturally occuring transition metals 4) Man made elements

KEY

ΦΦ TEACHING TASK :

1) 3	2) 3	3) 2	4) 4	5) 2	6) 3	7) 2	8) 1	9) 2
10) 3	11) 4	12) 2	13) 2	14) 2	15) 4	16) 3	17) 4	18)1
19) 4	20) 2	21) 2	22) 4	23)1,2	24)1,2,3		25)3,4	`
26)2	27)2	28)4	29)2	30)2	31)a-4,b-3,c-2,d-1			

32)a-1,b-2,3,c-4,d-5 33)a-4,b-3,c-2,d-1 34)a-1,b-4,c-2,d-3

LEARNER'S TASK

BEGINNERS (Level - I)

Single answer type:

1. The basis for the classification of elements in the modern periodic table is
1) Electronic configuration 2) Atomic weight
3) Atomic volume 4) Equivalent wieght

2. Considering the chemical properties, atomic weight of Be was corrected based on
1) electronic configuration 2) valency
3) atomic number 4) both 2 and 3

3. Mendeleef corrected the atomic weight of
1) Be 2) In 3) Os 4) all the above

4. Anamalous pair in Mendeleef's table is
1) Li, Na 2) Mg, Al 3) Co, Ni 4) Be, B

5. Eka silicon is now called as
1) Gallium 2) Scandium 3) Germanium 4) Indium

6. The atomic weights of "Be" and "In" were corrected by Mendeleef using the formula
1) $\sqrt{v} = a(Z - b)$ 2) $mvr = \frac{nh}{2\pi}$
3) Atomic weight = Equivalent weight × valency
4) Equivalent weight = Atomic weight × valency

7. The plot of $\sqrt{v}$ vs Z is
1) Straight line 2) exponential curve 3) hyperbolic 4) curve with-ve slope

8. Modern periodic table is based on the atomic number of the elements. The experiment which proved the significance of the atomic number was
1) Mullikan's oil drop experiment 2) Moseley's work on X-ray spectra
3) Bragg's work on X-ray diffraction 4) Discovery of X-rays by Rontgen

9. The atomicity of a noble gas is
1) 2 2) 1 3) 4 4) 6

10. The element with atomic number 19 is
1) halogen 2) chalcogen 3) noble gas 4) an alkali metal

11. A pair of atomic numbers which belong to s - block are
1) 7, 15 2) 6, 12 3) 9, 17 4) 3, 12

12. The element with electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 3d^{10}\ 4s^2\ 4p^5$ belongs to
1) 4th period, VA group 2) 5th period, IVA group
3) 4th period, VIIA group 4) 7th period, IVA group

13. The element with $ns^2\ np^4$ as outer electron configuration is a
1) alkalimetal 2) chalcogen 3) noble gas 4) halogen

14. Which of the following elements has the lowest ionization potential?
1) N 2) O 3) F 4) Ne

15. Atoms with three of their outer most orbits incompletely filled with electrons are present in
1) Lanthanides 2) Representative elements
3) s - block elements 4) transitional elements

16. The name of the element with atomic number 100 was adopted in honour of
1) Alfred Noble 2) Enric Fermi 3) Dimitri Mendeleef 4) Albert Einstein

17. Inner transition elements exhibit different coloured compound on account of unfilled…Orbitals
1) s 2) f 3) d 4) p

18. The element with atomic number 12 belongs to …. Group and …. Period
1) IA, third 2) IIIA, third 3) IIA, third 4) IIA, second

19. Elements which generally exhibit variable oxidation states and form coloured ions are
1) Metalloids 2) Transition elements 3) Non-metals 4) Gases

20. Ce-58 is a member of
1) s-block 2) p-block 3) d-block 4) f-block

21. 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

22. Which of the following grouping represents a collection of iso-electronic species? (at.Nos: Cs=55, Br=35)
1. Ca^{2+}, Cs^{2+}, Br 2. Na^{+}, Ca^{2+}, Mg^{2+} 3. N^{3-}, F^{-}, Na^{+} 4. Be, Al^{3+}, Cl^{+}

23. Which is the atomic number of another element present in the same group as the element with Z=13 is present
1. Z=14 2. Z=32 3. Z=49 4. Z=20

24. Which of the following pairs of ions have the same electronic configuration
1. Cr^{+3}, Fe^{+3} 2. Fe^{+3}, Mn^{+2} 3. Fe^{+3}, Co^{+3} 4. Sc^{+3}, Cr^{+3}

25. Among the following outermost configuration of metals, which shows the highest oxidation state
1. $3d^3\ 4s^2$ 2. $3d^5\ 4s^1$ 3. $3d^5\ 4s^2$ 4. $3d^6\ 4s^2$

26. The physical and chemical properties of elements are the periodic function of their atomic numbers, this was stated by
1) Mendeleef 2) Lother Meyer 3) Moseley 4) Bohr

27. Zero group was introduced by
1) Lother Meyer 2) Mendeleef 3) Ransay 4) Lockyes

28. According to Mendeleef's periodic law, the properties of elements are periodic function of
1) atomic number 2) atomic weight 3) number of electrons 4) density

29. umber of periods in the long form of periodic table is
1) 6 2) 7 3) 8 4) 18

30. In Mendeleef table, the triad of VII group is
1) Ru, Rh, Pd 2) Cu, Ag, Au 3) N, O F 4) Tl, Pb, Bi

31. Number of short periods in Mendeleef table
1) 2 2) 3 3) 4 4) 1

32. The properties of the following elements were predicted by Mendeleeff before their isolation are
1. Co and Ni 2. I and Te 3. Sc, Ga and Ge 4. Cl, Ar and K

33. The number of elements know when Mendeleef presented periodic table is
1) 50 2) 90 3) 63 4) 102

34. Mendeleeff's periodic law is based on the _____ of the elements
1. Atomic volumes 2. Atomic weights 3. Atomic radii 4.Atomic numbers

35. Which of the following is not an anamalous pair?
1) S, Cl 2) Te, I 3) Co, Ni 4) Ar, K

36. The statement that is false for the long form of the periodic table is
1) it reflects the sequence of filling the electrons in the order of sub-energy levels s, p, d and f
2) it helps to predict the stable valency states of the elements
3) it reflects trends in physical and chemical properties of the elements
4) it helps to predict the relative ionicity of the bond between any two elements.

37. As per the modern periodic law the physical and chemical function of their
1) atomic number 2) electronic configuration 3) aromic weight 4) atomic size

38. In a period, elements are arranged in strict sequence of
1) Decreasing charges in the nucleus 2) Increasing charges in the nucleus
3) Constant charges in the nucleus 4) Equal charges in the nucleus

39. Which of the following is not a representative element
1) Sodium 2) Boron 3) Calcium 4) Chromium

40. The inert gas present in the second long period is
1) Kr 2) Xe 3) Ar 4) Rn

41. Mono atomic element among the following is
1) Phosphorus 2) Oxygen 3) Krypton 4) Sulphur

42. Which one of the following pairs of atomic numbers, represents elements belonging to the same group?
1) 11, 20 2) 13, 30 3) 13, 31 4) 14, 33

43. In the long form of periodic table all non-metals are placed in
1) s - block 2) p - block 3) d - block 4) f - block

44. All elements of the same group will have
1) same electron configuration 2) similar outer electron configuration
3) same ionization potential value 4) different chemical properties

45. The atomic number of an element is always equal to
1. Number of protons in nucleus 2. Half of the atomic weight
3. Electrical charge of the nucleus 3. Weight of the nucleus

46. Which of the following is not the electronic configuration of a representative element
1) ns^2 2) ns^2np^5 3) ns^2np^1 4) ns^2np^6

ACHIEVERS (Level - II)

Descriptive questions:

47. Predict the name and position of the element in the periodic table with electronic configuration $(n-1)d^8 ns^2$ lfor n=5.

48. Last electron in Lu (71) go0es in to 5d, but it is studied in f-block. Explain.

49. How elements are classified in to S,P,d,f blocks.Explain.

50. Explain the classification of elements basing on chemical properties.

51. Write the charecteristics of transition elements.

EXPLORERS (Level - III)

Multi answer type :

♦ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which* ***ONE or MORE*** *is correct. Choose the correct options*

52. Which of the following are correct statements for d-block elements?
1) 1st Transition series is 3d series of electronic configuration $3d^{1-10}\ 4s^{1-2}$
2) 2nd Transition series is 4d - series of electronic configuration $4d^{1-10}\ 5s^{1-2}$
3) 3rd Transition series is 5d - series of electronic configuration $5d^{1-10}\ 6s^{1-2}$.
4) None of these

53. Which oif the following sttaemnts are correct merits of long form of periodic table?
1) It eliminates the even and odd series of IV,V and VI periods of Mendeleeff's periodic table.
2) This periodic table can be divided into four blocks namely s,p,d and f-block elements.
3) In this, classification of elements is based on the atomic number which is a more fundamental property of the elements.

4)None of the above.

54. The statement that is true for the long from of the periodic table is:

1) It reflects the sequence of filling the electrons in the order of sub - energy levels s, p, d and f.
2) It helps to predict the stable valency states of the elements.
3) It reflects trends in physical and chemical properties of elements.
4) None of the above.

Assertion & peason type:

⬧ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which* ***ONLY ONE*** *is correct Choose the correct option.*

1) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.
2) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

55. ***Statement I*** **:** The number of elements in each period is equal to twice the number of orbitals available in the energy level that is being filled.
Statement II **:** The longest period is the sixth period.

56. ***Statement I*** **:** Lanthanide series includes inner transitional elements.
Statement II **:** Lanthanide series starts with lanthanum and ends with lutetium

57. ***Statement I*****:** f-block elements are hard, high melting metals showing variable oxidation states.
Statement II **:** f-block elements form coloured complexes and have high densities.

58. ***Statement I*****:** p-block elements form ionic as well as covalent compounds.
Statement II **:** In p-block elements, most of them are non-metals.

59. ***Satement-I*****:** In the long form of periodic table, position of hydrogen is not fixed.
Statement-II**:** In the long form of periodic table, arrangement of elements is easy to remember and reproduce.

Matching type:

⬧ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column–I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

60.

Column-I	**Column-II**
a) Shortest period	1) Cs to Rn
b) Short period	2) Rb to Xe
c) Long period	3) Li to Ne
d) Longest period	4) H to He
	5) H to Ne

61.

Column-I	**Column-II**
a) First transition series	1) La to Hg
b) Second transition series	2) Sc to Zn
c) Third transition series	3) Incomplete
d) Fourth transition series	4) Y to Cd

62.

Column-I	**Column-II**
a) First transition series	1) Incomplete series
b) Second transition series	2) $5d^{1-10}\ 6s^{1-2}$
c) Third transition series	3) $4d^{1-10}\ 5s^{1-2}$
d) Fourth transition series	4) $3d^{1-10}\ 4s^{1-2}$
	5) 6d series

63.

Column-I	**Column-II**
a) 24	1) p
b) 38	2) f
c) 49	3) s
d) 59	4) d
	5) g

64.

Column-I	**Column-II**
a) Ionization energy α	1) On moving left to right in a period
b) Units of ionization energy	2) e.V/atom or K.cal/mole
c) Ionization energy decreases	3) On moving down the group
d) Ionization energy increases	4) Nuclear charge
	5) Stable electronic configuration

65.

Column-I	**Column-II**
a) Highest electronegativity value	1) Effective nuclear charge
b) Least electronegative element	2) S - character in hybrid orbital
c) Electronegativity α	3) Site of the atom
d) Electronegativity $\frac{1}{\alpha}$	4) Cs
	5) F

Comprehension type

*This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

A. This classification is based on the type of atomic orbital to which a differentiating (last) electron enters. On the bases of electronic configuration, the elements are grouped into four types. **They are:**

a) Representative elements b) Noble gases
c) Transition elements d) Inner transition elements

66. Which of the following is not the electronic configuration of a representative element.
1) ns^2 2) ns^2np^5 3) ns^2np^1 4) ns^2np^6

67. Which of the following electronic configuration corresponds to an inert gas?
1) $1s^12s^22p^5$ 2) $1s^22s^22p^6$ 3) $1s^22s^1$ 4) $1s^22s^22p^63s^1$

68. The elements whose atoms have two outermost shells incomplete are called:
1) Representative elements 2) Noble gases
3) Transition elements 4) Inner transition elements

B. This classification is based on the type of atomic orbital to which a differentiating (last) electron enters. On the bases of electronic configuration, the elements are grouped into four blocks. They are :

i) s-block elements ii) p-block elements
iii) d-block elements iv) f-block elements

69. Which of the following is/are the characterstics of the s - block elements?
1) Highly electro positive 2) Highly reactive
3) Soft metals 4) All the above

70. Which of the following is/are the characterstics of the p - block elements?

1) Highly electro negative 2) Non - metals
3) Show veriable oxidation states 4) All the above

71. The elements whose atoms have two outermost shells incomplete are called:
1) s-Block elements 2) p-Block elements
3) d-Block elements 4) f-Block elements

Hots

72. The elements with atomic numbers 39 to 48 belong to
1) Forth period 2) Fifth period 3) Sixth period 4) Third period

73. The general electronic configuration (n-1) d^3ns^2 indicates that particular element belongs to
1) VB 2) IVB 3) VIB 4) IIIB

74. Transition metals are often paramagnetic owing to
1) their high m.p. and b.p. 2) the presence of vacant d-orbitals
3) the presence of one or more unpaired d-electrons

75. What is wrong about transition metals?
1. They are diamagnetic 2.They are paramagnetic
3. They form complexes 4. They show variable oxidation state

76. The electron configuration of the starting and ending elements of fourth period are
1. $4s^1$ and $3d^{10}4s^2\ 4p^6$ 2. $4s^1$ and $4s^2\ 3d^{10}$
3. $4s^2\ 3d^1$ and $4s^2\ 4p^6$ 4. $4s^2\ 3d^1$ and $4s^2\ 3d^{10}$

77. The atomic number of an element 'X' is 34. Then it is present in _____ period and _____ in group.
1. 4th period and IVA group 2. 4th period and VIA group
3. 4th period and VIIA group 4. 5th period and VIA group

78. The elements which are radioactive and have been named after the names of planets are:
1) Hg 2) Np 3) Pu 4) Ra

79. Fe, Co, Ni are placed in
1) same period 2) same group
3) Only same in group 4) none

KEY

ΦΦ LEARNER'STASK :

☐ **BEGINNERS :**

1) 1	2) 2	3) 1	4) 3	5) 3	6) 3	7) 1	8) 1	9) 2	10) 4
11) 4	12) 3	13) 2	14) 2	15)1	16) 2	17) 2	18)3	19) 2	20) 4
21) 2	22) 3	23) 3	24) 2	25) 3	26) 3	27) 3	28) 2	29) 1	30) 2
31) 3	32) 3	33) 2	34) 1	35) 2	36) 2	37) 2	38) 2	39) 4	40) 2
41) 3	42) 3	43) 2	44) 2	45) 3	46) 4				

☐ **EXPLORERS :**

52)1,2,3 53)1,2,3 54)1,2,3 55)2 56)3 57)2 58)2 59)2
60)a-4,b-3,c-2,d-1 61)a-2,b-4,c-1,d-1,3 62)a-4,b-3,c-2,d-1,5
63)a-4,b-3,c-1,d-2 64)a-4 ,b-2 ,c-3 .d-1 65) a-5,b-4,c-1,d-3.

66) 4	67)2	68)3	69)1	70)4	71)3	72)2	73)1	74)3	75)1	76)1
77)2	78)3	79)3							

§§ PERIODIC PROPERTIES

§§ ATOMIC RADIUS:

In atoms, the electron cloud around the nucleus extends to infinity.The distance between the centre of the nucleus and the electron cloud of outer most energy level is called atomic radius.

Atomic radius cannot be determined directly, but measured from the inter nuclear distance of combined atoms, using X-ray diffraction techniques.

Atomic radius depends on

a) Nature of bonding

b) Number of bonds (multiplicity of bonding)

c) Oxidation states etc.

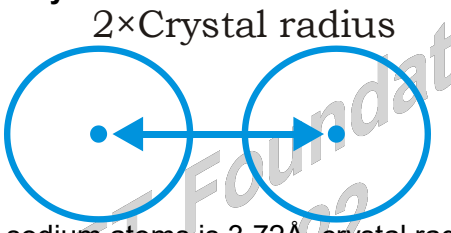
Three types of atomic radii are considered based on the nature of bonding they are

a) Crystal radius b) Van der waals radius c) Covalent radius

Atomic radii expressed in angstrom, nanometers, picometer units.

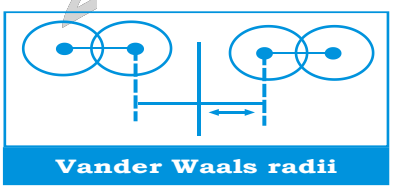
$1\text{Å} = 10^{-1}\text{nm}\,;\,1\text{Å} = 10^{2}\text{ pico.metres}$

a)Crystal Radius (Atomic Radius) - Half of the internuclear distance between the adjacent atoms of a solid metallic crystal is called **crystal radius** or **metallic radius**.



Ex :Distance between two sodium atoms is 3.72Å, crystal radius of Na = 3.72/2 = 1.86 Å.

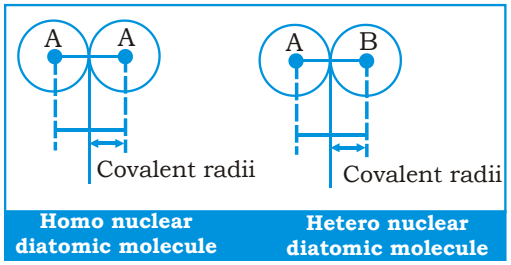
b)Van der waals radius - Half of the internuclear distance between two non bonded atoms of different molecules which are very close to each other due to vander waals forces is called **Vander waals radius**.



The distance between two adjacent chlorine atoms of different Cl_2 molecules is $3.6A^0$, Vander waals radius of Cl is $1.8A^0$.Vander waals radius is 40% greater than covalent radii.It is used for molecular substances in the solid state only.

c)*Covalent Radius* term is generally used in reference to non-metals.

Covalent radius - Half of the inter nuclear distance of the two atoms held together by a covalent bond is called covalent radius.



Note : Single bond covalent radii are additive in nature.

Ex : a) in Cl_2, Cl - Cl bond distance (Internuclear distanc) is $1.98A^0$.

Covalent Radius of Cl = 0.99Å.

b) in diamond C-C bond distance is 1.54Å.
Covalent radius of C = 0.77A^0.

In metals, the crystal radius (atomic radius) is slightly more than the covalent radius.

As the number of covalent bonds between two atoms increases the covalent radius decreases.

Ex: The covalent radius of carbon decreases with increase in the number of bonds between carbon atoms. $C-C \quad > C=C \quad > C\equiv C$

$(1.54\,A^0)\ (1.34\,A^0)\ (1.20\,A^0)$

Φ **Van der waal radius > crystal radius > covalent radius.**

§§ **IONIC RADIUS :**

When a neutral atom loses one (or) more electrons a positive ion called cation is formed.

$Na \rightarrow Na^+ + e^-$

The ionic radius of cation is less than that of neutral atom. It is because the cation has higher effective nuclear charge. eg: $Na > Na^+$

Among the cation as the positive charge increases, the ionic radius decreases.

eg: $Fe^{2+} > Fe^{3+}$

When a neutral atom gains one (or) more electrons a negative ion called anion is formed.

$Cl + e^- \rightarrow Cl^-$

The radius of anion is more than that of its atom, due to decrease in effective nuclear charge.

$Cl^- > Cl$

Among the anions as the negative charge increases the ionic radius increases.

eg: $O^{2-} > O^-$

The decreasing order of the radii is Anion > Atom > Cation

$I^- > I > I^+$

$H^- > H > H^+$

The species (atoms or ions) having the same number of electrons are known as iso - electronic species.

In iso electronic species, the size increases with increase of negative charge and decrease of positive charge. $\left(\text{size } \alpha \frac{1}{z/e \text{ ratio}}\right)$ i.e. effective nuclear charge.

Φ ***Decreasing order of size.***

$C^{4-} > N^{3-} > O^{2-} > F^- > Ne > Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$

§§ **IONIZATION ENERGY (IONIZATION POTENTIAL) :**

¶¶ **Ionization potential:** The minimum amount of energy required to remove the most loosely bound electron (i.e, outer - most shell electron) from an isolated neutral gaseous atom is called ionization potential.

IE is measured in eV/atom or kJ/mole or K.cal/mole.

1 eV / atom = 23.06 K.Cal/mole = 96.45 KJ/mole

Energy required to remove an electron from unipostive ion to convert it into dipositive ion is IE_2.

Energy required to remove an electron from dipositive ion to convert it into tripositive ion is IE_3.

$M_{(g)}^{+} + IE_2 \rightarrow M_{(g)}^{2+} + e^-$

$M_{(g)}^{2+} + IE_3 \rightarrow M_{(g)}^{3+} + e^-$

Ionization energy is determined by spectral studies or discharge tube experiments.

¶¶ **Ionization potential depends on :**

a) With increase in the atomic size "IP" decreases due to decrease in attractive force of nucleus on outer most orbit electrons.

b) With increase in the effective nuclear charge IP increases.

c) If the number of electrons in the inner shells are more, shielding capacity of the inner electrons on the nuclear charge will be more. Hence IP decreases.

d) Order of screening power of orbitals s > p > d > f

e) As the positive charge on cation increases, IP increases.

f) As the -ve charge on anion increases, IP decreases.

g) If the valency electrons are more penetrated into inner shells, IP increases.

h) Penetration power of different orbitals is in the order of s > p > d > f

i) IP order of electrons of different orbitals of same orbit.

Φ **IP of s-electrons > IP of p-electrons > IP of d-electrons > IP of f-electrons.**

j) IP is more for atoms with exactly half filled and completely filled orbitals.

Ex : IE_1 of N > IE_1 of O IE_1 of Be >IE_1 of 'B'

IE_1 of P > IE_1 of S IE_1 of Mg >IE_1 of 'Al'

k) Atoms of inert gases have highest IP values due to the presence of completely filled orbitals.

l) In the graph showing relation between IP and atomic number, the inert gases appear at the peaks and alkali metals appear at the bottom.

m) In any period an Alkali metal atom has lowest IP and Inert gas element has highest IP.

n) In periods from left to right side IP increases, due to decrease in atomic size and increase in effective nuclear charge.

o) In groups from top to bottom, IP decreases due to the increase in the atomic size and increase in the screening effect of inner electrons.

p) IE order among 2nd period elements.

IE_1 - Li < Be > B < C < N > O < F < Ne

IE_2 - Li > Be < B > C < N < O > F < Ne

q) IE order among 3rd period elements

IE_1 - Na < Mg > Al < Si < P > S < Cl < Ar

IE_2 - Na > Mg < Al > Si < P < S > Cl < Ar

r) Element with Lowest IP - Cs

s) IE_1 of Be greater than B due to

a) Completely filled s -orbital in Be b) More Penetration of s-orbitals.

t) Knowledge of successive IE can be used to find the number of valence electrons .

u) For alkali metals the IE_2 shows sudden jump.

v) For alkaline earth metals, the IE_3 shows sudden jump.

w) The number of IE possible for an atom of an element is equal to its atomic number.

TEACHING TASK

I.Single answer type

1. The radii of F, F^-, O and O^{2-} are in the order
1) $O^{2-}>F^->O>F$ 2) $O^{2-}>F^-F>O$ 3) $F^-> O^{2-}> F>O$ 4) $O^{2-}>O>F^-> F$

2. Of the following, the one with largest size is (1997)
1) Cl^- 2) Ar 3) K^+ 4) Ca

3. The order of decrease in atomic radii for Be, Na & Mg is
1) Na>Mg>Be 2) Mg>Na>Be 3) Be>Na>Mg 4) Be>Mg>Na

4. Which of the following is the largest ion
1) Na^+ 2) Mg^{+2} 3) O^{-2} 4) F^-

5. When a neutral atom is converted into cation, there is
1) a decrease in atomic number 2) in an increase in atomic number
3) a decrease in size 4) an increase in size

6. Ionisation potential of Boron is less than that of Beryllium. This is because
1) B has $1s^2\ 2s^2\ 2p^1$ configuration 2) B has small atomic size
3) B has higher nuclear charge 4) B has more number of shells

7. The energy required for the removal of outermost electron from an isolated unipositive gaseous ion is called
1) first ionisation potential 2) second ionisation potential
3) third ionisation potential 4) fourth ionisation potential

8. An alkaline earth element has the I_1, I_2 and I_3 values 9.2 eV/atom, 18.5 eV/atom and 'x' eV/atom. Then 'x' is
1) 3eV/atom 2) 154 eV/atom 3) 20 eV/atom 4) 10 eV/atom

9. The screening effect of d-electrons is
1) equal to the p-electrons 2) much more than the p-electrons
3) same as f-electrons 4) less than the p-electrons

10. The electron affinity of X is equal in magnitude with the ionisation potential of
1) X^+ 2) X^- 3) X 4) X^{2-}

11. Which is less for an element
1) I_1 2) I_2 3) I_3 4) I_4

12. The I_1, I_2, I_3, I_4 values of an element "M" are 120 kJ/mole, 600 kJ/mole, 1000 kJ/mole and 8000 kJ/mole. Then the formula of its sulphate is
1) MSO_4 2) $M_2(SO_4)_3$ 3) M_2SO_4 4) $M_3(SO_4)_2$

13. The electron configuration of elements A, B and C are [He] $2s^1$, [Ne]$3s^1$ and [Ar] $4s^1$ respectively. Which one of the following order is correct for the first ionization potentials (in $KJ.mol^{-1}$) of A, B and C?(2001E)
1) A>B>C 2) C>B>A 3) B>C>A 4) C>A>C

14. Which of the following species has the highest in ionization potential
1) Li^+ 2) Mg^+ 3) Al^+ 4) Ne

15. Element with lowest and highest I.P. values in each period respectively.
1) Alkali metals, Noble gases 2) Alkali metals, Halogens
3) Halogens, Alkalimetals 4) Noble gases, Alkalimetals

16. Which one of the following relations is correct with respect to first (I) and second (II) ionization potentials of sodium and Magnesium?
1) $I_{Na}>I_{Mg}$ 2) $I_{Mg}>II_{Na}$ 3) $II_{Mg}>II_{Na}$ 4) $II_{Na}>II_{Mg}$

17. Among the following elements that has lowest ionization potential value is

1) Nitrogen 2) Oxygen 3) Fluorine 4) Neon

Multi Correct Choice Type:

*This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

18. Which of the following are correct for consequences of Lanthanide contraction ?
1) Atomic sizes of 4d and 5d transition elements become almost equal,due to which their properties are very close.
2) Zr and Hf resemble very closely.
3) The crystal structure and other properties of lanthanides are very similar.
4) Separation of lanthanides is not easy from their mixture.

19. Which of the following factors effects the atomic radii?
1) Effective nuclear charge. 2) Atomic number.
3) Shielding effect. 4) None of the above.

20. In groups from top to bottom, IP decreases due to :
1) increase in the atomic size 2) increase in the screening effect of inner electrons.
3) decrese in the screening of inner electrons 4) None of these.

Assertion & peason type:

*This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

21. ***Statement I*** **:** Second ionization enthalpy will be higher than the first ionization enthalpy.
Statement II **:** ionization enthalpy is a quantitative measure of the tendency of an element to lose an electron.

22. ***Statement I*****:** Penetration power of different orbitals is in the order of s > p > d > f
Statement II **:**Order of screening power of orbitals s > p > d > f

23. ***Statement I*****:** With increase in the atomic size “IP” decreases due to decrease in attractive force of nucleus on outer most orbit electrons.
Statement II **:**With increase in the effective nuclear charge, IP increases.

Matrix Match Type:

*This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

24.

Column-I	**Column-II**
a) Ionization energy α	1) On moving left to right in a period
b) Units of ionization energy	2) e.V/atom or K.cal/mole
c) Ionization energy decreases	3) On moving down the group
d) Ionization energy increases	4) Nuclear charge
	5) Stable electronic configuration

Comprehension Type:

*This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

The minimum amount of energy required to remove the most loosely bound electron from an isolated neutral gases of atom $IP_n > IP_{n+1} > --- > IP_1$

The amount of energy released, when an electron is added to a neutral isolated gases atoms of an element is called electro affinity.

1^{st} EA_1 value is exothermic 2^{nd} EA_2 value is endotherimic

25. The first ionization potential of Li will be
1) Greater than Be 2) Less than Be 3) Equal to Na 4) Equal to F

26. Ionisation potential of Boron is less than that of Beryllium. This is because
1) B has $1s^2\ 2s^2\ 2p^1$ configuaration 2) B has small atomic size
3) B has higher nuclear charge 4) B has more number of shell

LEARNER'S TASK

BEGINNERS (Level - I)

SINGLE ANSWER TYPE:

27. The I.P. of an element on going from left to right in a period
1) increase 2) decreases 3) remain uncharged 4)gets double

28. The atomic radius decreases in a period due to
1. Increase in nuclear attraction 2. Decrease in nuclear attraction
3. Increase in number of electrons 4. Decrease in number of electrons

29. The Lanthanide contraction relates to
1. Oxidaion states 2. Magnetic state 3. Atomic radii 4. Valence electrons

30. When an atom of an electronegative element becomes anion, which of the following occurs?
1. It acts as a reducing agent 2. It loses electrons
3. It ionic radius becomes larger 4. None

31. The first, second, third, fourth, fifth ionization potential values of an element are 6.11, 11.87, 51.21, 67.0, 84.39 eV respectively. The element is
1) Calcium 2) Potassium 3) Aluminium 4) Carbon

32. The element with highest ionization potential is
1) Nitrogen 2) oxygen 3) Helium 4) Neon

33. In the long form of periodic table elements with low ionisation potentials are present in
1) I A group 2) IV A group 3) VII A group 4) Zero group

34. As atomic number of elements increases, the I.P. value of the elements of the same period
1) decreases 2) increases 3) remains constant 4)first increases and then decreases

35. The ionization potential values of an element are in the following order $I_1<I_2<<<<I_3<I_4<I_5$. The element is
1) alkali metal 2) chalcogen 3) halogen 4) alkaline earth metals

36. The ionization energy of nitrogen is more than that of oxygen because
1) of the extra stability of half-filled p orbitals in nitrogen
2) of the smaller size of nitrogen
3) the former contains less number of electrons
4) the former is less electronegative

37. The correct order of second I.P. values of carbon, nitrogen, oxygen and fluorine is
1) C>N>O>F 2) O>N>F>C 3) O>F>N>C 4) F>O>N>C

38. The ionisation potential of "X^+" ion is equal to
1) the electron affinity of "X" atom 2) the elcetronegativity of "X" atom
3) the ionisation energy of "X" atom 4) the electron affinity of " X^{2+} " ion

39. The I1 of potassium is 4.339 eV/atom. the I1 of sodium
1) 4.339 2) 2.21 3) 5.138 4) 1.002

40. The first ionization potential of four consecutive elements, present in the second period of the periodic table are 8.3, 11.3, 14.5 and 13.6 eV respectively. Which one of the following is the first ionization potential (in eV) of nitrogen?(2004)
1. 13.6 2. 11.3 3. 8.3 4. 14.5

41. Which of the following transitions involves maximum amount of energy?
1) $M^-(g) \rightarrow M(g)$ 2) $M(g) \rightarrow M^+(g)$ 3) $M^+(g) \rightarrow M^{2+}(g)$ 4) $M^{2+}(g) \rightarrow M^{3+}$

42. Elements X, Y and Z have atomic numbers 19, 37 and 55 respectively. Which of the following statements is true about them?
1. Their ionization potential would increase with increasing atomic number
2. 'Y' would have an ionization potential between those of X and Z
3. Z would have the highest ionization potential
4. Y would have the highest ionization potential

43. For any atom, the order of ionization potential values is
1) $I_1 < I_2 < I_3$ 2) $I_1 > I_2 > I_3$ 3) $I_1 < I_2 > I_3$ 4 $I_1 > I_2 < I_3$

44. The high ionistion potential of magnesium compared with aluminium, is due to
1) filled orbitals in magnesium 2) high nuclear charge in magnesium
3) low radius of magnesium atom 4) low effective nuclear charge in magnesium

45. The correct order of ionization potential values of Be, B, Li, C atom is
1) Be<B<Li<C 2) Li<Be<B<C 3) Li<Be>B<C 4) Li>Be>B<C

46. The ionisation energy is lowest for
1) Nitrogen 2) Oxygen 3) Fluorine 4) Neon

47. The element with highest ionisation potential is
1) Na 2) Ar 3) Cl 4) P

48. The ionisation potential is very low for
1) Be 2) Mg 3) B 4) Al

49. The I_1 value of potassium is less than the I_1 value of sodium. This is due to
1) large size of potassium atom 2) small size of potassium atom
3) low density of potassium 4) Univalent nature of potassium

50. The ionization potential of elements in any group decreases from top to bottom. This is due to
1) Increase in size of atom 2) Increase in atomic number
3) Increase in screening effect
4) both increase in size of atom and increase in screening effect

51. The energy required to remove an electron of a gaseous atom from its ground state is called
1) Potential energy 2) Ionization energy 3) Electrode potential 4) Activation energy

52. The first ionization energy of lithium will be
1) Greater than Be 2) Less than Be
3) Equal to that of Na 4) Equal to that of F

53. Which has maximum first ionization potential?
1) C 2) N 3) B 4) O

54. Which has the highest second ionization potential?
1) Nitrogen 2) Carbon 3) Oxygen 4) fluorine

55. Which has least ionization potential?
1) Li 2) Cs 3) Cl 4) I

56 . The first ionization energy values of an element are 191, 578,872, and 5692 kcals. The number of valence electrons in the element are
1) 5 2) 2 3) 3 4) 4

57. The peaks in ionisatoin potential curves are occuiped by
1) alkali metals 2) inert gases 3) transition metals 4) halogens

58. The first ionization potential of Li will be
1) greater than Be 2) less than Be 3) equal to Na 4) equal of F

59. The I.P. of sodium is 5.14 eV. The I.P. of potassium could be
1) same as that of sodium 2) 5.68eV 3) 4.34eV 4) 10.28eV

60. A sudden large jump between the values of second and third ionization energies of an element would be associated with the electronic configuration
1) $1s^2, 2s^2p^6, 3s^1$ 2) $1s^2, 2s^2p^6, 3s^2p^1$ 3) $1s^2, 2s^2p^6, 3s^2p^2$ 4) $1s^2, 2s^2p^6, 3s^2$

61. The first ionisation potential is maximum for
1. Lithium 2. Uranium 3. Iron 4. Hydrogen

62. In the following four elements, the ionisation potential of which one is the highest?
1. Oxygen 2. Argon 3. Barium 4. Cesium

63. The incorrect statement among the following is
1. The first ionisation potential of Al is less than the first ionisation potential of Mg
2. The second ionisation potential of Mg is greater than the second ionisation potential of Na
3. The first ionisation potential of Na is less than the first ionisation potential of Mg
4. The third ionisation of potential of Mg is greater than the third ionisation potential of Al

64. The decreasing order of the second ionization potential of K, Ca and Ba is
1. K > Ca > Ba 2. Ca > Ba > K 3. Ba > K > Ca 4. K > Ba > Ca

65. The low electron affinity value of nitrogen is due to
1) small size 2) high nuclear charge
3) half-filled 2p sublevel 4) high metallic character

66. Which of the following has zero electron affinity?
1) Oxygen 2) Fluorine 3) Nitrogen 4) Neon

67. Electron affinity values are obtained indirectly by
1) electric discharge method 2) Born-Haber cycle method
3) electron microscopic method 4) Millikian oil drop method

68. Energy is absorbed when a second electron is added to oxygen. This is because
1) O^- has stable configuration 2) O^- has repulsion with electron to be added
3) O^- has lower nuclear charge than O 4) O^{2-} has unstable configuration

69. The decreasing order of electron affinity of halogen's is
1) F > Cl > Br > I 2) F < Cl < Br < I 3) F < Cl > Br < I 4) Cl > F > Br > I

Descriptive Answers — ACHIEVERS (Level - II)

70. A student reported the atomic radii of Cu, Cu+ and Cu+2 as 96 pm,122 pm and 72 pm respectively. Do you agree with the reported values.

71. Mn+2 is smaller than O-2 in size, though both have same electronic configuration. Explain.

72. Calculate the amount of energy required to convert 7.974 g of cesium atom in the gaseous state to form cesium ions. IE1 of Cs =374 kj/mol and atomic mass of Cs is 132.9 amu.

Multi Correct Choice Type — EXPLORERS (Level - III)

*This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

73. Atomic radius depends upon.
1) Number of bonds formed by the atom 2) nature of bonding
3) oxidation state of the atom 4) None of the above

74. Which of the following effects the atomic radius?

1) Effective nucler charge 2) Number of orbits 3) Shielding effect 4) None

75. Which of the following order is correct?

1) Vanderwaal radius > crystal radius > covalent radius
2) Covalent radius < crystal radius < vanderwaal radius
3) Covalent radius > crystal radius > vanderwaal radius 4) None of these

Assertion &reason type:

✦ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which* ***ONLY ONE*** *is correct Choose the correct option.*

1) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.
2) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

76. ***Statement I*****:**Half of the internuclear distance between the adjacent atoms of a solid metallic crystal is called crystal radius .

Statement II **:**The effect of increase in the number of orbits in an atom increases the atomic size.

77. ***Statement I*****:**Covalent radius term is generally used in reference to non-metals.

Statement II **:**Vanderwaals is 40% greater than covalent radii.

78. ***Statement I*****:** The decreasing order of the radii is : Anion > Atom > Cation ;

$I^- > I > I^+$; $H^- > H > H^+$

Statement II **:**When a neutral atom gains one (or) more electrons a negative ion called anion is formed.

79. ***Statement I*****:** When a neutral atom loses one (or) more electrons a positive ion called cation is formed.

Statement II **:** Among the cation as the positive charge increases, the ionic radius decreases.

Matrix Match Type:

✦ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column–I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

80.

Column-I	**Column-II**
a) Size of anion α	1) Increases
b) Size of cation $\frac{1}{\alpha}$	2) Decreases
c) Atomic radii in a period	3) Effective nuclear charge
d) Atomic radii in a group	4) Number of orbits
	5) Electronic repulsion

Comprehension Type:

✦ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

A. In atoms, the electron colud around the nucleus extends to infinity. The distance between the centre of the nucleus and the electron cloud of outer most energy level is called atomic radius.

Atomic radius cannot be determined directly, but measured from the inter nuclear distance of combined atoms, using X-ray diffraction techniques.

81. Atomic radius is measured by
1) Rutherford's α - ray scattering experiment 2) X ray diffraction technique
3) Mulliken oil drop method 4) All of these

82. The atomic radii in case of inert gases is :
1) Ionic radii 2) Covalent radii 3) Vander waals radii 4) None of these

83. Lower atomic radius is:
1) Lithium 2) Magnesium 3) Sodium 4) Baryllium

B. When a neutral atom loses one (or) more electrons a positive ion called cation is formed.

$Na \rightarrow Na^+ + e^-$

The ionic radius of cation is less than that of neutral atom. It is because the cation has higher effective nuclear charge. eg: $Na > Na^+$

Among the cation as the positive charge increases, the ionic radius decreases.

eg: $Fe^{2+} > Fe^{3+}$

84. Na^+ , Mg^{2+}, Al^{3+}, Si^{4+} are isoelctronics. Their ionic size follows the order:
1) $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$ 2) $Na^+ > Mg^{2+} < Al^{3+} < Si^{4+}$
3) $Na^+ < Mg^{2+} > Al^{3+} > Si^{4+}$ 4) $Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$

85. In the isoelectronic series: K^+, Cl^-, S^{2-}, Ca^{2+} the largest size is of :
1) K^+ 2) Cl^- 3) Ca^{2+} 4) S^{2-}

HOTS

86. If the differentiating electron enters (n-1) d-sublevel. The element is
1) a representative element 2) a noble gas
3) an alkali metal 4) a transition element

87. Atomic number of next inert gas to be discovered will be
1) 87 2) 104 3) 118 4) 132

88. Total number of groups in Mendeleef's table
1) 18 2) 9 3) 7 4) 10

89. Which of the following electronic configuration corresponds to an inert gas?
1) $1s^1 2s^2 2p^5$ 2) $1s^2 2s^2 2p^6$ 3) $1s^2 2s^1$ 4) $1s^2 2s^2 2p^6 3s^1$

90. Ionic radii of (IIT)
1. $Ti^{4+} < Mn^{7+}$ 2. $^{35}Cl < ^{37}Cl$ 3. $K^+ > Cl^-$ 4. $P^{3+} > P^{5+}$

91. The I_1 values of Li, Be and C are 5.4 eV/atom, 9.32 eV/atom and 11.26 eV/atom. The I_1 value of Boron is
1) 13.6 eV/atom 2) 8.29 eV/atom 3) 14.5 eV/atom 4) 21.5 eV/atom

92. The process requiring the absorption of energy is
1) $F \rightarrow F^-$ 2) $Cl \rightarrow Cl^-$ 3) $O^- \rightarrow O^{2-}$ 4) $H \rightarrow H^-$

93. The electron affinity values ($KJmol^{-1}$) of three halogens X,Y and Z are respectively - 349, -333 and -325. Then X,Y and Z respectively are
1. F_2, Cl_2 and Br_2 2. Cl_2, F_2 and Br_2 3. Cl_2, Br_2 and F_2 4. Br_2, Cl_2 and F_2

KEY

ΦΦ TEACHING TASK :

1) 1	2) 1	3) 1	4) 3	5) 3	6) 1	7) 2	8) 3	9) 4	10) 2	11) 1
12) 2	13) 1	14) 1	15) 1	16) 4	17) 2	18) 2,3		19) 1,2,3		20)1,2
21) 3	22) 1	23) 1	24)a-4,b-2,c-3,d-1			25) 2	26)1			

ΦΦ LEARNER'STASK :

☐ **BEGINNERS :**

27) 1	28) 1	29) 3	30) 3	31) 1	32) 3	33) 1	34) 1	35) 4	36) 1	37) 3
38) 1	39) 3	40) 4	41) 4	42) 2	43) 1	44) 1	45) 3	46) 2	47) 2	48) 4
49) 1	50) 1	51) 2	52) 2	53) 2	54) 3	55) 2	56) 3	57) 3	58) 2	59) 3
60) 4	61) 1	62) 2	63) 4	64) 1	65) 1	66) 4	67) 2	68) 2	69) 4	

☐ **EXPLORERS:**

73)2,3	74)1,2,3	75)1	76)2	77)2	78)2	79)2	80)a-3,b-5,c-2,d-1	
81)2	82)3	83)4	84)4	85)4	86)4	87)3	88)2	89)2	90)4	91)2
92)3	93)2									

§§ ELECTRON AFFINITY

It is an atomic property which gives us an idea of the tendency of the element to accept the electron to form an anion.

The amount of energy released when an electron is added to a neutral isolated gaseous atom of an element is called EA.

$X_{(g)} + e^- \rightarrow X_{(g)}^- + EA_1$ (or) $X_{(g)} + e^- \rightarrow X_{(g)}^-$ $\Delta H = -EA_1$ (Exothermic process)

When an electron is added to uni-negative ion, energy is absorbed to overcome the repulsive forces. This energy is called second electron affinity.

EA_2 has positive sign. $X_{(g)}^- + e^- \rightarrow X_{(g)}^{2-}$ $\Delta H = +EA_2$ (Endothermic process).

EA is measured in eV/atom, Kcal/mole, KJ/mole

EA can be calculated indirectly from Born - Haber Cycle.

EA depends on size, effective nuclear charge and electronic configuration of an element.

Be group elements have completely filled orbitals and hence the addition of any extra electron from out side to these atoms is not possible. Therefore they have practically zero EA.

Noble gases have most stable ns^2np^6 configuration. Hence their EA values are practically zero.

For N, P - due to half filled orbitals, they have some extra stability hence their EA values are close to zero (very small values). $Be\left(+66\,KJ\,mol^{-1}\right)$, $Mg\left(+67\,KJ\,mol^{-1}\right)$ $N\left(+31\,KJ\,mol^{-1}\right)$

In groups, EA decreases from top to bottom as the atomic size increases.

EA_1 of third period element is greater than corresponding second period element of each group.

In VII A group EA of Cl > EA of F

VIA group EA of S > EA of O

VA group EA of P > EA of N

IV A group EA of Si > EA of C

EA of F (333 K.J $mole^{-1}$) < EA of Cl (348K.J $mole^{-1}$). This is due to

a) Smaller size of F-atom

b) Strong inter electronic repulsions

In a period from left to right side EA increases due to decrease in size of atoms and increase in the nuclear charge.

Note :

EA of a neutral atom = IE of its uninegative ion.

IE of a neutral atom = EA of its unipositive ion.

Among all the elements chlorine has the maximum EA.

The metal which has higher EA is gold.

§§ ELECTRO NEGATIVITY

It is property of an atom in a molecule.

The tendency of an atom to attract the shared electron pair towards itself in a molecule is called EN.

¶¶ **Pauling Scale** : EN of elements are calculated from the values of bond energies.

Pauling calculated the EN of other elements by using the formula

$X_A - X_B = 0.208\sqrt{\Delta}$. [Δ is in K.Cal./mole.]

In SI units, $X_A - X_B = 0.1017\sqrt{\Delta}$, [Δ is in KJ/mole.]

where X_A and X_B are the EN's of A & B.

Δ is a measure of the polarity of A-B bond.

Δ = Experimental BE - Theoritical BE

Δ = Actual BE -1/2 [E_{A-A} + E_{B-B}] . BE = Bond Energy

Hydrogen (whose EN is 2.1) is used to calculate EN of other elements.

¶¶ **Mulliken scale,**

EN is the average of IE and EA.

$$EN = \frac{IE + EA}{2}$$

$$EN = \frac{IE \text{ in } eV + EA \text{ in } eV}{5.6}$$

$$EN = \frac{(IE \text{ in } kj/mole) + (EA \text{ in } kj/mole)}{544}$$

$$EN = \frac{(IE \text{ in } kcals/mole) + (EA \text{ in } kcals/mole)}{125}$$

Mulliken EN values are approximately 2.8 times greater than Pauling EN values.

Mulliken scale is applicable only to univalent elements.

EN concept is not applicable for Inert gas elements. In groups from top to bottom EN decreases. In periods from left to right EN increases. In a period, Halogen has high EN value.Alkali metal has low EN value. Highest EN element is F(4.0).Next to F, oxygen has high EN (3.5) .Least EN element is Cesium (0.7).Noble gas elements have zero EN due to octet configuration. EN values are used to know the nature of chemical bond.

If EN difference is less than 1.7 the bond is covalent in nature equals to 1.7 the bond is 50% ionic in nature. more than 1.7 the bond is ionic in nature.

TEACHING TASK

Single answer type

1. The energy released when a neutral gaseous atom, takes up an electron and forms a uninegative ion is called its

1) effective nuclear charge 2) polarising power

3) electron affinity 4) ionization potential

2. Among fluorine and chlorine, the electron affinity of the latter is high.This is due to

1) high electronegativity of fluorine 2) low dissociation energy of fluorine

3) F repels with the added e- due to its small size 4) small size of Chlorine

3. Which of the following will have almost positive EA_1
1) Chlorine 2) Oxygen 3) Magnesium 4) Sulphur

4. The element having highest electron affinity is
1) Fluorine 2) Nitrogen 3) Chlorine 4) Oxygen

5. The element with high electron affinity is
1) nitrogen 2) oxygen 3) sulphur 4)phosphorous

6. The electron affinity of an atom is numerically equal to the
1) ionization potential of its uni negative ion
2) effective nuclear charge of its uni positive ion
3) ionization potential of its di negative ion 4) ionization potential of it uni positive ion

7. $X_{(g)} + e \rightarrow X^-_{(g)} + E$, Here "E" is
1) first electron affinity 2) first ionisation energy
3) second electron affinity 4) second ionisation energy

8. Among the following electronic configurations which one will have highest electron affinity value
1) $1s^2$ 2) $1s^2\ 2s^2$ 3) $1s^2\ 2s^2\ 2p^4$ 4) $1s^2\ 2s^2\ 2p^5$

9. Which has high Electron Affinity
1) F 2) O 3) I 4) N

10. The units of Electron Affinity are
1) k cal/mole 2) erg. sec 3) A^0 4) no units

11. The magnitude of electron affinity depends upon
1) the atomic size 2) the screening effect 3) the nuclear charge 4) all of these

12. Among the following electronic configurations which one will have low electron affinity value
1) $1s^2$ 2) $1s^2\ 2s^2$ 3) $1s^2\ 2s^2\ 2p^4$ 4) $1s^2\ 2s^2\ 2p^5$

13. Diagonal relationship is shown by
1) Elements of first period 2) Elements of second period
3) Elements of third period 4) None

14. The electron affinities of N, O, S and Cl are
1. N < O < S < Cl 2. O < N < Cl < S 3. O = Cl < N = S 4. O < S < Cl < N

Multi Correct Choice Type:

◆ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which* ***ONE or MORE*** *is correct. Choose the correct options*

15. Which one of the following statements are correct ?
1) Greater is the nuclear charge, greater is the electron gain enthalpy.
2) Nitrogen has zero electron gain enthalpy.
3) Electron gain enthalpy decreases from chlorine to iodine in the group.
4) Chlorine has highest electron gain enthalpy.

Assertion &reason type:

◆ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which* ***ONLY ONE*** *is correct Choose the correct option.*

1) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.
2) Statement-I, Statement-II both are true but Statement-II is not the 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*:** The lower electron gain enthalpy of fluorine than that of chlorine.
***Statement II* :** Chlorine is smaller in size than fluorine..

Matrix Match Type:

♦ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

17.

	Column-I	**Column-II**
a)	Highest electronegativity value	1) Effective nuclear charge
b)	Least electronegative element	2) S - character in hybrid orbital
c)	Electronegativity α	3) Site of the atom
d)	Electronegativity $\frac{1}{\alpha}$	4) Cs5) F

Comprehension Type:

♦ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

A. On moving from left to right in a period electronegativity values increases because atomic size decreases and effective nuclear charge increases.On moving down in a group, electronegativity desreases because atomic size increases.

18. Electronegativity is a measure of the capacity of an atom to:
1) Repel electrons 2) Attaract shared pair of electron
3) Share electrons with another atom 4) Combine with protons.

19. In periodic table from I group to VII group electronegativity of elements:
1) Decreases 2) Increases 3) Remains constant 4) All of these

20. In the series carbon, nitrogen , oxygen and fluorine the electronegativity :
1) Decreases from carbon to fluorine. 2) Increases from carbon to fluorine.
3) Remains constant. 4) Decreases from carbon to oxygen and then increases.

LEARNER'S TASK

BEGINNERS (Level - I)

Single answer type

21. For univalent elements, the average value of first ionization potential and first electron affinity is equal to its
1) Polarising power 2) Covalent radius 3) electronegativity 4)dipole moment

22. The reference element in Paulings scale of Electronegativity is
1) H 2) O 3) N 4) Cl

23. The electronegativity of Be is same as that of
1) Al 2) Mg 3) Na 4) Li

24. Electronegativity is the property related to
1) Isolated atom in gaseous state 2) Isolated atom in solid state
3) Inert gas 4) bonded atoms in a molecule

25. If the electronagativity difference between bonded atoms is exactly 1.7 the nature of bond formed is

1) >50% Ionic 2) <50% Ionic 3) 50% Ionic & 50% covalent 4) 100% Ionic

26. Which of the following elements have relatively high electronegativities
1) alkali metals 2) Halogens 3) alkaline earth metals 4) all the above

27. The element with high electronegativity is
1) Chlorine 2) Sulphur 3) Oxygen 4) Nitrogen

28. Element with high electronegativity is
1) Nitrogen 2) Chlorine 3) Fluorine 4) Hydrogen

29. Electronegativity is a measure of the capacity of an atom to
1) Attract electrons 2) Attract protons 3) Repel electrons 4)repel protons

30. Of the following elements, which one has the low electronegativity
1) I 2) Br 3) Cl 4) F

31. Keeping in view the periodic law and the periodic table, predict the element that has the maximum electronegative character.
1) P 2) As 3) Bi 4) Sb

32. Which of the following set of atoms is arranged in order of decreasing electronegativity
1) F > O > Cl > S 2) F < O < Cl < S 3) O > F > Cl > S 4) Cl > F > O > S

33. Pauling's values of electronegativities are dependent upon
1) Ionisation potentials 2) Bond energies 3) Electron affinities 4) Atomic radii

34. In a period from Alkali metal to Halogens, the Electronegativity
1) gradually increases 2) gradually decreases
3) gradually increases except inIIA and VI group elements
4) gradually decreases except in IIA and VI group elements.

35. Going from Fluroine, chlorine, bromine to iodine, the electronegativity
1) increases 2) first decreases then increases
3) decreases 4)Changes randomly

36. Let electronegativity, ionisation energy and electron affinity be represented as EN, IP and EA respectively.Which one of the following equation is correct according ot Mulliken?
1) EN=IP x EA 2) EN=IP/EA 3) EN=(IP+EA) / 2 4) EN=IP–EA

37. Which of the following has the highest electronegativity?(2000M)
1) Na 2) Cl 3) K 4) B

ACHIEVERS (Level - II)

38. Why E.A Of Flurine is lessthan chlorine.

39. Generally 2nd E.A is endothermic. Explain.

40. Calculate the E.N value of chlorine on mulliken scale, given that I.P= 13/O AND E.N =4.0.

EXPLORERS (Level - III)

Multi correct answer type:

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which ***ONE or MORE*** *is correct. Choose the correct options*

41. On which of the following factors, electron affinity depends?
1) Atomic size 2) Nuclear charge 3) Electronic configuration 4) None

42. Which one of the following factors affects the electronegativity?
1) Effective nuclear charge 2) Screening effect
3) Size of the atom 4) Oxidation state

43. Which of the following is/are correct order of increasing electronegativity in group?
1) Cs < Li 2) Ba < Be 3) Sn < C 4) None of the above

44. Which of the following scales are used to express electronegativity ?
1) Pauling's scale 2) Allred and Rochow scale 3) Mulliken's scale 4) None

Assertion &reason type:

⬧ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which* ***ONLY ONE*** *is correct Choose the correct option.*

1) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.
2) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.
3) Statement-I is true, Statement-II is false.
4) Statement-I is false, Statement-II is true.

45. ***Statement I*****:** Electron affinity is numerically equal to ionization energy but opposite to each other.
Statement II **:** Halogens have the highest electron affinity in their resoective periods.

46. ***Statement I*****:** An atom in higher oxidation state is more electronegative.
Statement II **:** Atom having less effective nuclear charge is more electronegative.

47. ***Statement I*****:** Greater is the s - character in hybrid orbital, greater will be its electronegativity.
Statement II **:** Greater is the s - character in hybrid orbital, lesser will be its electronegativity.

48. ***Statement I*****:** Electronegativity is used to detect the nature of bond.
Statement II **:** Electronegativity is used to measure the strength of bond.

Matrix Match Type:

⬧ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in* ***Column–I*** *have to be matched with statements (p, q, r, s) in* ***Column–II****. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

49.

Column-I **Element**	**Column-II** **Electronegativity on pauling scale**
a) Carbon	1) 0.8
b) Nitrogen	2) 1.6
c) Aluminium	3) 2.5
d) Cesium	4) 3.0
	5) 4.0

Comprehension Type:

⬧ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

According to Mulliken, electronegativity of an atom is average of I.E. and E.A.

$\chi_M = \frac{I.E + E.A.}{2}$ .I.E. and E.A. are ionization energy and electron affinity in electron volts.

Mulliken values are $\approx$ 2.8 times greater than pauling values.Pauling based his scale on thermochemical data. He concluded that the bond formed between the two atoms A and B must be stronger than the average of single bond energies A —— A and B —— B molecules.

According to him the electronegativity difference between two atoms A and B ($\chi_A \sim \chi_B$) is given by: $\chi_A \sim \chi_B = 0.208\sqrt{\Delta}$

50. Pauling's electronegativity scale is based on experimental value of:
1) Atomic radii 2) Bond energies 3) Bond lengths 4) Electron affinity

51. An atom with high electronegativity generally has:
1) Tendency to form +ve ions 2) High ionisation potential
3) Large atomic size 4) Low electron affinity.

52. The element among the following having maximum electronegativity is
1) Al 2) P 3) Si 4) S

HOTS

53. The energy released when an electron is added to a neutral gaseous atom would be highest if the element belongs to
1) VII A group 2) V A group 3) VI A group 4) II A group

54. The electron affinity of sulphur is -200 kJ/mole. Then the electron affinity of oxygen is
1) -142 kJ/mole 2) -702 kJ/mole 3) -332 kJ/mole 4) -348 kJ/mole

55. A correct variation in the electronegativity value of atoms is
1) F>N<O>C 2) F>O>N>C 3) F<N<O>C 4) F>N>O<C

56. Which of the following is a highly polar bond?
1) O-H 2) N-H 3) H-Cl 4) H-F

57. Which of the following would you except to have highest electronegativity?
1) Mg(Z=12) 2) S(Z=16) 3) B(Z=5) 4) Te(Z=52)

KEY

ΦΦ TEACHING TASK :

1)3 2)3 3) 3 4) 3 5)3 6)1 7) 1 8)4 9) 1 10) 1 11)4
12) 1 13) 2 14) 1 15) 3,4 16) 3 17)a-5,b-4,c-1,d-3 18) 2 19)2 20) 2

ΦΦ LEARNER'STASK :

☐ **BEGINNERS :**

21) 3 22) 1 23) 1 24) 4 25) 3 26) 2 27) 3 28) 1 29) 2 30) 4 31) 1
32) 1 33) 1 34) 1 35) 2 36) 1 37) 3

☐ **EXPLORERS :**

41)1,2 42)1,2,3 43)1,2,3 44)1,3 45)2 46)3 47)3 48)2
49)a-3,b-4,c-2,d-1 50)2 51)2 52)4 53)1 54)1 55)2 56)4 57)3

§§ VALENCY

Valency of an element is the number of H-atoms (or) double the number of oxygen atoms that can combine with one atom of that element.

The valency of an element is not always constant.

Exhibition of more than one valency by one element is known as variable valency.

The maximum valency of a representative element is equal to the number of electrons present in the outermost orbit of an atom.

§§ OXIDATION STATE

The possible charge with which an atom appears in a compound is called its oxidation state.

s-block elements, oxidation state is equal to group number. For alkali metals " +1 ".

For alkaline earth metals " +2 "

Oxidation state may be positive or negative or zero or fraction.

p-block elements show multi valency, their oxidation state change by two numbers.

The stable oxidation state of Thallium is +1. It is due to inert pair effect.

In IVA group +2 is more stable than +4 for Lead due to inert pair effect.

In VA group, +3 is more stable than +5 for Bismuth due to inert pair effect.

Group IV elements show +4 and +2 oxidation states.

Group V elements show +5 and +3 oxidation states.

The general oxidation state of group VI is -2.
The most electronegative element. Fluorine shows -1 oxidation state only (in its compounds)
The common oxidation state of d-block elements is +2. All transition elements show variable valencies.
Rutheum, Osmium and Xenon exhibit maximum oxidation state +8.
The common oxidation state of f-block elements is +3 due to their outer electron configuration $ns^2(n-1)d^1$.
Maximum oxidation state of an element never exceeds its group number.

§§ **ELECTRO POSITIVE NATURE**

The tendency of an element to lose an electron is called electro positivity.
It is the converse of electro negativity.
As electropositivity increases, metallic character increases.
The smaller the ionisation energy or ionisation potential the greater is the electro positivity.
As electropositive nature increases, capacity to form ionic bond increases.
Electropositive nature increases down the group, as the size of the atom increases.
Electro positivity decreases across a period.
In any period the strong electropositive element is alkali metal.
Most electro positive element is Cs in periodic table.
The ions of strong Electro Positive metal do not undergo hydrolysis.

§§ **METALLIC AND NON-METALLIC NATURE:**

If an element has low electro negativity, and high EP, then it will have high metallic nature.
The groups IA and IIA elements have strong metallic nature.
Group VIA and VIIA elements have strong non-metallic nature.

¶¶ **On moving from top to bottom**

a) non metallic nature decreases
b) metallic nature increases

¶¶ **On moving from left to right in a period**

a) metallic nature decreases b) non metallic nature increases
Order of metallic nature
Alkali metals > Alkaline earth metals > d-block > p-block.

§§ **ACIDIC AND BASIC NATURE OF OXIDES:**

Metal oxides are basic. Eg: Na_2O, BaO, MgO, CaO
IA, IIA group metal oxides are strong bases.
Non metal oxides are acidic. Examples : SO_2, P_2O_5, CO_2, P_2O_3, NO_2
Oxides of halogens are highly acidic.
Oxides of metalloids are amphoteric.
Eg: As_2O_3, Sb_2O_3.
Acidic oxides dissolve in water to form acidic solutions.
Basic oxides dissolve in water to form basic solutions, known as hydroxides.

¶¶ **In groups from top to bottom**

a) acidic nature of oxides decreases b) basic nature of oxides increases

¶¶ **In periods from left to right**

a) basic nature of oxides decreases b) acidic nature of oxides increases

§§ **DIAGONAL RELATIONSHIP**

In the periodic table the first element of a group has similar properties with the second element of the next group. This is called diagonal relationship.

	I	II	III	IV
2nd Period	Li	Be	B	C
3rd Period	Na	Mg	Al	Si

The diagonal relationship disappears after IVA group.

The diagonal relationship is due to similar sizes of atoms or ions and electronegativities of the participating elements and same polarising power. Polarising power = $\frac{ionic\ charge}{(ionic\ radius)^2}$

The elements present under diagonal relationship have very close properties.

1) BeO amphoteric, Al_2O_3 amphoteric
2) Be_2C or Al_4C_3 produce methane on hydrolysis.

TEACHING TASK

Single answer type

1. Of the following, electronegativity of Lithium is approximately equal to that of
1) Mg 2) B 3) Al 4) Na

2. Most metallic element has the following electron arrangement in its atom is
1) 2, 8, 4 2) 2, 8, 8 3) 2, 8, 8, 1 4) 2, 8, 8, 7

3. Boron and Silicon resemble chemically. This is due to the equal value of their
1) EA 2) Atomic Volume 3) ions polarizing power 4) Nuclear charge

4. Among (a) Na_2O, (b) MgO, (c) Al_2O_3, (d) P_2O_5 (e) Cl_2O_7 the most basic, most acidic and amphoteric oxide can be
1) a, b, c 2) b, e, c 3) a, e, c 4) e, c, a

5. Metal exhibiting higher oxidation state is in which block?
1) p 2) s 3) d 4) f

6. The less electropositive element is
1) Na 2) Be 3) Li 4) Mg

7. Electropositivity is very high for
1) Al 2) Ge 3) Li 4) Ba

8. The most electropositive element is
1) Cs 2) C 3) Cl 4) K

9. Which of the following electron configuration corresponds to the most electropositive character?
1) $[He]2s^1$ 2) $[He]2s^2$ 3) $[Xe]6s^1$ 4) $[Xe]6s^2$

10. Boron is related diagonally related to
1) Boron 2) Aluminium 3) Magnesium 4) Silicon

11. Diagonal relationship is shown by
1) B - S 2) Li - Mg 3) Mg - Ca 4) S - Se

12. In the first few groups of periodic table, the group number represents the
1) Valency 2) Atomic weight 3) Atomic number 4) both 1 & 3

13. Which has most stable +2 oxidation state?
1) Cs 2) Cl 3) Pb 4) *Tl*

Multi Correct Choice Type:

♦ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

14. Which of the following elements exhibit maximum oxidations state +8?
1) Rutheum 2) Osmium 3) Sodium 4) Magneaium

15. Which of the following is/are correct statements?
1) Be resembles A 2) B resembles Si 3) Li resembles Mg 4) None of these

Assertion &reason type:

♦ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose*

the correct option.

16. ***Statement I*:** Electropositivity increases on going down a group from top to bottom.
***Statement II* :** The most electropositive element in first period is hydrogen.

17. ***Statement I*:** Oxides of metals are usually basic.
***Statement II* :** Oxides of non - metals are acidic.

Matrix Match Type:

◆ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

18.

Column-I	**Column-II**
a) A strong base	1) MgO
b) A strong acid	2) SO_3
c) Acidic oxide	3) $HClO_4$
d) Basic oxide	4) NaOH
	5) Al_2O_3

19.

Column-I	**Column-II**
a) Common oxidation state of d-block elements	1)+2
b) Maximum oxidation state of an element	2)Never exceeds its group number
c) Maximum oxidation state of Os	3) +8
d) Stable oxidation state of thallium is	4) +1 5)+3

Comprehension Type:

◆ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

It is observed that the first few elements of period 2 resemble those placed diagonally across them, in period 3. More generally, the first element of a group is different from the rest in that group and resembles an element of the next group, in the next period

20. Diagonal relationship is shown by:
1) Elements of first period 2) Elements of second period
3) Elements of third period 4) Both 2 and 3

21. Beryllium resembles Aluminium in properties. This is mainly due to:
1) Equal electro negativity values of elements.
2) Equal atomic volumes of the elements.
3) Equal electron affinity. 4) Equal nuclear charges in their atoms.

22. Diagonal relationship is quite pronounced in the elements of:
1) 2^{nd} & 3^{rd} periods 2) 1^{st} & 2^{nd} periods 3) II & III groups 4) 3^{rd} & 4^{th} periods

KEY

ΦΦ TEACHING TASK :

1)1 2)3 3) 3 4) 3 5)3 6) 2 7)4 8)1 9) 3 10) 4 11)2
12) 1 13) 3 14) 1,2 15) 1,2,3 16) 3 17) 2 18)a-4,b-2,c-5,d-1
19) a-2,b-1,c-3,d-4 20) 4 21)1 22) 1

LEARNER'S TASK

BEGINNERS (Level - I)

Single answer type

23. Diagonal relationship is quite pronounced in the elements of
1) 2nd and 3rd periods 2) 1st and 2nd periods 3) II and III groups 4) 3rd and 4th periods

24. With increasing atomic number, the metallic nature in a period from left to right
1) increase 2) decrease 3) does not alter 4) none

25. The most metallic among the following is?
1) P 2) As 3) Bi 4) Sb

26. The pair of elements that have similar chemical properties are
1) Lithium and Magnesium 2) Beryllium and Boron
3) Aluminium and Magnesium 4) Carbon and Nitrogen

27. Atom becomes ion by
1) oxidation 2) reduction
3) either oxidation or reduction 4) neither oxidation nor reduction

28. Which has the maximum atomic radius?
1) Al^{3+} 2) Li^{+} 3) P 4) Mg

29. In which of the following pairs, the first atom or ion is not large than the second ?
1) Fe^{2+}, Fe^{3+} 2) O, S 3) N, O 4) Cl^{-} Cl

30. Which of the following is large radius
1) crystal 2) covalent 3) vanderwaal's 4) all are same

31. The element with the following atomic number may be bigger than aluminium atom is
1) 12 2) 14 3) 16 4) 17

ACHIEVERS (Level - II)

Descriptive answers:

32. Write a short notes on valency.

33. Explain diagonal relationship.

34. What is electro positivity. How vary E.P in a group and period.

35. Explain the variation of metallic and non metallic nature, nature o0f oxides in a group and period.

36. In s and p block elements the O.S changes by 2 units but in transition elements it changes in the units of 1. Explain.

EXPLORERS (Level - III)

Multi Correct Choice Type:

♦ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which* ***ONE or MORE*** *is correct. Choose the correct options*

1. Group V elements show oxidation states of _____.
1) +5 2) +3 3) +6 4) All of these

Reasoning Type:

♦ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which* ***ONLY ONE*** *is correct Choose the correct option.*

2. ***Statement I*****:** Non-metalic character increases across a period from left to right

Statement II : A more electropositive element has less metallic character.

3. ***Statement I*** : The possible charge with which an atom appears in a compound is called its oxidation state.

Statement II : Oxidation state may be positive or negative or zero or fraction.

4. ***Statement I***: The common oxidation state of f-block elements is +3.

Statement II : The general oxidation state of group VI is -2.

Matrix Match Type:

⬧ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

5.

Column-I	**Column-II**
a) Size of an atom decreases	1) Metal
b) Sulphur	2) From left to right decreases
c) Nitrogen	3) Low electro positive element in V group
d) Bismuth	4) Non-metal
	5) High electropositive element in V group

Comprehension Type:

⬧ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

As we move from top to bottom, the size of atoms increases resulting in the decrease in ionisation energy. Thus, the non-metallic character decreases down the group. So, as we move down the group, the metallic character increases and the non-metallic character decreases.In a period as we move from left to right, the size of atom decreases, resulting in a decrease in electropositivity.

Thus, metallic character decreases as we move from left to right in a period.

As we move from left to right, the size of atoms increases, resulting in an increase in ionisation energy or electronegativity.

Thus non-metallic character increases, as we move from left to right in a period.

Thus metallic character decreases and non-metallic character increases from left to right in a period.

6. Which of the following has least tendency to form unipositive ions in gaseous state?

1) I 2) C*l* 3) Br 4) F

7. Which of the following sets of elements has the strongest tendency to form positive ions in gaseous state?

1) Li, Na, K 2) Be, Mg, Ca 3) F, Cl, Br 4) O, S, Se

8. Among B, A*l*, C and Si which has the most metallic character?

1) B 2) A*l* 3) C 4) S

Higher Order Thinking Skills (HOTS)

9. In which group all the elements do not have same number of valence electrons?

1) Zero 2) Frist 3) Second 4) Seventh

10. Beryllium shows diagonal relationship with aluminium. Which of the following similarity is incorrect?

1) Be_2C like Al_4C_3 yields methane on hydrolysis

2) Be, like Al is renderd passive by HNO_3

3) Be $(OH)_2$ like $Al(OH)_3$ is basic

4) Be forms beryllates and Al forms aluminate

11. The elements x, y and z are present in one period of the periodic table. Chemically their oxides are acidic, amphoteric and basic respectively. When these elements are arranged in ascending order of atomic number they are
1) x, y, z 2) z, y, x 3) y, z, x 4) y, x, z

12. Which of the following is the smallest in size?
1) Br 2) I^- 3) I 4) Br

13. The size of Hafnium is almost similar to that of zirconium this is due to
1) increase in size as expected 2) decrease in size as expected
3) lanthanide contraction 4) similar chemical properties

RESEARCHERS (Level - IV)

I. Single answer type

1. Most common oxidation states of Ce **[AIEEE 2002]**
1) +2,+3 2) +2, +4 3) +3, +4 4) +3, +5

2. The correct order of atomic radii is: **[AIEEE 2002]**
1) $Yb^{+3}<Pm^{3+}<Ce^{3+}<La^{3+}$ 2) $Ce^{3+}<Yb^{3+}<Pm^{3+}<La^{3+}$
3) $Yb^{3+}<Pm^{3+}<La^{3+}<Ce^{3+}$ 4) $Pm^{+3}<La^{3+}<Ce^{3+}<Yb^{3+}$

3. The correct order of atomic radii is **[AIEEE 2002]**
1) Ce>Sn>Yb>Lu 2) Sn>Ce>Lu>Yb 3) Lu>Yb>Sn>Ce 4) SN>Yb>Ce>Lu

4. The radius La^{3+} (Atomic number=57) is 1.06 A^0.What may be the radius of Lu^{3+} (Atomic number=71)? **[AIEEE 2003]**
1) 1.06A^0. 2) 0.85A^0. 3) 0.60A^0. 4) 1.40A^0.

5. According to periodic law of elements, the variation in properties of elements is related to their
1) Atomic number 2) Atomic mass 3) Nuclear mass 4) Neutron/proton ratio

6. Which sets represents isoelectronic species
1) Be,Al^{3+},Cl^- 2) $Ca^{2+},Cs+,Br$ 3) Na,Ca^{2+},Mg^{2+} 4) N^{3-}, F-, Na^+

7. The atomic number of vanadium (V) chromium (Cr) manganese (Mn) and iron (Fe) are respectively 23, 24, 25 and 26. Which out of these may be expected to have the jump in second ionization enthalpy
1) Mn 2) Fe 3) V 4) Cr

8. A reduction in atomic size with increase in atomic number is a characteristic of element of
1) F-block 2) Radioactivce series 3) High atomic mass 4) d-block.

9. Which of the following has highest ionic radius:
1) F^+ 2) B^{3+} 3)O^{2-} 4) Li^+

10. The formatio of the oxide ion O2- requires first an exothermic and then an endothermic step as shwon below

$O_{(g)}+e^-$----------> $O^-_{(g)}$; $\Delta H = 142kj / mol$

$O_{(g)}+e^-$----------> $O^{2-}_{(g)}$; $\Delta H = 844kj / mol$ this is becuase

1) O^- ion has comparatively larger size than oxygen atom
2) Oxygen has high electron affinity
3) O- ion will tend to resist the addition of another electron
4) Oxygen is more electronegative

11. Which among the following factors is the most important in making flourine, the strongest oxidizing halogen
1) Bond dissocoation energy 2) Ionization enthalpy
3) Hydration enthalpy 4) Electron affinity

12. Beryllium and aluminium exhibit many properties which are similar, But the two elemets differ

in
1) Exhibiting amphoteric nature in their oxides 2) Formating polymeric hydrides
3) forming covalent halides 4) Exihibiting maximum covalent in compound

13. In which of the following arrangements, the order is not correct according to the property indicated against it
1) Increasing size: $Al^{3+}<Mg^{2+}<Na^{+}<F^{-}$ 2) Increasing IE,: B<C<N
3) Increasing EA,: I<Br<F<Cl
4) Increasing metalic radius Li<Na<K<RbIE,: B<C<N<O

14. What products are expected from the disproportionation reaction of hypochlorous acid?
1) HCl and $HClO_3$ 2) $HCLO_3$ and Cl_2O 3) $HClO_2$ and $HClO_4$ 4) HCl and Ci_2O

15. Which of the following statements is true:
1) HNO_3 is a stronger acid than HNO_2 2) H_3PO_3 is a stronger acid than H_2SO_3
3) In aqueous medium HF is a stronger acid than HCl
4) $HClO_4$ is a weaker acid than $HClO_3$

16. Lanthanoid conraction is caused due to
1) The imperfect shielding on outer electrons by 4f- electrons from the nuclear charge
2) The appreciable shielding on outer electrons by 4f- electrons from the nuclear charge
3) The imperfect shielding on outer electrons by 5d- electrons from the nuclear charge
4) The some effective nuclear charge from Ce to Lu

17. The ionic mobility of alkali metal ions in aqueous solution is maximum for
1) Na^{+} 2) K^{+} 3) Rb^{+} 4_ Li^{+}

18. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture
1) In alkali metals the reactivity increases but in the halogens it decrease with increse in atomic number down the group
2) The reactivity decreases in the alkali metals but increase in the halogens with increse in atomic number down the group
3) In both alkali metals and the halogens the chemical reactivity decrease with increase in atomic number down the group
4) Chemical reactivity increase with in atomic number down the group in both the alkali metals and halogens

19. The incrasing order of the first ionozation enthalpies of the elements B,P, S,and F (lower first) is
1) F<S<P<B 2) P<S<B<F 3) B<P<SPF 4) B<S<P<F

20. Which one of the following hydgrogen bonds is the strongest
1) O-H-N 2)F-H-F 3) O-H-O 4) O-H-F

21. Which one of the following sets of ion represents a collection if isoelectronic species
1) K^{+},Cl^{-},Ca^{2+},Sc^{3+} 2) Ba^{2+},Sr^{2+},K^{+},S^{2-} 3) N^{3-}, O^{2-}, F^{-}, S^{2-} 4) Li^{+}, Na^{+},$Mg^{2+}Ca^{2+}$

22. The charge/size ratio of a cation determine its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^{+}, Ca^{2+}, Mg^{2+} and Be^{2+}
1) $Mg^{2+}<Be^{2+}<K^{+}<Ca^{2+}$ 2) $Be^{2+}<K^{+}<Ca^{+}<Mg^{2+}$
3) $K^{+}<Ca^{2+}<Mg^{2+}<Be^{2+}$ 4) $Ca^{2+}<Mg^{2+}<Be^{2+}<K^{+}$

23. The first ionization potential of Na is 5.1 eV. The value of elctron gain enthalpy of Na^{+} will be **[JEE MAIN 2013]**
1) -2.55eV 2) -5.1eV 3) -10.2eV 4) +2.55eV

24. The ionic radii in (A^{o}) of N^{3-}, O^{2-} and F- are respectively **[JEE MAIN 2016]**
1) 1.36,1.40 and D 1.71 2) 1.36,1.71 and 1.40
3) 1.71,1.40 and 1.36 4) 1.71, 1.36 and 1.40

II. ADDITIONAL PRACTICE SHEET

1. Which metal does not exhibit the Malleability
1) Au 2)Fe 3) Hg 4) Cu

2. Which one of the following has the smallest atomic radius?
1) F 2)Cl 3)Cs 4) Mg

3. The electronic configuration fo Sodium is 2,8,1. Identify the position of element in the Periodic table
1) III A group and Ist Period 2) I A group and 3rd period
3) Ist A group and 2nd period 4) III A group and 2nd period

4. Which has maximum IE
1) Mg 2) Mg^{+} 3) Mg^{++} 4) Equal

5. The ionisation potential of Nitrogen is
1) same as that of Oxygen 2) Less than that of Oxygen
3) Grater than that of Oxygen 4) non of these

6. Electronegativity and electron affinity of an element A are X and Y respectively.Hence Ionisation potential of A is
1) $\frac{x+y}{2}$ 2) 2x-y 3) 2y-x 4) 2x +y

7. Recently discovered element with atomic number is 115 is
1) uun 2) uub 3)uup 4)uus

8. Pick out the property which is not shown by transition elements
1) Show variable oxidaion state 2) Impart colour to flame
3. are paramegnatic in nature 4) Act as catalitic agents

9. A molecule H- X will be 50% Ionic if electro negitivity differrence of H and X is
1) 1.2 ev 2) 1.4 ev 3) 1.5 ev 4) 1.7 ev

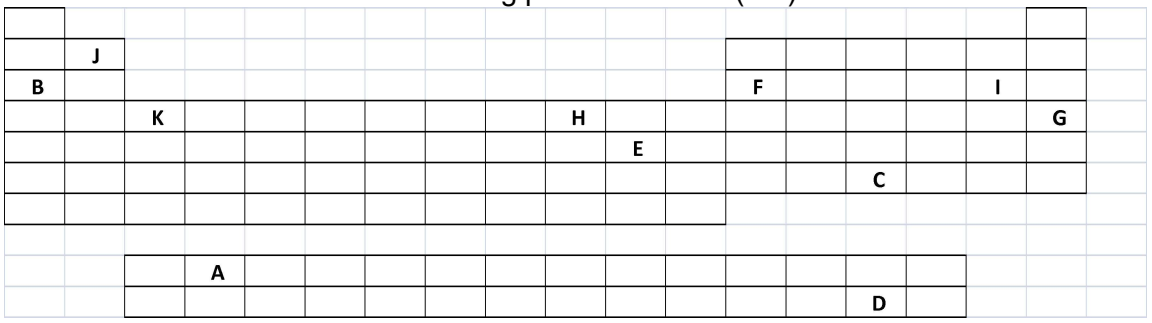
10. Which of the following has the elecritonic configuraion[Ar] $3d^5$?
1) Cr 2) Fe^{3+} 3) Mu 4) V

11. Match the following

	Root word		Number
A)	bi	1.	9
B)	tri	2.	6
C)	hex	3.	8
D)	oct	4.	3
E)	enn	5.	2

	A	B	C	D	E		A	B	C	D	E
a)	5	4	2	3	1	b)	5	4	3	2	1
c)	5	4	2	1	3	a)	5	3	4	2	1

12. Which of the elements in the following periodic table is (are)?



1) Alkali metals 2) An Element with the out configuration of d^8s^2
3) Lanthanide 4) Halogens 5) Noble gas

KEY

ΦΦ LEARNER'STASK :

☐ **BEGINNERS :**

23) 1 24) 2 25) 3 26) 1 27) 3 28) 4 29) 2 30) 3 31) 1

☐ **EXPLORERS:**

1)1,2 2)3 3)2 4)2 5) a-2,b-4,c-3,d-5 6)4 7)1 8)2 9) 1 10)4
11)2 12)1 13)3

☐ **RESEARCHERS:**

I. 1.3 2.1 3.1 4.2 5.1 6.4 7.4 8.1 9.3 10.3 11.3 12.2 13.2 14.1 15.1 16.1
17.3 18.1 19.4 20.2 21.1 22.3 23.2 24.3

II. 1)3 2)1 3)2 4)3 5)3 6)2 7)3 8)2 9)4 10)2 11)1 12) 1-B,2-H,3-A,4-I,5-G.