विघ्न विचारत भीरु जन, नहीं आरम्भे काम,   विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,   'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचितः मानव धर्म प्रणेता
सद्गुरु श्री रणछोड़दासजी महाराज

STUDY PACKAGE

This is TYPE 1 Package
plese Wait for Type 2

Subject : CHEMISTRY

Topic : CHEMICAL CLASSIFICATION &
PERIODICITY IN PROPERTIES
(S & P BLOCK)

Teko®
CLASSES
.....the support

Index
1. Key Concepts
2. Exercise I
3. Exercise II
4. Exercise III
5. Exercise IV
6. Answer Key
7. 34 Yrs. Que. from IIT-JEE
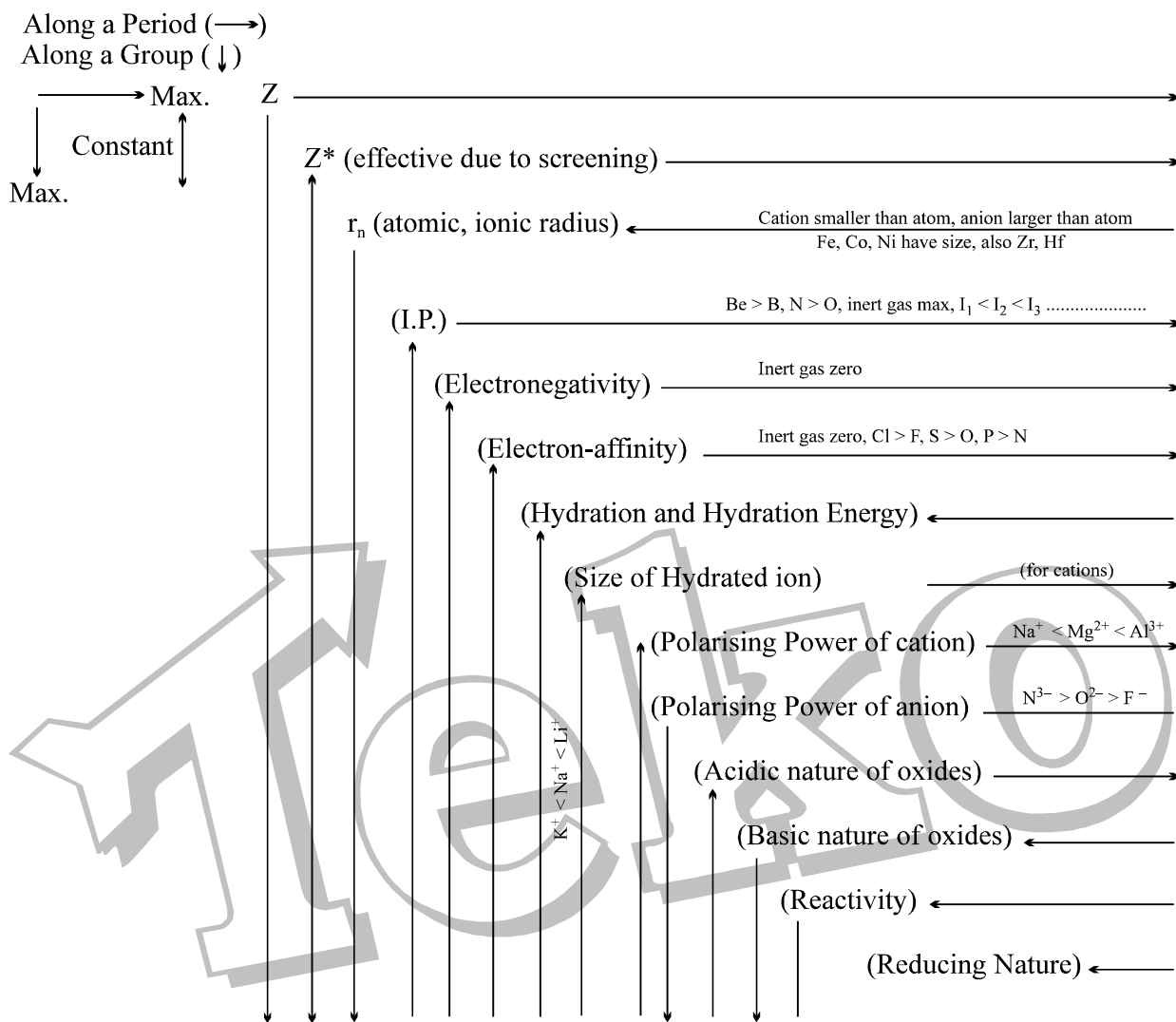8. 10 Yrs. Que. from AIEEE

Student's Name :_____

Class   :_____

Roll No.   :_____

ADDRESS: R-1, Opp. Raiway Track,
New Corner Glass Building, Zone-2, M.P. NAGAR, Bhopal
☎ : (0755) 32 00 000,   98930 58881,   www.tekoclasses.com

PERIODICITY

TEKO CLASSES, Director : SUHAG R. KARIYA (S. R. K. Sir) PH: (0755)- 32 00 000, 0 98930 58881 , BHOPAL, (M.P.)

Along a Period ($\longrightarrow$)
Along a Group ($\downarrow$)

$\longrightarrow$ Max. Constant Max.

Z ———————————————————————$\longrightarrow$

Z* (effective due to screening) ———————————$\longrightarrow$

r_n (atomic, ionic radius) $\longleftarrow$ Cation smaller than atom, anion larger than atom / Fe, Co, Ni have size, also Zr, Hf

(I.P.) ——— Be > B, N > O, inert gas max, $I_1 < I_2 < I_3$ ....

(Electronegativity) ——— Inert gas zero

(Electron-affinity) ——— Inert gas zero, Cl > F, S > O, P > N

(Hydration and Hydration Energy) $\longleftarrow$

(Size of Hydrated ion) ——— (for cations) $\longrightarrow$

(Polarising Power of cation) ——— $Na^+ < Mg^{2+} < Al^{3+}$

(Polarising Power of anion) ——— $N^{3-} > O^{2-} > F^-$

(Acidic nature of oxides) ———

(Basic nature of oxides) $\longleftarrow$

(Reactivity) $\longleftarrow$

(Reducing Nature) $\longleftarrow$

$K^+ < Na^+ < Li^+$

- Isoelectric ions have different size.
- Inert pair effect is in p-block. Stability of higher state decreases and that of lower state increases going along a group. $Ge^{2+} < Sn^{2+} < Pb^{2+}$
- Reducing nature of hydride increases in a group and decreases in a period.

Part–A (Periodic Table)

INTRODUCTION :

Many attempts were made to classify the known elements from time to time . These are :

(i) Proust Hypothesis   **(ii)** Doberniers Triad law   **(iii)** Newlands Octave law

(iv) Lother Meyer's curve   **(v)** Mendeleev Periodic law   **(vi)** Modern periodic law

PERIODIC LAW (1869) :

The physical and chemical properties of elements are periodic functions of their **atomic weight**.

MODERN PERIODIC LAW :

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

LONG FORM OF PERIODIC TABLE : [BOHR'S TABLE]

based on modern periodic law and Bohr Burry Scheme of E.C.

CLASSIFICATION OF ELEMENT INTO GROUPS AND PERIODS :

Group A :   s and p block elements, representative elements. IA to VII A and O group.

Group B :   d and f block elements, transition and inner transition elements IB to VII B and VIII groups.

Total   16 Groups

Period 1 to 7 classified as short, shortest, long, longest and incomplete period.

CLASSIFICATION OF ELEMENTS INTO s , p , d & f BLOCK ELEMENTS :

s − block :

     (i)   configuration ns^{1-2} **(ii)**   last e^- enters in s orbital

     (iii)   two groups I A or 1 ; II A or 2

p − block :

     (i)   configuration $ns^2 np^{1-6}$ **(ii)**   last e^- enters in p orbital

     (iii)   six groups III A , IV A , V A , VI A , VII A , zero or 13 , 14 , 15 , 16 , 17 , 18

d − block : [Transition Elements]

     (i)   configuration $ns^{1-2} (n-1) d^{1-10}$ **(ii)**   last e^- enters in d orbital

     (iii)   their two outermost shell are incomplete

     (iv)   10 groups III B , IV B , V B , VI B , VII B , VIII (Triad) , I B , II B   or

                3 , 4 , 5 , 6 , 7 , (8 , 9 , 10) , 11 , 12 .

     (v)   four series 3 d , 4 d , 5 d , 6 d .

f − block : [Inner Transition]

     (i)   configuration $ns^2 (n-1) d^{0-1} (n-2) f^{1-14}$

     (ii)   last e^- enters in f orbital

     (iii)   two series 4 f Lanthanides & 5 f Actinides

ESTIMATING POSITION OF AN ELEMENT FROM ITS ELECTRONIC CONFIGURATION:

The last electron enters which subshell gives idea of its block.

[😊] *Think* : $1s^1$ and $1s^2$ belongs to which block]

Period no. is equal to the valence shell present in the configuration. Also for s and p block elements.

Period no. = valence shell, for 'd' block = shell + 1, for f block = shell + 2 and so on.

Group no. for s and p block = valence shell electron (A)

for d block = d^1 to d^5 [no. of (s + d) electron (B)]

         d^6, d^7, d^8 (VIII)

         $s^1 d^9$, d^{10} (IB, IIB)

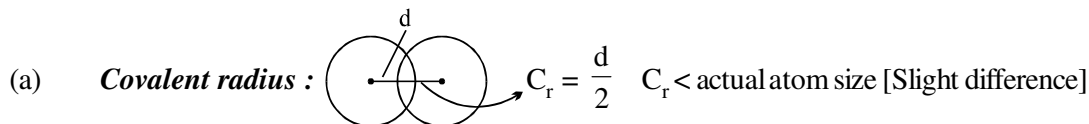[😊] **Use these carefully while locating the position.]**

COMMONLY ASKED PROPERTIES :

1.   *Atomic Volume* **:** Volume occupied by one gm atom of an element .
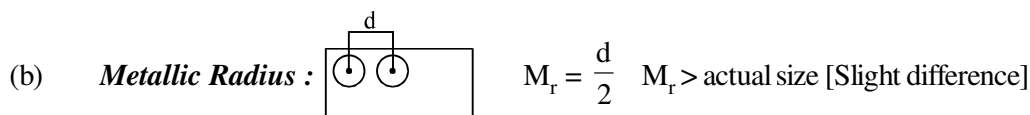
$$\text{Atomic volume} = \frac{\text{Atomic weight}}{\text{density}}$$

Lower atomic volume leads to higher density , increased hardness higher melting point, boiling point, less malleability & ductility.

2.   *Atomic Radius :* Problem in calculating actual size of atom and hence distance between nuclei is calculated giving rise to three type of radii for atoms.

(a)   *Covalent radius :* $C_r = \dfrac{d}{2}$ $C_r <$ actual atom size [Slight difference]

[Used for H_2, Cl_2 and such molecules]

(b)   *Metallic Radius :* $M_r = \dfrac{d}{2}$ $M_r >$ actual size [Slight difference]

[Used for metals]

(c)   *Vanderwaal radius :* $V_r = \dfrac{d}{2}$ $V_r \gg$ actual size [very large difference]

In general $V_R > M_r > C_R$

(d)   *Ionic Radius* **:** A cation is smaller than parent atom . An anion is larger than parent atom.

FACTORS AFFECTING ATOMIC SIZE :

(a)   'n' increase size increases

(b) Z_{eff} increase size decrease [$Z_{eff} = Z - \sigma$]

(c)   Type of measurement of radii.

Calculation of Z_{eff}

$Z_{eff} = \sqrt{\dfrac{En^2}{1312}}$ where E is I.E. in kJ/mole ; $Z_{eff} = \sqrt{\dfrac{E \times n^2}{13.6}}$ E is I.E. in eV per atom.

or   Calculated by *Slaters rule*.

SLATER'S RULE :

(a)   For calculating σ on a (s or p) block (other than on 1s)

Rule-1 : Each (ns, nP) electron contribute to a screening factor of 0.35.

Rule-2 : Each $(n-1)^{th}$ shell electron contribute to a screening factor of 0.85.

Rule-3 : Each $(n-2)^{nd}$ and deeper shell electron contribute to a screening factor of 1.

[* On 1s, the screening factor due to other electron is taken as 0.3]

(b)   For calculating σ on (d or f) block.

Rule-1 : Each screening causing electron (d or f) of same shell has factor of 0.35.

Rule-2 : Each electron other than *Rule*-1 have screening factor of 1.

General Trend :

Along a period, size decrease ['n' constant, $Z_{eff} \uparrow$]

Along a group, size increase ['n' increasing, Z_{eff} constant]

Exceptions :

(1)   Noble gases have largest atomic sizes [Vander waal radii]. However, their covalent radii are smaller *e.g.* Xe.

(2)   Size of Ga and Al are same, [Z_{eff} increasing]

ISOELECTRONIC SPECIES [Size depends upon Z, more Z less size]:

(i) S^{2-}, Cl^-, K^+, Ca^{2+}, Sc^{2+} **(ii)** SO_3, NO_3^-, CO_3^{2-}, $COCl_2$

(iii) N_2, CO, CN^- **(iv)** NH_3, H_3O^+

(v) H^-, He, Li^+ **(vi)** CH_4, NH_4^+

(vii) NCS^-, CS_2 **(viii)** $\dfrac{\text{radius of cation}}{\text{radius of anion}} = \dfrac{Z_{eff} \text{ of Anion}}{Z_{eff} \text{ of Cation}}$

[☺ Check out for size for an isoelectronic noble gas.]

IONISATION ENERGY :

Amount of energy required to remove the most loosely bounded electron from an isolated gaseous atom.

Units : $kJ\ mol^{-1}$, $k\ cal\ mol^{-1}$, eV per atom.

Ionisation is endothermic (endoergic) i.e. requires energy hence

ΔH is +ve

$M + \text{Energy (IE}_1) \longrightarrow M^+ + e^-$

$M \longrightarrow M^+ + e^- \qquad \Delta H = IE_1$

$M^+ \longrightarrow M^{+2} + e^- \qquad \Delta H = IE_2$

$M^{+2} \longrightarrow M^{+3} + e^- \qquad \Delta H = IE_3$
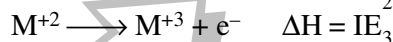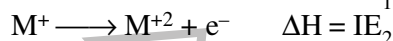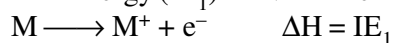
$IE_3 > IE_2 > IE_1$ always

FACTORS AFFECTING IONISATION ENERGY :

(1)   Atomic size : Varies inversely

(2)   Screening effect : varies inversely

(3)   Nuclear charge : varies directly

(4)   Sp Elect. config of outermost electron (half filled / fully filled)

(5)   Type of orbital involved in Ionisation : s > p > d > f.

Half fillness and full fillness of inner orbitals. [affects d block and f block trends]

General Trend: Along period I.E. increases [with some exception] [$Z_{eff} \uparrow$]

Along a group I.E. decrease [Z_{eff} constant, $n \uparrow$]

Exception :

(1)   Along a period, half filled and fully filled have higher I.E.   e.g. Be > B and N > O.

(2)   along a group, Ga > Al

PROPERTIES AFFECTED BY IONISATION ENERGY:

(1)   Metallic character

(2)   Tending to stay in which state A^{+1}. A^{+2} or A^{+3}

(3)   Other properties based on (1)

ELECTRON AFFINITY :

Amount of energy released when an electron is added to an isolated gaseous atom.

Units : $k\ J\ mol^{-1}$, $k\ Cal\ mol^{-1}$ and eV per atom.

Addition of electron results in release of energy in most of the cases but 2nd E. A. is always energy required. The sum of EA_1 & EA_2 is energy required.

$E A \propto \dfrac{1}{\text{atomic size}} \propto Z_{eff}$. Cl has the highest E.A.

ELECTRON GAIN ENTHALPY :

When expressed in terms of enthalpy change (ΔH) then it is termed as E.G.E. Remember that $\Delta H = -$ ve for exothermic change.

For EA_1, energy is released ∴ $\Delta H_{EA1} = -$ ve

For EA_2, onwards is required ∴ $\Delta H_{EA2} = +$ ve

$EA_1 + EA_2$, energy is always required.

FACTORS AFFECTING ELECTRON AFFINITY :

(1) *Atomic size :* varies inversely

(2) *Nuclear change :* varies directly

(3) Sp E.C. of half filled and fully filled shells.

General Trend : Along a period, electron affinity increases [with exception] as Z_{eff} ↑.

Along a group, electron affinity decreases after 3rd period. Between 2nd and 3rd period in p block electron affinity of 2nd period is lesser due to high electron density.

Exception :

(1) A fully filled and half filled which have low values or even sometimes energy is required rather than getting released.

(2) 2nd period has lower value than 3rd owing to repulsion between electrons.

ELECTRO NEGATIVITY : [Properties of an atom in a molecule]

F has highest. Decreasing order → $F > O > Cl = N > Br > S = C > I > H$.

Pauling Scale: $X_A - X_B = 0.208 \sqrt{\Delta}$ E in kcal/mol

$$\Delta = E_{A-B} - (E_{A-A} \times E_{B-B})^{1/2}$$

Mulliken's Scale : $X_A = \dfrac{I_p + E_A}{2}$ (e v) .

Mulliken's values of E N are about 2.8 times as large as Pauling .

Allred−Rochows : $X_A = \dfrac{0.359 \, Z_{eff}}{r^2} + 0.744$

FACTOR AFFECTING ELECTRO NEGATIVITY :

(1) *Nuclear attraction :* varies directly

(2) *Atomic radius :* varies inversely

(3) *Change on ions :* More positive charge more electronegativity and more –ve change less electronegativity.

(4) *Hybridisation :* to be discussed later in bonding.

General Trends : Along a period, electronegativity increases

Along a group, electronegativity decreases

Exceptions : None noteworthy.

FACTORS DEPENDENT ON ELECTRO NEGATIVITY :

(1) % ionic character varies directly.

(2) Strength of bond varies directly.

(3) B.L. : varies inversely.

(4) Nature of hydrides

(5) Nature of hydroxide.

MISCELLANEOUS CHEMICAL PROPERTIES :

1. Periodicity of hydra acids :

(a) Acidic character of hydra acid increases from left to right in a period.

(b) Acidic character of hydra acid increases from top to bottom in a group.

2. **Periodicity of oxy acids :**
(a) Acidic character of oxy acid increases from left in a period.
(b) Acidic character of oxy acid decreases from top to bottom in a group.

3. **Periodicity of nature of oxide :**
(a) On moving from left to right in a period acidic nature of oxide generally increases.
e.g. $CO_2 < P_2O_3 < SO_2 < ClO_2$
(b) On moving from top to bottom in a group acidic nature of oxide generally decreases.

4. **Solubility of salt in water :**
(a) **Hydration energy** decreases along a group.
(b) **Lattice energy** decreases along a group.

TRENDS IN PHYSICAL PROPERTIES :
Physical properties are mostly dependent on. Atomic weight and so not regular trend. Mark out exception in the graph and think out of the reasons?

SOME COMMONLY USED TERMS :
1. **Noble Gases :** Element of group 18 are called noble gases. These are also called as inert gases because their outermost ns and np orbitals are completely filled (except He and $1s^2$) and these gaseous are non-reactive in nature under ordinary conditions.

2. **Representative elements :** All the s and p block elements are known as representative elements except zero group.

3. **Transition elements :** All the d-block elements (except IIB group) are called transition element. It comprises into 4th, 5th, 6th and 7th period. They lie between s and p block elements.

4. **Inner transition elements :** All the f-block elements or 4f and 5f block elements are called inner transition element. Total number of these elements is 28. They lie in IIIB and placed at the bottom of periodic table.

5. **Typical elements :** Elements second and third period are known as typical elements.

6. **Diagonal relationship :** Properties of elements of second period resemble with the element of third period. These resembled properties between two periods or this type of relation between two periods are called diagonal relationship.

	IA	IIA	IIIA	IVA
2nd period	Li	Be	B	C
3rd period	Ba	Mg	Al	Si
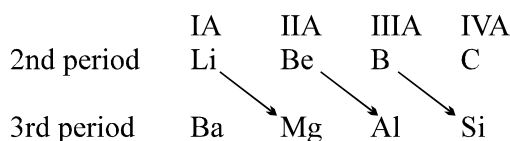
Increase your I bank

(i) **Resemblance between Li and Mg :**

(a) Unlike the other members of the group, lithium reacts with N_2 to form a nitride in the same way as magnesium does.
(b) Lithium hydroxide, carbonate and nitrate decomposes on heating to give Li_2O as like Mg but other alkali hydroxides and carbonates are unchanged on heating where as the nitrate decompose to give nitrite.
(c) Lithium hydroxide carbonate and fluoride are much soluble than the corresponding sodium or potassium compounds. The solubilities are comparable to those of corresponding magnesium compound.

(ii) **Resemblance between Be and Al :**

(a) The ionic radius of Be^{2+} is nearly same as that for the Al^{3+}.

(b) Like aluminium, beryllium is not readily attacked by acids because of the pressure of an oxide film.

(c) Beryllium dissolved in alkali to give the beryllate ion $[B(OH)_4]^{2-}$ just as aluminium does to give $(Al(OH)_6)^3$.

(d) The oxides BeO and Al_2O_3 are hard high melting insoluble solids. The oxides as well as their hydroxides amphoteric and dissolve in sodium hydroxide solution.

(e) Beryllium and aluminium from fluoro complex anion, BeF_4^{2-} and AlF_6^{3-} in solution, the other group II metals do not form stable fluoro complexes in solution.

(f) Beryllium chloride $(BeCl_2)$ is essentially covalent and has a bridged polymeric structure just as aluminium trichloride is covalent forming a bridged dimer, Al_2Cl_6. Both the chlorides are soluble in organic solvent and are strong Lewis acid.

(iii) **Resemblance between B and Si :**

(a) Boron and silicon form numerous hydride which spontaneously catch fire on exposure to air and are easily hydrolysed.

(b) Boron halide like silicon halides hydrolysed by water. Aluminium halides are only partially hydrolysed by water.

(c) Boron forms binary compounds with several metals known as borides just as silicon forms metal silicides some of the borides and silicides under go hydrolysis to yield boron and silicon respectively.

(d) B_2O_3 and SiO_2 are acidic in nature, Borates and silicates have tetrahedral BO_4 and SiO_4 structural units respectively. Boro silicates are known in which form can replace silicon in three dimensional lattice. However boron can also form planer BO_3 unit.

(e) Both B and Al are semiconductors.

Bridge Elements : Typical elements of II period.

NOMENCLATURE OF THE ELEMENT :

The names are derived by using roots for the three digits in the atomic number of the element and adding the ending –ium. The roots for the number are

Digit	Name	Abbreviation
0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quad	q
5	pent	p
6	hex	h
7	sept	s
8	oct	o
9	enn	e

Thus element with atomic number 109 will be named as **une** (**u** for 1, **n** for 0 and **e** for 9). Table summarises the names of the elements with atomic number above 100.

EXERCISE # I

General Info about periodic table

Q.1 Which of the following does not reflect the periodicity of element
(A) Bonding behaviour (B) Electronegativity (C) Ionisation potential (D) Neutron/Proton ratio

Q.2 Choose the s-block element in the following:
(A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$
(B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^1$
(C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
(D) all of the above

Q.3 False statement for periodic classification of elements is
(A) The properties of the elements are periodic function of their atomic numbers.
(B) No. of non-metallic elements is less than the no. of metallic elements.
(C) First ionization energy of elements does change continuously with increasing of atomic no. in a period.
(D) d-subshell is filled by final electron with increasing atomic no. of inner transition elements.

Q.4 Pick out the isoelectronic structure from the following:

I. $^+CH_3$ II. H_3O^+ III. NH_3 IV. CH_3^-

(A) I and II   (B) III and IV   (C) I and III   (D) II, III and IV

Q.5 If there were 10 periods in the periodic table then how many elements would this period can maximum comprise of.

Q.6 If $(n + l)$ rule for energy is not followed, what are the blocks of the following elements if they are filled according to increasing shell number
(a) K(19)   (b) Fe(26)   (c) Ga(31)   (d) Sn(50)

Q.7 Use the following system of naming elements in which first alphabets of the digits are written collectively,

0	1	2	3	4	5	6	7	8	9
nil	uni	bi	tri	quad	pent	hex	sept	oct	enn

to write three-letter symbols for the elements with atomic number 101 to 109.
[Example : 101 is Unu....]

Properties and Periodic trends

Q.8 The size of the following species increases in the order:
(A) $Mg^{2+} < Na^+ < F^- < Ar$
(B) $F^- < Ar < Na^+ < Mg^{2+}$
(C) $Ar < Mg < F^- < Na^+$
(D) $Na^+ < Ar < F^- < Mg^{2+}$

Q.9 Element in which maximum ionization energy of following electronic configuration would be
(A) $[Ne] 3s^2 3p^1$ (B) $[Ne] 3s^2 3p^2$ (C) $[Ne] 3s^2 3p^3$ (D) $[Ar] 3d^{10} 4s^2 4p^3$

Q.10 The outermost electronic configuration of most electronegative element is:
(A) $ns^2 np^1$ (B) $ns^2 np^4$ (C) $ns^2 np^5$ (D) $ns^2 np^6$

Q.11 The electron affinity of the members of oxygen of the periodic table, follows the sequence
(A) O > S > Se   (B) S > O < Se   (C) O < S > Se   (D) Se > O > S

Q.12 The process of requiring absorption of energy is
(A) $F \rightarrow F^-$ (B) $Cl \rightarrow Cl^-$ (C) $O^- \rightarrow O^{2-}$ (D) $H \rightarrow H^-$

Q.13 In the following which configuration of element has maximum electronegativity.
(A) $1s^2, 2s^2 2p^5$ (B) $1s^2, 2s^2 2p^6$ (C) $1s^2, 2s^2 2p^4$ (D) $1s^2, 2s^2 2p^6, 3s^2 3p^3$

Q.14 Highest size will be of
(A) Br^- (B) I   (C) I^- (D) I^+

Q.15 Atomic radii of flourine and neon in Å units are respectively given by
(A) 0.72, 1.60   (B) 1.60, 1.60   (C) 0.72, 0.72   (D) 1.60, 0.72

Q.16 The correct order of second ionisation potential of C, N, O and F is:
(A) C > N > O > F   (B) O > N > F > C   (C) O > F > N > C   (D) F > O > N > C

Q.17 Decreasing ionization potential for K, Ca & Ba is
(A) Ba > K > Ca   (B) Ca > Ba > K   (C) K > Ba > Ca   (D) K > Ca > Ba

Q.18 Element Hg has two oxidation states Hg^{+1} & Hg^{+2}. the right order of radii of these ions.
(A) $Hg^{+1} > Hg^{+2}$ (B) $Hg^{+2} > Hg^{+1}$ (C) $Hg^{+1} = Hg^{+2}$ (D) $Hg^{+2} \geq Hg^{+1}$

Q.19 The ionization energy will be maximum for the process.
(A) $Ba \rightarrow Ba^{++}$ (B) $Be \rightarrow Be^{++}$ (C) $Cs \rightarrow Cs^+$ (D) $Li \rightarrow Li^+$

Q.20 Why the first ionisation energy of carbon atom is greater than that of boron atom whereas, the reverse is true for the second ionisation energy.

Q.21 On the Pauling's electronegativity scale, which element is next to F.

Q.22 Mg^{2+}, O^{2-}, Na^+, F^-, N^{3-} (Arrange in decreasing order of ionic size)

Q.23 Why Ca^{2+} has a smaller ionic radius than K^+.

Q.24 Which of the ions are paramagnetic Sr^{2+}, Fe^{3+}, Co^{2+}, S^{2-}, Pb^{2+}

Q.25 Why do alkaline earth metals always form dipositive ions.

Q.26 State giving reasons which one have higher value :
(a) IE_1 of F or Cl   (b) E A of O or O^- (c) ionic radius of K^+ or Cl^-

Q.27 Explain why a few elements such as Be (+0.6), N(+0.3) & He(+0.6) have positive electron gain enthalpies while majority of elements do have negative values.

Q.28 From among the elements, choose the following: Cl, Br, F, Al, C, Li, Cs & Xe.
(i) The element with highest electron affinity.   (ii) The element with lowest ionisation potential.
(iii) The element whose oxide is amphoteric.   (iv) The element which has smallest radii.
(v) The element whose atom has 8 electrons in the outermost shell.

Q.29 Which property will increase and which will decrease for IA group as we go down the group.
(a) Atomic size   (g) E N
(b) Ionic radii   (h) At. mass
(c) I E   (i) Valance e^-
(d) Density   (j) Metallic ch
(e) Melting point   (k) Chemical reactivity
(f) Boiling point

Q.30 The IE do not follow a regular trend in II & III periods with increasing atomic number. Why?

Q.31 Arrange in decreasing order of atomic size : Na, Cs, Mg, Si, Cl.

Q.32 In the ionic compound KF, the K^+ and F^- ions are found to have practically radii, about 1.34 Å each. What do you predict about the relative covalent radii of K and F?

Q.33 Does $Na_2(g)$ molecule exhibit metallic properties.

Q.34 Which will have a higher boiling point, Br_2 or ICl, & why?

Q.35 Which bond in each pair is more polar
(a) P – Cl or P – Br   (b) S – Cl or S – O   (c) N – O or N – F

Q.36 Arrange noble gases, in the increasing order of b.p.

ENERGY BASED CALCULATIONS

Q.37 Calculate E.N. of flourine if $(r_F)_{covalent} = 0.72$ Å.

Q.38 Calculate E.N. of chlorine atom on Pauling scale if I.E. of Cl^- is 4eV & of E.A. of Cl^+ is + 13.0 eV.

Q.39 Calculate the electronegativity of fluorine from the following data :
$E_{H-H} = 104.2$ kcal mol^{-1} $E_{F-F} = 36.2$ kcal mol^{-1}
$E_{H-F} = 134.6$ kcal mol^{-1} $X_H = 2.1$

Q.40 Calculate the E.N. of Cl from the bond energy of ClF (61 KCal/mol). Given that bond energies of F_2 and Cl_2 are 38 and 58 KCal/mol respectively.

Q.41 The IE values of $Al_{(g)} = Al^+ + e$ is 577.5 kJ mol^{-1} and ΔH for $Al_{(g)} = Al^{3+} + 3e$ is 5140 kJ mol^{-1}. If second and third IE values are in the ratio 2 : 3. Calculate IE_2 and IE_3.

Q.42 How many chlorine atoms will be ionised $Cl \longrightarrow Cl^+ + e^{-1}$ by the energy released from the process $Cl + e^{-1} \longrightarrow Cl^-$ for 6.02×10^{23} atoms (I.P. for Cl = 1250 kJ mol^{-1} and E.A. = 350 kJ mole^{-1})

Q.43 For the gaseous reaction,
$K + F \longrightarrow K^+ F^-$, ΔH was calculated to be 19 kcal under conditions where the cations and anions were prevented by electrostatic separation from combining with each other. The ionisation potential of K is 4.3 eV. What is the electron affinity of F?

Q.44 The ionisation potentials of atoms A and B are 400 and 300 kcal mol^{-1} respectively. The electron affinities of these atoms are 80.0 and 85.0 k cal mol^{-1} respectively. Prove that which of the atoms has higher electronegativity.

Q.45 The As-Cl bond distance in $AsCl_3$ is 2.20 Å. Estimate the SBCR (single bond covalent radius) of As. (Assume EN of both to be same and radius of Cl = 0.99 Å.)

Q.46 The Pt-Cl distance has been found to be 2.32 Å in several crystalline compounds. If this value applies to both of the compounds shown in figure. What is Cl - Cl distance in (a) and (b)

Effective nuclear charge and screening

Q.47 Calculate the screening constant of Ca. (atomic number 20)

Q.48 Calculate the effective nuclear charge on–
(i) 4s valency e$^-$ in Bromine atom.   and   (ii) 3d electron in Bromine atom.

Q.49 I.P. of Be^{+x} is found to be 217.6 electron volt. What is the value of x.

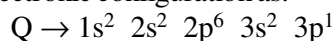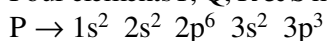**Q.50** Calculate Z_{eff} from slater's rule & from Bohr's model. Take I.E. of K from graph. IE of K is 4.3 eV.

Miscellaneous Properties

Q.51 Arrange following oxides in increasing acidic nature
Li_2O, BeO, B_2O_3

Q.52 Which oxide is more basic, MgO or BaO? Why?

Q.53 The basic nature of hydroxides of group 13 (III-A) decreases progressively down the group. Comment.

Q.54 Based on location in P.T., which of the following would you expect to be acidic & which basic.
(a) CsOH (b) IOH (c) $Sr(OH)_2$ (d) $SeO_3(OH)_2$ (e) FrOH (f) BrOH

EXERCISE # II

Question No. 1 and 2 are based on the following information.
Four elements P, Q, R & S have ground state electronic configuration as:
$P \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$ $Q \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
$R \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^3$ $S \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^1$

Q.1 Comment which of the following option represent the correct order of true (T) & false (F) statement.
I size of P < size of Q
II size of R < size of S
III size of P < size of R (appreciable difference)
IV size of Q < size of S (appreciable difference)
(A) TTTT   (B) TTTF   (C) FFTT   (D) TTFF

Q.2 Order of IE_1 values among the following is
(A) P > R > S > Q (B) P < R < S < Q (C) R > S > P > Q (D) P > S > R > Q

In *following question* a statement S and an explanation E is given. Choose the correct answers from the codes A, B, C, D given for given question.
(A) S is correct but E is wrong.
(B) S is wrong but E is correct.
(C) Both S and E are correct and E is correct explanation of S.
(D) Both S and E are correct but E is not correct explanation of S.

Q.3 S : Lithium is a better reducing agent than Cs.
E : Sublimation energy and Ionisation energy of lithium is less than that of Cs.

Q.4 S : The first ionization energy of Be is greater than that of B.
E : 2p orbital is lower in energy than 2s.

Q.5 Bond distance C–F in (CF_4) & Si–F in (SiF_4) are respective 1.33Å & 1.54 Å. C–Si bond is 1.87 Å. Calculation the covalent radius of F atom ignoring the electronegativity differences.

(A) 0.64 Å   (B) $\dfrac{1.33+1.54+1.8}{3}$ Å (C) 0.5 Å (D) $\dfrac{1.54}{2}$ Å

Q.6 Two elements A & B are such that B. E. of A–A, B–B & A–B are respectively 81 Kcal / mole, 64 Kcal / mole, 76 Kcal / mole & if electronegativity of B is 2.4 then the electronegativity of A may be approximately
(A) 2.81   (B) 1.8   (C) 1.99   (D) 3.0

Q.1 Moving from right to left in a periodic table, the atomic size is: **[JEE 1995]**
(A) increased   (B) decreased   (C) remains constant   (D) none of these

Q.2 The increasing order of electronegativity in the following elements: **[JEE 1995]**
(A) C, N, Si, P   (B) N, Si, C, P   (C) Si, P, C, N   (D) P, Si, N, C

Q.3 One element has atomic weight 39. Its electronic configuration is $1s^2, 2s^2 2p^6, 3s^2 3p^6 4s^1$. The true statement for that element is:
(A) Hight value of IE   (B) Transition element
(C) Isotone with $_{18}Ar^{38}$ (D) None   **[JEE 1995]**

Q.4 The number of paired electrons in oxygen is: **[JEE 1995]**
(A) 6   (B) 16   (C) 8   (D) 32

Q.5 Fluorine is the most reactive among all the halogens, becuase of its: **[JEE 1995]**
(A) small size   (B) low dissociation energy of F-F bond.
(C) large size   (D) high dissociation energy of F-F bond.

Q.6 The decreasing size of K^+, Ca^{2+}, Cl^- & S^{2-} follows the order: **[REE 1995]**
(A) $K^+ > Ca^{+2} > S^{-2} > Cl^-$ (B) $K^+ > Ca^{+2} > Cl^- > S^{-2}$
(C) $Ca^{+2} > K^+ > Cl^- > S^{-2}$ (D) $S^{-2} > Cl^- > K^+ > Ca^{+2}$

Q.7 Which of the following oxide is neutral? **[JEE 1996]**
(A) CO   (B) SnO_2 (C) ZnO   (D) SiO_2

Q.8 Which of the following has the maximum number of unpaired electrons **[JEE 1996]**
(A) Mg^{2+} (B) Ti^{3+} (C) V^{3+} (D) Fe^{2+}

Q.9 The following acids have been arranged in the order of decreasing acid strength. Identify the correct order **[JEE 1996]**
     ClOH(I)   BrOH(II)   IOH(III)
(A) I > II > III   (B) II > I > III   (C) III > II > I   (D) I > III > II

Q.10 The incorrect statement among the following is **[JEE 1997]**
(A) IE_1 of Al is less than IE_1 of Mg   (B) IE_2 of Mg is greater than IE_2 of Na
(C) IE_1 of Na is less than IE_1 of Mg   (D) IE_3 of Mg is greater than IE_3 of Al

Q.11 The incorrect statement among the following is: **[JEE 1997]**
(A) the first ionisation potential of Al is less that the first ionisation potential of Mg
(B) the second ionisation potential of Mg is greater that the second ionisation potential of Na
(C) the first ionisation potential of Na is less than the first ionisation potential of Mg
(D) the third ionisation potential of Mg is greater than the third ionisation potential of Al

Q.12 Which of the following are amphoteric? **[REE 1997]**
(A) $Be(OH)_2$ (B) $Sr(OH)_2$ (C) $Ca(OH)_2$ (D) $Al(OH)_3$

Q.13 Li^+, Mg^{2+}, K^+, Al^{3+} (Arrange in increasing order of radii) **[JEE 1997]**

Q.14 Ionic radii of: **[JEE 1999]**
(A) $Ti^{4+} < Mn^{7+}$ (B) $^{35}Cl^- > ^{37}Cl^-$ (C) $K^+ > Cl^-$ (D) $P^{3+} > P^{5+}$

Directions: The questions below to consist of an 'assertion in column-1 and the 'reason' in column-2. Against the specific question number, write in the appropriate space.
(A) If both assertion and reason are CORRECT, and reason is the CORRECT explanation of the assertion. (B) If both assertion and reason are CORRECT, but reason is not the CORRECT explanation of the assertion. (C) If assertion if CORRECT but reason is INCORRECT (D) If assertion is INCORRECT reason in CORRECT.

Q.15 **Assertion**: F atom has a less negative electron gain enthalpy than Cl atom. **[JEE 2000]**
Reason: Additional electron is repelled more efficiently by 3p electron in Cl atom than by 2p electron in F atom.

Q.16 **Assertion**: $Al(OH)_3$ is amphoteric in nature. **[JEE 2000]**
Reason: Al –O and O – H bonds can be broken with equal case in $Al(OH)_3$.

Q.17 The correct order of radii is: **[JEE 2000]**
(A) N < Be < B
(B) $F^- < O^{2-} < N^{3-}$
(C) Na < Li < K
(D) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

Q.18 The correct order of acidic strength is: **[JEE 2000]**
(A) $Cl_2O_7 > SO_2 > P_4O_{10}$
(B) $CO_2 > N_2O_5 > SO_3$
(C) $Na_2O > MgO > Al_2O_3$
(D) $K_2O > CaO > MgO$

Q.19 The IE_1 of Be is greater than that of B. **[T/F]** **[JEE 2001]**

Q.20 The set representing correct order of IP_1 is **[JEE 2001]**
(A) K > Na > Li
(B) Be > Mg > Ca
(C) B > C > N
(D) Fe > Si > C

Q.21 Identify the least stable ion amongst the following: **[JEE 2002]**
(A) Li^-
(B) Be^-
(C) B^-
(D) C^-

Q.22 Identify the correct order of acidic strengths of CO_2, CuO, CaO, H_2O: **[JEE 2002]**
(A) $CaO < CuO < H_2O < CO_2$
(B) $H_2O < CuO < CaO < CO_2$
(C) $CaO < H_2O < CuO < CO_2$
(D) $H_2O < CO_2 < CaO < CuO$

ANSWER KEY
EXERCISE # I

Q.1	D	Q.2	C	Q.3	D	Q.4	D

Q.5   72   Q.6   (a) d block, (b) d block, (c) p block, (e) f block

Q.7	101	102	103	104	105	106	107	108	109
	Unu	Unb	Unt	Unq	Unp	Unh	Uns	Uno	Une

Q.8	A	Q.9	C	Q.10	C	Q.11	C
Q.12	C	Q.13	A	Q.14	C	Q.15	A
Q.16	C	Q.17	B	Q.18	A	Q.19	B

Q.20   Zeff & half filled config.   Q.21   O

Q.22 $N^{3-} > O^{2-} > F^- > Na^+ > Mg^{2+}$ Q.23   Isolelectronic Ca^{+2} (higher)

Q.24 Fe^{3+} , CO^{2+} Q.25   difference in $1E_1$ & $1E_2$ is less than 10ev.

Q.26   (a) F   (b) O   (c) Cl^- Q.27   half filled and fully filled orbitals

Q.28   (i) Cl   (ii) Cs (iii) Al (iv) F   (v) Xe

Q.29   Increases $\to$ a , b , d, h , j , k ,   Decrease $\to$ c , e , f , g , Same $\to$ i

Q.30   half filled & fully filled orbitals   Q.31 $Cs > Na > Mg > Si > Cl$

Q.32 $r_k > 1.34 Å > r_F$ Q.33   No   Q.34   ICl

Q.35   (a) P–Cl   (b) S–O, (C) N–F   Q.36 $He < Ne < Ar < Kr < Xe < Rn$

Q.37   4, 4.3   Q.38   3.03 (Pauling) Q.39   3.8752   Q.40   3.2

Q.41 $IE_2 = 1825$ kJ/mole, $IE_3 = 2737.5$ kJ/mol   Q.42 1.686×10^{23} atom

Q.43   3.476 eV   Q.44 $EN_1 > EN_2$

Q.45   1.21 Å   Q.46   4.64 Å ; b = 3.28 Å   Q.47   17.15 Q.48   (i) 7.6   (ii) 13.85

Q.49 Be^{+3} Q.50   2.2, (Slater's rule) 2.25 (Bohr's model)

Q.51 Li_2O <   BeO   < B_2O_3

      basic   amphoteric   acidic

Q.52   BaO   Q.53   False

Q.54   (a) basic   (b) acidic   (c) basic   (d) acidic   (e) basic   (f) acidic

EXERCISE # II

Q.1	B	Q.2	A	Q.3	A	Q.4	C	Q.5	C	Q.6	A, C

EXERCISE # III

Q.1	A	Q.2	C	Q.3	C	Q.4	A
Q.5	A B	Q.6	D	Q.7	A	Q.8	D
Q.9	A	Q.10	B	Q.11	B	Q.12	AD
Q.13	$Al^{+3} < Li^+ < Mg^{2+} < K^+$	Q.14	D	Q.15	C	Q.16	C
Q.17	B	Q.18	A	Q.19	True	Q.20	B
Q.21	A	Q.22	A				

MODERN (MODIFIED) MENDELEEFF'S PERIODIC TABLE

GROUP / PERIOD	I A	I B	II A	II B	III A	III B	IV A	IV B	V A	V B	VI A	VI B	VII A	VII B	VIII	0
1.	H 1													H 1		He 2
2.	Li 3		Be 4			B 5		C 6		N 7		O 8		F 9		Ne 10
3.	Na 11		Mg 12			Al 13		Si 14		P 15		S 16		Cl 17		Ar 18
4.	K 19		Ca 20		Sc 21		Ti 22		V 23		Cr 24		Mn 25		Fe 26 Co 27 Ni 28	Kr 36
4.		Cu 29		Zn 30		Ga 31		Ge 32		As 33		Se 34		Br 35		
5.	Rb 37		Sr 38		Y 39		Zr 40		Nb 41		Mo 42		Tc 43		Ru 44 Rh 45 Pd 46	Xe 54
5.		Ag 47		Cd 48		In 49		Sn 50		Sb 51		Te 52		I 53		
6.	Cs 55		Ba 56		La* 57-71		Hf 72		Ta 73		W 74		Re 75		Os 76 Ir 77 Pt 78	Rn 86
6.		Au 79		Hg 80		Tl 81		Pb 82		Bi 83		Po 84		At 85		
7.	Fr 87		Ra 88		Act†. 89-103		Ku(Rf) 104		Ha 105		Unh(Sg) 106		Uns(Bh) 107		Uno (Hs) 108 Une (Mt) 109 Uun 110	Uuo 118
7.		Uuu 111		Uub 112		———		Uuq 114				Uuh 116		———		

INNER TRANSITION ELEMENTS

*LANTHANIDE SERIES	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
†ACTINIDE SERIES	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

Fig. 1.3 Modern Mendeleeff's Periodic Table