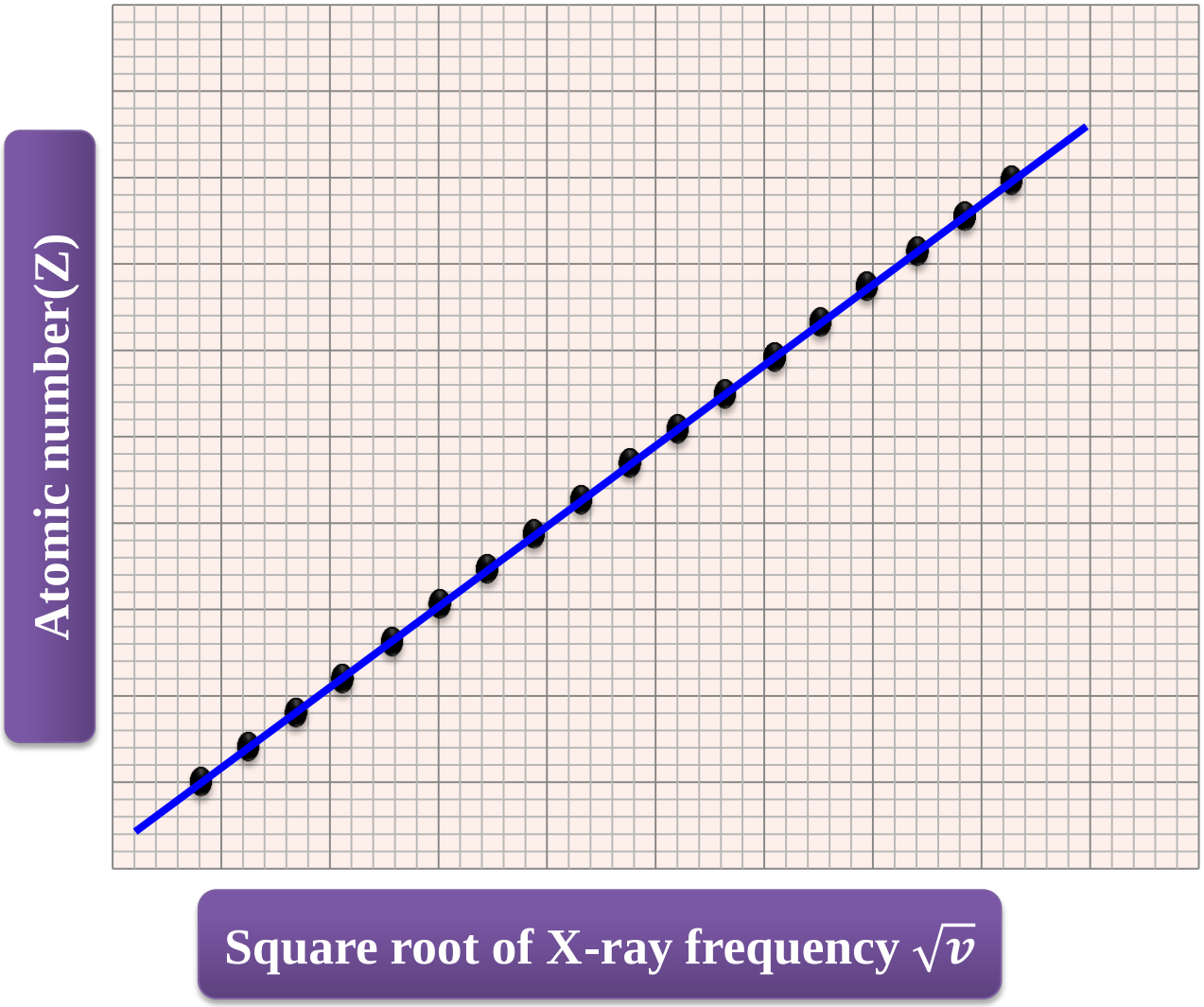
MODERN PERIODIC TABLE

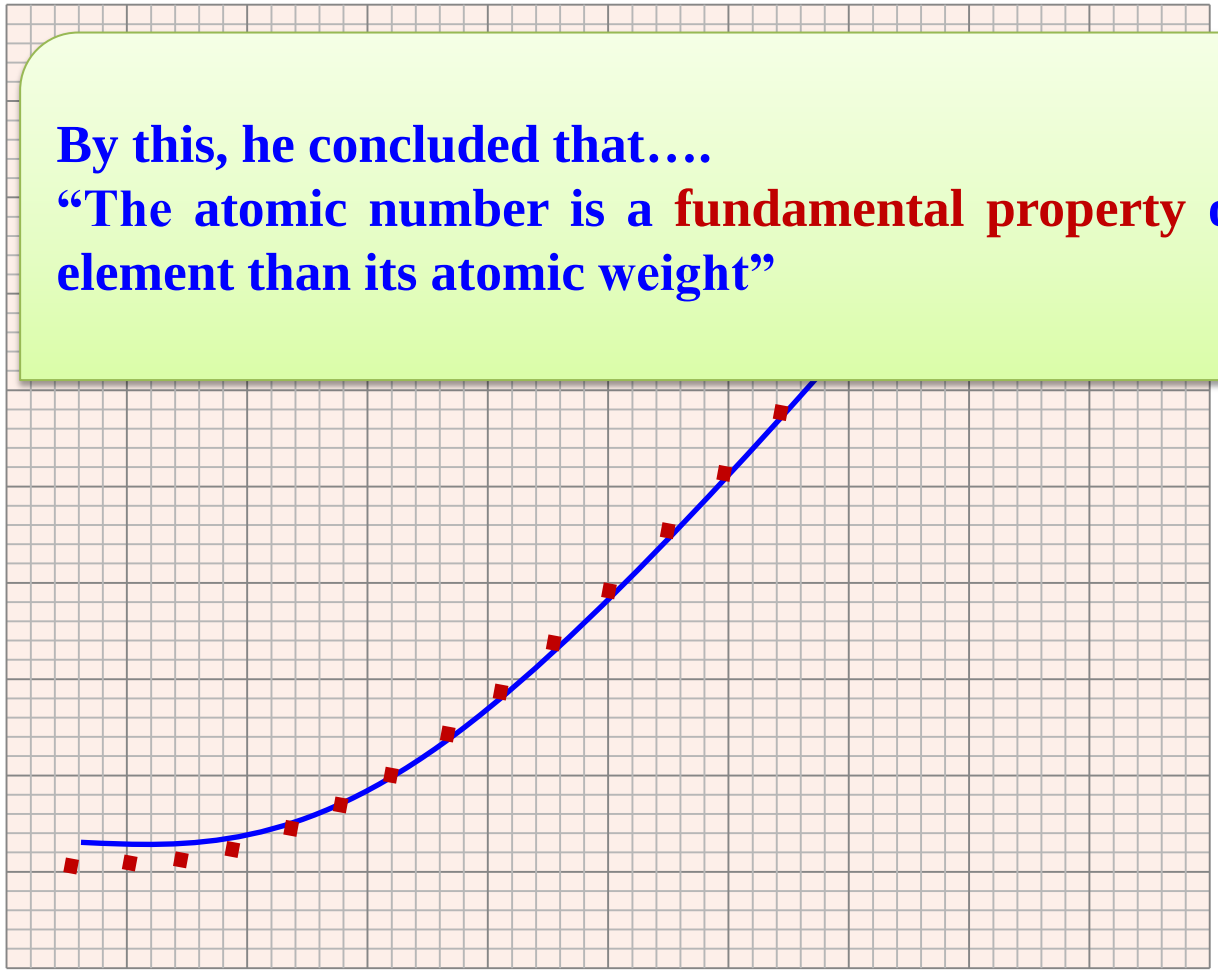
5. Modern Periodic Table

Henry Moseley

Atomic number "Z" can be related to frequency of the X-ray emitted by the using, $\sqrt{\nu} = a(Z - b)$. Where a and b are constants

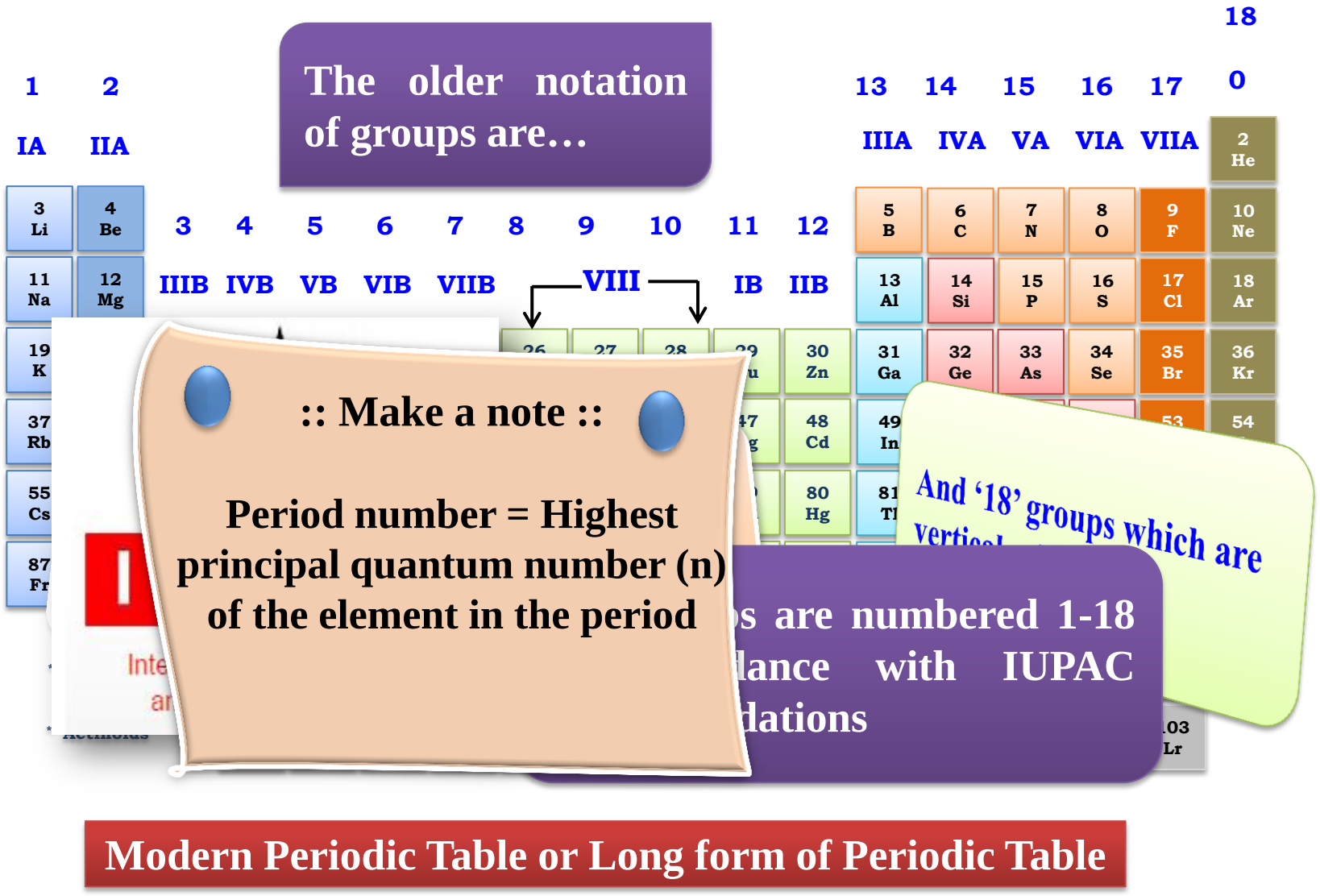


By this, he concluded that….
"The atomic number is a fundamental property of an element than its atomic weight"



Modern Periodic Law:

The physical and chemical properties of elements are periodic functions of their atomic numbers and electronic configurations



Modern Periodic Table or Long form of Periodic Table

Important points of modern periodic table…

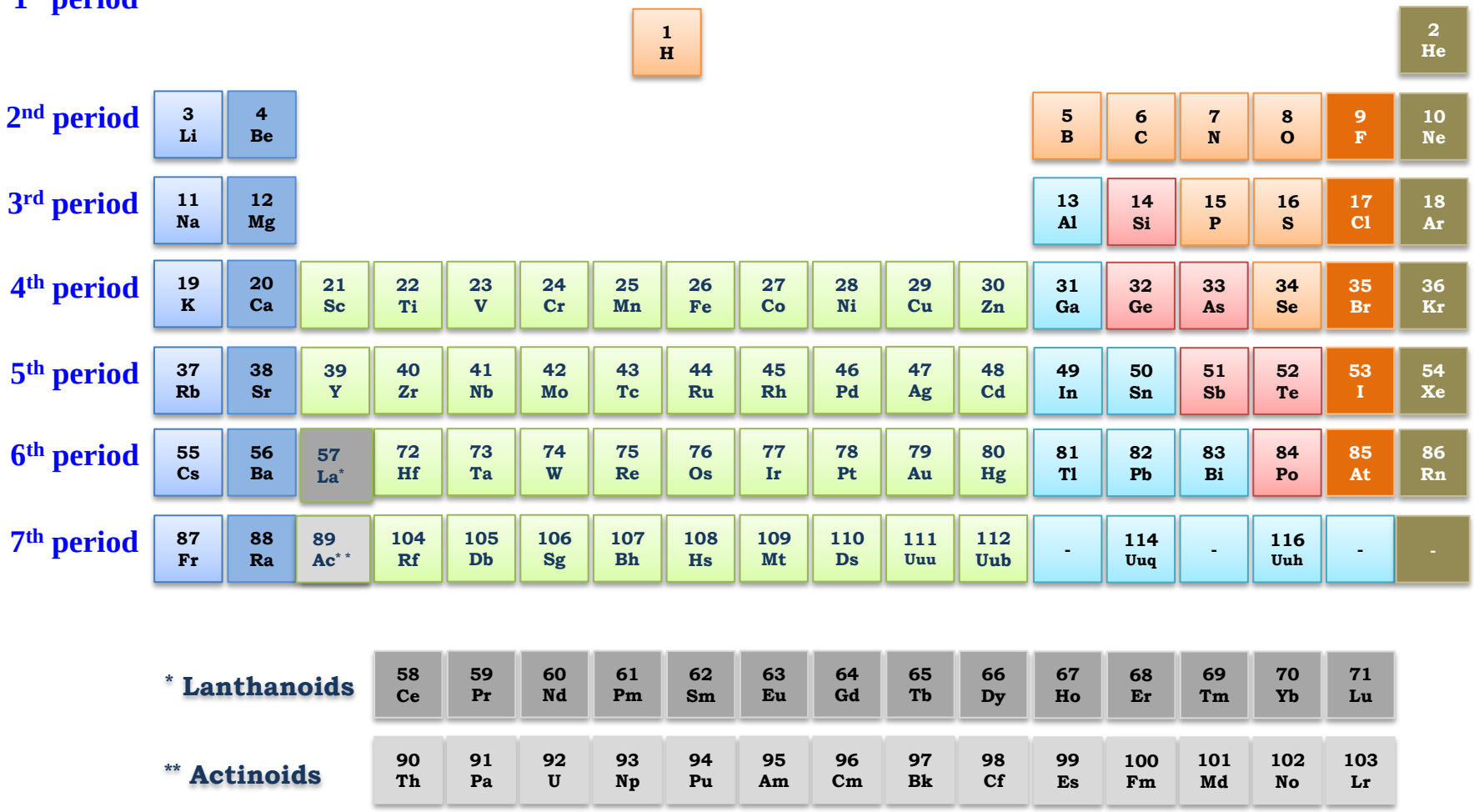
The First period of periodic table consists of ‘2’ Elements

The remaining periods 2, 3, 4, 5 and 6 consist of 8, 8, 18, 18 and 32 elements respectively.

Important points of modern periodic table…

The seventh period is incomplete.

'14' elements of both 6th and 7th periods (Lanthanoids and actinides) are placed below the main body of the periodic table.



What is the difference in the approach between the mendeleev's periodic table and the modern periodic table?

Answer:

- **The atomic weight is the periodic function to Mendeleev's and atomic number is the periodic function to modern periodic table.**

Which element do you think would have been named by

a) Lawrence Berkeley Laboratory

b) Seaborg's group

Answer:

a) Lawrencium (Lr (Z) = 103)

b) Seaborgium (Sg (Z) = 106)

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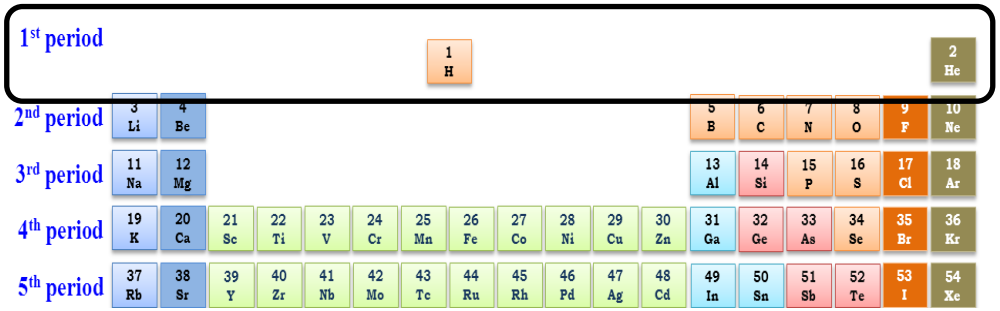
1) The period that contains only gaseous elements is…

a) 1

b) 2

c) 3

d) 4



2) The period that includes all types of elements is…

a) 1

b) 2

c) 6

d) 7

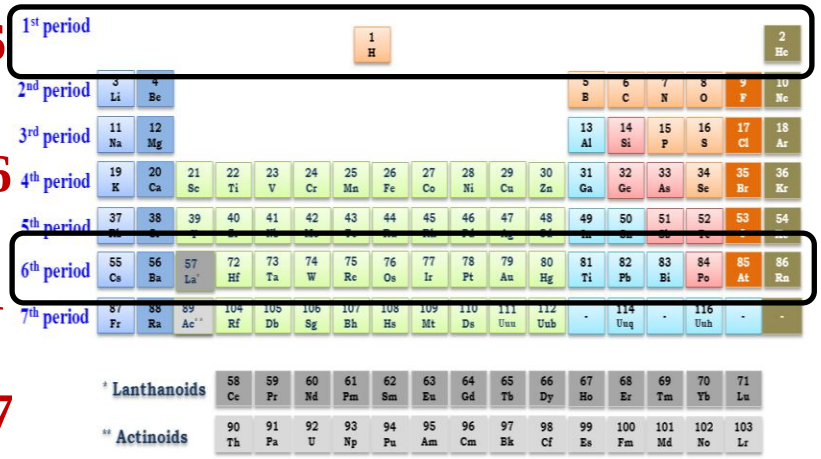
3) The longest and shortest periods are…

a) 1 & 6

b) 2 & 6

c) 6 & 1 ✓

d) 1 & 7



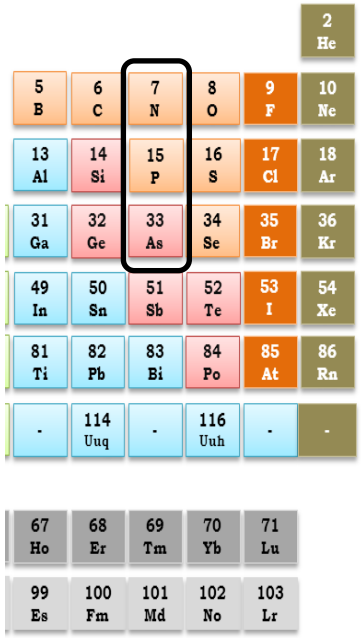
4) Atomic number of nitrogen is 7. The atomic number of the third member in the same family is…

a) 23

b) 15

c) 33 ✓

d) 51



DESCRIPTION OF PERIODS

- Seven horizontal rows of the periodic table are known as periods.
- Each period begins with the outermost electron entering into a new principal quantum number and completes after the outermost shell p – subshell is complete.
- The number of periods denotes the number f outermost shell of that element.
- The first element of each period (except period 1) is an alkali metal and the last element is an inert gas.

- **The periods are described below :**

1 period	Very short period	2 element
2 and 3 periods	Short periods	8 elements
4 and 5 periods	Long periods	18 elements
6 period	Very long period	32 elements
7 period	Incomplete	

To avoid the inconvenience, 14 elements, which do not include lanthanum and actinium belong to sixth and seventh periods, are placed in two separate rows at the bottom of the periodic table (now called as lanthanides and actinides respectively)

f – Block Elements

i) In these elements, the differentiating electron enters in (n- 2) f-orbital.

ii) Elements having three incomplete outer shells are known as
inner –transition of f – block elements,
that is, they have configuration
$(n-2)s^2p^6d^{10}f^{1-14}$, $(n-1)s^2p^6d^{0-2}$, ns^2.

iii) There are two series of f – block elements corresponding to the filling of 4f and 5f – orbitals.

a) Lanthanides series : The differentiating electron occupies 4f- subshell.

$_{57}La$: …….. $4f^0, 5s^2, 5p^6, 5d^1, 6s^2$

$_{58}Ce$: …….. $4f^1, 5s^2, 5p^6, 5d^1, 6s^2$

b) Actinides series : The differentiating electron occupies 5f – subshell.

$_{89}Ac$: …….. $5f^0, 6s^2, 6p^6, 6d^1, 7s^2$

$_{90}Th$: …….. $5f^1, 6s^2, 6p^6, 6d^1, 7s^2$

: :

$_{103}Lr$: …….. $5f^{14}, 6s^2, 6p^6, 6d^1, 7s^2$

iv) The actinoids are radioactive elements.

- **The elements from atomic number 93 onwards are called transuranic elements and have been made artificially.**

Characteristics

i) The electronic configuration of outermost shell of f-block elements is ns^2 followed with $(n-2)f^{1-14}$, $(n-1)d^{0-2}$

ii) All are metals of lanthanoids are also known as rare earth elements, whereas most of the members of actinoid series are known as transuranic elements (made artificially)

iii) These show variable valence and also form colored ions.

iv) Actinoids are radioactive and also form complexes.

IMPORTANCE OF ELECTRON AFFINITY

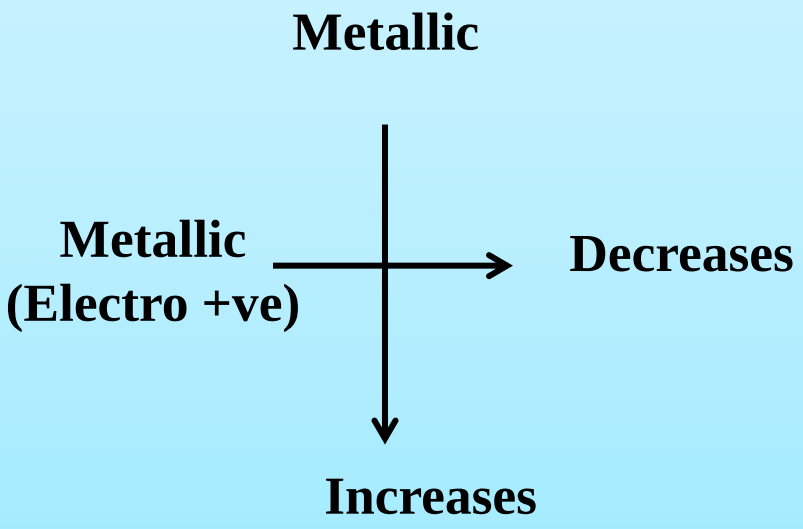
Certain properties of the elements are predicted on the basis of values of electron affinity.

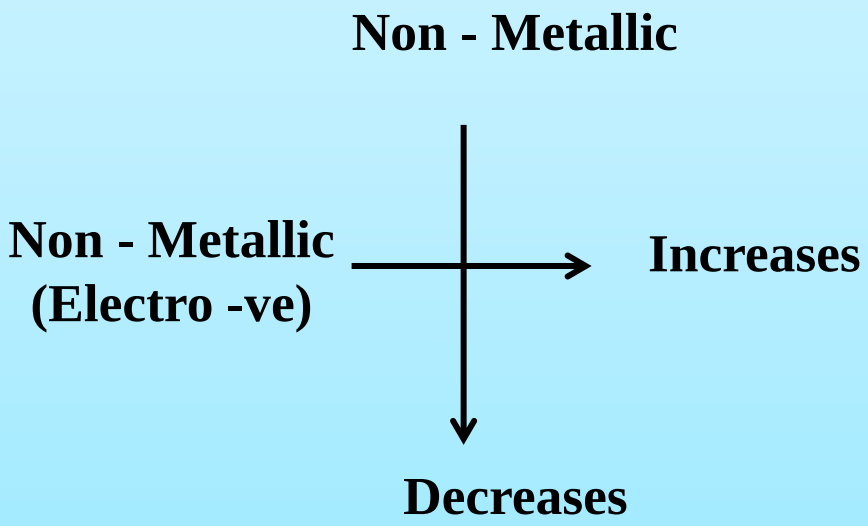
i) The elements having high values of electron affinity are capable of accepting electron easily. They form anions and electrovalent compounds. These elements are electronegative in nature.

ii) The elements having high values of electron affinity act as strong oxidizing agents, for example. etc.

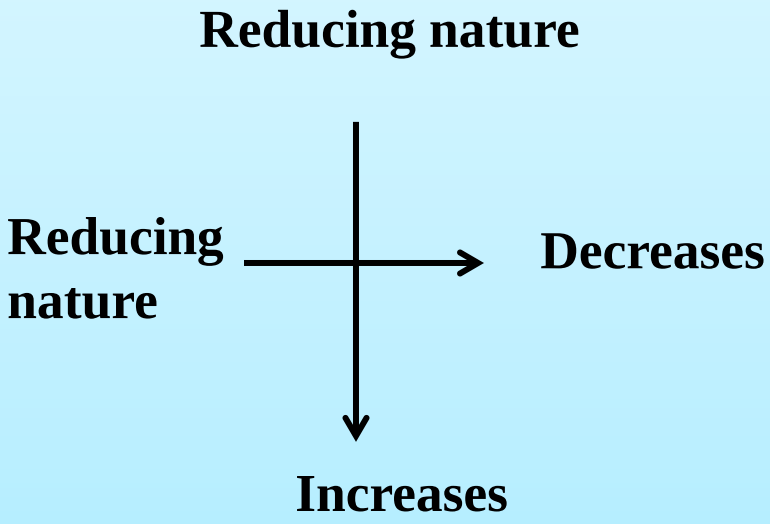
On the basis of the general trend of ionization potential and electron affinity, the following properties can be predicted

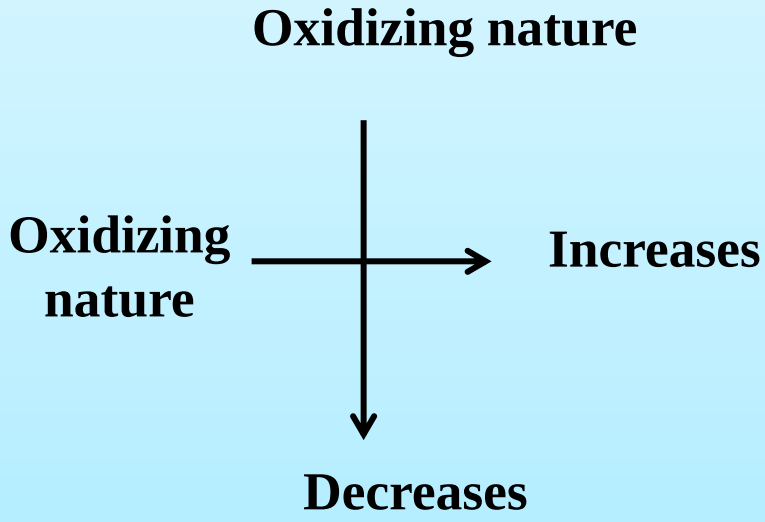
a) **Metallic nature decreases in a period while nonmetallic nature increases. Metallic nature increases in a group, while non-metallic nature decreases. The arrow (↓) represents a group (→) and represents a period.**



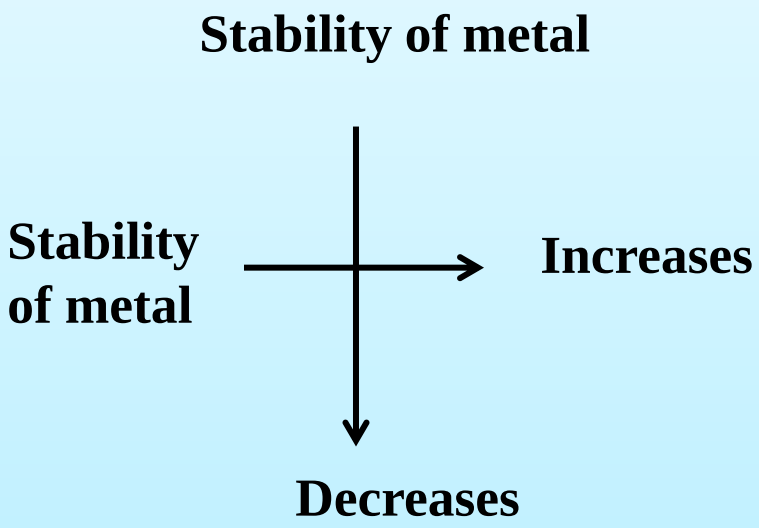


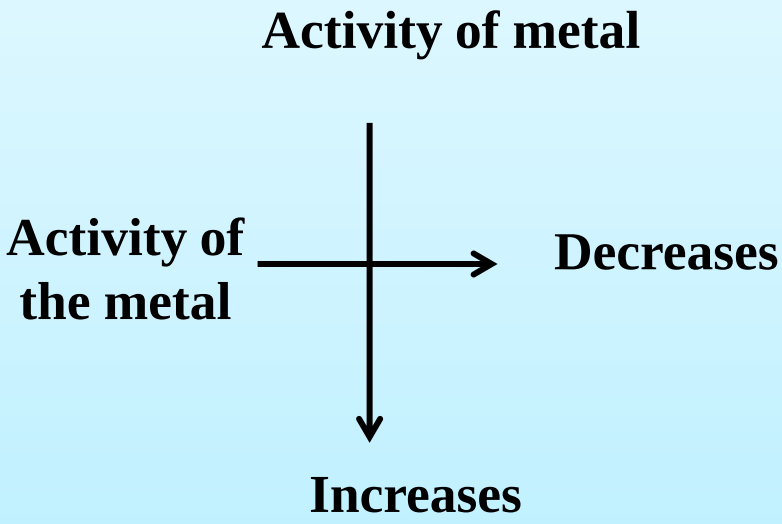
b) Reducing nature decreases in a period while oxidizing nature increase. The reducing nature increases in a group while oxidizing decreases.





c) Stability of metal increases while activity of the metal decreases in a period and in group stability decreases while activity increases.





This trend is observed especially in IA, IIA, and IIA elements.

PERIODIC VARIATION IN PROPERTIES OF COMPOUNDS

Melting and boiling points of halides of alkali metals

i) For the same alkali metals, the melting points and boiling points decrease in the order fluoride > chloride > bromide > iodide.

Halides	NaF		NaCl		NaBr		NaI
m.pt (^{0}C)	996	>	801	>	747	>	660

Explanation This trend can be easily explained on the basis of lattice energy.

ii) For the same halide ion, the melting point decreases as we move down the group from Na to Cs.

Fluorides	LiF		NaF		KF		RbF		CsF
m.pt (^{0}C)	846	>	996	>	858	>	775	>	703

Solubility of carbonates and bicarbonates of alkali and alkaline earth metals.

The carbonates and bicarbonates of alkali metals are soluble in water. Their solubilites decrease as we move down the group from Li to Cs.

$$Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$$

$$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$$

Solubility of hydroxides of alkali metals and alkaline earth metals in water

i) The hydroxides of alkali metals are appreciably soluble in water and their solubilites further increase as we move from

$$LiOH \rightarrow NaOH \rightarrow RbOH \rightarrow CsOH$$

(or)

$$LiOH < NaOH < KOH < RbOH < CsOH.$$

ii) The hydroxides of alkaline earth metals $M(OH)_2$ are sparingly soluble in water. Their lower solubility than alkali metal hydroxides is due to the grater ionization energy of alkaline earth metal atoms than ionization atoms. However, their solubilities in water increase markedly as we have down the group.

Group 2 (or II) $Be(OH)_2 < Mg(OH)_2 < Sr(OH)_2 < Ca(OH)_2 < Ba(OH)_2$

The basic nature of alkaline earth metal hydroxides also increase down the group $Be(OH)_2$ is amphoteric $Mg(OH)_2$ is a weak base, $Ca(OH)_2$ and $Sr(OH)_2$ are moderately strong bases, whereas $Ba(OH)_2$ is nearly as strongly basic as alkali metal hydroxides.

Solubility of alkaline earth metal sulphates in water

The solubility of alkaline earth metals sulphate decreases down the group

$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

$BeSO_4$ and $MgSO_4$ are soluble, $CaSO_4$ is slightly soluble, and $SrSO_4$ and $BaSO_4$ are almost insoluble or sparingly soluble in water. It is due to this fact, we test Ba^{2+} ion or ion in qualitative analysis as $BaSO_4$ getting a white precipitate in either case.

PREVIOUS COMPETATIVE QUESTIONS

1. The oxidation state and covalence of *Al* in $[AlCl(H_2O)_5]^{2+}$ are respectively [E-2014]

1) +3, 6 2) +2, 6 3) +3, 3 4) +6, 6

Solution :

$[AlCl(H_2O)_5]^{2+}$; x+(-1)+5(0) = +2

In this cationic complex 5 – H_2O, 1 – Cl ligands
total six ligands are present.
So covalence of 'Al' is 6

2. The increasing order of the atomic radius of Si, S, Na, Mg, Al [E-2014]

1) Na < Al < Mg < S < Si **2) Na < Mg < Si < Al < S**

3) Na < Mg < Al < Si < S **4) S < Si < Al < Mg < Na** ✓

Solution :

In 3rd period , from left to right atomic radius decreases

So, increasing order is S < Si< Al < Mg < Na

3. The number of elements present in fourth period is: [E – 2013]

1) 32 **2) 8** **3) 18** **4) 2**

Solution :

4^{th} period – ‘K’ to ‘Kr’ – 18 elements

4. Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to : (JEE MAINS ONLINE-2013)

1) High ionization enthalpy of fluorine

2) bigger size of 2p orbital of fluorine

3) smaller size of chlorine atom

4) smaller size of fluorine atom ✓

Solution :

In fluorine electron – electron repulsions are more

5. Which is the correct order of second ionization potential of C,N,O and F in the following ? (JEE MAINS ONLINE - 2013)

1) O > N > F >

2) O > F > N > C

3) F > O > N > C

4) C > N > O > F

Solution :

Removing of second electron from 'O' is difficult,
because after removing of one electron from oxygen it acquires half filled configuration. Similarly in other also.

6. The order of increasing sizes of atomic radii among the elements O, S, Se and As is : (JEE MAINS ONLINE - 2013)

1) O < S < Se < As

2) Se < S < As < O

3) O < S < As < Se

4) As < S < O < Se

Solution :

O, S, Se – belongs to VIA group

As – belongs to VA group

So atomic size O <S < Se < As

7. The element with which of the following outer electron configuration may exhibit the largest number of oxidation states in its compounds : (JEE MAINS ONLINE - 2013)

1) $3d^6 4s^2$ **2) $3d^5 4s^2$** **3) $3d^7 4s^2$** **4) $3d^8 4s^2$**

Solution :

In $3d^5\ 4s^2$ – more unpaired electrons are present so it exhibits largest oxidation numbers

8. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be: [JEEMAINS-2013]

1) -5.1 eV **2) -10.2 eV**

3) +2.55 eV **4) -2.55 eV**

Solution :

$\mathbf{Na - e^- \rightarrow Na^+; IP = 5.1}$

$\boldsymbol{Na^+ + e^- \rightarrow Na; EA = ?}$

$\boldsymbol{EA\ of\ Na^+ = -IP\ of\ Na = -5.1eV}$

9. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar? [JEEMAINS-2013]

1) S < Se < Ca < Ba < Ar

2) Ba < Ca < Se < S < Ar

3) Ca < Ba < S < Se < Ar

4) Ca < S < Ba < Se < Ar

Solution :

Ca, Ba belongs to IIA group

S, Se belongs to VIA group

Ar is inert gas

Left to right in a period I.P increases. Top to bottom, in a group I.P. decreases .

So, increasing order of I.P = Ba < Ca < Se < S < Ar

10. Which one of the following cannot form an amphoteric oxide?

[E-2012]

1) Al **2) Sn** **3) Sb** **4) P** ✓

Solution :

Phosphorus is not amphoteric metal

11. The increasing order of the ionic radii of the given isoelectronic species is [A-2012]

1) Ca^{2+}, K^{+}, Cl^{-}, S^{2-}

2) K^{+}, S^{2-}, Ca^{2+}, Cl^{-}

3) Cl^{-}, Ca^{2+}, K^{+}, S^{2-}

4) S^{2-}, Cl^{-}, Ca^{2+}, K^{+}

Solution :

In iso electronic series (-ve) charge increases, ionic size also increases

12. Which one of the following orders presents the correct sequence of the increasing basic nature of the given oxides ? [A- 2011]

1) $Al_2O_3 < MgO < Na_2O < K_2O$

2) $MgO < K_2O < Al_2O_3 < Na_2O$

3) $Na_2O < K_2O < MgO < Al_2O_3$

4) $K_2O < Na_2O < Al_2O_3 < MgO$

Solution :

More electro positivity of metal – more will be the basic nature of oxide

13. The correct order of electron gain enthalpy with negative sign of F, C*l*, Br and I having atomic number 9,17,35 and 53 respectively is :

[A-2011]

1) *Cl > F > Br > I*

2) *Br > Cl > I > F*

3) *I > Br > Cl > F*

4) *F > Cl > Br > I*

Solution :

Electron gain enthalpy

F = -328 KJ / mole

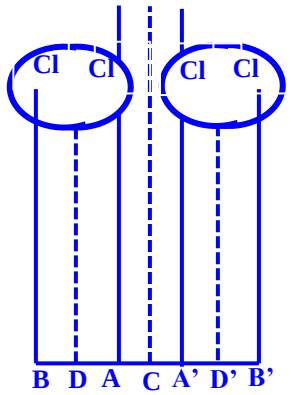
Cl = -349 KJ / mole

Br = -325 KJ / mole

I = -270 KJ / mole

So Cl > F >Br >I

14. With reference to the diagram given, the vander Waals radius is equal to [E-2011]



1) A-A' **2) B-A** **3) B-D** **4) A-C** ✓

Solution :

Half of the internuclear distance of adjacent atoms of different molecules

15. The electron affinity values of elements A, B, C and D are respectively –135, –60, –200 and –348 kJ mol^{-1}. The outer electronic configuration of element B is : [E-2010]

1) $3s^2\ 3p^5$ **2) $3s^2\ 3p^4$** **3) $3s^2\ 3p^3$** **4) $3s^2\ 3p^2$**

Solution :

-60 KJ/mole is E.A. of phosphorus

16. The correct sequence which shows decreasing order of the ionic radii of the elements is: [A- 2010]

1) $O^{2-} > F^{-} > Na^{+} > Mg^{2+} > Al^{3+}$

2) $Al^{3+} > Mg^{2+} > Na^{+}F^{-} > O^{2-}$

3) $Na^{+} > Mg^{2+} > Al^{3+} > O^{2-} > F^{-}$

4) $Na^{+} > F^{-} > Mg^{2+} > O^{2-} > Al^{3+}$

Solution :

In iso electronic series if +ve charge increases on the species, ionic size decreases.

17. In which of the following arrangements, the sequence is not strictly according to the property written against it ? [A 2009]

1) HF < HCl < HBr < HI : increasing acid strength

2) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength

3) B < C < O < N : increasing first ionization enthalpy

4) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power

Solution :

Basic strength from VA group hydrides is

$$NH_3 > PH_3 > AsH_3 > SbH_3$$

18. The set representing the correct order of ionic radius is [A-2009]

1) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$

2) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

3) $Li^{2+} > Na^+ > Mg^{2+} > Be^{2+}$

4) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

Solution :

In a group from top to bottom ionic radius increases.

19. The set representing the correct order of ionic radius is [A- 2009]

1) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

2) $Li^{2+} > Na^+ > Mg^{2+} > Be^{2+}$

3) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

4) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$

20. Which one of the following order is correct for the first ionisation energies of the elements ? [E -2009]

1) B < Be < N < O **2) Be < B < N < O**

3) B < Be < O < N **4) B < O < N < Be**

Solution :

'Be' electronic configuration is $1s^2\ 2s^2$ – i.e., full filled

'N' electronic configuration is $1s^2\ 2s^2\ 2p^3$ – i.e., half filled

So, $I.P_1$ order B < Be < O < N

21. The atomic numbers of elements A,B,C and D are Z - 1,Z, Z+1 and Z +2 respectively. If 'B' is a noble gas , choose the correct answers from the following statements [E -2008]

1) 'A' has higher electron affinity

2) 'C' exists in +2 oxidation state

3) 'D' is an alkaline earth metal

1) 1 and 2 **2) 2 and 3** **3) 1 and 3** **4) 1,2 and 3**

Solution :

'B' – is noble gas - atomic number - Z

'A' –- atomic number – Z-1, i.e., Halogen

'C' –- atomic number – Z+1, i.e., Alkali metal

'D' –- atomic number – Z+2, i.e., Alkaline earth metal

Key : 3

22. Which one of the following constitutes a group of the isoelectronic species ? **[A- 2008]**

1) N_2, O_2^-, NO^+, CO

2) C_2^{2-}, O_2^-, CO, NO

3) $NO^+, C_2^{-2}, CN^-, N_2$ ✓

4) $CN^-, N_2, O_2^-, C_2^{2-}$

Solution :

$NO^+ = 14$ electrons ; $CN^- = 14$ electrons

$C_2^{-2} = 14$ electrons ; $N_2 = 14$ electrons

23. Which of the following pair of transition metal ions, have the same calculated values of magnetic moment ? [E-2007)]

1) Ti^{2+} and V^{2+} 2) Fe^{2+} and Cu^{2+} 3) Cr^{2+} and Fe^{2+} 4) Co^{2+} and Ti^{2+}

Solution :

Cr = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

Cr^{+2} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$ Number of unpaired electron = 4

Fe = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

Fe^{+2} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$ Number of unpaired electron = 4

If unpaired electrons are same, magnetic moment is also same

24. An oxide of an element is a gas and dissolves in water to give an acidic solution .The element belongs to [E-2007]

1) II group **2) IV group** **3) VIII group** **4) Zero group**

Solution :

$$CO_2 + H_2O \rightarrow H_2CO_3,$$

'C' belongs to IV A group

25. The correct order of Vander Waals radius of F, Cl and Br is :[E-2006]

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

Solution :

In VIIA group, top to bottom Vander Waals radius increases.

26. Observe the following statements : [E- 2006]

I. The physical and chemical properties of elements are periodic functions of their electronic configuration.

II. Electronegativity of fluorine is less than the electronegativity of chlorine.

III. Electropositive nature decreases from top to bottom in a group

The correct answer is :

1) I, II and III are correct

2) Only I is correct

3) Only I and II are correct

4) Only II and III are correct

Solution :

Modern periodic law

27. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture [A-2006]

1) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens

2) In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group

3) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group

4) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group

28. The increasing order of the first ionisation enthalpies of the elements B,P,S and F (lowest first) is [A-2006]

1) F < S < P < B **2) P < S < B < F**

3) B < P < S < F **4) B < S < P < F** ✓

Solution :

In a period, left to right E.N increases and size decreases ,IP increases.

So B < S < P < F

29. Which does not contain isoelectronic species? [A-2005]

1) $PO_4^{3-}, SO_4^{2-}, ClO_4^-$

2) CN^-, N_2, C_2^{2-}

3) $SO_3^{2-}, CO_3^{2-}, NO_3^-$

4) $BO_3^{3-}, CO_3^{2-}, NO_3^-$

Solution :

$SO_3^{2-} = 16 + 24 + 2 = 42$

$CO_3^{2-} = 6 + 24 + 2 = 32$

$NO_3^- = 7 + 24 + 1 = 32$

The species which contains same number of electrons is called isoelectronic series.

30. In which of the following arrangements, the order is NOT according to the property indicated against it ? [A-2005]

1) Li < Na < K < Rb : Increasing metallic radius

2) I < Br < F < Cl : Increasing electron gain enthalpy (with negative sign)

3) B < C < N < O increasing first ionization enthalpy

4) $Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ Increasing ionic size

Solution :

B<C<N<O is not correct for IP order

B<C<O<N is correct for IP order

31. Which of the following oxide is amphoteric in character ? [A-2005]

1) SnO_2

2) SiO_2

3) CO_2

4) CaO

Solution :

SnO_2 is amphoteric oxide

32. Identify the correct order in which the ionic radius of the following ions increases: I. F^- II. Na^+ III. N^{3-} [E- 2005]

1) III, I, II **2) I, II, III** **3) II, III, I** **4) II, I, III** ✓

Solution :

Ionic radius increasing order $Na^+ < F^- < N^{-3}$

(-)ve charge increases on atoms in iso electronic series ionic radius also increases

33. Identify the correct order in which the covalent radius of the following elements increases : [E-2005]

(I) Ti (II) Ca (III) Sc

1) (I), (II), (III) 2) (III), (II), (I) 3) (II), (I), (III) 4) (I), (III), (II)

Solution :

Left to right in a period covalent radius decreases

so increasing order $_{22}Ti < {}_{21}Sc < {}_{20}Ca$

34. 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? [E-2004]

1) 13.6 **2) 11.3** **3) 8.3** **4) 14.5** ✓

Solution :

IP_1 values for consecutive elements 8.3, 11.3, 14.5 and 13.6eV

'N', IP_1 is more than oxygen,
so answer is 14.5eV

35. The formation of the oxide ion $O^{2-}_{(g)}$ requires first in exothermic and then an endothermic step as shown below : [A-2004]

$$O_{(g)} + e^- = O^-_{(g)} \Delta H^0 = -142 kJmol^{-1}$$

$$O^-_{(g)} + e^- = O^{2-}_{(g)} \Delta H^0 = 844 kJmol^{-1}$$

This is because

1) O^- ion will tend to resist the addition of another electron

2) oxygen has high electron affinity

3) oxygen is more electronegative

4) O^- ion has comparatively larger size than oxygen atom

36. Which one of the following ions has the highest value of ionic radius? [A-2004]

1) O^{2-} 2) B^{3+} 3) Li^{+} 4) F^{-}

Solution :

In O^{2-} more number of electrons are present.
So highest ionic radius

37. Which among the following factors is the most important in making fluorine the strongest oxidising agent ? [A- 2004]

1) Electron affinity

2) Ionisation enthalpy

3) Hydration enthalpy

4) Bond dissociation energy

Solution :

F_2 has the most negative ΔG^0 value which is dependent on hydration energy.

$$\Delta_{Hyd}H(F^-) = 515\ KJ/mole$$

38. Which of the following sets represents the collection of isoelectronic species ? **[A-2004]**

1) $Na^+, Mg^{2+}, Al^{3+}, Cl^-$

2) $Na^+, Ca^{2+}, Sc^{3+}, F^-$

3) $K^+, Cl^-, Mg^{2+}, Sc^{3+}$

4) $K^+, Ca^{2+}, Sc^{3+}, Cl^-$ ✓

Solution :

$K^+ = 19 - 1 = 18$; $Ca^{2+} = 20 - 2 = 18$;

$Sc^{+3} = 21 - 3 = 18$; $Cl^- = 17 + 1 = 18$

39. Which one of the following is an amphoteric oxide [A-2003]

1) Na_2O 2) SO_2 3) B_2O_3 4) ZnO ✓

Solution :

ZnO is amphoteric oxide

Metals like, Be, Al, Zn, Pb, In are able to react with acids and bases. So amphoteric metals

40. According to the Periodic Law of elements, the variation in properties of elements is related to their [A-2003]

1) nuclear masses

2) atomic numbers

3) nuclear neutron-proton number ratios

4) atomic masses

41. A reduction in atomic size with increase in atomic number is a characteristic of elements of [A-2003]

1) Radio active series

2) High atomic masses

3) d-block

4) f-block

Solution :

In f-block elements lanthanide contraction takes place

42. Which of the following grouping represents a collection of iso-electronic species? (at.Nos: Cs=55, Br=35) [A-2003]

1) Ca^{2+}, Cs^{+}, Br

2) Na^{+}, Ca^{2+}, Mg^{2+}

3) N^{3-}, F^{-}, Na^{+}

4) Be, Al^{3+}, Cl^{+}

Solution :

$N^{-3} = 7 + 3 = 10e^{-}$; $F^{-} = 9 + 1 = 10e^{-}$; $Na^{+} = 11 - 1 = 10e^{-}$

43. The radius of the La^{3+} (atomic number of La = 57) is $1.06A^0$. Which one of the following given values will be closest to the radius of Lu^{3+} (atomic number of Lu = 71) [A-2003]

1) $0.85A^0$ **2) $1.60A^0$** **3) $1.40A^0$** **4) $1.06A^0$**

Solution :

Due to lanthanide contraction, there occurs net decrease in size only $0.85A^0$ is smaller one

44. The atomic numbers of vanadium (V), chromium (Cr),manganese (Mn) and iron (Fe) are, respectively 23,24,25 and 26.Which one of these may be expected to have the highest second ionisation enthalpy? [A- 2003]

1) V **2) Cr** **3) Mn** **4) Fe**

Solution :

The electronic configuration of Cr^{+} is most stable, hence formation of Cr^{+2} by second IP required maximum enthalpy

45. 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 [E- 2003]

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

Solution :

X = Cl_2= -349 KJ/mole

Y = F_2= -333 KJ/mole

Z = Br_2= -325 KJ/mole

E.A. of 'Cl' is more

46. Which of the following pairs of ions have the same electronic configuration [E-2002]

1) Cr^{+3}, Fe^{+3} **2) Fe^{+3}, Mn^{+2}** **3) Fe^{+3}, Co^{+3}** **4) Sc^{+3}, Cr^{+3}**

Solution :

Fe^{+3} = 26-3 = 23

Mn^{+2} = 25-2 = 23

Same number of electrons, same is the configuration .

47. The electronic configurations 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 ionisation potentials of A, B and C

[E-2001]

1) A > B > C ✓

2) C > B > A

3) B > C > A

4) C > A > B

Solution :

A = $[He]2s^1$ = Li **B = $[Ne]3s^1$ = Na** **C = $[Ar]4s^1$ = K**

I.P_1 value order Li > Na > K or A >B > C

In given group top to bottom I.P values decreases

48. Ionic radius (A^{o}) of As^{+3}, Sb^{+3} and Bi^{+3} follow the order [E-2001]

1) $As^{+3} > Sb^{+3} > Bi^{+3}$

2) $Sb^{+3} > Bi^{+3} > As^{+3}$

3) $Bi^{+3} > As^{+3} > Sb^{+3}$

4) $Bi^{+3} > Sb^{+3} > As^{+3}$

Solution :

Top to bottom ionic radius increases in a group

$Bi^{+3} > Sb^{+3} > As^{+3}$

49. The electronic configuration of group III elements is [E-2000]

1) $ns^2 np^3$ **2) ns^2np^5**

3) ns^2np^1 **4) ns^2np^2**

Solution :

Group IIIA elements outer most configuration = ns^2np^1

50. Which of the following has highest first ionisation potential ?

[E- 2000]

1) Al **2) Si** **3) K** **4) P** ✓

Solution :

$P = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

Due to Half filled configuration, more will be I.P value

51. Which of the following has highest electronegativity [E-2000]

1) Na **2) Cl** **3) K** **4) B**

Solution :

Element	E.N
Na	0.9
Cl	3.0
K	0.8
B	2.0

52. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acidic strength is [A-2004]

1) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$

2) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$

3) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$

4) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

Solution :

While moving along a period acidic nature of oxides increases.

Al_2O_3	SiO_2	P_2O_3	SO_2
Amphoteric	acidic	acidic	more acidic

53. Which pair of element with the given atomic number is expected to have similar properties

1) 11, 12 2) 40, 72 3) 20, 36 4) 10, 28

Solution :

At. No. = 40 : Zr

At. No. = 72 : Hf

Both having similar properties due to lanthanide contraction in 'Hf'. They having similar radii.

54. The electron affinity of chlorine is 3.7 eV. 1 Gram of chlorine is completely converted to Cl^- ion in a gaseous state. (1 eV. = 23.06 K.cal $mole^{-1}$). Energy released in the process is:

1) 4.8 K.cal **2) 2.4 K.cal** **3) 8.2 K.cal** **4) 7.2 K.cal**

Solution :

35.5 gr 'Cl' ------ = 3.7 × 23.06 K.Cal /mol energy released

1 gr 'Cl' ------ ?

$$= \frac{1}{35.5} \times 3.7 \times 23.06 = 2.4 \ K.Cal$$

55. Which among the following elements has the highest first ionization enthalpy ?

1) Boron **2) Carbon** **3) nitrogen** **4) oxygen**

Solution :

In nitrogen half filled configuration is present.
so removing of electron from half filled configuration is difficult

56. Which of the following represent the correct order of second ionization enthalpies of C, N, O and F

1) C > N > O > F **2) O > N > F > C**

3) O > F > N > C **4) F > O > N > C**

Solution :

I.P_2 order O > F > N > C

After removing of one electrons from oxygen, it acquires 'N' configuration. So removing of second electron is difficult.

57. The number of elements present in fourth period is: [E-2013]

1) 32 **2) 8** **3) 18** **4) 2**

Solution :

18 elements

58. Which one of the following exhibits the largest number of oxidation states? [J.M.O.L-2014]

1) Ti(22) **2) V(23)** **3) Cr(24)** **4) Mn(25)** ✓

Solution :

Mn = 25 = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

'Mn' shows largest number of oxidation states due to more unpaired electrons.

59. Similarity in chemical properties of the atoms of elements in a group of the periodic table is most closely related to: [J.M.O.L-2014]

1) Atomic Numbers

2) Atomic Masses

3) Number of principal energy levels

4) Number of valance electrons

Solution :

Valence electrons are only responsible for chemical bonding

60. Which of the following arrangement represents the increasing order (smallest to largest) of ionic radii of the given species $O^{2-}, S^{2-}, N^{3-}, P^{3-}$? [J.M.O.L -2013]

1) $O^{2-} < N^{3-} < S^{2-} < P^{3-}$

2) $O^{2-} < P^{3-} < N^{3-} < S^{2-}$

3) $N^{3-} < O^{2-} < P^{3-} < S^{2-}$

4) $N^{3-} < S^{2-} < O^{2-} < P^{3-}$

Solution :

Effective nuclear charge decreases, ionic radius increases

61. The ionic radii (in A^0) of N^{3-}, O^{2-} and F^- are respectively

[JEE Mains -2015]

1) 1.36, 1.40 and 1.71

2) 1.36, 17.71 and 1.40

3) 1.71, 1.40 and 1.36

4) 1.71, 1.36 and 1.40

Solution :

In Isoelectronic series as –Ve charge increases on atom, ionic radii increases

$$N^{3-} > O^{2-} > F^-$$

$$\therefore\ 1.71 > 1.40 > 1.36$$

62. In the long form of the periodic table, the valence shell electronic configuration of $5s^2 5p^4$ corresponds to the element present in :

[J.M.O.L -2015]

1) Group 17 and period 5

2) Group 16 and period 5 ✓

3) Group 17 and period 6

4) Group 16 and period 6

63. Match the following **[AP EAMCET-2015]**

LIST - I	LIST - I
A) Rubedium	1) Germanium
B) Platinum	2) Radio active chalogen
C) Eka silicon	3) S-block element
D) Polonium	4) Atomic number = 78

The correct match is

	A	B	C	D
1)	4	3	2	1
2)	3	4	1	2
3)	2	1	4	3
4)	4	3	1	2

64. The equation used to represent the electron gain enthalpy is

[TS E -2015]

1) $X(g) + e^- \rightarrow X^-(g)$

2) $X(s) + e^- \rightarrow X^-(g)$

3) $X(g) \rightarrow X^+(g) + e^-$

4) $X(s) \rightarrow X^+(g) + e^-$

65. The first ionization enthalpies of N, O, F follow the order

[TS M -2015]

1) O < N < F

2) N < O < F

3) F < N < O

4) F < O < N

66. The metal which can form an oxide having metal : oxygen ration 2 : 3 is **[TS M -2015]**

1) Sn **2) Na**

3) Ba **4) Bi** ✓

67. In the periodic table an element with atomic number 56 belongs to
[AP M -2015]

1) IIIA group , 6th period

2) IVA group , 5th period

3) IIA group , 6th period ✓

4) IVA group , 6th period

68. Match the following **[AP M-2015]**

LIST - I	LIST - I
A) Na_2O_2	I) Zero
B) RbO_2	II) +1
C) OF_2	III) -1
D) O_2F_2	IV) +2
	V) -1/2

The correct match is

	A	B	C	D
1)	I	II	III	IV
2)	II	IV	III	I
3)	III	V	IV	II
4)	I	IV	III	II