Fill Ups of Classification of Elements and Periodicity in Properties

Q.1. The energy released when an electron is added to a neutral gaseous atom is called ..... of the atom. (1982 - 1 Mark)

Ans. Sol. Electron affinity

Q.2. On Mulliken scale, the average of ionization potential and electron affinity is known as ..... . (1985 - 1 Mark)

Ans. Sol. Electronegativity

True False of Classification of Elements and Periodicity in Properties

Q.1. In group IA, of alkali metals, the ionisation potential decreases on moving down the group. Therefore, lithium is a strongest reducing agent. (1987 - 1 Mark)

Ans. Sol. True : Ionisation energy decreases on moving down in group IA from Li to Cs, the reducing property should increase in the same order, i.e., from Li to Cs which is found to be so except an anomaly in lithium which is found to be the strongest reducing agent; because of its higher oxidation potential (E^o).

Q.2. The decreasing order of electron affinity of F, Cl, Br is F > Cl > Br. (1993 - 1 Mark)

Ans. Sol. False : Halogens have high electr on affinities which decrease as we move down the group. However, fluorine has lower value of E.A. than chlorine which is due to its small size and more repulsion between the electron added and electrons already present. Hence the order Cl > Br > F.

Q.3. The basic nature of the hydroxides of group 13 (Gr. III B) decreases progressively down the group. (1993 - 1 Mark)

Ans. Sol. False : On moving down the group 13 (III) A the basic nature of hydroxides increases. The basic nature increases as the element becomes more electropositive or acquires more metallic character when we move down a group.

Subjective questions of Classification of Elements and Periodicity in Properties

Q.1. Arrange the following in :

(i) Decreasing ionic size : Mg^{2+}, O^{2-}, Na^{+}, F^{-} (1985 - 1 Mark)

Ans. Sol. O2– > F– > Na+ > Mg2+

NOTE : All the above ions are isoelectronic having 10 electron each.

In such case the greater the nuclear charge, the greater is the attraction for electrons and smaller is the ionic radius. Hence O^{2-} has the highest and Mg^{2+} has the least ionic size.

(ii) Increasing acidic property : ZnO, Na_2O_2, P_2O_5, MgO (1985 - 1 Mark)

Ans. Sol. $\overset{+1}{Na_2}O_2 < \overset{+2}{Mg}O < \overset{+2}{Zn}O < \overset{+5}{P_2}O_5$

Among oxides the acidic strength increases with oxidation state. So Na_2O_2 is least acidic and $P_2O_5$is most acidic. Further Na_2O_2 and MgO are basic, ZnO is amphoteric and P_2O_5 is acidic.

(iii) Increasing first ionization potential : Mg, Al, Si, Na (1985 - 1 Mark)

Ans. Sol. The first ionization potential of the 3rd period elemens follows the order : Na < Al < Mg < Si

NOTE : Ionisation energy increases across a period but not regularly. Mg ($1s^2$, $2s^2p^6$, $3s^2$) is more stable because the electron is to be removed from 3s which is difficult as compared to Al ($1s^2$, $2s^2p^6$, $3s^2p^1$) where electron is to be removed from 3p.

(iv) Increasing size : Cl^{-}, S^{2-}, Ca^{2+}, Ar (1986 - 1 Mark)

Ans. Sol. $Ca^{2+} < Ar < Cl^{-} < S^{2-}$; All of these are isoelectronic. In such cases the greater the nuclear charge, the greater is the attraction for electrons and smaller is ionic size.

$$\text{ionic radius} \propto \frac{1}{\text{effective nuclear charge}}$$

(v) Increasing order of ionic size : N^{3-}, Na^{+}, F^{-}, O^{2-}, Mg^{2+} (1991 - 1 Mark)

Ans. Sol. Increasing order of ionic size : $Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$

NOTE : All the above ions are isoelectronic having 10 electrons each.
In such a case the greater the nuclear charge, the greater is the attraction for electrons and smaller is the ionic radius. Hence N^{3-} has the highest and Mg^{2+} has the least ionic size.

(vi) Increasing order of basic character : MgO, SrO, K_2O, NiO, Cs_2O (1991 - 1 Mark)

Ans. Sol. Increasing order of basic character : NiO < MgO < SrO < K_2O < Cs_2O The basic character of oxides increases when we move down the group. So, K_2O < Cr_2O and MgO < SrO.
Further higher the group number lesser is the basic character. Hence NiO is the least basic.

(vii) Arrange the following ions in order of their increasing radii : Li^{+}, Mg^{2+}, K^{+}, Al^{3+}.

Ans. Sol. $Al^{3+} < Mg^{2+} < Li^{+} < K^{+}$ In these Al^{3+} & Mg^{2+} are isoelectronic species, so in these size decreases with increase in atomic number because increase in atomic number decreases Z_{eff}.

$$\text{Size} \propto \frac{1}{Z_{\text{eff}}}$$

In Li^{+} & K^{+}, K^{+} is bigger in size than Li^{+} because on moving from top to bottom in a group, the group size increases.

Q.2. The first ionization energy of carbon atom is greater than that of boron atom whereas, the reverse is true for the second ionization energy. (1989 - 2 Marks)
Ans. Sol. C (1s22s2p2) h as h alf filled orbitals in its excited state $(C \rightarrow 1s^2 2s^1 p^3)$ due to which it becomes more stable and hence IE1 for C is greater than B.

Further for second ionization energy (IE_2) in C^{+} ($1s^2 2s^2 p^1$) the electron is to be removed from 2p which is easy as compared to B^{+} ($1s^2 2s^2$), where it has to be removed from 2s.